

**CLINICAL PRACTICE GUIDELINES FOR THE PERIOPERATIVE NUTRITION, METABOLIC, AND NONSURGICAL SUPPORT OF PATIENTS UNDERGOING BARIATRIC PROCEDURES – 2019 UPDATE: COSPONSORED BY AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS/AMERICAN COLLEGE OF ENDOCRINOLOGY, THE OBESITY SOCIETY, AMERICAN SOCIETY FOR METABOLIC & BARIATRIC SURGERY, OBESITY MEDICINE ASSOCIATION, AND AMERICAN SOCIETY OF ANESTHESIOLOGISTS\***

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## 2 Bariatric Surgery Guidelines, *Endocr Pract.* 2019;25(No. 12)

American Association of Clinical Endocrinologists, The Obesity Society, American Society for Metabolic & Bariatric Surgery, Obesity Medicine Association, and American Society of Anesthesiologists medical guidelines for clinical practice are systematically developed statements to assist health-care professionals in medical decision-making for specific clinical conditions. Most of the content herein is based on clinical evidence. In areas of uncertainty, or when clarification is required, expert opinion and professional judgment were applied. These guidelines are a working document that reflects the state of the field at the time of publication. Because rapid changes in this area are expected, periodic revisions are inevitable. We encourage medical professionals to use this information in conjunction with their best clinical judgment. The presented recommendations may not be appropriate in all situations. Any decision by practitioners to apply these guidelines must be made considering local resources and individual patient circumstances.

### ABSTRACT

**Objective:** The development of these updated clinical practice guidelines (CPGs) was commissioned by the American Association of Clinical Endocrinologists (AACE), The Obesity Society, American Society of Metabolic and Bariatric Surgery, Obesity Medicine Association, and American Society of Anesthesiologists Boards of Directors in adherence with the AACE 2017 protocol for standardized production of CPGs, algorithms, and checklists.

**Methods:** Each recommendation was evaluated and updated based on new evidence from 2013 to the present and subjective factors provided by experts.

**Results:** New or updated topics in this CPG include: contextualization in an adiposity-based chronic disease complications-centric model, nuance-based and algorithm/checklist-assisted clinical decision-making about procedure selection, novel bariatric procedures, enhanced recovery after bariatric surgery protocols, and logistical concerns (including cost factors) in the current health-care arena. There are 85 numbered recommendations that have updated supporting evidence, of which 61 are revised and 12 are new. Noting that there can be multiple recommendation statements within a single numbered recommendation, there are 31 (13%) Grade A, 42 (17%) Grade B, 72 (29%) Grade C, and 101 (41%) Grade D recommendations. There are 858 citations, of which 81 (9.4%) are evidence level (EL) 1 (highest), 562 (65.5%) are EL 2, 72 (8.4%) are EL 3, and 143 (16.7%) are EL 4 (lowest).

**Conclusion:** Bariatric procedures remain a safe and effective intervention for higher-risk patients with obesity. Clinical decision-making should be evidence based within the context of a chronic disease. A team approach to perioperative care is mandatory, with special attention to nutritional and metabolic issues. (*Endocr Pract.* 2019;25:1-75)

#### Abbreviations:

**A1C** = hemoglobin A1c; **AACE** = American Association of Clinical Endocrinologists; **ABCD** = adiposity-based chronic disease; **ACE** = American College of Endocrinology; **ADA** = American Diabetes Association; **AHI** = Apnea-Hypopnea Index; **ASA** = American Society of Anesthesiologists; **ASMBS** = American Society of Metabolic and Bariatric Surgery; **BMI** = body mass index; **BPD** = biliopancreatic diver-

sion; **BPD/DS** = biliopancreatic diversion with duodenal switch; **CI** = confidence interval; **CPAP** = continuous positive airway pressure; **CPG** = clinical practice guideline; **CRP** = C-reactive protein; **CT** = computed tomography; **CVD** = cardiovascular disease; **DBCD** = dysglycemia-based chronic disease; **DS** = duodenal switch; **DVT** = deep venous thrombosis; **DXA** = dual-energy X-ray absorptiometry; **EFA** = essential fatty acid; **EL** = evidence level; **EN** = enteral nutrition; **ERABS** = enhanced recovery after bariatric surgery; **FDA** = U.S. Food and Drug Administration; **G4GAC** = Guidelines for Guidelines, Algorithms, and Checklists **GERD** = gastroesophageal reflux disease; **GI** = gastrointestinal; **HCP** = health-care professional(s); **HTN** = hypertension; **ICU** = intensive care unit; **IGB** = intragastric balloon(s); **IV** = intravenous; **LAGB** = laparoscopic adjustable gastric band; **LAGBP** = laparoscopic adjustable gastric banded plication; **LGP** = laparoscopic greater curvature (gastric) plication; **LRYGB** = laparoscopic Roux-en-Y gastric bypass; **LSG** = laparoscopic sleeve gastrectomy; **MetS** = metabolic syndrome; **NAFLD** = nonalcoholic fatty liver disease; **NASH** = nonalcoholic steatohepatitis; **NSAID** = nonsteroidal anti-inflammatory drug; **OA** = osteoarthritis; **OAGB** = one-anastomosis gastric bypass; **OMA** = Obesity Medicine Association; **OR** = odds ratio; **ORC** = obesity-related complication(s); **OSA** = obstructive sleep apnea; **PE** = pulmonary embolism; **PN** = parenteral nutrition; **PRM** = pulmonary recruitment maneuver; **RCT** = randomized controlled trial; **RD** = registered dietician; **RDA** = recommended daily allowance; **RYGB** = Roux-en-Y gastric bypass; **SG** = sleeve gastrectomy; **SIBO** = small intestinal bacterial overgrowth; **TOS** = The Obesity Society; **TSH** = thyroid-stimulating hormone; **T1D** = type 1 diabetes; **T2D** = type 2 diabetes; **VTE** = venous thromboembolism; **WE** = Wernicke encephalopathy; **WHO** = World Health Organization

### LAY ABSTRACT

Obesity is an officially recognized global disease and continues to be a risk factor for chronic medical conditions such as cardiovascular diseases, diabetes, chronic kidney disease, nonalcoholic fatty liver disease, metabolic

syndrome, and many cancers. This updated guideline is based on an increased number and quality of the best available scientific studies to guide physicians in the clinical care of patients with obesity who undergo surgical and nonsurgical bariatric procedures. This guideline identifies patient candidates for bariatric procedures, discusses which types of bariatric procedures should be offered, outlines management of patients before procedures, and recommends how to optimize patient care during and after procedures. Since publication of the previous guideline in 2013, the role of bariatric surgery in the treatment of patients with type 2 diabetes has grown substantially. Studies have demonstrated that bariatric/metabolic surgery achieves superior improvements in glycemic control of patients with type 2 diabetes and obesity, compared with various medical and lifestyle interventions, and leads to substantial cost savings. Improved cardiovascular outcomes and quality of life have also been reported in patients undergoing bariatric surgery. New and emerging surgical and nonsurgical bariatric procedures are described. Criteria for bariatric procedures are better defined. This update includes checklists to assist health-care professionals achieve greater precision in clinical decision-making and discusses the importance of a team approach to patient care, with special attention on nutrition, metabolism, and interventions to improve recovery after bariatric surgery. Enhanced recovery after bariatric surgery procedures are discussed in detail. Bariatric procedures remain a safe and effective intervention for higher-risk patients with obesity.

## INTRODUCTION

This 2019 clinical practice guideline (CPG) update provides revised clinical management recommendations

that incorporate evidence from 2013 to the present, a period marked by a significant increase in the total number of publications on bariatric surgery, especially randomized controlled trials (RCTs), meta-analyses, and reviews (Table 1). In addition, this update requires reinterpretation of the utility and decision-making process within the context of an evolving obesity-care model, increasingly detailed management strategies and protocols, and the need for a more transparent tactical plan in a probing and scrutinizing health-care environment. New diagnostic terms, structured lifestyle approaches, pharmaceutical options, and surgical and nonsurgical procedures have reshaped the obesity-care space. A general overview of the clinical pathway for bariatric surgery is provided in Figure 1. Readers are advised to refer to earlier editions of this CPG for additional supporting evidence, including the basics of bariatric surgery mechanisms of actions, risks, and benefits.

### Update on Obesity as a Disease and Clinical Assessment

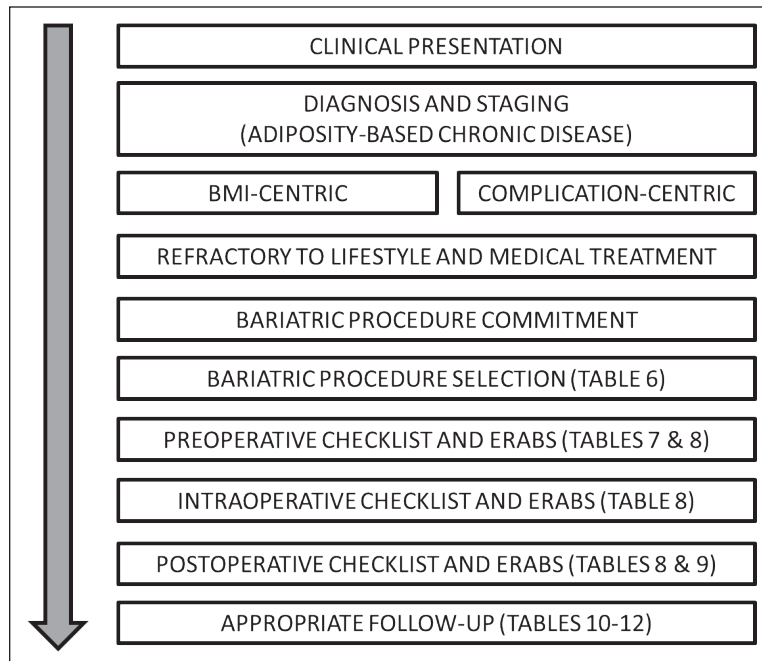
Since the publication of the 2013 American Association of Clinical Endocrinologists (AACE)/The Obesity Society (TOS)/American Society of Metabolic and Bariatric Surgery (ASMBS) bariatric surgery CPG (1), obesity continues to be a major national and global health challenge, as well as a risk factor for an expanding set of chronic diseases, including cardiovascular disease (CVD), diabetes, chronic kidney disease, nonalcoholic fatty liver disease (NAFLD), metabolic syndrome (MetS), and many cancers, among other comorbid conditions. Obesity is now included among the global noncommunicable disease targets identified by the World Health Organization (WHO) (2-4). In 2015, a total of 107.7 million children and 603.7 million adults had obesity worldwide (5). The prevalence

**Table 1**  
Increased PubMed Citations on Bariatric Surgery with Each Clinical Practice Guidelines Update<sup>a</sup>

Years	Non-English (% total)	RCT (% Δ)	Meta-Analysis (% Δ)	Review (% Δ)	Guideline (% Δ)	Total (% Δ)
<2008	975 (13)	204	20	1,148	34	7,746
2008-2012	576 (8)	201 (-0.01)	46 (130)	1,210 (5)	40 (18)	7,254 (-6)
2013-2018	605 (4)	746 ( <b>271</b> )	218 ( <b>374</b> )	2,396 ( <b>98</b> )	44 (0.1)	14,105 ( <b>94</b> )
All years	2156 (7)	1,154	284	4,754	118	29,105

Abbreviation: RCT = randomized controlled trial.

<sup>a</sup>The search term used was “bariatric surgery” on December 31, 2018. Standard PubMed filters were used with customized publication dates. Non-English figures were the difference of unfiltered amounts and the “English” language filter. Non-English percentages use “Total” publications as the denominator. Percentage change (% Δ) uses the figure at the previous publication date range as the denominator. Simple analysis shows that the greatest increase in total, RCT, meta-analysis, and reviews occurred since publication of the last AACE/ASMBS/TOS bariatric surgery CPG update in 2013 in bold (1). The number of guidelines and non-English publications on bariatric surgery has remained generally constant over the years.



**Fig. 1.** Bariatric procedure decision-making. *BMI* = body mass index; *ERABS* = enhanced recovery after bariatric surgery.

of obesity in the United States is among the highest in the world. According to the National Health and Nutrition Examination Survey 2013-2016 dataset, 38.9% of U.S. adults and 18.5% of youth aged 2 to 19 years had obesity (6,7). This translates into 93.3 million adults and 13.7 million children and youth, respectively. More women (40.8%) than men (36.5%) were obese, with non-Hispanic black women (55.9%) showing the highest rates of prevalence (6,7). Although the prevalence of obesity has been steady among adults since 2011-2012, rates of prevalence in certain subpopulations continue to rise, particularly for those with severe (class III, body mass index [BMI]  $\geq 40$  kg/m<sup>2</sup>) obesity where overall age-adjusted rates of prevalence are 5.5% and 9.8% for men and women, respectively, and 16.8% for non-Hispanic women (8).

The global burden of obesity is driven by the association between BMI and increased morbidity and mortality. Although BMI is simplistic (it is only an anthropometric calculation of height-for-weight; or more specifically, weight in kilograms [kg] divided by height in meters squared) and has been criticized as an insensitive marker of disease, it currently provides the most useful population-level measurement of overweight and obesity, and its utility as an estimate of risk has been validated in multiple large population studies across multiple continents. The j-shaped curve for BMI and mortality has recently been confirmed in a large meta-analysis (9) and a systematic review (10) that included 10.6 million and 30 million participants, respectively. These two studies confirm that both overweight and obesity increase the risk of all-cause mortality and should be prioritized on a population level.

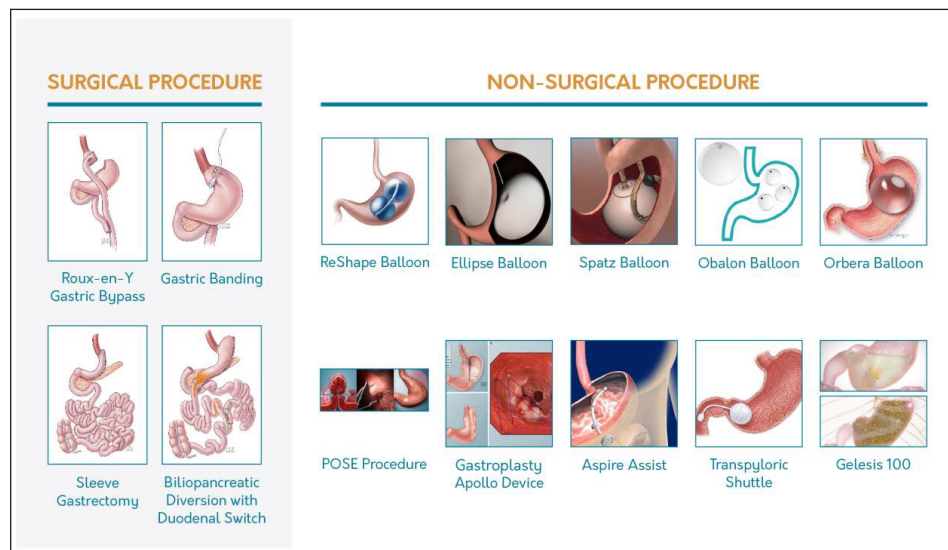
Based on the complexity of body-weight regulation, increased morbidity and mortality associated with obesity, and the substantial burden on public health, obesity was officially recognized as a disease by the American Medical Association in 2013 along with multiple other organizations, and most recently by the World Obesity Federation (11). Several guidelines for treatment of obesity have also been published as a resource for clinicians since 2013. Most notable are the American Heart Association / American College of Cardiology/TOS *Guideline for the Management of Overweight and Obesity in Adults* (12), The ACE and the American College of Endocrinology (ACE) *Clinical Practice Guidelines for Comprehensive Care of Patients with Obesity* (13), the Obesity Medicine Association (OMA) *Obesity Management Algorithm* (14), and the *Pharmacological Management of Obesity* guidelines from the Endocrine Society (15). In 2017, the American Gastroenterological Association (AGA) issued a Practice Guide on Obesity and Weight Management, Education, and Resources (POWER) that emphasized a comprehensive approach to assessment, treatment, and prevention (16). This AGA guideline is particularly important for the increasing number of gastroenterologists who are performing endoscopic procedures for the treatment of obesity that include placement of intragastric balloons, plications and suturing of the stomach, and insertion of a duodenal-jejunal bypass liner, among other emerging procedures (17).

In addition to these guidelines, efforts are also underway to develop more practical and useful assessments to identify patients who require increased medical attention

for obesity-related conditions. Analogous to other staging systems commonly used for congestive heart failure or chronic kidney disease, the AACE/ACE obesity CPG proposes an obesity staging system that is based on ethnic-specific BMI cutoffs along with assessment for adiposity-related complications (13). Stage 0 is assigned to individuals who have overweight or obesity by BMI classification but have no complications, whereas Stage 1 and 2 are defined as individuals who are overweight or obese by BMI classification and have one or more mild-moderate complications (Stage 1) or at least one severe complication (Stage 2). Building off this complications-centric approach to obesity care, AACE/ACE recently proposed a new diagnostic term for obesity using the abbreviation “ABCD,” which stands for *adiposity-based chronic disease* (18). A different functional staging system for obesity was proposed by Sharma and Kushner (19). Using a risk-stratification construct, referred to as the “Edmonton Obesity Staging System” (EOSS), individuals with obesity are classified into five graded categories, based on their morbidity and health-risk profile along three domains: medical, functional, and behavioral. The staging system was shown to predict increased mortality in two large population cohorts (20,21). The need to shift from BMI- to complications-centric decision-making has applications beyond the U.S.; for example, in China, acceptance levels for bariatric surgery are principally based on the need for and expectations of weight loss, rather than treatment of severe obesity-related complications (ORC) (22,23).

### Update on Nonsurgical Therapies

There are many bariatric surgical and nonsurgical procedures that are reimbursed by third-party payers, use U.S. Food and Drug Administration (FDA)-approved devices, or remain available through clinical investigative protocols (Fig. 2). Advancements in nonsurgical approaches to obesity include development of endoscopic bariatric therapies and approval of newer anti-obesity medications. Various endoscopic bariatric therapies function to reduce gastric volume by one of three techniques: (1) reduce the stomach’s capacity via space-occupying devices, such as intragastric balloons, (2) remodel the stomach utilizing endoscopic suturing/plication devices, such as endoscopic sleeve gastropasty, and (3) divert excess calories away from the stomach, such as aspiration therapy (17). Three gastric balloons have been approved by the FDA since 2015 for patients with a BMI 30 to 40 kg/m<sup>2</sup>: the ReShape Duo™ (ReShape Medical, San Clemente, CA), the Orbera® intra-gastric balloon (Apollo EndoSurgery, Austin, TX), and the Obalon® Balloon (Obalon Therapeutics, Inc). Although these endoscopically placed devices are associated with short-term (6-month) weight loss, their utility and safety in long-term obesity management remain uncertain (24). The other nonsurgical resources for treatment of obesity are anti-obesity medications, which are well defined in guidelines for obesity treatment based on demonstrable weight-loss efficacy and associated metabolic improvements. Four medications have been approved by the FDA since 2012: phentermine/topiramate ER, lorcaserin, naltrexone/bupro-



**Fig. 2.** Current surgical and endoscopic bariatric procedures. The four surgical procedures shown are endorsed by the American Society of Metabolic and Bariatric Surgery. Laparoscopic sleeve gastrectomy comprises 70% of currently performed procedures, followed by laparoscopic gastric bypass (25%), adjustable gastric banding (3%), and duodenal switch (2%). Endoscopic procedures include aspiration therapy (AspireAssist\*), space-occupying gastric devices (Ellipse™, Obalon®, Orbera®, Reshape™, Spatz™ balloons, and Gelesis capsule\*), gastric-emptying device (Transpyloric Shuttle®\*\*), and suturing/plication procedures (endoscopic sleeve gastropasty with Apollo Overstitch™ and POSE procedure with the Incisionless Operating Platform™\*\*\*). POSE = primary obesity surgery endoluminal.

\*FDA-approved devices; \*\*FDA trial underway; \*\*\*Devices FDA approved for tissue approximation.

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tion ER, and liraglutide 3.0 mg (25). Anti-obesity medications are approved by the FDA for patients with a BMI  $\geq 30$  kg/m<sup>2</sup> without ORC, or  $\geq 27$  kg/m<sup>2</sup> when associated with at least one ORC. Based primarily on retrospective data and personal experience, these medications are increasingly used in patients who have undergone bariatric surgery but have experienced either insufficient weight loss or frank weight regain.

### Update on Bariatric Surgery

Significant additions to the evidence base have occurred since the publication of the 2013 TOS/ASMBS/AACE bariatric surgery CPG (1). A PubMed computerized literature search (performed between January 1, 2013, and December 31, 2018) using the search term “bariatric surgery” revealed a total of 14,105 citations. Update of this 2019 CPG focuses on the most significant advances and changes in clinical care of the patient who undergoes bariatric surgery. Regarding procedure type, the sleeve gastrectomy (SG) has continued to trend upward, while the Roux-en-Y gastric bypass (RYGB) and laparoscopic adjustable gastric band (LAGB) have trended downward. In one large database from 2015, the SG accounted for 63% of procedures performed, compared to 30% and 2% for RYGB and LAGB, respectively (26). The increase in SG is principally due to comparable metabolic and weight-loss outcomes, but with lower complication rates (27) and fewer nutritional deficiencies, compared with RYGB.

One of the most significant advances since the 2013 CPG has been the growing role of bariatric surgery in the treatment of patients with type 2 diabetes (T2D). A substantial body of evidence from 12 RCTs demonstrates that bariatric/metabolic surgery achieves superior improvements in glycemic-control metrics in patients with T2D, compared with various medical and lifestyle interventions. The improvement in glycemic control appears to be due to both weight loss–dependent and –independent effects (28). Based on these data, the Second Diabetes Surgery Summit Consensus Conference published guidelines in 2015 that were endorsed by more than 50 other organizations interested in the treatment of T2D (29). According to these guidelines, metabolic surgery should be considered in patients with T2D and obesity (BMI  $>35.0$  kg/m<sup>2</sup>) when hyperglycemia is inadequately controlled with lifestyle and optimal medical therapy. The 2016 Standards of Care for Diabetes from the American Diabetes Association (ADA) includes bariatric surgery in the treatment algorithm for T2D. Warren et al (30) demonstrated that in a population-based model where an increased number of bariatric surgeries are performed in patients with T2D, there is a substantial cost savings over a 10-year period, roughly \$5.4 million per 1,000 patients.

There have also been two cohort studies, six RCTs, and five meta-analyses published since 2013 that report mortality and cardiovascular outcomes, such as myocardial infarction, stroke, CVD risk and events, hypertension

(HTN), and dyslipidemia (31–43). Despite heterogeneity in study design, these data favor significantly improved CVD outcomes in patients undergoing bariatric surgery. DiaSurg 2, a randomized controlled multicenter trial comparing RYGB versus medical treatment in German patients with insulin-requiring T2D with BMI 26 to 35 kg/m<sup>2</sup>, is currently underway (44). The primary endpoint is composite time-to-event using 8-year data, including CVD mortality, myocardial infarction, coronary bypass, percutaneous coronary intervention, nonfatal stroke, amputation, and surgery for peripheral atherosclerotic artery disease.

The evolving role of bariatric procedures, or more generally speaking gastrointestinal (GI) procedures, to decrease cardiometabolic risk is more clearly envisioned within the nexus of ABCD and a newly proposed model of dysglycemia-based chronic disease (DBCD) (45). In this model, abnormal adiposity intersects with stage-I DBCD as a driver for insulin resistance, T2D, and CVD (45). The recent findings of a large, multicenter, retrospective matched cohort study by Fisher et al (46) corroborate this concept. They found a lower risk of macrovascular outcomes associated with bariatric surgery in patients with T2D and severe obesity (46). From a pragmatic standpoint, once this ABCD-DBCD model can be scientifically validated, decision-making for the use of GI interventional procedures on cardiometabolic risk reduction will be based on complication risk assessments, rather than just hemoglobin A1c (A1C), BMI, or other simplistic metrics.

Quality of life was reported in two RCTs and improved in the patients undergoing bariatric surgery (33,34). The impact of bariatric surgery on skeleton and fracture risk has also been recently studied (47–49). Follow-up data from the National Institutes of Health–supported, prospective cohort Longitudinal Assessment of Bariatric Surgery continue to inform clinical care regarding various aspects of postoperative management, including weight-loss trajectories (50), behavioral variables, 3-year weight changes (51), and risks for developing alcohol-use disorder (52). Lastly, postoperative weight regain is recognized as a significant clinical issue that requires focused attention.

### The American Board of Obesity Medicine

Based on the increased prevalence and burden of overweight and obesity among U.S. adults and children, a distinct need for more advanced competency in the field of obesity, burgeoning approaches in obesity care expected to continue over the next decade, and complex perioperative care of the patient undergoing bariatric surgery, the American Board of Obesity Medicine (ABOM) was established in 2011 ([www.abom.org](http://www.abom.org)). Certification as an ABOM diplomate signifies specialized knowledge in the practice of obesity medicine and distinguishes a physician as having achieved competency in obesity care. As of 2018, over 2,600 physicians have become Diplomates, of which over half co-manage patients who have undergone bariatric surgery (53). This team-based approach to bariatric surgery

that also includes dietitians, mental health professionals, and advanced practitioners (e.g., nurse practitioner and physician assistant) is important in perioperative management. Thus, the tactical approach to an obesity epidemic that can effectively implement evidence-based strategies, as well as increase exposure of health-care professionals (HCP) to patients having bariatric surgery, mandates leadership roles of experts and champions for obesity care, development of formal obesity-care teams, and a friendly logistical infrastructure to facilitate favorable outcomes.

## METHODS

The Boards of Directors for the AACE, TOS, ASMBS, OMA, and American Society of Anesthesiologists (ASA) approved this update of the 2008 (54) and 2013 (1) AACE/TOS/ASMBS Medical Guidelines for Clinical Practice for the Perioperative Nutritional, Metabolic, and Nonsurgical Management of the Bariatric Surgery Patient. Selection of the co-chairs, primary writers, and reviewers, as well as the logistics for creating this 2019 evidence-based CPG update were conducted in strict adherence with the AACE Protocol for Standardized Production of Clinical Practice Guidelines, Algorithms, and Checklists—2017 Update (2017 Guidelines for Guidelines; 2017 G4GAC) (55) (Tables 2 through 5). This updated CPG methodology provides for patient-first language (“patient undergoing bariatric procedures” instead of disease-first language: “bariatric patient”) and greater detail for evidence ratings and structure for the involvement of the American College of Endocrinology Scientific Referencing Subcommittee, a dedicated resource for the rating of evidence, mapping of grades, and general oversight of the entire CPG production process. In addition, the term “bariatric procedure” is used to broadly apply to both surgical and nonsurgical procedures. However, when the evidence specifically pertains to surgical procedures, then the term “bariatric surgery” is used. A critical improvement in the 2017 G4GAC is to create documents that are easier to use and less cumbersome. Nevertheless, as with all white papers and increasing diligence on the part of the writing team and sponsoring professional medical organizations, there remains an element of subjectivity that must be recognized by the reader when interpreting the information.

*Key Updates* are provided to highlight the most important new recommendations in this CPG. The *Executive Summary* is reorganized into seven clinical questions and provides updated recommendation numbers (R1, R2, R3, ... R85) in their entirety followed by the respective publication year of the creation or last update in parentheses and an indication of updated explanations and/or references by an asterisk. In many cases, recommendations have been condensed for clarity and brevity. In other cases, recommendations have been expanded for more clarity to assist with complex and/or nuanced-based decision-

making. The relevant evidence base, supporting tables, and figures for the updated recommendations follow the Executive Summary in an Appendix. The reader is encouraged to refer to the 2008 (54) and 2013 (1) AACE-TOS-ASMBS CPG for background material not covered in this 2019 update.

### Key Updates for 2019

- **Technical:** there is an increased amount and quality of recent evidence to guide clinical decision-making; the analysis of evidence is based on the updated 2017 G4GAC; there are now five sponsoring professional medical societies that provide a greater fund of expert knowledge and higher level of diligence in the iterative review process.
- **Disease Context:** the role for surgical and nonsurgical bariatric procedures has been re-examined in a complications-centric framework of ABCD and DBCD, providing the potential for greater precision for clinical decision-making based on biological correlates, clinical relevance, cardiometabolic risk assessment, and ethnicity-related differences in anthropometrics.
- **Procedure Selection:** new and emergent surgical and nonsurgical bariatric procedures are introduced and described, nuanced criteria for bariatric procedures are better defined, and an algorithm with supporting tables and checklists are provided to assist the reader with decision-making.
- **Perioperative Protocols:** proactive interventions to improve postoperative outcomes with an emphasis on perioperative enhanced recovery after bariatric surgery (ERABS) clinical pathways are presented and elaborated.

## EXECUTIVE SUMMARY

There are 85 numbered recommendations in this 2019 update, compared with 74 updated recommendations in 2013 and 164 original recommendations in 2008. There are 12 new recommendations in this 2019 update (14%), and among the others, 61 were revised (72%). Unanimous consensus among primary writers was obtained for each of the recommendations. Updated recommendation numbers are indicated by the most recent update year, updated evidence by an asterisk after the year, and new recommendations by “NEW.” The semantic descriptors of “must,” “should,” and “may” generally, but not strictly, correlate (or map) with Grade A (strong), Grade B (intermediate), and Grade C (weak) recommendations, respectively; each semantic descriptor can be used with Grade D (no conclusive evidence and/or expert opinion) recommendations. Deviations from this mapping are not unusual and take into consideration further decision-making requirements, logistics, and subjective factors. Bariatric procedures include both surgical and nonsurgical procedures; the latter are generally performed endoscopically. Recommendations

**8 Bariatric Surgery Guidelines, *Endocr Pract.* 2019;25(No. 12)**

are oriented to the procedure type based on the respective evidence base and expert opinion.

**Q1. Which patients should be offered bariatric procedures?**

**R1.** (2019\*). Patients with a body mass index  $\geq 40$  kg/m<sup>2</sup> without co-existing medical problems and for whom bariatric procedures would not be associated with excessive risk are eligible for a bariatric procedure (**Grade A; BEL 1**).

**R2.** (2019\*). Patients with a body mass index (BMI)  $\geq 35$  kg/m<sup>2</sup> and one or more severe obesity-related complications remediable by weight loss, including type 2 diabetes (T2D), high risk for T2D (insulin resistance, prediabetes, and/or metabolic syndrome), poorly controlled hypertension, nonalcoholic fatty liver disease/nonalcoholic steatohepatitis, obstructive sleep apnea, osteoarthritis of the knee or hip, and urinary stress incontinence, should be considered for a bariatric procedure (**Grade C; BEL 3**). Patients with the following comorbidities and BMI  $\geq 35$  kg/m<sup>2</sup> may also be considered for a bariatric procedure,

Table 2 Step I AACE G4GAC: Evidence Rating <sup>a</sup>		
Numerical descriptor <sup>b</sup>	Semantic descriptor	Methodology descriptor
<b>STRONG EVIDENCE</b>		
1 (1)	RCT	Randomized controlled trial <sup>c</sup>
1 (1)	MRCT	Meta-analysis of only randomized controlled trials
<b>INTERMEDIATE EVIDENCE</b>		
2 (2)	MNRCT	Meta-analysis including nonrandomized prospective or case-controlled trials
2 (new)	NMA	Network meta-analysis
2 (2)	NRCT	Nonrandomized controlled trial (or unconfirmed randomization)
2 (2)	PCS	Prospective cohort study (does not include open-label extension study)
2 (2)	RCCS	Retrospective case-control study
2 (new)	NCCS	Nested case-control study
2 (3; re-assigned)	CSS	Cross-sectional study
2 (3; re-assigned)	ES	Epidemiologic study (hypothesis driven; includes survey, registry, data-mining, with or without retrospective uni-multivariate analyses or propensity matching)
2 (new)	OLES	Open-label extension study
2 (new)	PHAS	<i>Post hoc</i> analysis study
<b>WEAK EVIDENCE</b>		
3 (new)	DS	Discovery science (explorative/inductive; includes -omics, “big data,” network analysis, systems biology, Bayesian inference, modeling)
3 (new)	ECON	Economic study (includes Markov models, pharmaco-economics)
3 (3)	CCS	Consecutive case series (N > 1)
3 (3)	SCR	Single case report (N = 1)
3 (new)	PRECLIN	Preclinical study (e.g., feasibility, safety)
3 (new)	BR	Basic research (must be high impact and relevant)
<b>NO EVIDENCE</b>		
4 (4)	NE	No evidence (theory, opinion, consensus, review, position, policy, guideline)
4 (new)	O	Other (e.g., lower impact/relevant basic research; any highly flawed study)
Abbreviations: AACE = American Association of Clinical Endocrinologists; G4GAC = Guidelines for Guidelines, Algorithms, and Checklists.		
<sup>a</sup> Based on principle that interventions, scientific control, generalizability, methodological flaws, and evidentiary details determine strength, consistent with other evidence-based methodology systems. Numerical and semantic descriptors of evidence levels provided in online supplementary material.		
<sup>b</sup> The original numerical description from G4GAC 2004, 2010, and 2014 are provided in parentheses.		
<sup>c</sup> The superiority of RCT over all other studies, and in particular MRCT, is discussed in reference elsewhere.		
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Table 3 Step II AACE G4GAC – Scientific Analysis and Subjective Factors <sup>a</sup>		
Study design <sup>a</sup>	Data analysis <sup>b</sup>	Interpretation of results
Allocation concealment (randomization)	Intent-to-treat	Generalizability
Blinding <sup>c</sup>	Modeling (e.g., Markov)	Incompleteness
Comparator group	Network analysis	Logical
Endpoints (real clinical vs. surrogate)	Statistics	Overstated
Hypothesis	Appropriate follow-up	Validity
Power analysis (too small sample size)	Appropriate trial termination	
Premise		
Type 1 error (e.g., adjusted for PHAS)		

Abbreviations: AACE = American Association of Clinical Endocrinologists; G4GAC = Guidelines for Guidelines, Algorithms, and Checklists; PHAS = *post hoc* analysis study.  
<sup>a</sup>These subjective factors pertain to an individual citation. Subjective factors are provided in online supplementary material from (55).  
<sup>b</sup>Are these elements appropriate for the given study?  
<sup>c</sup>Including patients, clinicians, data collectors, adjudicators of outcome, and data analysts.  
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Table 4 Step III AACE G4GAC – Recommendation Qualifiers*
Cascades (are there other recommendation versions based on ethnocultural factors?)
Dissenting opinions (based on HCP and patient preferences)
Economic (e.g., cost-effectiveness, cost-benefit, value)
Evidence base (are there significant gaps or is there overwhelming evidence?)
Relevance (patient-oriented evidence that matters vs. disease-oriented evidence; social acceptability)
Resource availability (limited or sufficient)
Risk to benefit

Abbreviations: AACE = American Association of Clinical Endocrinologists; G4GAC = Guidelines for Guidelines, Algorithms, and Checklists; HCP = health-care professional(s).  
 \*Each of these elements pertains to the recommendation statement with the evidence considered in aggregate. The element may be positive or negative and therefore modify a final recommendation grade. Recommendation qualifiers are provided in online supplementary material from (55).  
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though the strength of evidence is more variable: obesity-hypoventilation syndrome and Pickwickian syndrome after a careful evaluation of operative risk; idiopathic intracranial hypertension; gastroesophageal reflux disease; severe venous stasis disease; impaired mobility due to obesity; and considerably impaired quality of life (**Grade C; BEL 3**).

**R3.** (2019\*). Patients with body mass index 30 to 34.9 kg/m<sup>2</sup> and type 2 diabetes with inadequate glycemic control despite optimal lifestyle and medical therapy should be considered for a bariatric procedure; current evidence is insufficient to support recommending a bariatric procedure in the absence of obesity (**Grade B; BEL 2**).

**R4.** (NEW). The body mass index criterion for bariatric procedures should be adjusted for ethnicity (e.g., 18.5 to

22.9 kg/m<sup>2</sup> is normal range, 23 to 24.9 kg/m<sup>2</sup> overweight, and ≥25 kg/m<sup>2</sup> obesity for Asians) (**Grade D**).

**R5.** (2019\*). Bariatric procedures should be considered to achieve optimal outcomes regarding health and quality of life when the amount of weight loss needed to prevent or treat clinically significant ORC cannot be obtained using only structured lifestyle change with medical therapy (**Grade B; BEL 2**).

#### Q2. Which bariatric procedure should be offered?

**R6.** (2019\*). Selecting a bariatric procedure should be based on individualized goals of therapy (e.g., weight-loss target and/or improvements in specific obesity-related complications), available local-regional expertise (obesity specialists, bariatric surgeon, and institution), patient

**Table 5**  
**Step IV AACE G4GAC – Creating Initial Recommendation Grades<sup>a</sup>**

Best evidence level	Predominantly negative SF and/or RQ	Predominantly positive SF and/or RQ	Consensus for recommendation and for grade	EL to grade mapping	Map to final recommendation grade
1	No	No	>66%	Direct	1 → A
Any <sup>b</sup>	No	No	100%	Rule	Any → A (new)
2	No	Yes	>66%	Adjust up	2 → A
2	No	No	>66%	Direct	2 → B
1	Yes	No	>66%	Adjust down	1 → B
3	No	Yes	>66%	Adjust up	3 → B
3	No	No	>66%	Direct	3 → C
2	Yes	No	>66%	Adjust down	2 → C
4	No	Yes	>66%	Adjust up	4 → C
4	No	No	>66%	Direct	4 → D
3	Yes	No	>66%	Adjust down	3 → D
Any <sup>b</sup>	Yes/no	Yes/no	>66%	Rule	Any → AD (new)

Abbreviations: AACE = American Association of Clinical Endocrinologists; BEL = best evidence level; EL = evidence level; G4GAC = Guidelines for Guidelines, Algorithms, and Checklists; RQ = recommendation qualifiers; SF = subjective factors.

<sup>a</sup>Recommendation Grade A = “Very Strong”; B = “Strong”; C = “Not Strong”; D = “Primarily Based on Expert Opinion.” Mappings are provided in online supplementary material from (55).

<sup>b</sup>Rule-based adjustment wherein any recommendation can be a “Very Strong” Grade A if there is 100% consensus to use this designation. Similarly, if >66% consensus is not reached, even with some degree of scientific substantiation, a “Primarily Based on Expert Opinion” Grade D designation is assigned. The reasons for downgrading to D may be an inconclusive or inconsistent evidence base or simply failure of the expert writing committee to sufficiently agree. Note that any formulated recommendation is omitted from the document if sufficiently flawed, so any Grade D recommendation in the final document must be deemed sufficiently important. Rule-based adjustments are provided in online supplementary material from (55).

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preferences, personalized risk stratification that prioritizes safety, and other nuances as they become apparent (Table 6) (**Grade C; BEL 3**). Notwithstanding technical surgical reasons, laparoscopic bariatric procedures should be preferred over open bariatric procedures due to lower early postoperative morbidity and mortality (**Grade B; BEL 2**). Laparoscopic adjustable gastric banding, laparoscopic sleeve gastrectomy, laparoscopic Roux-en-Y gastric bypass, and laparoscopic biliopancreatic diversion without/with duodenal switch (LBDP/DS), or related procedures should be considered as primary bariatric and metabolic procedures performed in patients requiring weight loss and/or amelioration of obesity-related complications (**Grade A; BEL 1**). Physicians must exercise caution when recommending biliopancreatic diversion (BPD), BPD with duodenal switch (BPD/DS), or related procedures because of the greater associated nutritional risks related to the increased length of bypassed small intestine (**Grade A; BEL 1**). Newer nonsurgical bariatric procedures may be considered for selected patients who are expected to benefit from short-term (i.e., about 6 months) intervention with ongoing and durable structured lifestyle with/without medical therapy (**Grade C; BEL 3**). Investigational procedures may be considered for selected patients based on available institutional review board–approved proto-

cols, suitability for clinical targets, and individual patient factors, and only after a careful assessment balancing the importance for innovation, patient safety, and demonstrated effectiveness (**Grade D**).

### **Q3. How should potential candidates be managed before bariatric procedures?**

**R7.** (2008). Patients must undergo pre-procedure evaluation for obesity-related complications and causes of obesity, with special attention directed to those factors that could influence a recommendation for bariatric procedures (see Pre-operative Checklist in Table 7) (**Grade A; BEL 1**) and consider a referral to a specialist in obesity medicine (**Grade D**).

**R8.** (2008). The pre-procedure evaluation must include a comprehensive medical history, psychosocial history, physical examination, and appropriate laboratory testing to assess surgical risk (see Pre-operative Checklist in Table 7) (**Grade A; BEL 1**).

**R9.** (2008). Medical records should contain clear documentation of the indications for bariatric surgery (**Grade D**).

**R10.** (2019\*). Because informed consent is a dynamic process, there must be a thorough discussion with the patient regarding the risks and benefits, procedural options, choices of surgeon and medical institution, and the need for long-term follow-up and vitamin supplementation (including costs required to maintain appropriate follow-up and nutrient supplementation) (**Grade D**). Patients must also be provided with educational materials, which are culturally and educationally appropriate, as well as access to similar pre-operative educational sessions at prospective bariatric surgery centers (**Grade D**). Consent should include experience of the surgeon with the specific procedure offered and whether the hospital has an accredited bariatric surgery program (**Grade D**).

**R11.** (2013). The bariatric surgery program must be able to provide all necessary financial information and clinical material for documentation so that, if needed, third-party payer criteria for reimbursement are met (**Grade D**).

**R12.** (2013). Pre-procedure weight loss can reduce liver volume and may help improve the technical aspects of surgery in patients with an enlarged liver or fatty liver disease and therefore may be recommended before a bariatric procedure (**Grade B; BEL 1; downgraded due to inconsistent evidence**). Pre-procedure weight loss or medical nutritional therapy may be recommended to patients in selected cases to improve comorbidities, such as pre-procedure glycemic targets (**Grade D**).

**Table 6a**  
**Guiding Bariatric Procedure Selection Based on Risks, Benefits, and Target Weight Loss:**  
*Procedures Endorsed by ASMBS and Possibly Covered by Insurance*

Procedure (ref)	Target weight loss (%TBWL)	Favorable aspects	Unfavorable aspects
LAGB (845)	20%-25%	-No anatomic alteration -Removable -Adjustable	-High explant rate -Erosion -Slip/Prolapse
SG (845)	25%-30%	-Easy to perform -No anastomosis -Reproducible -Few long-term complications -Metabolic effects -Versatile for challenging patient populations	-Leaks difficult to manage -Little data beyond 5 years -20%-30% GERD
RYGB (845)	30%-35%	-Strong metabolic effects -Standardized techniques -<5% major complication rate -Effective for GERD -Can be used as second stage after SG	-Few proven revisional options for weight regain -Marginal ulcers -Internal hernias possible -Long-term micronutrient deficiencies
BPD/DS (845)	35%-45%	-Very strong metabolic effects -Durable weight loss -Effective for patients with very high BMI -Can be used as second stage after SG	-Malabsorptive -3%-5% protein-calorie malnutrition -GERD -Potential for internal hernias -Duodenal dissection -Technically challenging -Higher rate of micronutrient deficiencies than RYGB

Abbreviations: ASMBS = American Society of Metabolic and Bariatric Surgery; BMI = body mass index; GERD = gastroesophageal reflux disease; GI = gastrointestinal; HTN = hypertension; IGB = intragastric balloon; LAGB = laparoscopic adjustable gastric banding; LBPD/DS = laparoscopic biliopancreatic diversion with duodenal switch; LRYGB = laparoscopic Roux-en-Y gastric bypass; LSG = laparoscopic sleeve gastrectomy; MetS = metabolic syndrome; NAFLD = nonalcoholic fatty liver disease; NASH = nonalcoholic steatohepatitis; ORC = obesity-related complication; OSA = obstructive sleep apnea; PCOS = polycystic ovary syndrome; TBWL = total body weight loss; T2D = type 2 diabetes; vBLOC = vagal nerve-blocking device.

\*Selection of the specific bariatric procedure is done after a decision is made to have a bariatric procedure. Estimate of bariatric surgery numbers can be found at <http://asmbs.org/resources/estimate-of-bariatric-surgery-numbers>. (Accessed March 25, 2018).

- **STEP 1:** Identify durable target weight loss beyond that achieved with lifestyle and medications to mitigate relevant ORCs -- a primary determinant of an optimal procedure selection:
  - >5%-10% weight loss: T2D, dyslipidemia, HTN, NAFLD, low testosterone, OSA/reactive airway disease, urinary stress incontinence, PCOS
  - >10%-15% weight loss: MetS, prediabetes, NASH, osteoarthritis, GERD, depression (13).
- **STEP 2:** Identify other factors that can affect decision-making, including: durability, eating behaviors, surgeon skills, institutional experience, cardiometabolic effects, prior GI surgery, and GI disease. “Favorable” aspects show key parameters to favor selection of the respective procedure. “Unfavorable” aspects show key parameters against selection of the respective procedure.

<b>Table 6b</b> <b>Guiding Bariatric Procedure Selection Based on Risks, Benefits, and Target Weight Loss:</b> <i>Procedures and Devices Not Currently Covered by Insurance</i>			
Procedure (ref)	Target weight loss (%TBWL)	Favorable aspects	Unfavorable aspects
Primary obesity surgery endoluminal (POSE) (846)	5%	-Endoscopic -4.7% adverse events -Device FDA approved for tissue apposition	-Pain (45%) -Nausea (21%) -Vomiting (19%) - ? Durability
Gelesis100 (ingested Hydrogel capsules)	6%	-Swallowed, noninvasive -Not absorbed -No major adverse events -Increased fullness -FDA approved	-Minor gastrointestinal side effects -Only 24-week trial, no long-term data
vBLOC (847, 848)	8-9%	-No anatomic changes -Low complication rate (4%) -FDA approved	-Pain at neuroregulatory site -Explant required for conversion to another procedure
Intragastric balloon (17, 849, 850)	10-12%	-Endoscopic or swallowed -Good safety profile -FDA approved	-Temporary (6-month) therapy -Temporary n/v, pain -Early removal rate 10%-19%
AspireAssist (851)	12-14%	-Endoscopic -Changes eating behavior -FDA approved	-1-year therapy -Tube-related problems/complications -26% early removal
Transpyloric shuttle (852)	14%	-Endoscopic -Delays gastric emptying -FDA approved	-6-month data -Gastric ulcers
Endoscopic sleeve gastroplasty (ESG) (853)	16-20%	-Endoscopic -Low adverse event rate -Device FDA approved for tissue apposition	-One study, 2-year data -No RCTs -? Durability

Abbreviations: FDA = U.S. Food and Drug Administration; TBWL = total body weight loss; vBLOC = vagal nerve-blocking device, n/v = nausea/vomiting, RCT = randomized controlled trial.

<b>Table 6c</b> <b>Guiding Bariatric Procedure Selection Based on Risks, Benefits, and Target Weight Loss:</b> <i>Emerging Procedures Not Currently Covered by Insurance or Endorsed by ASMBS<sup>a</sup></i>			
Procedure (ref)	Target weight loss (%TBWL)	Favorable aspects	Unfavorable aspects
Laparoscopic greater curvature plication (LGP) (854)	15-25%	-Non-resectional -No staplers or devices -Reversible/revisable	-Limited data beyond 2 years -GERD -Difficult to standardize -Disruption of plication -Dilation of stomach -Not “leak-proof”
OAGB (845)	35-40%	-Simpler to perform than RYGB -More malabsorptive -Strong metabolic effects -No mesenteric defects	-Potential for bile reflux -Malabsorptive (long BP limb) -Little experience in U.S.
OADS (SIPS, SADI-S) (265, 854)	35-45%	-Single anastomosis -Simpler to perform than BPD/DS -Strong metabolic effects -Low early complication rate	-Little long-term data -Nutritional and micronutrient deficiencies possible -Duodenal dissection

Abbreviations: ASMBS = American Society of Metabolic and Bariatric Surgery; BPD/DS = biliopancreatic diversion with duodenal switch; GERD = gastroesophageal reflux disease; OAGB = one-anastomosis gastric bypass; OADS = one-anastomosis duodenal switch; RYGB = Roux-en-Y gastric bypass; SIPS = stomach intestinal pylorus-sparing; SADI-S = single anastomosis duodeno-ileal bypass with sleeve gastrectomy; TBWL = total body weight loss.

<sup>a</sup>Institutional review board (IRB) or IRB exemption required (<https://asmbs.org/resources/endorsed-procedures-and-devices>).

#### Q4. What are the elements of medical clearance for bariatric procedures?

**R13.** (NEW). A lifestyle medicine checklist should be completed as part of a formal medical clearance process for all patients considered for any bariatric procedure (Table 7) (**Grade D**).

**R14.** (2019\*). Pre-procedure glycemic control must be optimized using a diabetes comprehensive care plan, including healthy low-calorie dietary patterns, medical nutrition therapy, physical activity, and, as needed, pharmacotherapy (**Grade A; BEL 1**). Reasonable targets for pre-operative glycemic control, which may be associated with shorter hospital stays and improved bariatric procedure outcomes, include an A1C value of 6.5% to 7.0% (48 to 53 mmol/mol) or less and peri-procedure blood glucose levels of 80 to 180 mg/dL (**Grade B; BEL 2**). More liberal pre-procedure targets, such as an A1C of 7% to 8% (53 to 64 mmol/mol), are recommended in patients with advanced microvascular or macrovascular complications, extensive comorbid conditions, or long-standing diabetes in which the general goal has been difficult to attain despite intensive efforts (**Grade A; BEL 1**). In patients with A1C >8% or otherwise uncontrolled diabetes, clinical judgment determines the need and timing for a bariatric procedure (**Grade D**).

**R15.** (2013\*). Routine screening for primary hypothyroidism with a thyroid-stimulating hormone (TSH) level before a bariatric procedure is not recommended, though many insurance plans require a pre-procedure serum TSH level (**Grade D**). A serum TSH level should be obtained only if clinical evidence of hypothyroid is present (**Grade B; BEL 2**). Patients found to be hypothyroid must be treated with levothyroxine monotherapy (**Grade A; BEL 1**).

**R16.** (2019\*). A fasting lipid panel should be obtained in all patients with obesity (**Grade A; BEL 1**). Treatment should be initiated according to available and current clinical practice guidelines (see [www.aace.com/files/lipid-guidelines.pdf](http://www.aace.com/files/lipid-guidelines.pdf) and [www.lipid.org/recommendations](http://www.lipid.org/recommendations)) (**Grade D**).

**R17.** (2013\*). Candidates for bariatric procedures should avoid pregnancy pre-procedure and for 12 to 18 months post-procedure (**Grade D**). Women who become pregnant after bariatric procedures should be counseled and monitored for appropriate weight gain, nutritional supplementation, and fetal health (**Grade C; BEL 3**). All women of reproductive age should be counseled on contraceptive choices before and after bariatric procedures (**Grade D**). Patients undergoing RYGB or another malabsorptive procedure should be counseled about non-oral contraceptive therapies (**Grade D**). Patients who become pregnant following bariatric procedure should have nutritional surveillance and laboratory screening for nutrient deficiencies

every trimester, including iron, folate, vitamin B12, vitamin D, and calcium, and if after a malabsorptive procedure, fat-soluble vitamins, zinc, and copper (**Grade D**). Patients who become pregnant post-laparoscopic adjustable gastric band should have band adjustments as necessary for appropriate weight gain for fetal health (**Grade B; BEL 2**).

**R18.** (2008\*). Estrogen therapy should be discontinued before a bariatric procedure (1 cycle of oral contraceptives in premenopausal women; 3 weeks of hormone replacement therapy in postmenopausal women) to reduce the risks for post-procedure thromboembolic phenomena (**Grade D**).

**R19.** (2008\*). Women should be advised that their fertility status might be improved after a bariatric procedure (**Grade D**).

**R20.** (2019\*). Case-by-case decisions to screen for monogenic and syndromic causes of obesity should be based on specific historical and physical findings. (**Grade D**).

**R21.** (2019\*). The need for an electrocardiogram and other noninvasive cardiac testing is determined on the basis of the individual risk factors and findings on history and physical examination and should be based on the latest American College of Cardiology/American Heart Association guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery (<http://circ.ahajournals.org/content/early/2014/07/31/CIR.000000000000106>) (**Grade D**). Patients with known heart disease require a formal cardiology consultation before bariatric procedures (**Grade D**). Patients at risk for heart disease must undergo evaluation for peri-procedure  $\beta$ -adrenergic blockade (**Grade A; BEL 1**).

**R22.** (2019\*). In patients evaluated for bariatric procedures, clinical screening for obstructive sleep apnea (with confirmatory polysomnography if screening tests are positive) should be considered (**Grade C, BEL 3**). Patients with intrinsic lung disease or disordered sleep patterns should have a formal pulmonary evaluation, including arterial blood gas measurement, when knowledge of the results would alter patient care (**Grade C; BEL 3**).

**R23.** (2019\*). Tobacco use must be avoided at all times by all patients. In particular, patients who smoke cigarettes should stop as soon as possible, preferably 1 year, but at the very least, 6 weeks before bariatric procedures (**Grade A; BEL 2, upgraded by consensus**). Also, tobacco use must be avoided after bariatric procedures given the increased risk of poor wound healing, anastomotic ulcer, and overall impaired health (**Grade A; BEL 1**). Structured intensive cessation programs are preferable to general advice and should be implemented (**Grade D**).

**R24.** (2013\*). Patients with a history of deep venous thrombosis (DVT) or cor pulmonale should undergo a risk assessment for bariatric surgery and an appropriate diagnostic evaluation for DVT (**Grade D**). In selecting treatment approaches to prevent thrombosis, the routine placement of a vena cava filter is discouraged; however, prophylactic placement of a vena cava filter may be considered in individual patients after careful evaluation of the risks and benefits (**Grade C; BEL 3**).

**R25.** (2019\*). Clinically significant gastrointestinal (GI) symptoms should be evaluated before bariatric procedures with imaging studies, upper GI series, or endoscopy (**Grade D**). The use of pre-operative endoscopy may be considered in all patients being evaluated for sleeve gastrectomy (**Grade D**).

**R26.** (2019\*). Imaging studies are not recommended as a routine screen for liver disease (**Grade B, BEL 2**). Abdominal ultrasound is indicated to evaluate symptomatic biliary disease and elevated liver function tests (**Grade C, BEL 3**). Abdominal ultrasonography or elastography may be helpful and may be considered to identify nonalcoholic fatty liver disease, but may not be diagnostic (**Grade B, BEL 2**). Consideration can be made for liver biopsy at the time of a bariatric procedure to document steatohepatitis and/or cirrhosis that may otherwise be unknown due to normal appearance on imaging and/or liver function tests (**Grade C, BEL 3**). A comprehensive evaluation is recommended in those patients with clinically significant and persistent abnormal liver function tests (**Grade A; upgraded by consensus rule**).

**R27.** (2013\*). Routine screening for the presence of *Helicobacter pylori* before bariatric procedures may be considered in areas of high prevalence (**Grade C; BEL 3**).

**R28.** (2013\*). Prophylactic treatment for gouty attacks should be considered before bariatric procedures in patients with a history of gout (**Grade C, BEL 3**).

**R29.** (2008\*). There are insufficient data to warrant pre-procedure assessment of bone mineral density with dual-energy X-ray absorptiometry (DXA) or serum or urinary bone turnover markers outside formal recommendations by the National Osteoporosis Foundation (<http://www.iscd.org/documents/2014/10/nof-clin-guidelines.pdf/>) (**Grade D**).

**R30.** (2019\*). A formal psychosocial-behavioral evaluation performed by a qualified behavioral health professional (i.e., licensed in a recognized behavioral health discipline, such as psychology, social work, psychiatry, psychiatric nursing, etc., with specialized knowledge and training relevant to obesity, eating disorders, and/or bariatric

procedures), which assesses environmental, familial, and behavioral factors, as well as risk for suicide, should be required for all patients before a bariatric procedure (**Grade C; BEL 3**). Any patient considered for a bariatric procedure with a known or suspected psychiatric illness, or substance abuse or dependence, should undergo a formal mental health evaluation before the procedure (**Grade C; BEL 3**). Following Roux-en-Y gastric bypass and sleeve gastrectomy, high-risk groups should eliminate alcohol consumption due to impaired alcohol metabolism and risk of alcohol-use disorder postoperatively (**Grade C; BEL 3**).

**R31.** (2013\*). All patients should undergo evaluation of their ability to incorporate nutritional and behavioral changes before and after any bariatric procedure (**Grade C; BEL 3**).

**R32.** (2013\*). All patients must undergo an appropriate nutritional evaluation, including micronutrient measurements, before any bariatric procedure (Table 7) (**Grade A; BEL 1**). In comparison with purely restrictive procedures, more extensive nutritional evaluations are required for malabsorptive procedures (**Grade A; BEL 1**). Whole-blood thiamine levels may be considered in patients prior to bypass procedures (Roux-en-Y gastric bypass and biliopancreatic diversion with duodenal switch) (**Grade C; BEL 3**).

**R33.** (2013\*). Patients should be followed by their primary-care physician and have age- and risk-appropriate cancer screening before bariatric procedures (**Grade C; BEL 3**).

**R34.** (NEW). Pre-operative enhanced recovery after bariatric surgery (ERABS) clinical pathways should be implemented in all patients who are having bariatric surgery to improve postoperative outcomes (**Grade D**). Comprehensive pre-operative optimization (prehabilitation) should be implemented, including but not limited to deep breathing exercises, continuous positive airway pressure (CPAP) as appropriate, incentive spirometry, leg exercises, continued oral nutrition with carbohydrates, including sips of clear liquids up to 2 hours pre-operatively, H2 blocker or proton-pump inhibitor, opioid-sparing multimodal analgesia, thromboprophylaxis, and education about perioperative protocols (Table 8) (**Grade B; BEL 2**).

#### **Q5. How can care be optimized during and within 5 days of a bariatric procedure?**

**R35.** (NEW). Appropriate perioperative enhanced recovery after bariatric surgery (ERABS) clinical pathways should be implemented in all patients undergoing bariatric surgery (Table 8) (**Grade D**). Routine pulmonary recruitment maneuvers should be performed intra-operatively as needed (**Grade D**). Intra-operative use of dexmedetomi-

dine may be considered to decrease perioperative opioid use (**Grade C; BEL 3**). Intra-operative protocols to detect possible silent bleeding sites should be performed (**Grade D**). Consider dynamic indicators to guide goal-directed fluid therapy to avoid excess intra-operative fluid administration (**Grade B; BEL 2**).

**R36.** (NEW). A postoperative checklist should be reviewed and implemented (Table 9). Appropriate postoperative enhanced recovery after bariatric surgery (ERABS) clinical pathways should be implemented in all patients who have had bariatric surgery (Table 8) (**Grade D**).

**R37.** (NEW). Pre-emptive anti-emetic and non-opioid analgesic medications immediately before and during bariatric procedures as part of a multimodal pain management strategy should be implemented to decrease early

post-procedure opioid use and postoperative nausea and vomiting (**Grade C; BEL 3**).

**R38.** (2013\*). A low-sugar clear liquid meal program can usually be initiated within 24 hours after any of the surgical bariatric procedures, but this diet and meal progression should be discussed with the surgeon and guided by the registered dietician (RD) (Table 10) (**Grade C; BEL 3**). A consultation for postoperative meal initiation and progression must be arranged with an RD who is knowledgeable about the postoperative bariatric diet (**Grade A, BEL 1**). Patients should receive education in a protocol-derived staged meal progression based on their surgical procedure (**Grade D**). Patients should be counseled to eat 3 small meals during the day and chew small bites of food thoroughly before swallowing (**Grade D**). Patients should be counseled about the principles of healthy eating, includ-

**Table 7**  
**Preprocedure Checklist (including Lifestyle Medicine)<sup>a</sup>**

<input checked="" type="checkbox"/>	Complete H & P (obesity-related comorbidities, causes of obesity, weight, BMI, weight-loss history, commitment, and exclusions related to surgical risk)
<input checked="" type="checkbox"/>	Routine labs (including fasting blood glucose and lipid panel, kidney function, liver profile, lipid profile, urine analysis, prothrombin time/INR, blood type, CBC)
<input checked="" type="checkbox"/>	Nutrient screening with iron studies, B <sub>12</sub> and folic acid (RBC folate, homocysteine, methylmalonic acid optional), and 25-vitamin D (vitamins A and E optional); consider more extensive testing in patients undergoing malabsorptive procedures based on symptoms and risks
<input checked="" type="checkbox"/>	Cardiopulmonary evaluation with sleep apnea screening (ECG, CSR, echocardiography if cardiac disease or pulmonary hypertension suspected; deep-venous thrombosis evaluation, if clinically indicated)
<input checked="" type="checkbox"/>	GI evaluation ( <i>H. pylori</i> screening in areas of high prevalence; gallbladder evaluation and upper endoscopy, if clinically indicated)
<input checked="" type="checkbox"/>	Endocrine evaluation (A1C with suspected or diagnosed prediabetes or diabetes; TSH with symptoms or increased risk of thyroid disease; androgens with PCOS suspicion (total/bioavailable testosterone, DHEAS, Δ <sub>4</sub> -androstenedione); screening for Cushing syndrome if clinically suspected (1 mg overnight dexamethasone test, 24-hour urinary free cortisol, 11 PM salivary cortisol)
<input checked="" type="checkbox"/>	Lifestyle medicine evaluation: healthy eating index; cardiovascular fitness; strength training; sleep hygiene (duration and quality); mood and happiness; alcohol use; substance abuse; community engagement
<input checked="" type="checkbox"/>	Clinical nutrition evaluation by RD
<input checked="" type="checkbox"/>	Psychosocial-behavioral evaluation
<input checked="" type="checkbox"/>	Assess for individual psychological support/counseling
<input checked="" type="checkbox"/>	Document medical necessity for bariatric surgery
<input checked="" type="checkbox"/>	Informed consent
<input checked="" type="checkbox"/>	Provide relevant financial information
<input checked="" type="checkbox"/>	Continue efforts for pre-operative weight loss
<input checked="" type="checkbox"/>	Optimize glycemic control
<input checked="" type="checkbox"/>	Pregnancy counseling
<input checked="" type="checkbox"/>	Smoking-cessation counseling
<input checked="" type="checkbox"/>	Verify cancer screening by primary care physician
Abbreviations: BMI = body mass index; CBC = complete blood count; CSR = Cheyne Stokes respiration; ECG = electrocardiogram; GI = gastrointestinal; INR = international normalized ratio; PCOS = polycystic ovary syndrome; RBC = red blood cell; RD = registered dietician; DHEAS = dehydroepiandrosterone-sulfate; TSH = thyroid-stimulating hormone.	
<sup>a</sup> Based on information included in Mechanick et al. <i>Endocr Pract.</i> 2013;19:337-372 (1).	

Table 8 Summary of AHRQ Safety Program for Improving Surgical Care and Enhanced Recovery after Bariatric Surgery (ERABS) <sup>a</sup>	
Protocol Component/Intervention	Outcome
<i>Immediate Pre-operative</i>	
Carbohydrate loading	Decrease insulin resistance Decrease protein catabolism, LOS Faster return of bowel function
Reduced fasting	No adverse outcomes
Multimodal pre-anesthesia medication	Decreased pain, PONV, opioid use
<i>Intra-operative</i>	
Standard intra-operative anesthesia pathway	Decreased pain, PONV, opioid use
Protective ventilation strategies	Decreased pulmonary complications
Goal-directed fluid management	Decrease morbidity, LOS
Postoperative nausea and vomiting prophylaxis	Decreased PONV
Regional block	Decreased pain, opioid use
<i>Postoperative</i>	
Standard multimodal analgesia regimen	Decreased pain, PONV, opioid use
Early ambulation	Decreased VTE
Early return of oral intake	Easier return of bowel function
Abbreviations: AHRQ = Agency for Healthcare Research and Quality; LOS = length of stay; PONV = postoperative nausea and vomiting; VTE = venous thromboembolism. <sup>a</sup> Based on information included in Grant et al. <i>Anesth Analg.</i> 2018 (855); Thorell et al. <i>World J Surg.</i> 2016;40:2065-2083 (568); Ljungqvist et al. <i>JAMA.</i> 2017;152:292-298 (856); Alvarez et al. <i>Curr Opin Anaesthesiol.</i> 2017;30:133-139 (593); and Bellamy et al. <i>Perioper Med (Lond).</i> 2013;2:12 (549).	

ing at least 5 daily servings of fresh fruits and vegetables (**Grade D**). Protein intake should be individualized, assessed, and guided by an RD, regarding gender, age, and weight (**Grade D**). A minimal protein intake of 60 g/d and up to 1.5 g/kg ideal body weight per day should be adequate; higher amounts of protein intake—up to 2.1 g/kg ideal body weight per day—need to be assessed on an individualized basis (**Grade D**). Concentrated sweets should be eliminated from the diet after Roux-en-Y gastric bypass to minimize symptoms of the dumping syndrome, as well as after any bariatric procedure to reduce caloric intake (**Grade D**). Crushed or liquid rapid-release medications should be used instead of extended-release medications to maximize absorption in the immediate post-procedure period (**Grade D**).

**R39.** (2019\*). After consideration of pre-procedure deficiency states, as well as risks and benefits in the early (<5 days) post-procedure period, patients with, or at risk for, demonstrable micronutrient insufficiencies or deficiencies must be treated with the respective micronutrient, and then adjusted based on recommendations for the late post-procedure period (Tables 9, 11, and 12) (**Grade A, BEL 2, upgraded by consensus**). Minimal daily nutritional supplementation for patients with biliopancreatic diversion with/without duodenal switch, Roux-en-Y gastric bypass, and sleeve gastrectomy should be in chewable

form initially, and as 2 adult multivitamins plus minerals (each containing iron, folic acid, and thiamine) (**Grade B, BEL 2**), elemental calcium (1,200 to 1,500 mg/d for sleeve gastrectomy and Roux-en-Y gastric bypass and 1,800 to 2,400 mg/d for biliopancreatic diversion with duodenal switch in diet and as citrated supplement in divided doses) (**Grade B, BEL 2**), at least 2,000 to 3,000 international units of vitamin D (titrated to therapeutic 25-hydroxyvitamin D levels >30 ng/mL) (**Grade A, BEL 1**), total iron as 18 to 60 mg via multivitamins and additional supplements (**Grade A, BEL 1**), and vitamin B12 (parenterally as sublingual, subcutaneous, or intramuscular preparations, or orally, if determined to be adequately absorbed) (**Grade B; BEL 2**). Minimal daily nutritional supplementation for patients with laparoscopic adjustable gastric banding should include 1 adult multivitamin plus minerals (including iron, folic acid, and thiamine) (**Grade B, BEL 2**), 1,200 to 1,500 mg/d of elemental calcium (in diet and as citrated supplement in divided doses), and at least 2,000 to 3,000 international units of vitamin D (titrated to therapeutic 25-dihydroxyvitamin D levels) (**Grade B, BEL 2**). Additional recommendations to prevent micronutrient deficiencies are included in Tables 9, 11, and 12.

**R40.** (2019\*). Goal-directed intra- and early post-procedure fluid management should be guided by continuous noninvasive measurements to avoid over- and underhydra-



tion (**Grade B, BEL 2**). Once patients can tolerate orals, fluids should be consumed slowly, preferably at least 30 minutes after meals to prevent gastrointestinal symptoms, and in sufficient amounts to maintain adequate hydration (more than 1.5 liters daily) (**Grade D**).

**R41.** (2019\*). Nutrition support (enteral nutrition [EN; tube feeds] or parenteral nutrition [PN]) should be considered in bariatric surgery patients at high nutritional risk; PN should be considered in those patients who are unable to meet their needs using their gastrointestinal tract for at least 5 to 7 days with noncritical illness or 3 to 7 days with critical illness (**Grade D**). In patients with severe protein malnutrition and/or hypoalbuminemia, not responsive to oral or EN protein supplementation, PN should be considered (**Grade D**). PN formulation for patients after bariatric procedures should be hypocaloric with relatively high nitrogen (**Grade D**).

**R42.** (2019\*). Intra-/perioperative intravenous (IV) insulin is recommended for glycemic control (**Grade B; BEL 2**). In immediate postoperative patients with type 2 diabetes (T2D), the use of all insulin secretagogues (sulfonylureas and meglitinides), sodium-glucose cotransporter-2 inhibitors, and thiazolidinediones should be discontinued and insulin doses adjusted (due to low calorie intake) to minimize the risk for hypoglycemia (**Grade D**). Except for metformin and incretin-based therapies, antidiabetic medications should be withheld if there is no evidence of hyperglycemia (**Grade D**). Metformin and/or incretin-based therapies may be continued postoperatively in patients with T2D until prolonged clinical resolution of T2D is demonstrated by normalized glycemic targets (including fasting and postprandial blood glucose and A1C) (**Grade D**). Subcutaneous insulin therapy, using a rapid-acting insulin analogue (insulin lispro, aspart, or glulisine) before meals and a basal long-acting insulin analogue (insulin glargine, detemir, or degludec) should be used to achieve glycemic targets (140 to 180 mg/dL) in hospitalized patients not in intensive care (**Grade D**). In the intensive care unit (ICU), IV regular insulin as part of a standard intensive insulin therapy protocol should be used to control hyperglycemia to a 140 to 180 mg/dL blood glucose target (**Grade D**). Endocrinology consultation should be considered for patients with type-1 diabetes (T1D), or with T2D and uncontrolled hyperglycemia (**Grade D**). Once home, in patients with T2D, periodic fasting blood glucose concentrations must be determined (**Grade A; BEL 1**). Preprandial, 2-hour postprandial, and bedtime reflectance meter glucose (RMG; “fingerstick”) determinations, or the use of continuous glucose monitors, in the home setting is also recommended, depending on the patient’s ability to test the level of glycemic control targeted, use of oral agents or insulin, and overall care plan (**Grade A; BEL 1**). RMG determinations or the use of continuous glucose

monitors is recommended if symptoms of hypoglycemia occur (**Grade A; BEL 1**).

**R43.** (2013\*). Patients with high perioperative risk for myocardial infarction should be managed in a telemetry-capable setting for at least the first 24 hours after a bariatric surgical procedure (**Grade B; BEL 2**).

**R44.** (2019\*). Pulmonary management includes aggressive pulmonary toilet and incentive spirometry, oxygen supplementation to avoid hypoxemia, and early institution of continuous positive airway pressure (CPAP) when clinically indicated (**Grade C, BEL 3**). Routine admission to an intensive care unit should not be implemented in patients solely due to the presence of severe obstructive sleep apnea provided there is adequate CPAP use (**Grade D**).

**R45.** (2019\*). Prophylaxis against deep venous thrombosis (DVT) is recommended for all patients after bariatric surgical procedures (**Grade B; BEL 2**). Prophylactic regimens after bariatric surgery may include sequential compression devices (**Grade C; BEL 3**), as well as subcutaneously administered unfractionated heparin or low-molecular-weight heparin given within 24 hours after bariatric surgery (**Grade B; BEL 2**). Extended chemoprophylaxis after hospital discharge should be considered for high-risk patients, such as those with history of DVT, known hypercoagulable state, or limited ambulation (**Grade C, BEL 3**). The use of DVT risk calculators (**Grade C; BEL 3**) and early ambulation are encouraged (**Grade C; BEL 3**). Serum anti-Xa levels should be considered to guide low-molecular-weight heparin dosing in the prophylactic range (**Grade A; BEL 1**). Daily fondaparinux 5 mg should be considered as a preventive option (**Grade A; BEL 1**).

**R46.** (NEW). Respiratory distress or failure to wean from ventilatory support should prompt a diagnostic work-up for pulmonary embolus (**Grade B; BEL 2**).

**R47.** (2019\*). Patients with respiratory distress or failure to wean from ventilatory support after a bariatric procedure should prompt a standard diagnostic work-up with a particular emphasis to detect anastomotic leak (**Grade D**). In the clinically stable patient, computed tomography (CT) (preferred over upper-gastrointestinal (GI) studies [water-soluble contrast followed by thin barium]) may be considered to evaluate for anastomotic leaks in suspected patients (**Grade C; BEL 3**). Exploratory laparotomy or laparoscopy is justified and may therefore be considered in the setting of high clinical suspicion for anastomotic leaks (**Grade A; BEL 1**). A selected diatrizoate meglumine and diatrizoate sodium upper-GI study in the absence of abnormal signs or symptoms may be considered to identify any subclinical leaks before discharge of the patient from the hospital, but routine studies are not cost-effective (**Grade**

**C; BEL 3).** C-reactive protein (CRP) and/or procalcitonin testing should be considered if a postoperative leak is suspected or the patient is at increased risk for a leak after hospital discharge (**Grade B; BEL 2**).

**R48.** (2019\*). Patients should have adequate padding at pressure points during bariatric surgery (**Grade D**). When rhabdomyolysis is suspected, creatine kinase (CK) levels should be determined, urine output monitored, and adequate hydration provided (**Grade C; BEL 3**). The risk for rhabdomyolysis increases as body mass index (BMI) increases (particularly with BMI >55 to 60 kg/m<sup>2</sup>); therefore, screening CK levels may be tested in these higher risk groups (**Grade D**). Excessive postoperative IV fluids should be avoided (**Grade D**).

#### **Q6. How can care be optimized 5 or more days after a bariatric procedure?**

**R49.** (2019\*). Follow-up should be scheduled depending on the bariatric procedure performed and the severity of comorbidities (Table 9) (**Grade D**). Following laparoscopic adjustable gastric band procedures, frequent nutritional follow-up and band adjustments are recommended to optimize safety and achieve weight-loss targets (**Grade C; BEL 3**). Significant weight regain or failure to lose weight should prompt a comprehensive evaluation for (a) decreased patient adherence with lifestyle modification, (b) evaluation of medications associated with weight gain or impairment of weight loss, (c) development of maladaptive eating behaviors, (d) psychological complications, and (e) radiographic or endoscopic evaluation to assess pouch enlargement, anastomotic dilation, formation of a gastrogastic fistula among patients who underwent Roux-en-Y gastric bypass, or inadequate band restriction among patients who underwent laparoscopic adjustable gastric banding (**Grade B; BEL 2**). Interventions should first include dietary change, physical activity, behavioral modification with frequent follow-up, and then, if appropriate, pharmacologic therapy and/or surgical revision (**Grade B; BEL 2**). In those patients with or without complete resolution of their comorbidities, such as type 2 diabetes, dyslipidemia, obstructive sleep apnea or hypertension, continued surveillance and management should be guided by current clinical practice guidelines for those conditions (**Grade D**). Routine metabolic and nutritional monitoring is recommended after all bariatric procedures (**Grade A; BEL 1**).

**R50.** (2013\*). Patients who have undergone Roux-en-Y gastric bypass, biliopancreatic diversion with/without duodenal switch, or sleeve gastrectomy and who present with postprandial hypoglycemic symptoms that have not responded to nutritional manipulation should undergo an evaluation to differentiate noninsulinoma pancreatogenous

hypoglycemia syndrome (NIPHS) from factitious or iatrogenic causes, dumping syndrome, and insulinoma (**Grade C; BEL 3**). In patients with NIPHS, therapeutic strategies should be implemented, and include dietary changes (low-carbohydrate diet), octreotide, diazoxide, acarbose, calcium-channel antagonists, gastric restriction, and/or reversal procedures, with partial or total pancreatectomy reserved for the rare recalcitrant cases (**Grade C; BEL 3**). Continuous glucose monitoring may be considered in those patients with hypoglycemia syndromes after bariatric procedures (**Grade C, BEL 3**).

**R51.** (2013\*). Unless specifically contra-indicated, patients must be advised to incorporate at least some amount of physical activity, with a target of moderate aerobic physical activity that includes a minimum of 150 minutes per week and goal of 300 minutes per week, including strength training 2 to 3 times per week (**Grade A; BEL 1**).

**R52.** (2019\*). All patients should be encouraged to participate in ongoing support groups (**Grade B; BEL 2**), self-monitoring (**Grade B; BEL 2**), and/or mobile technologies (**Grade B; BEL 2**) to improve weight loss and cardiometabolic risks after bariatric procedures.

**R53.** (2019\*). Baseline and annual postoperative evaluation for vitamin D deficiency is recommended after Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy, or biliopancreatic diversion without/with duodenal switch (BPD/DS) (**Grade B; BEL 2**). In patients who have undergone RYGB, BPD, or BPD/DS, treatment with oral calcium citrate and vitamin D (ergocalciferol [vitamin D<sub>2</sub>] or cholecalciferol [vitamin D<sub>3</sub>]) is indicated to prevent or minimize secondary hyperparathyroidism without inducing frank hypercalciuria (**Grade C; BEL 3**). In patients with severe vitamin D malabsorption, initial oral doses of vitamin D<sub>2</sub> 50,000 IU 1 to 3 times/weekly or D<sub>3</sub> (minimum of 3,000 IU/day to 6,000 IU/day) should be recommended. Of note, vitamin D<sub>3</sub> is recommended as a more potent treatment than vitamin D<sub>2</sub> based on frequency and amount of dosing needed for repletion; however, both can be utilized (**Grade B; BEL 2**). Recalcitrant cases may require concurrent oral administration of calcitriol (1,25-dihydroxyvitamin D) (**Grade D**). Hypophosphatemia is usually due to vitamin D deficiency, and oral phosphate supplementation should be provided for mild to moderate hypophosphatemia (1.5 to 2.5 mg/dL) (**Grade D**).

**R54.** (2008). In patients who have had Roux-en-Y gastric bypass or biliopancreatic diversion without/with duodenal switch, bone density measurements with use of axial (spine and hip) dual-energy X-ray absorptiometry may be indicated to monitor for osteoporosis at baseline and at about 2 years (**Grade D**).

**Table 9**  
**Postprocedure Checklist<sup>a</sup>**

Checklist Item	LAGB	SG	RYGB	BPD/DS	
<i>Early postoperative care</i>					
✓	monitored telemetry at least 24 h if high risk for MI	✓	✓	✓	✓
✓	protocol-derived staged meal progression supervised by RD	✓	✓	✓	✓
✓	healthy eating education by RD	✓	✓	✓	✓
✓	multivitamin plus minerals (# tablets for minimal requirement)	1	2	2	2
✓	elemental calcium (as calcium citrate)	1,200-1,500 mg/d	1,200-1,500 mg/d	1,200-1,500 mg/d	1,800-2,400 mg/d
✓	vitamin D, at least 3,000 units/d, titrate to >30 ng/mL	✓	✓	✓	✓
✓	vitamin B <sub>12</sub> as needed for normal range levels	✓	✓	✓	✓
✓	maintain adequate hydration (usually >1.5 L/d PO)	✓	✓	✓	✓
✓	monitor blood glucose with diabetes or hypoglycemic symptoms	✓	✓	✓	✓
✓	pulmonary toilet, spirometry, DVT prophylaxis	✓	✓	✓	✓
✓	if unstable, consider PE, IL	PE	PE	PE/IL	PE/IL
✓	if rhabdomyolysis suspected, check CPK	✓	✓	✓	✓
<i>Follow-up</i>					
✓	visits: initial, interval until stable, once stable (months)	1, 1-2, 12	1, 3, 6, 12	1, 3, 6-12	1, 3, 6
✓	monitor progress with weight loss and evidence of complications each visit	✓	✓	✓	✓
✓	SMA-21, CBC/plt with each visit (and iron at baseline and after as needed)	✓	✓	✓	✓
✓	avoid nonsteroidal anti-inflammatory drugs	✓	✓	✓	✓
✓	adjust postoperative medications	✓	✓	✓	✓
✓	consider gout and gallstone prophylaxis in appropriate patients	✓	✓	✓	✓
✓	need for antihypertensive therapy with each visit	✓	✓	✓	✓
✓	lipid evaluation every 6-12 months based on risk and therapy	✓	✓	✓	✓
✓	monitor adherence with physical activity recommendations	✓	✓	✓	✓
✓	evaluate need for support groups	✓	✓	✓	✓
✓	bone density (DXA) at 2 years	✓	✓	✓	✓
✓	24-h urinary calcium excretion at 6 months and then annually <sup>b</sup>	x	x	x	✓
✓	B <sub>12</sub> (annually; MMA and Hcy optional; then q 3-6 months if supplemented)	✓	✓	✓	✓
✓	folic acid (RBC folic acid optional), iron studies, 25-vitamin D, iPTH	x	x	✓	✓
✓	vitamin A (initially and q 6-12 months thereafter)	x	x	optional	✓
✓	copper, zinc, selenium evaluation with specific findings	x	x	✓	✓
✓	thiamine evaluation with specific findings	✓	✓	✓	✓
✓	consider eventual body contouring surgery	✓	✓	✓	✓
✓	lifestyle medicine evaluation: healthy eating index; cardiovascular fitness; strength training; sleep hygiene (duration and quality); mood and happiness; alcohol use; substance abuse; community engagement	✓	✓	✓	✓
✓	hemoglobin A1c, TSH evaluation in long-term follow-up	✓	✓	✓	✓

Abbreviations: BPD/DS = biliopancreatic diversion with duodenal switch; CBC = complete blood count; CPK = creatine phosphokinase; DVT = deep vein thrombosis; DXA = dual-energy X-ray absorptiometry; Hcy = homocysteine; IL = intestinal leak; iPTH = intact parathyroid hormone; LAGB = laparoscopic adjustable gastric band; MI = myocardial infarction; MMA = methylmalonic acid; PE = pulmonary embolus; plt = platelets; PO = orally; q = daily; RBC = red blood cell; RD = registered dietician; RYGB = Roux-en-Y gastric bypass; SG = sleeve gastrectomy; SMA-21 = chemistry panel; TSH = thyroid-stimulating hormone.

<sup>a</sup>Based on information included in Mechanick et al. *Endocr Pract.* 2013;19:337-372 and Parrott et al. *Surg Obes Rel Dis.* 2017;13:727-741 (1, 448).

<sup>b</sup>This testing should be considered for any patient after a bariatric procedure at 6 months and then annually if there is a history of renal stones.

Table 10 Dietary Recommendations Following Bariatric Procedure				
Recommendations	UpToDate: Postoperative Nutritional Management (857)	2008 ASMBS Allied Health Nutritional Guidelines (858)	Guidelines for Perioperative Care in Bariatric Surgery: ERAS Society Recommendations (568)	Academy of Nutrition and Dietetics Pocket Guide to Bariatric Surgery, 2 <sup>nd</sup> ed (859)
<b>Diet Progression</b>	<p>Surgeon or institution specific</p> <p>Stage 1 and 2: Hydration and liquids</p> <ul style="list-style-type: none"> <li>Clear liquid diet (brief period)</li> <li>Full liquids and possibly pureed foods -- which includes liquid sources of protein and small amounts of carbohydrates (up to several weeks after surgery)</li> </ul> <p>Stage 3: Solid foods with an emphasis on protein sources, some carbohydrates, and fiber (~10-14 days after surgery)</p> <p>Stage 4: Micronutrient supplementation (when patient reaches a stable or maintenance weight)</p> <p>Long-term diet:</p> <ul style="list-style-type: none"> <li>Roux-en-Y gastric bypass -- well balanced diet containing all the essential nutrients; possible postoperative diets may include                             <ul style="list-style-type: none"> <li>My Plate</li> <li>DASH Diet</li> </ul> </li> </ul> <p>The Vegetarian Resource Group</p> <ul style="list-style-type: none"> <li>Sleeve gastrectomy -- same advancement and recommendations post-SG as for post-RYGB</li> <li>LAGB -- generally resume a normal diet soon after surgery</li> <li>Biliopancreatic diversion/duodenal switch -- small, nutrient-dense meals that are high in protein, along with fruits, vegetables, whole grains, and omega-3 fatty acids, and avoidance of concentrated sweets</li> </ul>	<p>Diet Stage:</p> <p>Clear liquid (1 to 2 days after surgery)</p> <ul style="list-style-type: none"> <li>Sugar-free or low sugar</li> </ul> <p>Full liquid (10-14 days after surgery)</p> <ul style="list-style-type: none"> <li>Sugar-free or low sugar</li> </ul> <p>Pureed (10-14+ days)</p> <ul style="list-style-type: none"> <li>Foods that have been blended or liquefied with adequate fluid</li> </ul> <p>Mechanically altered soft (&gt;14 days after surgery)</p> <ul style="list-style-type: none"> <li>Textured-modified</li> <li>Require minimal chewing</li> <li>Chopped, ground, mashed, flaked or pureed foods</li> </ul> <p>Regular textured (6-8 weeks after surgery)</p> <p>* Purpose of nutrition care after surgical weight loss procedures:</p> <ul style="list-style-type: none"> <li>Adequate energy and nutrients to support tissue healing after surgery and support preservation of lean body mass during extreme weight loss</li> <li>Foods and beverages must minimize reflux, early satiety, and dumping syndrome while maximizing weight loss and weight maintenance</li> </ul>	<p>Clear liquid meal regimen initiated a couple of hours postoperatively</p> <p>Balanced meal plan to include:</p> <ul style="list-style-type: none"> <li>&gt;5 servings of fruit and vegetables daily for optimal fiber consumption, colonic function, and phytochemical intake</li> </ul> <p>Avoid concentrated sweets to reduce caloric intake and to minimize symptoms of dumping (gastric bypass)</p>	<p>Postoperative nutrition care of the bariatric patient has 2 distinct stages during the first year:</p> <ul style="list-style-type: none"> <li>0-3 months</li> <li>3 months-1 year</li> </ul> <p>Typically described in stages:</p> <ul style="list-style-type: none"> <li>Diet Stage 1: Clear Liquid Diet -- very short-term; used in the hospital on postoperative days (POD) 1 and 2; liquids low in calories and sugar and free of caffeine, carbonation, and alcohol</li> <li>Diet Stage 2: Full Liquid Diet -- started between POD 2 and POD 3; continues for ~14 days; clear liquids + full liquids that are low in sugar with up to 25-30 g protein per serving</li> <li>Diet Stage 3: Soft Food Texture Progression -- timing varies by type of surgery and duration depends on patient's response to foods; replace protein-containing full liquids with soft, semi-solid protein sources (moist, soft, diced, ground or pureed), 3-5 times/day, as tolerated</li> <li>Diet Stage 4: Regular Solid Food Diet</li> </ul>
<b>Fluids</b>	Throughout all the diet stages, patients should be counseled to consume adequate fluid to prevent dehydration	N/A	>1.5 L daily	48-64 ounces (oz)/d <ul style="list-style-type: none"> <li>Women: 48 oz/d</li> <li>Men: 64 oz/d</li> <li>50% goal should be met with clear liquids</li> </ul>

Continued on next page.

<b>Table 10 Continued</b>				
<b>Protein</b>	46 g/day – women 56 g/day – men  Protein needs: <ul style="list-style-type: none"> <li>• Should constitute 10-35% of daily caloric intake</li> <li>• Weight maintenance: 0.8-1.2 g/kg body weight per day</li> <li>• Active weight loss: 1.2 g/kg body weight (BPD/DS may require 1.5-2.0 g/kg body weight per day)</li> </ul>	Exact needs have yet to be defined	Should average 60-20 g daily	Guidelines for protein consumption not defined
<b>Carbohydrates</b>	<ul style="list-style-type: none"> <li>• Early postop – 50 g/day</li> <li>• As diet intake increases – 130 g/day</li> </ul>	N/A	N/A	N/A
<b>Fat</b>	20-35% of the daily caloric intake; bulk of the fat intake should be unsaturated fat	N/A	N/A	N/A
<b>Behavior</b>	<ul style="list-style-type: none"> <li>• Eat slowly</li> <li>• Chew food extensively</li> <li>• Stop eating as soon as reach satiety</li> <li>• Avoid taking food and beverages at the same time</li> <li>• Simple sugars should be limited to less than 10% of daily caloric intake</li> </ul>	Avoid/Delay <ul style="list-style-type: none"> <li>• Concentrated sweets</li> <li>• Carbonated beverages</li> <li>• Fruit juice</li> <li>• High-saturated fat, fried foods</li> <li>• Soft doughy bread, pasta, rice</li> <li>• Tough, dry, red meat</li> <li>• Nuts, popcorn, other fibrous foods</li> <li>• Caffeine</li> <li>• Alcohol</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple small meals each day</li> <li>• Chewing food thoroughly without drinking beverages at the same time</li> <li>• Consume fluids slowly</li> </ul>	<ul style="list-style-type: none"> <li>• Practice mindful eating</li> <li>• Chew all food until it is smooth</li> <li>• Make sure food is soft and moist enough to swallow without sticking</li> <li>• Do not drink liquids during meals</li> <li>• Wait 30 minutes after eating before resuming fluid intake</li> <li>• Avoid bread, rice and pasta until able to comfortably consume adequate protein, vegetables and fruits</li> </ul>
<b>Other</b>	Close monitoring with a registered dietitian	Dietitian’s role is a vital component of the bariatric surgery process  Follow up with registered dietitian	Nutritional and meal planning guidance should be provided to patient and family before bariatric surgery and during the postoperative hospital course and reinforced at subsequent outpatient visits  Consultation should be provided with a dietitian and a protocol-derived staged meal progression, based on the type of surgical procedure, should be adhered to	RD responsible for the nutrition care of the post-surgery patient and plays an important role in every aspect of care, from pre-operative assessment of the patient to long-term follow-up, evaluation, and monitoring
Abbreviations: ASMBS = American Society of Metabolic and Bariatric Surgery; BPD/DS = biliopancreatic diversion with duodenal switch; DASH = dietary approaches to stop hypertension; ERAS = enhanced recovery after surgery; LAGB = laparoscopic adjustable gastric band; N/A = not applicable; RD = registered dietitian; RYGB = Roux-en-Y gastric bypass; SG = sleeve gastrectomy.				

<b>Table 11</b> <b>Nutrient Deficiencies After Bariatric Procedures</b>		
<b>Vitamin/ Mineral</b>	<b>Prevalence of Deficiency</b>	<b>Screening</b>
Vitamin B <sub>1</sub> (Thiamine)	<1-49% depending on procedure and post WLS time frame	<p>Recommended for high-risk groups</p> <ul style="list-style-type: none"> <li>• Patients with risk factors for thiamin deficiency</li> <li>• Females</li> <li>• African Americans</li> <li>• Patients not attending a nutritional clinic after surgery</li> <li>• Patients with GI symptoms (intractable nausea and vomiting, jejunal dilation, mega-colon, or constipation)</li> <li>• Patients with concomitant conditions such as cardiac failure (especially those receiving furosemide)</li> <li>• Patients with SBBO</li> <li>• Other risk factors such as malnutrition, excessive and/or rapid weight loss, and excessive alcohol use increase the risk of thiamin deficiency</li> </ul> <p>Post-WLS patients with signs and symptoms or risk factors should be assessed for thiamin deficiency at least during the first 6 months and then every 3-6 months until symptoms resolve</p>
Vitamin B <sub>12</sub> (Cobalamin)	at 2-5 years post-WLS <ul style="list-style-type: none"> <li>• RYGB: &lt;20%</li> <li>• SG: 4-20%</li> </ul>	<p>Recommended for patients who have undergone RYGB, SG, or BPD/DS</p> <p>More frequent screening (every 3 months) recommended in the first-year post-surgery, and then at least annually or as clinically indicated for patients who chronically use medications that exacerbate risk of B<sub>12</sub> deficiency, such as nitrous oxide, neomycin, metformin, colchicine, proton-pump inhibitors, and seizure medications</p> <p>Screening should include serum MMA with or without homocysteine to identify metabolic deficiency of B<sub>12</sub> in symptomatic and asymptomatic patients and in patients with history of B<sub>12</sub> deficiency or preexisting neuropathy</p> <p>Vitamin B<sub>12</sub> deficiencies can occur due to food intolerances or restricted intake of protein and vitamin B<sub>12</sub>-containing foods</p>
Folate (Folic Acid)	Up to 65% of patients	<p>Screening recommended for all patients</p> <p>Particular attention should be given to female patients of childbearing age</p> <p>Poor dietary intake of folate-rich foods and suspected nonadherence with multivitamin may contribute to folate deficiency</p>
Iron	3 months-10 years post-WLS <ul style="list-style-type: none"> <li>• AGB: 14%</li> <li>• SG: &lt;18%</li> <li>• RYGB: 20-55%</li> <li>• BPD: 13-62%</li> <li>• DS: 8-50%</li> </ul>	<p>Iron deficiency can occur after any bariatric procedure, despite routine supplementation</p> <p>Routine postbariatric screening is recommended within 3 months after surgery, and then every 3 to 6 months until 12 months, and annually thereafter for all patients</p> <p>Iron status should be monitored in postbariatric patients at regular intervals using an iron panel, complete blood count, total iron-binding capacity, ferritin, and soluble transferrin receptor (if available), along with clinical signs and symptoms</p> <p>Additional screening should be performed based on clinical signs and symptoms and/or laboratory findings or in cases where deficiency is suspected</p>

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Table 11 Continued		
Vitamin D and Calcium	Up to 100% of patients	Routine screening is recommended for all patients 25(OH)D is the preferred biochemical assay Elevated PTH levels and increased bone formation/resorption markers may also be considered
Vitamin A	Up to 70% of patients within 4 years post-surgery	Screening is recommended within the first postoperative year, particularly for those who underwent BPD/DS, regardless of symptoms Screening is recommended in patients who have undergone RYGB and BPD/DS, particularly in those with evidence of protein-calorie malnutrition
Vitamin E	Uncommon	Screening is recommended in patients who are symptomatic
Vitamin K	Uncommon	Screening is recommended in patients who are symptomatic
Zinc	Up to 70% of patients post-BPD/DS Up to 40% of patients post-RYGB Up to 19% of patients post-SG Up to 34% of patients post-AGB	Zinc deficiency is possible, even during zinc supplementation and especially if primary sites of absorption (duodenum and proximal jejunum) are bypassed Screening should be performed at least annually post-RYGB and post-BPD/DS Serum and plasma zinc are the preferred biomarkers for screening in post-bariatric patients
Copper	Up to 90% in patients post-BPD/DS 10-20% in patients post-RYGB 1 case report for patients post-SG No data for patients post-AGB	Screening is recommended at least annually after BPD/DS and RYGB, even in the absence of clinical signs or symptoms Serum copper and ceruloplasmin are recommended biomarkers for determining copper status because they are closely correlated with physical symptoms of copper deficiency
<p>Abbreviations: 25(OH)D = 25-hydroxyvitamin D; AGB = adjustable gastric band; BPS/DS = biliopancreatic diversion/duodenal switch; GI = gastrointestinal; MMA = methylmalonic acid; PTH = parathyroid hormone; RYGB = Roux-en-Y gastric bypass; SBBO = small bowel bacterial overgrowth; SG = sleeve gastrectomy; WLS = weight loss surgery. Adapted from <i>Surg Obes Rel Dis.</i>13, Parrott J, et al American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update: Micronutrients, 727-741, 2017, with permission from Elsevier.</p>		

Table 12 Nutrient Supplementation and Repletion After Bariatric Surgery		
Micronutrient	Supplementation to Prevent Deficiency	Repletion for Patients with Deficiency
Vitamin B <sub>1</sub> (Thiamine)	≥12 mg thiamine daily; preferably a 50-100 mg daily dose of thiamine from a B-complex supplement or high-potency multivitamin	<p>Bariatric patients with suspected thiamine deficiency should be treated before or in the absence of laboratory confirmation and monitored/evaluated for resolution of signs and symptoms</p> <p>Repletion dose for thiamine deficiency varies based on route of administration and severity of symptoms:</p> <ul style="list-style-type: none"> <li>• Oral therapy: 100 mg 2-3 times daily until symptoms resolve</li> <li>• IV therapy: 200 mg 3 times daily to 500 mg once or twice daily for 3-5 d, followed by 250 mg/d for 3-5 d or until symptoms resolve, then consider treatment with 100 mg/d orally, indefinitely, or until risk factors have been resolved</li> <li>• IM therapy: 250 mg once daily for 3-5 d or 100-250 mg monthly</li> </ul> <p>Magnesium, potassium, and phosphorus should be given simultaneously to patients at risk for refeeding syndrome</p>
Vitamin B <sub>12</sub> (Cobalamin)	<p>Supplement dose varies based on route of administration</p> <ul style="list-style-type: none"> <li>• Orally by disintegrating tablet, sublingual, or liquid: 350-1,000 µg daily</li> <li>• Nasal spray as directed by manufacturer</li> <li>• Parenteral (IM or SQ): 1,000 µg monthly</li> </ul>	1,000 µg/d to achieve normal levels and then resume dosages recommended to maintain normal levels

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<b>Table 12 Continued</b>		
Folate (Folic Acid)	<p>400-800 µg oral folate daily from their multivitamin</p> <p>800-1,000 µg oral folate daily in women of child-bearing age</p>	<p>Oral dose of 1000 µg of folate daily to achieve normal levels and then resume recommended dosage to maintain normal levels</p> <p>&gt;1 mg/d supplementation is not recommended because of the potential masking of vitamin B<sub>12</sub> deficiency</p>
Iron	<p>Males and patients without a history of anemia: 18 mg of iron from multivitamin</p> <p>Menstruating females and patients who have undergone RYGB, SG, or BPD/DS: 45-60 mg of elemental iron daily (cumulatively, including iron from all vitamin and mineral supplements)</p> <p>Oral supplementation should be taken in divided doses separately from calcium supplements, acid-reducing medications, and foods high in phytates or polyphenols</p>	<p>Oral supplementation should be increased to provide 150-200 mg of elemental iron daily to amounts as high as 300 mg 2-3 times daily</p> <p>Oral supplementation should be taken in divided doses separately from calcium supplements, acid-reducing medications, and foods high in phytates or polyphenols</p> <p>Vitamin C supplementation may be added to increase iron absorption and decrease risk of iron overload</p> <p>IV iron infusion should be administered if iron deficiency does not respond to oral therapy</p>
Vitamin D and Calcium	<p>Appropriate dose of daily calcium from all sources varies by surgical procedure</p> <ul style="list-style-type: none"> <li>• BPD/DS: 1,800-2,400 mg/d</li> <li>• LAGB, SG, RYGB: 1,200-1,500 mg/d</li> </ul> <p>To enhance calcium absorption in post-WLS patients</p> <ul style="list-style-type: none"> <li>• Calcium should be given in divided doses</li> <li>• Calcium carbonate should be taken with meals</li> <li>• Calcium citrate may be taken with or without meals</li> </ul> <p>Recommended preventative dose of vitamin D should be based on serum vitamin D levels</p> <ul style="list-style-type: none"> <li>• Recommended vitamin D<sub>3</sub> dose is 3,000 IU daily, until blood levels of 25(OH)D are greater than sufficient (30 ng/mL)</li> <li>• 7-90% lower vitamin D<sub>3</sub> bolus is needed (compared to vitamin D<sub>2</sub>) to achieve the same effects as those produced in healthy nonbariatric surgical patients</li> </ul>	<p>All bariatric patients with vitamin D deficiency or insufficiency should be repleted as follows:</p> <ul style="list-style-type: none"> <li>• Vitamin D<sub>3</sub> at least 3,000 IU/d and as high as 6,000 IU/d, or 50,000 IU vitamin D<sub>2</sub> 1-3 times weekly</li> <li>• Vitamin D<sub>3</sub> is recommended over vitamin D<sub>2</sub> as a more potent treatment when comparing frequency and amount needed for repletion</li> </ul> <p>Repletion of calcium deficiency varies by surgical procedure:</p> <ul style="list-style-type: none"> <li>• BPD/DS: 1,800-2,400 mg/d</li> <li>• LAGB, SG, RYGB: 1,200-1,500 mg/d</li> </ul>
Vitamin A	<p>Dosage is based on type of procedure:</p> <ul style="list-style-type: none"> <li>• LAGB: 5,000 IU/d</li> <li>• RYGB and SG: 5,000-10,000 IU/d</li> <li>• DS: 10,000 IU/d</li> </ul> <p>Higher maintenance doses of fat-soluble vitamins may be required for bariatric patients with a previous history of vitamin A deficiency</p> <p>Water-miscible forms of fat-soluble vitamins are also available to improve absorption</p> <p>Special attention should be paid to post-bariatric supplementation of vitamin A in pregnant women</p>	<p>For bariatric patients with vitamin A deficiency without corneal changes, a dose of 10,000-25,000 IU/d of vitamin A should be given orally until clinical improvement is evident</p> <p>For bariatric patients with vitamin A deficiency with corneal changes, a dose of 50,000-100,000 IU of vitamin A should be administered IM for 3 d, followed by 50,000 IU/d IM for 2 weeks</p> <p>Bariatric patients with vitamin A deficiency should also be evaluated for concurrent iron and/or copper deficiencies because these can impair resolution of vitamin A deficiency</p>
Vitamin E	<p>15 mg/d</p> <p>Higher maintenance doses of fat-soluble vitamins may be required for postbariatric patients with a previous history of vitamin E deficiency</p> <p>Water-miscible forms of fat-soluble vitamins are also available to improve absorption</p>	<p>Optimal therapeutic dose of vitamin E for bariatric patients is not defined</p> <p>Potential antioxidant benefits can be achieved with supplements of 100-400 IU/d, which is higher than the amount found in multivitamins. Additional supplementation may be required for repletion</p>

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Table 12 Continued		
Vitamin K	<p>Dosage is based on type of procedure:</p> <ul style="list-style-type: none"> <li>LAGB: 90-120 µg/d</li> <li>RYGB and SG: 90-120 µg/d</li> <li>DS: 300 µg/d</li> </ul> <p>Higher maintenance doses of fat-soluble vitamins may be required for post-WLS patients with a previous history of vitamin K deficiency</p> <p>Water-miscible forms of fat-soluble vitamins are also available to improve absorption</p> <p>Special attention should be paid to post-WLS supplementation of vitamin K in pregnant women</p>	<p>A parenteral dose of 10 mg is recommended for bariatric patients with acute malabsorption</p> <p>A dose of either 1-2 mg/d orally or 1-2 mg/week parenterally is recommended for post-WLS patients with chronic malabsorption</p>
Zinc	<p>All post-WLS patients should take 4 RDA zinc, with dosage based on type of procedure</p> <ul style="list-style-type: none"> <li>BPD/DS: Multivitamin with minerals containing 200% of the RDA (16-22 mg/d)</li> <li>RYGB: Multivitamin with minerals containing 100-200% of the RDA (8-22 mg/d)</li> <li>SG/LAGB: Multivitamin with minerals containing 100% of the RDA (8-11 mg/d)</li> </ul> <p>The supplementation protocol should contain a ratio of 8-15 mg of supplemental zinc per 1 mg of copper to minimize the risk of copper deficiency</p> <p>The formulation and composition of zinc supplements should be considered in post-WLS patients to calculated accurate levels of elemental zinc provided by the supplement</p>	<p>A dose-related recommendation for repletion cannot be made due to insufficient evidence</p> <p>Repletion doses should be chosen carefully to avoid inducing a copper deficiency</p> <p>Zinc status should be routinely monitored using consistent parameters throughout treatment</p>
Copper	<p>All post-WLS patients should take 4 RDA copper as part of routine multivitamin and mineral supplementation, with dosage based on type of procedure:</p> <ul style="list-style-type: none"> <li>BPD/DS or RYGB: 200% of the RDA (2 mg/d)</li> <li>SG or LAGB: 100% of the RDA (1 mg/d)</li> </ul> <p>Supplementation with 1 mg copper is recommended for every 8-15 mg of elemental zinc to prevent copper deficiency in all post-WLS patients</p> <p>Copper gluconate or sulfate is the recommended source of copper for supplementation</p>	<p>Recommended repletion regimen varies with severity of deficiency:</p> <ul style="list-style-type: none"> <li>Mild to moderate (including low hematologic indices): 3-8 mg/d oral copper gluconate or sulfate until indices return to normal</li> <li>Severe: 2-4 mg/d intravenous copper can be initiated for 6 d or until serum levels return to normal and neurologic symptoms resolve</li> <li>Copper levels should be monitored every 3 months after they return to normal</li> </ul>

Abbreviations: 25(OH)D = 25-hydroxyvitamin D; BPD/DS = biliopancreatic diversion/duodenal switch; IM = intramuscular; IV = intravenous; LAGB = laparoscopic adjustable gastric band; RDA = recommended dietary allowance; RYGB = Roux-en Y gastric bypass; SG = sleeve gastrectomy; SQ = subcutaneous; WLS = weight loss surgery.

Adapted from *Surg Obes Rel Dis.* 13, Parrott J, et al American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update: Micronutrients, 727-741, 2017, with permission from Elsevier.

**R55.** (2013\*). Evaluation of patients for bone loss after bariatric procedures may include serum parathyroid hormone, total calcium, phosphorus, 25-hydroxyvitamin D, and 24-hour urine calcium levels (**Grade C; BEL 3**). Antiresorptive agents (bisphosphonates or denosumab) should only be considered in patients after bariatric procedures with osteoporosis once appropriate therapy for calcium and vitamin D insufficiency has been implemented (**Grade D**). If antiresorptive therapy is indicated after bariatric procedures, then intravenously administered bisphosphonates should be used (zoledronic acid, 5 mg once a year, or ibandronate, 3 mg every 3 months), as

concerns exist about adequate oral absorption and potential anastomotic ulceration with orally administered bisphosphonates (**Grade D**). If concerns about absorption or potential anastomotic ulceration are obviated, oral bisphosphonate administration can be provided (alendronate, 70 mg/week; risedronate, 35 mg/week or 150 mg/month; or ibandronate, 150 mg/month). Alternatively, if bisphosphonates are poorly tolerated or ineffective, denosumab (60 mg subcutaneously every 6 months) may be considered, but again once appropriate therapy for calcium and vitamin D insufficiency has been implemented (**Grade D**).

**R56.** (2013\*). Management of oxalosis and calcium oxalate stones includes avoidance of dehydration (**Grade D**), a low-oxalate meal plan (**Grade D**), oral calcium (**Grade B; BEL 1; downgraded due to small evidence base**), and potassium citrate therapy (**Grade B; BEL 1; downgraded due to small evidence base**). Probiotics containing *Oxalobacter formigenes* may be used, as they have been shown to improve renal oxalate excretion and improve supersaturation levels (**Grade C; BEL 3**).

**R57.** (2019\*). Aggressive case finding (i.e., detecting a disorder in patients at risk) for vitamin A undernutrition may be performed in the first postoperative year after Roux-en-Y gastric bypass (RYGB) or biliopancreatic diversion without/with duodenal switch (BPD/DS) or with evidence of malnutrition due to high prevalence for this deficiency state in these settings (**Grade C; BEL 3**). Aggressive case finding for vitamin E and K deficiencies should be reserved for those postoperative patients demonstrating symptoms (hemolytic anemia and neuromuscular, particularly ophthalmologic, for vitamin E; excessive bleeding or bruising for vitamin K) (**Grade D**). When indicated, the dosing strategies for vitamin A are 5,000 IU/day for laparoscopic adjustable gastric banding (LAGB), 5,000 to 10,000 IU/day for RYGB and SG, and 10,000 IU/day for BPD/DS; for vitamin E, 15 mg/day for all procedures; and for vitamin K, 90 to 120 µg/d for LAGB, RYGB, and SG and up to 300 µg/d for BPD/DS (**Grade D**).

**R58.** (2008\*). In the presence of any established fat-soluble vitamin deficiency (vitamins A, D, E, and/or K) with, for example, hepatopathy, neuromuscular impairment, coagulopathy, or osteoporosis, or suspected essential fatty acid deficiency (symptoms include hair loss, poor wound healing, and dry scaly skin), clinical and biochemical assessments of the other fat-soluble vitamins may be considered and then supplemented if abnormally low (**Grade D**). In patients with suspected essential fatty acid deficiency in the setting of malabsorptive procedures, therapeutic trials with topical borage, soybean, or safflower oil may be considered due to the low risk profile, but these trials are unproven at present (**Grade D**).

**R59.** (2019\*). Anemia without evidence of blood loss warrants evaluation of nutritional deficiencies, as well as age-appropriate causes during the late postprocedure period (**Grade D**). Iron status should be monitored in all patients within the first 3 months after bariatric procedures, then every 3 to 6 months until 12 months, and then annually thereafter for all patients (**Grade B; BEL 2**). Treatment regimens include oral ferrous sulfate, fumarate, or gluconate to provide up to 150 to 200 mg of elemental iron daily (**Grade A; BEL 1**). Vitamin C supplementation may be added simultaneously to increase iron absorption (**Grade C; BEL 3**). Intravenous iron infusion (preferably with

ferric gluconate or sucrose) may be needed for patients with severe intolerance to oral iron or refractory deficiency due to severe iron malabsorption (**Grade D**).

**R60.** (2019\*). Baseline and annual post-bariatric procedure evaluation for vitamin B12 deficiency should be performed in all patients (**Grade B; BEL 2**). More frequent aggressive case finding (e.g., every 3 months) should be performed in the first postoperative year, and then at least annually or as clinically indicated for patients who chronically use medications that exacerbate the risk of B12 deficiency: nitrous oxide, neomycin, metformin, colchicine, proton-pump inhibitors, and seizure medications (**Grade B, BEL 2**). Since serum B12 may not be adequate to identify B12 deficiency, consider measuring serum methylmalonic acid, with or without homocysteine, to identify a metabolic deficiency of B12 in symptomatic and asymptomatic patients and in patients with a history of B12 deficiency or pre-existing neuropathy (**Grade B, BEL 2**). Oral supplementation (via disintegrating tablet, sublingual, or liquid) with crystalline vitamin B12 at a dosage of 350 to 1,000 µg daily or more is recommended to maintain normal vitamin B12 levels (**Grade A; BEL 1**). Intranasally administered vitamin B12 may also be considered (**Grade D**). Parenteral (intramuscular or subcutaneous) B12 supplementation, 1,000 µg/month to 1,000 to 3,000 µg every 6 to 12 months, is indicated if B12 sufficiency cannot be maintained using oral or intranasal routes (**Grade C; BEL 3**).

**R61.** (2013). Folic acid supplementation (400 to 800 µg/day) should be part of a routine multivitamin-multimineral preparation (**Grade B; BEL 2**) and must be supplemented further (1,000 µg/day) when a deficiency state is suspected (e.g., with skin, nail, or mucosal changes) or found, as well as in all women of childbearing age (800 to 1,000 µg/day) to reduce the risk of fetal neural tube defects (**Grade A; BEL 1**). B12 status should be assessed in patients on higher-dose folic acid supplementation (>1,000 µg/day) to detect a masked B12 deficiency state (**Grade D**).

**R62.** (2013). Nutritional anemias resulting from malabsorptive bariatric procedures can involve deficiencies in vitamin B12, folate, protein, copper, selenium, and zinc and may be evaluated when routine aggressive case finding for iron-deficiency anemia is negative (**Grade C; BEL 3**).

**R63.** (2013). There is insufficient evidence to support routine selenium screening or supplementation after a bariatric procedure (**Grade D**). However, selenium levels may be checked as part of aggressive case finding in patients with a malabsorptive bariatric surgical procedure who have unexplained anemia or fatigue, persistent diarrhea, cardiomyopathy, or metabolic bone disease (**Grade C; BEL 3**).

**R64.** (2019\*). Zinc supplementation should be included as part of a routine multivitamin-multimineral preparation with 8 to 22 mg/day to prevent a deficiency state; the amount indicated varies depending on the bariatric procedure performed, with greater amounts required for Roux-en-Y gastric bypass (RYGB) and biliopancreatic diversion without/with duodenal switch (BPD/DS) (**Grade C; BEL 3**). Routine aggressive case finding for zinc deficiency utilizing serum and plasma zinc determinations should be performed after malabsorptive bariatric surgical procedures (RYGB and BPD/DS) (**Grade C; BEL 3**), and zinc deficiency should also be considered in any patient after a bariatric procedure with chronic diarrhea, hair loss, pica, significant dysgeusia, or in male patients with unexplained hypogonadism or erectile dysfunction (**Grade D**). Treatment of zinc deficiency should target normal biochemical levels with 1 mg/day copper also supplemented for every 8 to 15 mg/day elemental zinc provided (**Grade D**).

**R65.** (2019\*). Routine aggressive case finding for copper deficiency using serum copper and ceruloplasmin may be considered for all patients who have undergone Roux-en-Y gastric bypass (RYGB) or biliopancreatic diversion without/with duodenal switch (BPD/DS) at least annually, even in the absence of clinical signs or symptoms of deficiency (**Grade C, BEL 3**), but especially in patients who are experiencing anemia, neutropenia, myeloneuropathy, or impaired wound healing (**Grade D**). Copper supplementation (2 mg/day) should be included as part of a routine multivitamin-multimineral preparation; further supplementation varies depending on the surgical procedure performed, with greater amounts required for patients who have had RYGB or BPD/DS (**Grade D**). In severe deficiency, treatment can be initiated with IV copper (3 to 4 mg/day) for 6 days (**Grade D**). Subsequent treatment of severe deficiency, or treatment of mild-to-moderate deficiency, can usually be achieved with oral copper sulfate or gluconate 3 to 8 mg/day until levels normalize and symptoms resolve (**Grade D**). Patients being treated for zinc deficiency or using supplemental zinc for hair loss should receive 1 mg of copper for each 8 to 15 mg of elemental zinc, since zinc replacement can cause copper deficiency (**Grade C; BEL 3**). Copper gluconate or sulfate is the recommended source of copper for supplementation (**Grade C; BEL 3**).

**R66.** (2019\*). Thiamine (vitamin B1) supplementation above the recommended dietary allowance (RDA) is suggested to prevent thiamine deficiency (**Grade D**). Routine thiamine screening may be considered following bariatric procedures (**Grade C; BEL 3**). Aggressive case finding for thiamine deficiency and/or empiric thiamine supplementation is indicated for high-risk postprocedure patients, such as those with established prepro-

cedure risk factors for thiamine deficiency, females, African Americans, patients not attending a nutritional clinic, patients with gastrointestinal symptoms, patients with heart failure, protracted vomiting, parenteral nutrition, excessive alcohol use, neuropathy or encephalopathy (**Grade C; BEL 3**), or small intestinal bacterial overgrowth (SIBO) (**Grade C; BEL 3**). All post-WLS patients should take at least 12 mg thiamine daily (**Grade C; BEL 3**). A 50-100 mg daily dose of thiamine from a B-complex supplement or high-potency multivitamin may be needed to maintain sufficient blood levels of thiamine and prevent thiamine deficiency in some patients (**Grade D**). Patients with severe thiamine deficiency (suspected or established) should be treated with intravenous (IV) (or intramuscular if IV access is not available) thiamine, 500 mg/day, for 3 to 5 days, followed by 250 mg/day for 3 to 5 days or until resolution of symptoms, and then to consider treatment with 100 mg/day, orally, usually indefinitely or until risk factors have resolved (**Grade C; BEL 3**). Mild deficiency can be treated with IV thiamine, 100 mg/day, for 7 to 14 days (**Grade C; BEL 3**). In patients with recalcitrant or recurrent thiamine deficiency with one of the above risks, the addition of antibiotics for SIBO should be considered (**Grade C; BEL 3**).

**R67.** (NEW). Commercial products that are used for micronutrient supplementation need to be discussed with a health-care professional familiar with dietary supplements, since many products are adulterated and/or mislabeled (**Grade D**).

**R68.** (2013\*). Lipid levels and the need for lipid-lowering medications should be periodically evaluated (**Grade D**). The effect of weight loss on dyslipidemia is variable and incomplete; therefore, lipid-lowering medications should not be stopped unless clearly indicated (**Grade C; BEL 3**).

**R69.** (2019\*). The need for antihypertensive medications should be evaluated repeatedly and frequently during the active phase of weight loss (**Grade D**). Because the effect of weight loss on blood pressure is variable, incomplete, and at times transient, antihypertensive medications should not be stopped unless clearly indicated; however, dosages may need to be titrated downward as blood pressure improves (**Grade D**).

**R70.** (NEW). Close attention to dosing of diabetes medication is recommended for those having had sleeve gastrectomy, Roux-en-Y gastric bypass, or biliopancreatic diversion without/with duodenal switch, since these patients generally have dosing reduced in the early postoperative period, whereas those having had laparoscopic adjustable gastric banding require significant weight loss before dosing must be reduced (**Grade B; BEL 2**). Patients with type 2 diabetes who had their diabetes medication stopped after bariatric

ric procedures must be monitored closely for recurrence of hyperglycemia, particularly with weight regain or suboptimal weight loss (**Grade B; BEL 2**).

**R71.** (NEW). In patients on thyroid hormone replacement or supplementation, thyroid-stimulating hormone (TSH) levels must be monitored after bariatric procedures and medication dosing adjusted, as dose reductions are more likely with weight loss but can increase with malabsorption (**Grade B; BEL 2**). Oral liquid forms of levothyroxine may be considered in those patients who have difficulty swallowing tablets after bariatric procedures (**Grade D**). Oral liquid or softgel forms of levothyroxine may be considered in patients with significant malabsorption in whom adequate TSH suppression to normal ranges is difficult after bariatric procedures (**Grade C; BEL 3**).

**R72.** (2019\*). Persistent and severe gastrointestinal (GI) symptoms (e.g., nausea, vomiting, abdominal pain, diarrhea, and constipation) warrant evaluation utilizing a pertinent history and physical exam, appropriate laboratory testing, and imaging (most commonly computerized tomography and/or upper GI series) (**Grade C; BEL 3**). Upper endoscopy with small-bowel biopsies and aspirates remains the gold standard and should be part of the evaluation of celiac disease and bacterial overgrowth in patients who have had a bariatric procedure (**Grade C; BEL 3**). Screening with a stool specimen should be obtained if the presence of *Clostridium difficile* colitis is suspected (**Grade C; BEL 3**). Persistent steatorrhea after BPD without/with DS should prompt evaluation for nutrient deficiencies (**Grade C; BEL 3**).

**R73.** (NEW). Patients with de novo gastroesophageal reflux and severe symptoms after sleeve gastrectomy should be treated with proton-pump inhibitor therapy, and those recalcitrant to medical therapy considered for conversion to Roux-en-Y gastric bypass (**Grade C; BEL 3**).

**R74.** (2019\*). Nonsteroidal anti-inflammatory drugs should be avoided after bariatric procedures, if possible, because they (and steroids to a lesser extent) have been implicated in the development of anastomotic ulcerations, perforations, and leaks (**Grade C; BEL 3**); ideally, alternative pain medication should be identified before the bariatric procedure (**Grade D**). If the use of nonsteroidal anti-inflammatory drugs is unavoidable, then the use of proton-pump inhibitors may be considered (**Grade C; BEL 3**).

**R75.** (2019\*). Endoscopy is safe and should be the preferred procedure to evaluate gastrointestinal (GI) symptoms suggestive of stricture or foreign body (e.g., suture or staple), as it can be both diagnostic and therapeutic (e.g., endoscopic dilation or foreign body removal) (**Grade C; BEL 3**). Endoscopy may also be used for *Helicobacter*

*pylori* testing as a possible contributor to persistent GI symptoms after bariatric procedures (**Grade D**).

**R76.** (NEW). Anastomotic ulcers after bariatric procedures should be treated with proton-pump inhibitors; prophylactic therapy with proton-pump inhibitors should be considered for 90 days to 1 year, depending on risk (**Grade B; BEL 2**). H2 receptor blockers and sucralfate may also be considered for postprocedure anastomotic ulcers, and if *Helicobacter pylori* is identified, triple therapy, including antibiotics, bismuth, and proton-pump inhibitors, may be used (**Grade C; BEL 3**).

**R77.** (2013\*). Patients who have undergone Roux-en-Y gastric bypass with a nonpartitioned stomach and developed a gastrogastic fistula with symptoms (e.g., weight regain, marginal ulcer, stricture, or gastroesophageal reflux) may be considered for a revisional procedure (**Grade C; BEL 3**).

**R78.** (2019\*). Persistent vomiting, regurgitation, and upper-gastrointestinal (GI) obstruction after laparoscopic adjustable gastric banding (LAGB) should be treated with immediate removal of fluid from the adjustable band (**Grade D**). Persistent symptoms of gastroesophageal reflux, regurgitation, chronic cough, or recurrent aspiration pneumonia in a patient after LAGB raise concern for band slippage, esophageal dilation, and, in some cases, erosion, and should prompt evaluation of the patient with upper-GI endoscopy or fluoroscopy (**Grade C; BEL 3**), immediate referral to a bariatric surgeon, and depending on the clinical course, consideration of conversion to sleeve gastrectomy or Roux-en-Y gastric bypass (**Grade D**).

**R79.** (2019\*). Ultrasound should be used to evaluate patients with right upper-quadrant pain for cholecystitis (**Grade D**). Patients who undergo sleeve gastrectomy (SG), Roux-en-Y gastric bypass (RYGB), or biliopancreatic diversion without/with duodenal switch (BPD/DS) are at increased risk for cholelithiasis due to rapid weight loss, and oral administration of ursodeoxycholic acid is recommended: 500 mg once daily for SG and 300 mg twice a day for RYGB or BPD/DS (**Grade A; BEL 1**). In asymptomatic patients with known gallstones and a history of RYGB or BPD/DS, prophylactic cholecystectomy may be considered to avoid choledocholithiasis, since traditional endoscopic retrograde cholangiopancreatography can no longer be performed in these patients. Otherwise, cholecystectomy should be reserved for patients with symptomatic biliary disease due to a generally low incidence of biliary complications (**Grade B; BEL 2**).

**R80.** (2013\*). Although uncommon, suspected small intestinal bacterial overgrowth in the biliopancreatic limb after biliopancreatic diversion without/with duodenal switch

may be treated empirically with metronidazole or rifaximin (**Grade C; BEL 3**). For antibiotic-resistant cases of bacterial overgrowth, probiotic therapy with *Lactobacillus plantarum* 299v and/or *Lactobacillus GG* may be considered (**Grade D**). Thiamine deficiency may be suspected in patients with small intestinal bacterial overgrowth after bariatric procedures, especially when gut dysmotility occurs (**Grade C; BEL 3**).

**R81.** (2008\*). Definitive repair of asymptomatic abdominal wall hernias can be deferred until weight loss has stabilized and nutritional status has improved to allow for adequate wound healing (12 to 18 months after bariatric surgery) (**Grade D**). Symptomatic hernias that occur after bariatric surgery may require prompt surgical evaluation (**Grade C; BEL 3**). Patients with sudden-onset of severe cramping, periumbilical pain, or recurrent episodes of severe abdominal pain any time after bariatric surgery should be evaluated with an abdominal and pelvic computerized tomography (CT) scan to exclude the potentially life-threatening complication of a closed-loop bowel obstruction (**Grade D**). Exploratory laparotomy or laparoscopy is indicated in patients who are suspected of having an internal hernia because this complication can be missed with upper gastrointestinal X-ray studies and CT scans (**Grade C; BEL 3**).

**R82.** (2013\*). Body-contouring surgery may be performed after bariatric procedures to manage excess tissue that impairs hygiene, causes discomfort, and is disfiguring (**Grade C; BEL 3**). Body-contouring surgery is best pursued after weight loss has stabilized (12 to 18 months after bariatric surgery) (**Grade D**).

#### **Q7. What are the criteria for hospital admission after a bariatric procedure?**

**R83.** (2013). Severe malnutrition or hypoglycemia after a bariatric procedure should prompt hospital admission (**Grade D**). The initiation and formulation of enteral (tube feeding) or parenteral nutrition should be guided by current clinical practice guidelines (**Grade D**). Hospital admission is required for the management of gastrointestinal (GI) complications after bariatric procedures in clinically unstable patients (**Grade D**). Surgical management should be pursued for GI complications not amenable or responsive to medical therapy (**Grade D**). However, if not dehydrated, patients may undergo endoscopic stomal dilation for stricture as an outpatient procedure (**Grade D**).

**R84.** (2008). Revision of a bariatric surgical procedure can be recommended when serious complications related to previous bariatric surgery cannot be managed medically (**Grade C; BEL 3**).

**R85.** (2008). Reversal of a bariatric surgical procedure is recommended when serious complications related to previ-

ous bariatric surgery cannot be managed medically and are not amenable to surgical revision (**Grade D**).

#### **UPDATED EVIDENCE BASE FOR 2019**

This evidence base pertains to the 7 questions and 85 updated numbered recommendations. There are 858 citations, of which 81% were published in 2013 or later, with 81 (9.4%) EL 1, 562 (65.5%) EL 2, 72 (8.4%) EL 3, and 143 (16.7%) EL 4, compared with 32 (7.9%) EL 1, 129 (32%) EL 2, 173 (43%) EL 3, and 69 (17.1%) EL 4 in the 2013 AACE/TOS/ASMBS CPG and 13 (1.7%) EL 1, 112 (14.4%) EL 2, 460 (59.2%) EL 3, and 192 (24.7%) EL 4 in the 2008 AACE/TOS/ASMBS CPG. There is a relatively high proportion (75%) of strong (EL 1 and 2) studies, compared with 40% in the 2013 AACE/TOS/ASMBS CPG and only 16% in the 2008 AACE/TOS/ASMBS CPG. The primary evidence base, supporting tables, and unrevised recommendations for general information are not provided in this document and may be found in the 2008 (54) and 2013 AACE/TOS/ASMBS CPG (1). Readers are strongly encouraged to review these past CPGs to place the updated explanations and references into better context. The technical evidence ratings for these updated references are found in the reference section of this document, appended at the end of each citation.

#### **Q1. Which patients should be offered bariatric procedures?**

**R1.** (2019\*). Mortality rates, the risk and prevalence of ORCs conferring disease morbidity, and social costs of obesity are highest in those patients with class-III severe obesity (i.e., BMI  $\geq 40$  kg/m<sup>2</sup>) (56-58). The evidence base for recommending bariatric surgery for patients with BMI  $\geq 40$  kg/m<sup>2</sup> without co-existing medical problems or severe ORC is supported by recent studies demonstrating benefit with respect to reduced mortality (32,38,58-63), improvements in cardiovascular risk factors (33,38,64), reduced rates of some cancers (65-67), substantial weight loss that is persistent in most patients (38,58,62,63,68-71), diabetes prevention (72-74), improved pulmonary function (75), and better mobility and quality of life (76-78). Currently, the WHO classification scheme for obesity determines diagnostic and therapeutic management based on BMI. However, BMI is a surrogate measure of adipose tissue mass, is confounded by ethnic differences and aspects of body composition (79-83), and does not provide information regarding the impact of excess adiposity on the health of the patient (13). Improved risk stratification strategies for bariatric surgery involving patients with BMI  $\geq 40$  kg/m<sup>2</sup> may incorporate the risk, presence, and severity of ORCs (13,19,84), the functional status of the patient, and body-composition technologies (83) to more precisely evaluate the mass and distribution of adipose tissue (79,80,85). The benefits of bariatric procedures must be balanced against

the inherent risks of complications and mortality, potential nutritional deficiencies, weight regain in some patients, and the need for lifelong lifestyle support and medical care. Factors found to be associated with poor outcome include open procedures, male gender, older age, congestive heart failure, peripheral vascular disease, DVT, pulmonary embolism (PE), OSA, impaired functional status, chronic kidney disease, and suicidality (86,87). Therefore, further studies are needed that utilize clinical risk-stratification systems to optimize patient selection criteria in patients with BMI  $\geq 40$  kg/m<sup>2</sup> who do not have severe complications and that evaluate consequent patient outcomes.

**R2.** (2019\*). Bariatric procedures can prevent and/or ameliorate ORCs that are responsive to weight loss, and these clinical benefits augment the benefit-risk ratio of the procedure and the salutary effects on the health of the patient. The strength of evidence for efficacy of bariatric procedures to ameliorate ORCs varies according to the complication. As described below, there exists strong evidence to support bariatric procedures in the prevention and/or treatment of several ORCs. Specifically, interventional cohort studies and RCTs have demonstrated clinical benefits in patients with BMI  $\geq 35$  kg/m<sup>2</sup> and the following complications: T2D (31,36,40,42,88-90), high risk for T2D (prediabetes and/or MetS) (72,73,91-94), poorly controlled HTN (88,95-97), NAFLD/nonalcoholic steatohepatitis (NASH) (98-104), OSA (105-110), OA of the knee or hip (111-116), and improving outcomes of knee or hip replacement (114,116-119) and urinary stress incontinence (120-123).

Several other comorbidities may be ameliorated by bariatric procedures, although the evidence is weaker, often consisting of case reports and case series; these comorbidities include obesity-hypoventilation syndrome and Pickwickian syndrome after a careful evaluation of operative risk (75,124,125), idiopathic intracranial HTN (126-130), GERD preferentially employing RYGB (13,110,131-136), severe venous stasis disease (137,138), impaired mobility due to obesity (77,78,139), and considerably impaired quality of life (77,78,139).

#### **Clinical benefits with BMI $\geq 35$ kg/m<sup>2</sup>**

**T2D.** Bariatric surgery can be considered in patients with T2D when the BMI is  $\geq 35$  kg/m<sup>2</sup>, especially if diabetes is difficult to control with lifestyle and pharmacologic therapy (1,31,36,40,42,88-90,140). The Surgical Treatment and Medications Potentially Eradicate Diabetes Efficiently (STAMPEDE) trial is a randomized controlled single-center study comparing outcomes of intensive medical therapy alone versus intensive medical therapy plus RYGB or SG (34,88,141). One-, 3-, and 5-year outcomes showed that a significantly higher percentage of patients after bariatric surgery met the primary endpoint of A1C  $\leq 6\%$

( $\leq 42$  mmol/mol), which was associated with a decrease in the number of diabetes medications when compared to the patients treated by medical therapy alone. These data underscore the effectiveness of bariatric surgery but should be interpreted cautiously when comparing medical and bariatric approaches because glycemic control in the medically treated patients was not optimal, and the study did not include a weight-loss arm using intensive lifestyle/behavior therapy plus weight-loss medications. The Swedish Obese Subjects study is a nonrandomized, prospective, controlled study in 4,047 patients with obesity who underwent bariatric surgery or received conventional treatment (31,94). In a subgroup analysis of 343 patients with T2D at baseline, bariatric surgery brought 72% into remission (i.e., blood glucose  $\leq 110$  mg/dL on no diabetes drugs) compared with 16% in remission in medically treated controls at 2 years, decreasing to 30% in remission versus 7% in controls at 15 years (31). Additional trials and cohort studies have demonstrated clinical benefits of bariatric surgery in T2D (40,89,142-146).

Meta-analyses that include RCTs, nonrandomized interventional trials, and/or single-arm observational studies concluded that bariatric surgical procedures led to T2D remission rates of 60 to 66% (37,147-150), with an order of effectiveness as follows: BPD/DS > RYGB  $\geq$  SG > LAGB (149). The relative effectiveness of individual procedures producing T2D remission is not entirely clear, since some studies favor RYGB over SG (149,151,152) and many others conclude that these procedures are equally effective (153-156). Many (149,151,157) but not all (152,153) studies indicate that greater degrees of weight loss following surgery are more likely to result in T2D remission. One study found that a composite scoring system (e.g., age, BMI, C-peptide level, and duration of T2D) predicted response in glycemic markers to bariatric surgery (158). In another study, higher baseline BMI was associated with a greater improvement in T2D after RYGB (159). In any event, "remission" is the proper terminology as opposed to "cure," since overt T2D returns in over half of these patients in less than 10 years (31). Bariatric surgery must be balanced against the inherent risks of surgical complications and mortality, potential nutritional deficiencies, weight regain in some patients, and the need for lifelong lifestyle support and medical monitoring (1,157,160,161).

**Prediabetes, MetS, and T2D Prevention.** Rates of incident T2D were reduced following a variety of bariatric surgical procedures (72,73,91-93,155,161). In two studies, bariatric surgery led to a 76 to 80% reduction in rates of T2D (72,73), which was similar to the degree of prevention when lifestyle intervention (162) and/or weight-loss medications (163,164) achieved 10% weight loss, even though bariatric surgery produced greater weight loss than observed with lifestyle and pharmacotherapy. These combined data suggest that 10% weight loss will reduce

the risk of future T2D by ~80%, and this represents a threshold above which further weight loss will not result in additional preventive benefits.

**HTN.** Bariatric surgery is effective in lowering blood pressure in patients with obesity. This has been demonstrated in multiple uncontrolled interventional cohort studies (165,166), controlled clinical trials (95,96,167-172), RCTs (88,146,173,174), and in meta-analyses (36,97,175). Bariatric surgery promotes weight loss and lowering of blood pressure across all levels of obesity, as demonstrated by systematic reviews in class-I (36,175) and class-II (175) obesity and in patients with severe obesity and BMI >50 kg/m<sup>2</sup> (176). When different bariatric surgical approaches are compared, patients experiencing greater weight loss generally have better outcomes regarding blood pressure and HTN (167,175). Analysis of the Bariatric Outcomes Longitudinal Database found that HTN was better resolved after BPD/DS, compared with SG or RYGB (177). Beneficial effects of bariatric surgery in patients with HTN are maintained long term in many but not all patients (50,178). In the Longitudinal Assessment of Bariatric Surgery multicenter observational cohort study, HTN was present in 68% of 2,458 subjects with obesity (median BMI 45.9 kg/m<sup>2</sup>) (50). After 3 years, HTN remained in remission in 269 of 705 patients (38%) undergoing RYGB (weight loss 31.5%) and 43 of 247 patients (17%) who had LAGB (weight loss 15.9%) (50). Effects of SG to produce complete remission of HTN in a retrospective cohort study occurred in 46% of patients at year 1, 48% at year 3, and 46% at year 5 (178).

**T1D.** There are limited data on the effects of bariatric or metabolic procedures on T1D. In a 2018 meta-analysis by Hussain (179), only 9 studies (N = 78 patients) demonstrated improvements in A1C, insulin dosing, and BMI. Improvements in diabetes management were not exclusively related to excess weight loss, arguing for roles of other factors. More data are needed to better define a role for GI procedures in the management of T1D.

**NASH.** In patients with NAFLD and NASH, bariatric surgery results in reductions in liver fat and improvements in histologic manifestations of liver injury, inflammation, and fibrosis (98-104,180-182). In 39 patients undergoing RYGB, a postoperative weight loss of 50 kg over 18 months led to marked improvements in histologic steatosis, hepatocellular ballooning, centrilobular fibrosis, lobular inflammation, and the fibrosis stage (98). Nineteen patients with biopsy-proven NASH at the time of RYGB lost 40% total body weight after 21 months, and repeat biopsy demonstrated marked improvements in histologic steatosis, lobular inflammation, and portal and lobular fibrosis (99). Importantly, histopathologic criteria for NASH were no longer present in 89% of patients. Mummadi et al (100) conducted a meta-analysis of 15 interventional studies that included 766 paired liver biopsies; the reductions in BMI after bariatric surgeries ranged from 19.11 to 41.76%, and

the pooled proportion of patients with improvement or resolution in steatosis was 91.6%, steatohepatitis 81.3%, fibrosis 65.5%, and for complete resolution of NASH, 69.5%. Bariatric surgery has been observed to result in long-term reductions in liver transaminases in the Swedish Obese Subjects study, consistent with persisting salutary effects in NAFLD (104). Transient deterioration in liver function has also been observed following bariatric surgery in some patients with NASH (101).

**OSA.** Weight loss of ~10% or more can improve OSA as assessed by polysomnography and the apnea-hypopnea index (AHI) (183). Multiple trials assessing the efficacy of bariatric surgery have demonstrated efficacy for improvements in symptomatology and AHI scores in patients with OSA (105-110,184). For example, bariatric surgery resulting in 27 to 47% weight loss produced a 49 to 98% reduction in the AHI (107). In another study, LAGB resulted in 20.2% weight loss and 54% improvement in sleepiness scores (99). Dixon et al (183) found that LAGB was effective but not superior to conventional weight-loss programs in patients with OSA as measured by the AHI score.

**OA.** Multiple studies have demonstrated that bariatric surgery can reduce pain and improve function in patients with OA (112,113,185-187). In 59 consecutive patients followed prospectively after bariatric surgery, there was a significant increase in medial joint space on knee X-ray and clear improvements in the Knee Society Score (186). A meta-analysis of studies assessing effects of bariatric surgery on OA included 13 studies and 3,837 patients, but only 2 studies had a control group, and 11 were uncontrolled prospective studies (113). All studies measuring intensity of knee pain, knee physical function, and knee stiffness showed a significant improvement after bariatric surgery, with weight loss ranging from 14.5 to 35.2%. The quality of evidence was considered low for most of the included studies and moderate for one study. A case-control study by Peltonen et al (112) that included patients who underwent bariatric surgery enrolled in the Swedish Obese Subjects study was the one deemed to be of moderate quality in this meta-analysis. Weight loss associated with bariatric surgery was associated with a significant improvement in pain, including work-restricting pain, in knees and ankles of men and women, with odds ratios (ORs) of 1.4 to 4.8 (112). A second systematic review of the literature in patients with obesity undergoing bariatric surgery (187) identified six studies for analysis; five were case series and one was the case-controlled trial by Peltonen et al (112). All studies demonstrated improvements in pain, functional scores, and/or joint space width, resulting in a conclusion by these authors that bariatric surgery can benefit patients with knee and hip OA, but recognized the need for further investigation with RCTs.

Obesity is associated with higher rates of treatment involving arthroplasty or knee and hip replacement (188). The evidence base addressing efficacy and safety

of knee replacement consists of observational and retrospective analyses. Patients with obesity undergoing total knee replacement can experience significant improvements in pain and functionality, often assessed using the Knee Society Score, the Western Ontario and McMaster Universities Osteoarthritis Index, or other instruments (117-119,189,190). However, knee replacement surgery in patients with obesity is more often associated with complications such as deep prosthetic infections, wound healing, superficial infections, and DVT (117-119,189,190). Patients with severe obesity can experience inferior survival of the prosthesis after total knee replacement compared with patients without obesity (114-116), although this was not consistently observed (190,191). For these reasons, weight loss is recommended both before and after knee replacement surgery in patients with overweight and obesity. Many centers require the BMI to be below a specified threshold (e.g., <35 to 40 kg/m<sup>2</sup>) before arthroplasty is entertained (192), although this is controversial (193). Bariatric surgery can therefore be used to reduce BMI to a level that will permit arthroplasty.

*Urinary Stress Incontinence.* Interventional cohort studies employing bariatric surgery have demonstrated improvements in urinary incontinence (120-122,194-196). A systematic review identified five interventional cohort studies involving bariatric surgery, all of which reported improvements in stress incontinence symptoms in the clear majority of patients (123). In one such study, RYGB in 1,025 patients (78% women) produced a decrease in mean BMI from 51 kg/m<sup>2</sup> to 33 kg/m<sup>2</sup> and a decrease in urinary incontinence from 23% of the patients affected at baseline to only 2% of patients 1 to 2 years postoperatively (121).

**R3.** (2019\*). Since 2013, there is increasing evidence from RCTs and meta-analyses regarding the metabolic benefits of bariatric procedures in patients with BMI of 30 to 34.9 kg/m<sup>2</sup> (i.e., class-I obesity). With respect to weight loss per se, multiple studies (40,197,198) document efficacy in patients with class-I obesity. As a result, the FDA approved the adjustable gastric band for patients with a BMI of 30 to 34.9 kg/m<sup>2</sup> with an ORC. However, the preponderance of studies in patients with class-I obesity have focused on the clinical benefits of bariatric procedures in those patients with T2D. A substantial number of RCTs and cohort interventional trials have demonstrated that bariatric surgical procedures can effectively result in sustained improvement in glycemic control concomitant with reductions in diabetes medications in patients with BMI 30 to 34.9 kg/m<sup>2</sup> (42,88,90,159,173,199-207). Multiple meta-analyses that specifically examined bariatric surgery outcomes in patients with BMI <35 kg/m<sup>2</sup> have been published and support clinical benefits regarding glycemic control and weight loss (36,208-210). In patients with T2D and class-I obesity, bariatric surgery can also lead to improvements in blood pressure and dyslipidemia (36). Importantly,

a significant number of patients will experience remission of T2D with maintenance of normal or near-normal blood glucose values in the absence of diabetes medications (88,141,173,200,207,210-214).

The STAMPEDE trial randomized patients with T2D and BMI 27 to 43 kg/m<sup>2</sup> to medical therapy or to RYGB or SG with the primary endpoint being A1C ≤6% (≤42 mmol/mol) on or off medications. After 1, 3, and 5 years, this outcome was met by 42%, 38%, and 29%, respectively, in the RYGB group, 37%, 24%, and 23% in the SG group, and 12%, 5%, and 5% in patients treated with medical therapy (34,88,141). Overall, the patients randomized to bariatric surgery maintained lower A1C with fewer diabetes medications, improved lipids, and better quality of life than the medically treated patients. Nevertheless, the STAMPEDE trial indicates that, while remission rates can be higher in the immediate years following surgery, over time, T2D tends to recur consistent with the progressive nature of the disease. In the Swedish Obese Subjects study, remission of T2D was observed to be 72% at 2 years, falling to 30% at 15 years, compared with 16% and 7%, respectively, in matched controls (31). Shorter-duration T2D is associated with a higher likelihood of remission in both mild (210) and severe (31) obesity.

Because of increasing evidence, the second Diabetes Surgery Summit Consensus Conference guidelines recommend that bariatric surgery be considered for BMI 30 to 34.9 kg/m<sup>2</sup> in patients with T2D (210). It will be important to continue to follow these patients long term to determine the lifelong impact of bariatric surgery on metabolic status and CVD risk. A rigorous definition of “T2D remission” should be standardized and applied across studies (215), and the a priori predictors for efficacy of T2D remission will need to be better defined to optimize the benefit-risk ratio of the procedure (216,217). Finally, with SG now the most common bariatric surgical procedure performed, future studies will need to elucidate the differential impact of multiple current surgical treatments for efficacy and safety. The ongoing DiaSurg2 trial has randomized patients with BMI 26 to 35 kg/m<sup>2</sup> and insulin-requiring T2D to RYGB or standard medical therapy (44). The primary endpoint is a composite time-to-event endpoint, including cardiovascular death, myocardial infarction, coronary bypass, percutaneous coronary intervention, nonfatal stroke, amputation, and surgery for peripheral atherosclerotic artery disease, with follow-up of 8 years. These and other trials should help better define evidence-based utilization of bariatric surgery in patients with mild obesity.

**R4.** (NEW). BMI cutoffs for identifying excess adiposity and risk of cardiometabolic disease are lower for some ethnicities and should be taken into account during screening and diagnosis (85,192,218). Specifically, a lower BMI threshold for screening of obesity is recommended in South Asian, Southeast Asian, and East Asian adult populations.



Based on the evidence that lower BMI values are correlated with risk of T2D, the ADA (81), the WHO Expert Consult Group (219), and the Working Group on Obesity in China (220) recommend that screening for diabetes should be considered for all Asian American adults who present with BMI  $\geq 23$  kg/m<sup>2</sup> and that a BMI cutoff of  $\geq 23$  kg/m<sup>2</sup> would be the optimal single criterion for screening all Asian ethnicities for obesity based upon correlations with cardiometabolic risk factors and increased risk of mortality (82,220-227). Based on epidemiologic data, the WHO has proposed the following weight classifications in adult Asians: BMI  $< 18.5$  kg/m<sup>2</sup> indicates underweight, 18.5 to 22.9 kg/m<sup>2</sup> normal weight, 23 to 24.9 kg/m<sup>2</sup> overweight, 25 to 29.9 kg/m<sup>2</sup> obese class I, and  $\geq 30$  kg/m<sup>2</sup> obese class II (219). The prevalence of various ORCs may also vary as a function of region and ethnicity, and this should be considered in the transculturalization application of these guidelines in the evaluation of patients with obesity.

Waist circumference measurements provide additional information regarding risk of cardiometabolic disease and should be measured in all patients, especially when BMI is  $< 35$  kg/m<sup>2</sup>. Risks conferred by waist circumference are continuous despite the use of categorical cutoff values, and, at any given BMI (above and below 35 kg/m<sup>2</sup>), risks of T2D and CVD increase progressively with additional increments in waist circumference (228). However, when the BMI exceeds 35 kg/m<sup>2</sup>, most patients will exceed categorical waist circumference cutoff values by a high BMI whether they are insulin resistant and have cardiometabolic risk factors. Thus, above a BMI of 35 kg/m<sup>2</sup>, waist circumference cutoff values become less effective in describing cardiometabolic risk. Waist circumference cutoff points for predicting CVD also exhibit ethnic variation, including a consistently lower threshold in South Asian, Southeast Asian, and East Asian adults. Therefore, ethnic-specific cutoffs as advocated in the 2009 Joint Interim Statement of the International Diabetes Federation Task Force on Epidemiology and Prevention should be used. Waist circumference predicted increased risk with values starting at  $\geq 84$  cm for men and  $\geq 74$  cm for women in a large Hong Kong cohort, while a value of 85 cm for men and 80 cm for women were recommended as cutoffs for central obesity in Chinese adults, according to the Cooperative Meta-Analysis Group of the Working Group on Obesity in China (220,229). Waist circumference estimates relative accumulation of visceral adipose tissue relevant to the ABCD model, which incorporates abnormal distribution (in addition to amount and function) of adiposity as an important metric (18).

**R5.** (2019\*). The following clinical questions best frame goal-directed obesity care using a bariatric procedure:

- Are baseline and target anthropometrics (BMI, weight, excess weight, etc.) determinants of whether a bariatric procedure should be recommended?

- Are ORCs determinants of whether a bariatric procedure should be recommended?
- Should patients with qualifying indications proceed directly to a bariatric procedure or rather proceed only after a trial of more intensive lifestyle change with or without weight-loss medications?

The main purpose of any therapeutic intervention is to improve the health and quality of life of the patient. Morbidity and mortality associated with obesity arise from complications that result from increased adiposity mass, distribution, and/or function (13,18,230). BMI provides an indirect anthropometric measure of adipose tissue mass but alone is not sufficient to indicate the health status in patients with obesity (231). The impact of obesity on health is directly related to the risk, presence, and severity of ORCs (13,231-234). ORCs are wide ranging (13,231-234) and include problems related to cardiometabolic, biomechanical, and psychological processes. The amount of weight loss that is necessary to predictably prevent or treat ORCs varies as a function of the specific complication profile unique to each patient (231-234). In short, bariatric procedures optimally address health and quality of life when enough weight loss needed to prevent or treat ORC cannot be obtained using lifestyle or medical therapy alone.

## Q2. Which bariatric procedure should be offered?

**R6.** (2019\*). Shifts in procedure preference by bariatric surgeons and their teams reflect an evolution in decision-making based on technical surgical factors, risk-benefit analysis, costs, and other logistics, as well as new surgical and nonsurgical bariatric procedures and an updated knowledge base about mechanisms of action and clinical goals in current obesity-care models (Table 6). Unfortunately, there are very few pre-operative factors among the wealth of available biochemical and clinical information that are sufficiently predictive of actual weight loss for an individual patient after a specific bariatric procedure. To this point, Courcoulas et al (235) analyzed data from 2006-2009 in 10 hospitals, extracted over 100 pre-operative variables, and found only a few variables with statistically significant predictive power for weight loss: diabetes, kidney function, and tobacco history for RYGB, and band size for LAGB. Additionally, Robinson et al (236) found that behavioral variables, such as increased dietary adherence and decreased grazing, were associated with greatest weight loss after bariatric surgery. Seyssell et al (237) developed a predictive model for 5-year weight loss after RYGB and validated the tool with a French cohort of patients. Higher BMI, younger age, and male gender were the best predictors of more weight loss, and this calculator can be used to provide patients with realistic expectations about their long-term weight-loss outcomes after RYGB. The emergence of new information, technology, and clinical

cal trial data on established and emergent procedures will hopefully provide more concrete direction in shaping clinical decision-making and the calculus for selecting specific bariatric procedures. As an example, Samczuk et al (238) found different molecular pathways affected by SG versus RYGB in patients with obesity and T2D, which in the future can improve the highly sought precision in bariatric procedure selection.

RYGB, once the most performed bariatric procedure, was relegated to the second most performed bariatric procedure in 2015 (239). Specifically, in 2011, RYGB was the most highly performed bariatric procedure at 36.7% and SG third at 17.8% (239). By 2015, these numbers significantly changed, with SG as the dominant bariatric procedure at 53.8% and RYGB second at 23.1% (239). According to an analysis of the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) data registry, SG had approximately half of the risk-adjusted odds of mortality, serious morbidity, and leak in the first 30 days compared with LRYGB (240). The benefits of SG on weight loss were also similar in patients over age 50 years compared with younger patients (241). A novel single-incision laparoscopic SG has also been developed and has comparable mean operative times, hospital length of stay, and complication rates, but better cosmetic results, compared with conventional SG (242). However, in a 2018 report by the National Institute for Health Research, RYGB was found to be the most costly but also the most cost-effective intervention for obesity (BMI  $\geq 35$  kg/m<sup>2</sup>) compared with orlistat or weight-management programs, with or without very-low-calorie diets (243). Another swing in the numbers has been the steady decline in the number of LAGB from 35.4% of all bariatric procedures in 2011 to less than 5.7% in 2015 (239). There are also declines in the number of BPD/DS procedures performed, primarily due to the risks involved and decreased number of surgeons trained in this technique (239).

The most recent estimate (2016) of bariatric procedures provided by the ASMBS found that the total number of procedures performed in the United States is 216,000 (18% RYGB, 58% SG, 3.5% LAGB, 1% BPD/DS, and 14% revisions) (244). Notwithstanding the published benefits of LAGB (245), in a meta-analysis, Chang et al (246) found that LAGB had relatively low complication rates but high re-operation rates, with SG having weight-loss effects comparable with RYGB, which had more complications. The emergence of gastroesophageal reflux as a long-term complication after SG, however, may temper some of the enthusiasm about this procedure or lead to a more tailored approach for these procedures (247).

The laparoscopic greater curvature (gastric) plication (LGP) is an alternative to the SG that is reversible and avoids gastrectomy but has less weight loss at 2 years compared with the conventional SG procedure (248,249). However, LGP has not gained popularity in the U.S. and

is still considered investigational by the ASMBS (250). In addition, when LGP is performed with LAGB (laparoscopic adjustable gastric banded plication [LAGBP]), there is greater weight loss at 36 months and less band slippage (251). In a retrospective, matched control analysis of LAGBP and SG, Cottam et al (252) found that weight regain started at 1 year with the SG, but not with the LAGBP, which still showed weight stability.

The mini-gastric bypass, or more recently termed single- or one-anastomosis gastric bypass (OAGB), is a simple alternative to RYGB performed with one anastomosis but results in more acid and bile reflux (253,254). In patients with very high BMI ( $\geq 60$  kg/m<sup>2</sup>), Parmar et al (255) found that OAGB achieved greater weight loss at 18 and 24 months compared with RYGB. Moreover, in patients with milder BMI elevations, OAGB with a longer (80 cm) biliopancreatic limb had better T2D remission rates than RYGB (256). In a meta-analysis, Wang et al (257) found that the OAGB had a great weight reduction effect compared with RYGB. The OAGB is not recommended for patients with GERD or hiatus hernia (253). While it remains a concern, the long-term risk of bile reflux-related adenocarcinoma of the esophagus appears to be small based on the current literature (258). Currently, the OAGB is not an endorsed procedure by the ASMBS because of these and other concerns (259).

A loop (single-anastomosis) duodenal-jejunal bypass with laparoscopic sleeve gastrectomy (LDJB-LSG) has also been developed in China with specific application to patients with mild obesity (ethnicity-adjusted; BMI  $> 27.5$  and  $< 32.4$  kg/m<sup>2</sup>) and T2D (260). There were comparable benefits in weight loss, glycemic control, insulin resistance,  $\beta$ -cell function, lipids, and uric acid compared with LRYGB (260). Interestingly, the LDJB-LSG affected intestinal microbiota differently than SG alone (261).

Another type of single anastomosis procedure has also emerged. The one-anastomosis duodenal switch (OADS, also referred to in the literature as single-anastomosis duodeno-ileal bypass with sleeve [SADI-S] or stomach intestinal pylorus-sparing [SIPS] procedure) has been developed as a primary procedure but is still under review by the ASMBS. This procedure involves creating an SG (larger volume than a primary sleeve) with duodenal transection and a loop duodenoileostomy. The length of the efferent alimentary limb (anastomosis to colon) varies from 150 to 300 cm. These procedures have been shown to be safe and as effective as a Roux-en-Y duodenal switch with a trend toward fewer nutritional deficiencies at mid-term (3 to 5 years) follow-up (262-271). When compared with LAGB and RYGB, single-anastomosis duodenal switch was most effective for weight loss in patients age 70 years and over (272). SIPS surgery has also been used to treat GERD in patients with severe obesity, with (273,274) and without laparoscopic fundoplication (274). Due to the lack of robust longer-term follow-up, the OADS

procedures have not been endorsed by the ASMBS as primary procedures.

The choice of re-operative bariatric surgery depends on the type of primary operation and the indications for re-operation. The ASMBS has developed nomenclature for re-operative bariatric surgery to better characterize this heterogeneous group of procedures (275). Re-operations that result in a new or different type of procedure are considered conversions, operations intended to resolve a complication or anatomic defect are called corrective procedures, and those that attempt to restore normal anatomy are called reversals. In addition to providing additional therapy for weight loss, re-operative procedures have been shown to improve metabolic outcomes, specifically diabetes improvement and remission rates (276,277). In a study by Boru et al (278), among high-volume bariatric surgery centers, only 3% of patients having an SG required re-operations.

Salama and Sabry (279) have proposed both OAGB and RYGB as a conversion option for vertical-banded gastroplasty, depending on the pouch length available. The optimal conversion of SG for GERD is RYGB, and conversions for additional weight loss after SG can either be RYGB or DS. Conversion of SG to DS results in greater weight loss than conversion to RYGB but poses a higher risk of long-term nutritional deficiencies. Conversions after LAGB to RYGB or SG can be performed in one or two stages (band removal with interval procedure). Behavioral factors, such as binge-eating, may be responsible for increased risk of poor weight outcomes after re-operation following LAGB (280). Retrospective data suggest a higher leak rate with a single-stage approach, particularly with conversion to SG (275). There are currently very little data to provide evidence-based decision-making for re-operative strategies for RYGB after weight regain. Revision of the gastric pouch and gastrojejunostomy as well as conversion to a distal bypass have been proposed with variable success rates (275).

Many of the new bariatric procedures involve endoscopic disruption of normal physiology and/or the insertion of a device, with variable weight-loss results (262,264-271,281,282). Vagal nerve-blocking device therapy is an FDA-approved surgically implanted medical device that intermittently blocks vagus nerve signaling, impacting both hunger and satiety (281,283-286). Intra-gastric balloons (IGBs) are space-occupying devices inserted into the stomach. The IGBs work by occupying space in the stomach, especially when the antrum is involved, thereby limiting capacity and altering gastric motility (17,281,287). Three of the products (ReShape™, Orbera®, and Obalon®) have been FDA approved for patients with a BMI 30 to 40 kg/m<sup>2</sup>, age 22 and older (for Reshape™: age 22 to 60 years and one comorbidity) (281). IGBs have a maximal implantation time of 6 months, with variable amount of fill in the balloon(s) as per product recommendations (281).

Using the Orbera® device, the early removal rate was 16.7% (median 8 weeks) associated with use of selective serotonin or serotonin-norepinephrine re-uptake inhibitors, and with average weight loss of 8.5% (3 months), 11.8% (6 months), and 13.3% (9 months) and significant reduction of lipid and glycemic status markers at 6 months (288). Other balloon products (e.g., BioEnterics® and End-ball® [non-adjustable] (289,290), Spatz Balloon® [adjustable], and Eclipse Balloon® [a procedureless device that is swallowed]) are not FDA approved at this time but function similarly as other space-occupying devices within the stomach. Medications that reduce nausea and production of gastric acid are frequently used concomitantly (291-293). Common complications include abdominal discomfort, balloon deflation, and late intolerance (294). Rare complications such as gastric perforation, erosive esophagitis, and acute pancreatitis support regular follow-up and appropriate timing for device removal (292,295-297). The FDA issued a communication to HCP, informing them of five reported deaths since 2016 that occurred unexpectedly in patients who had been treated with fluid-filled intragastric balloons, though root causes of these deaths are not yet available (24,298).

Aspiration therapy is an endoluminal device that can eliminate gastric content through a gastrostomy (17). This “A-tube” is inserted endoscopically and has FDA approval for patients with a BMI of 35 to 55 kg/m<sup>2</sup> (17). Mechanism of action is primarily through the postprandial elimination of 25 to 30% of the consumed meal but may also include behavioral changes (17).

Primary obesity surgery endoluminal (299) and endoscopically sutured gastroplasty (ESG) (300-303) are two endoscopic procedures that are safe and alter the anatomy of the stomach to limit the capacity for intake (304). In a single-center retrospective cohort study by Novikov et al (302), ESG achieved 12-month weight-loss amounts (13.3% total body weight loss) between SG and LAGB but had lower morbidity rates and hospital lengths of stay than the other procedures. Other endoscopic bariatric and metabolic devices/procedures being developed include small-bowel therapy such as the duodenal-jejunal bypass liner (305-310) and duodenal mucosal resurfacing (311), as well as transoral gastroplasty, transoral endoscopic restrictive implant system, articulating circular endoscopic stapler, gastric botulinum toxin A injection, endoscopic sclerotherapy, and radiofrequency ablation (304).

Clinical decision-making regarding the selection of an appropriate bariatric procedure depends not only on a stipulated target weight loss and therefore indirect effects to manage specific ORCs but also the direct effects of the procedure on those specific complications (13,312). Cardiometabolic risks such as dysglycemia, HTN, and dyslipidemia qualify as these strategic targets (313). Hence, a joint statement by several international diabetes organizations indicates that metabolic surgery should

be recommended to treat T2D in patients with class-III obesity (BMI >40 kg/m<sup>2</sup>) and in those with class-II obesity (BMI 35.0 to 39.9 kg/m<sup>2</sup>) when hyperglycemia is inadequately controlled by lifestyle and optimal medical therapy (29). Surgery should also be considered for patients with T2D and BMI 30.0 to 34.9 kg/m<sup>2</sup> if hyperglycemia is inadequately controlled despite treatment with either oral or injectable medications (29).

More recent data (217) indicate procedure-specific recommendations based on the severity of T2D utilizing an individualized metabolic surgery (IMS) score and risk-benefit analysis. Based on the IMS score, which classifies T2D as mild, moderate, or severe (according to predictors of long-term remission, such as pre-operation number of T2D medications, insulin use, duration of T2D, and glyce-mic control), SG was the preferred bariatric procedure for patients with a higher risk profile. Aminian et al (217) recently published a calculator to predict 5-year T2D remission rates after SG based on the severity of the disease at the time of surgery. The findings were validated with data from another institution, and the study concluded that early T2D remission rates were high with either procedure (but favored RYGB); patients with moderately severe diabetes had significantly higher 5-year remission rates compared to SG, and those with severe, long-standing diabetes at the time of surgery had equally low remission rates after both procedures. While there are other factors that should be considered regarding procedure choice (nonsteroidal anti-inflammatory drug [NSAID] use, inflammatory bowel disease, GERD, or organ transplant), this calculator is a valuable tool to be used as part of the informed consent and education process for those patients with diabetes at the time of a bariatric procedure (217). Additionally, Haskins et al (314) reported a small increased risk in 30-day morbidity and mortality among smokers (compared with nonsmokers) after SG. RYGB was the bariatric surgery of choice for patients with GERD or Barrett's esophagus. Sudan and Jain-Spangler found that SG and RYGB were associated with higher resolution of GERD compared with BPD/DS (177,315). Of note, Casillas et al (316) studied 48 patients undergoing conversion of SG to RYGB for reflux, highlighting the importance of reflux as a specific ORC in the determination of a best surgical procedure.

Further recommendations for the SG were endorsed by expert surgeons at the Fifth International Consensus Conference, including a stand-alone procedure in high-risk patients, kidney and liver transplant candidates, patients with MetS, BMI 30 to 35 kg/m<sup>2</sup> with associated comorbidities, inflammatory bowel disease, and the elderly (317).

There are no data available to guide definitive recommendations for referral to a regional or national center. However, bariatric surgery programs accredited through the MBSAQIP must meet criteria for patient acuity based on the accredited level of practice. At present, all centers should be available to manage any patient requiring serv-

es based on the level of accreditation. Patients beyond the scope of accreditation should be referred to a center with appropriate accreditation. Specifically, patients age ≥65 years, males with a BMI >55 kg/m<sup>2</sup> and females with a BMI >60 kg/m<sup>2</sup>, patients with organ failure, organ transplant, or significant cardiac or pulmonary impairment, patients on a transplant list, and nonambulatory patients should be referred to an accredited *comprehensive* center. Patients <18 years of age should be referred to a center accredited for adolescents (318). Improvements in overall clinical outcomes have been, at least in part, attributed to facility accreditation (319) (though Doumouras et al found no association in a Canadian cohort), and despite longer travel times, centralization of care to these accredited facilities has actually improved access, particularly among underserved populations (321).

Decisions regarding bariatric procedures should also be based on safety concerns regarding specific organ systems. In general, the greater the inherent risk of a specific bariatric procedure, independent of the risk of not treating obesity and severity of ORCs, the less complicated procedure is selected (322). In addition, pre-operative estimation of the likelihood that a patient will experience a cardiac complication at the time of noncardiac surgery can guide procedure selection and prevent postoperative morbidity and mortality. In addition to the history, physical examination, and 12-lead electrocardiogram, several risk assessment tools are available for risk stratification. These include the Revised Cardiac Risk Index (323-325) and the Gupta Myocardial Infarction (326) or Cardiac Arrest Calculator (327). The Revised Cardiac Risk Index (323-325) includes six independent prognostic factors: (1) high-risk intervention (including intra-abdominal); (2) history of coronary disease; (3) past or present heart failure; (4) stroke; (5) diabetes needing insulin; and (6) creatinine >2.0 mg/dL. Similarly, the Gupta Myocardial (326) Infarction or Cardiac Arrest Calculator (327) (not externally validated) includes 20 patient risk factors, such as increasing age, ASA class, pre-operative serum creatinine >1.5 mg/dL, functional status, and the surgical procedure. Other dedicated organ-system assessments that impact selection of procedure include, but are not limited to, diabetes (13), behavioral health (328-338), and reproductive health (339).

Procedure selection also depends on cost, insurance coverage, and ability to pay. For the general population, bariatric surgery had a cost until postoperative years 4 to 5, when cost savings appeared, which were higher in patients with T2D (340,341). In contrast, overall health-care costs in the Brazilian system were not reduced as a result of decreased ORCs after bariatric surgery, indicating that there are likely many direct and indirect economic factors involved (342). Demonstrable drivers of costs related to bariatric surgery in the U.S. are suboptimal outcomes (343) and the rising number of malpractice claims, though these

appear to simply parallel the increased number of surgical procedures performed (344). Bariatric surgery is associated with a positive effect on social transfer payments (e.g., Social Security, unemployment benefits, and welfare) but no real effect on income (345). Similarly, in the adolescent population with severe obesity, bariatric surgery initially incurred substantial costs and morbidity; however, when assessed over a 5-year period, bariatric surgery was found to be a cost-effective treatment in adolescents (346). Unfortunately, there has been inconsistent support for Medicaid coverage of bariatric surgery for adolescents with severe obesity (347), even though among middle-aged patients with Medicaid coverage, weight loss was comparable to those with Medicare or private insurance coverage (348). In 2010, the cost-effectiveness of bariatric surgery was <\$25,000 per quality-adjusted life year versus no treatment and well below benchmarks of \$50,000 to \$100,000 (349,350). However, in a 2013 longitudinal analysis of claims data, bariatric surgery, regardless of type, was not associated with reduced health-care costs (351). In a 2015 report, inpatient mortality rates with bariatric surgery decreased 9-fold with only modest increases in cost after adjusting for inflation (lower increase than for appendectomy) (352). What is alarming, however, is a report that with 22% of medically acceptable candidates not approved for insurance reimbursement, their mortality rate increases 3-fold (353). Taken together, these data support a shift in emphasis from cost savings to relevant health-related metrics for patients, on a population scale, undergoing bariatric surgery (354).

Coverage for bariatric surgery is often lacking, even when there is a perception by employees that their wellness programs will reimburse for these procedures (354). When available, coverage for bariatric surgery under the Affordable Care Act varies from state to state (355), even though 2015 data do not show an association of coverage with increased monthly premiums (356). Unfortunately, in a retrospective study of patients having RYGB by Jensen-Otsu et al (357), patients with Medicaid coverage, in aggregate, had longer lengths of hospital stays and higher hospital readmission rates within 30 days of discharge, compared with those having commercial insurance coverage. On the other hand, among patients having LAGB, there was no difference in postoperative weight loss between those paying out-of-pocket and those covered by private insurance (358). An assessment on the cost evaluation in patients receiving Medicare reimbursements demonstrated significantly lower payments at hospitals with low complication rates (359). With increased variation in hospital episode payments, bundled payment programs are being considered for bariatric procedures (360).

After LAGB in an Australian retrospective study, drug utilization—especially those treating T2D and CVD—is decreased and significantly contributes to cost reductions (361). However, in a large retrospective study of 19,221

LAGB procedures from 2004-2010 in the state of New York, the total revision rate was 34.2% (362). In another retrospective review among Medicare beneficiaries who underwent LAGB from 2006-2013, device-related re-operation was common, costly, and varied widely across hospital referral regions (363). Based on these and other similar findings, it has been suggested that payers should reconsider their coverage of LAGB (363).

RYGB continues to demonstrate sustained long-term weight-loss results as well as improvement and resolution of ORCs, such as GERD, CVD, degenerative joint disease, T2D, OSA, HTN, pulmonary disease, and psychiatric disease (364-367). In addition to weight loss and comorbid disease improvement/resolution, both RYGB and SG were further validated as durable bariatric surgeries with significant improvement in patient-reported outcomes based on quality-of-life scores (368).

The preference of the individual bariatric surgeon, performance of medical institutions, learning curve of the bariatric surgeon, as well as the subjective experience base of the referring physician also play significant roles in the decision regarding which procedure to select. For robotic surgery in general, an adequate number of cases deemed necessary for surgical competence was 10 to 128 cases, depending on the procedure involved and determined primarily by docking, robot, and total operative time (369). The learning curve for robot-assisted RYGB was 66 cases in a study by Starnes et al (370). Another study of robot-assisted RYGB found 100 cases on the learning curve to be a discriminator in terms of operative time but without any differences in outcomes or complications (371). This 100-case mark was also reported in a study by Beitner et al (372) for RYGB, in which late complication and re-operation rates were eventually improved with modification in surgical technique. In a Chinese study of patients undergoing RYGB, the learning curve was more associated with operating time and morbidity than mortality or amount of eventual weight loss (373). However, Rausa et al (374) found that the relative superiority of LRYGB over open RYGB may be due to extended learning curves in the former. For LAGB, the learning curve is closer to 50 cases (375). For SG, the learning curve is in the same or higher range as for RYGB—100 to 200 cases—below which correlates with increased risk for a proximal leak (376-378). Guebbels et al (379) found that bariatric surgery learning curves depend on mentorship and improve as the preceding surgeon's skill improves. The superiority of 3D over 2D laparoscopy was observed at early and later stages in the learning curve (380). In Polish (381) and Dutch studies (382), the involvement of residents in training with an experienced teacher does not compromise complication rates or weight-reduction outcomes after bariatric surgery. On the other hand, mastery refers to having outcomes significantly better than the average surgeon, whereas competency (the learning curve figure discussed

above) refers to having outcomes comparable to the average surgeon. Mastery for RYGB surgeries is approximated at 500 cases (383). Thus, the question arises of whether selection of a bariatric surgery procedure should, in some fashion, depend on availability of a surgeon with competency versus mastery for the specific procedure.

The likelihood of malpractice lawsuits was also found to correlate with the number of procedures performed and years in practice by the bariatric surgeon (384). Nevertheless, there does not appear to be correlation of hospital charges with improved bariatric surgery outcomes (385).

Doumouras et al (320) found that surgeon volume and a teaching hospital setting (but not accreditation) predicted lower all-cause morbidity after bariatric surgery. However, Kwon et al (386) did find a favorable association of accreditation with lower rates of bariatric re-operations and complications. But then again, Scally et al (387) demonstrated no association of the Medicare distinction of Center of Excellence status with savings to the health-care system for bariatric surgery. Furthermore, Nicholas et al (388) found that the Center of Excellence designation had the unintended consequence of reducing bariatric surgery in non-white Medicare beneficiaries. However, this was refuted by a different study using the National Inpatient Sample from 2006-2011 where the Center of Excellence designation was not associated with limited access to bariatric surgery (389). These and other inconsistent studies have fueled the controversy about the need for and nature of accreditation for bariatric surgery, especially considering the subsequent elimination of the Center of Excellence accreditation requirement for Medicare reimbursement of bariatric surgery and in the context of selecting specific bariatric procedures and settings (390,391).

Such intertwining relative risks support a nuance-based clinical decision-making approach to the selection of bariatric procedures. Despite all this available information, both scientific and vetted in the popular lay press, the lack of knowledge about bariatric procedures by patients and referring HCPs remains a distinct barrier to effective decision-making (392). Hence, a critical analysis of the above factors is provided as an algorithm in Figure 1 (incorporating information in Table 6) to assist with clinical decision-making for bariatric procedure selection.

### **Q3. How should potential candidates be managed before bariatric procedures?**

**R7.** (2008). Decision-making concerning the use and type of bariatric procedures should be based on comprehensive health goals, meaning the prevention and management of ORCs in patients with obesity. This overarching precept is detailed in the AACE obesity-care model (393).

**R8.** (2008). The pre-operative checklist in Table 7 compiles evidence-based items that should be evaluated to mitigate operative and postoperative risks of bariatric procedure. The primary goal of checklists is to maximize safety. However, this tool can also assist with decision-making by highlighting potential variables that can influence selection of bariatric procedure. Other variables should also be considered to guide decision-making. Unfortunately, in a review of RCTs, Colquitt et al (394) found that adverse events and re-operation rates were poorly reported with follow-up times of only 1 to 2 years, precluding any conclusions about long-term effects. Risks for re-admission, which can be better integrated into decision-making, include surgical complexity, ASA class, prolonged operative time, and major postoperative complications (395). Overall risks for morbidity and mortality with bariatric procedures primarily correlate with age and BMI, but also with male gender, gastric bypass procedure, and open procedures (396,397). Interestingly, there was no statistical association of advancing chronic kidney disease stage with 30-day postoperative complication rates (398), with good safety and efficacy in those patients on dialysis (399). SG has been identified as a preferable option in those over age 65 years (400). Various composite scoring systems have been devised for estimating risks of bariatric procedures, and further validation studies are eagerly awaited (397,401). Various pre-operative psychological instruments have also been used to predict postoperative outcomes (338,402,403). The use of chronic steroids is associated with mortality and serious postoperative complications after stapled bariatric procedures, with no difference between patients undergoing RYGB and patients undergoing SG (404,405).

**R9.** (2008). Pre-bariatric surgery insurance requirements and correct documentation of medical necessity can be onerous, despite a lack of evidence that they correlate with improved clinical outcomes. Love et al (406) found that surgical dropout during this process was due to a longer diet requirement (OR, 0.88;  $P<0.0001$ ), primary-care physician letter (OR, 0.33;  $P<0.0001$ ), cardiology evaluation (OR, 0.22;  $P<0.038$ ), and advanced laboratory testing (OR, 5.75;  $P<0.019$ ).

**R10.** (2019\*). The informed consent process should include the provision of appropriate educational materials. Mahoney et al (407) found that levels of education and health literacy figure prominently in a patient's ability to adhere with postoperative instructions and avoid hospital re-admissions.

**R11.** (2013). The costs of bariatric procedures vary greatly and mainly depend on ORCs and other comorbidities, concurrent procedures, robotic platform, surgical complexity, and length of hospital stay (408). For example, in a

2017 study by Khorgami et al (408), the calculated cost (median and interquartile range) for RYGB was \$12,543 (\$9,970 to \$15,857), for SG \$10,531 (\$8,248 to \$13,527), and for LAGB \$9,219 (\$7,545 to \$12,106).

**R12.** (2013). A review from 2016 (56) suggests little impact of pre-operative weight loss attempts on surgical outcomes. In a retrospective review of 1,432 patients having bariatric surgery, insurance-mandated pre-operative weight-loss programs were not associated with better outcomes at 2 years (409). In another observational study, pre-operative weight loss was not associated with greater postoperative weight loss, comorbidity resolution at 1 year, or lower 30- or 90-day rates of re-admission (410). In fact, Keith et al (411) found that insurance-mandated pre-operative diets delay treatment and adversely affect weight outcomes. On the other hand, Deb et al (412) also found that pre-operative weight loss did not affect long-term postoperative weight-loss outcomes. Watanabe et al (413) even found minor beneficial effects of pre-operative weight loss on postoperative complications in patients undergoing SG. Notwithstanding the potential benefits of improved pre-operative health associated with weight loss on postoperative outcomes, taken together, these studies argue against weight loss as a prerequisite for bariatric surgery, since a likely adverse effect of failure is denial of a potentially life-saving procedure (i.e., denial of a timely bariatric procedure). Routine prehabilitation clinical pathways that include deep breathing exercises, CPAP as appropriate, incentive spirometry, leg exercises, sips of clear liquids up to 2 hours pre-operatively, H2 blocker or proton-pump inhibitor, thromboprophylaxis, and education about perioperative protocols, in conjunction with intra-operative and postoperative ERABS protocols, are associated with improved outcomes (414).

#### **Q4. What are the elements of medical clearance for bariatric procedures?**

**R13.** (NEW). Lifestyle medicine is the nonpharmacological and nonsurgical management of chronic disease (and to re-emphasize: obesity is a chronic disease) (415). A significant number of patients fail to meet target metrics following bariatric procedures. This is not only due to biological factors, selection pitfalls, and technical issues, but also pre-operative lifestyle habits. Gilbertson et al (416) provide evidence that supports the hypothesis that lifestyle intervention is beneficial in those patients with unhealthy lifestyles and *bariatric surgery resistance*. However, in a prospective, randomized intervention study (N = 143) on pre-operative behavioral lifestyle using face-to-face and telephone encounters for 6 months, there were no improvements in weight loss by 24 months postoperatively (417). Nevertheless, completing the lifestyle medicine component of the pre-operative checklist (Table 7) can be

useful, particularly since formal lifestyle medicine training is seldom part of formal medical education, though the specific timing, content, and methodology of pre-operative lifestyle intervention, beyond usual standards of care for patients with obesity, remain to be determined.

**R14.** (2019\*). Current evidence-based glycemic control targets are provided by updated AACE/ACE (418) and ADA (419) CPGs and algorithms (420). In general, chronic hyperglycemia is associated with poor surgical outcomes (421). Achieving pre-operative glycemic control within months without weight gain can be facilitated using an interprofessional diabetes team (422). Better pre-operative glycemic control, with pharmacotherapy and low-calorie diets, correlates with complete T2D remission rates after RYGB (423-425). Aminian et al (217) individualized bariatric surgery procedure selection in patients with T2D using a Metabolic Surgery Score based on T2D duration, number of pre-operative T2D medications, insulin use, and glycemic control (A1C <7% [53 mmol/mol]). If there is doubt concerning diabetes type in a pre-operative evaluation, beyond history (more abrupt onset possibly with an episode of diabetic ketoacidosis with T1D), C-peptide and autoantibodies (e.g., anti-glutamic acid decarboxylase, insulin autoantibodies, insulinoma-associated-2 autoantibodies, zinc transporter 8) may be ordered to assist differentiating T1D (usually antibody-positive with very low C-peptide) from T2D (usually antibody-negative with low, normal, or elevated C-peptide) (426).

**R15.** (2013\*). Patients evaluated for bariatric procedures have a significant number of endocrine abnormalities, with nodular goiter and autoimmune thyroiditis among the most prevalent; for instance, 18.1% had hypothyroidism (427). Obesity is associated with TSH elevation in the absence of a primary thyroid disease, with reference ranges increasing based on BMI classes: underweight (BMI <20 kg/m<sup>2</sup>), 0.6 to 4.8 mUI/mL; normal weight and overweight (BMI 20 to 29.9 kg/m<sup>2</sup>), 0.6 to 5.5 mUI/mL; obese (BMI 30 to 39.9 kg/m<sup>2</sup>), 0.5 to 5.9 mUI/mL; and severely obese (BMI ≥40 kg/m<sup>2</sup>), 0.7 to 7.5 mUI/mL (428, 429). TSH levels are therefore not recommended as a routine screen prior to bariatric procedures, since the higher upper limit with obesity may result in considerable overdiagnosis and unnecessary lifestyle levothyroxine treatment. However, many insurance companies still require pre-operative TSH testing before bariatric procedures (1). Postoperatively, thyroid hormone replacement or supplementation requirements are variable due to decreased requirements as body mass and volume of distribution decrease, increased requirements as thyroiditis may progress in some, and variable effects such as GI absorption may worsen or actually improve (430,431).

**R16.** (2019\*). Evidence-based recommendations to manage lipid disorders are provided in recent AACE/

ACE (432) and National Lipid Association (NLA) CPGs (433,434), with an emphasis on bariatric surgery in another CPG by ASMBS/NLA/OMA (435,436). Baseline pre-operative abnormalities in the lipid profile can guide procedure selection. In a systematic review and meta-analysis, Christelle et al (437) found that RYGB was superior to SG in not only improving weight loss and glycemic control, but also improving short- (1-year) and mid-term (5-year) lipid metabolism, with and without T2D. In a small (N = 38) prospective cohort trial before and after RYGB, pre-operative n-3 polyunsaturated fatty acid and vitamin A levels were negatively correlated with fasting insulinemia and high-sensitivity CRP, and positively with high-density-lipoprotein cholesterol; pre-operative linoleic levels were associated with postoperative weight loss (438). In a meta-analysis, Heffron et al (439) found that mean low-density-lipoprotein cholesterol decreased by 42.5 mg/dL with BPD/DS, 24.7 mg/dL with RYGB, 8.8 mg/dL with LAGB, and 7.9 mg/dL with SG (the changes for LAGB and SG were not significantly less than those among patients in the nonsurgical control group). Interestingly, in a longitudinal study, improvements in pancreatic lipid metabolism (fat volume and fatty acid uptake) with RYGB or SG were associated with better glycemic control and  $\beta$ -cell function (440). Somewhat surprisingly, Lima et al (441) found a high rate of chromium deficiency—55 of 73 (75.3%) patients tested who were awaiting bariatric surgery—and this low chromium state was associated with lower cholesterol and higher triglyceride levels. More studies are required to understand the role of chromium nutrition on insulin sensitivity, obesity, and responses to bariatric surgery.

**R17.** (2013\*). Bariatric surgery has a significant effect on increased fertility (442). Fetal growth is positively correlated with protein supply and negatively correlated with maternal iron status. This need for monitoring increases with increasing malabsorptive procedures (443,444). Typical recommendations for time to conception have been based primarily on nutritional concerns, with the implication that weight stability (12 to 24 months) is important. However, there are no studies showing outcome differences for conception at less than 1 year postoperatively, with one large study showing no differences in outcomes at less than 1 year (445-447). Multiple studies show an improvement in fertility and lower risk for gestational diabetes and large-for-gestational-age births following bariatric surgery. By contrast, risk for small-for-gestational-age births were increased, with possibly a small increase in premature births (445,446). The harmful effects of various deficiencies (iron, calcium, B12, folic acid, and vitamin D) and teratogens (vitamin A) are well known. Appropriate monitoring and supplementation are recommended (445, 448).

**R18.** (2008\*). Hormone therapy, including oral hormonal contraception, postmenopausal hormone therapy, and use

of selected estrogen-receptor modulators, has been associated with an increased risk of venous thromboembolism (VTE) (449,450). There is insufficient evidence for any recommendation regarding optimal timing of hormone therapy resumption after a bariatric procedure.

**R19.** (2008\*). Bariatric surgery can improve both incidence of polycystic ovary syndrome (PCOS) and associated infertility as well as reduced risk of endometrial hyperplasia (339,451).

**R20.** (2019\*). Most rare causes of severe obesity will manifest in childhood. A recent review found 79 distinct obesity syndromes, of which 19 have been elucidated genetically (452). Prader-Willi syndrome is the most common syndromic monogenic cause (incidence 1/15,000), and MC4R defects are the most common nonsyndromic monogenic cause (2 to 4% of pediatric obesity) (453,454). Craniopharyngiomas and resultant surgery are rare causes of hypothalamic obesity (455). A small study of eight matched patients with craniopharyngioma showed benefit from RYGB but not SG (456,457).

**R21.** (2019\*). The latest American College of Cardiology/American Heart Association guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery provides the evidence base for recommendations regarding pre-operative noninvasive cardiac testing (458). Additional guidelines are provided by Feely et al (459) and the European Society of Cardiology and European Society of Anaesthesiology (460).

**R22.** (2019\*). Studies have shown prolonged hospital stays and higher complication rates after bariatric surgery in patients with OSA (461-463). Hence, routine pre-operative clinical screening for OSA with confirmatory polysomnography may be considered, with further diagnostic testing and treatment of appropriate at-risk patients (461,464-467). However, the data are generally mixed in terms of overall benefit of screening, with several studies showing no risk reduction with OSA screening or treatment (463,466,468-472).

**R23.** (2019\*). Recent data support the association of smoking cigarettes with an increased risk of postoperative morbidity (473). Among 12,062 patients undergoing bariatric surgery in Western Australia, anesthetic complications were uncommon (0.5%) but accounted for 9.7% of all ICU postoperative re-admissions, of which, smoking history (and not BMI) was the only prognostic factor for airway-related complications (474). All smokers must be advised to stop smoking at any time before bariatric surgery, even if it is within 6 weeks before surgery (475). Unfortunately, in a retrospective review of the NSQIP database, Haskins et



al (314) found that smoking within the year before SG was associated with increased 30-day morbidity and mortality risk, compared with nonsmokers. Structured cessation programs are more effective than general advice, which is more effective than usual care (476).

**R24.** (2013\*). Recent position papers continue to recommend routine prophylactic measures to prevent VTE, which includes both DVT and PE, after bariatric surgery (477,478).

**R25.** (2019\*). Survey data in the U.K. fail to show consensus on the use of routine versus selective pre-operative esophagogastroduodenal endoscopy in patients considered for bariatric surgery (479). Yet, in one notable exception in a primarily Chinese population with obesity, routine pre-operative upper-GI endoscopy demonstrated significant abnormalities (480). Systematic reviews, meta-analyses, and other retrospective studies have demonstrated benefit of pre-operative endoscopy in patients with GI symptoms, where results altered surgical planning in roughly 7 to 12% of patients (481-485). A retrospective study by Yormaz et al (486) found that in patients undergoing bariatric surgery, the Gastrointestinal Symptom Rating Scale and upper-GI symptoms were independent predictive markers of abnormalities found with pre-operative esophagogastroduodenal endoscopy. The correlation of pre-operative endoscopic abnormalities with postoperative complications is not clear based on current evidence (486,487).

**R26.** (2019\*). NAFLD is common across age groups in obesity (488). While age, waist circumference, serum alanine aminotransferase, serum triglycerides, aminotransferase-to-platelet ratio, and ultrasound and transient elastography all have some predictive value, there are no reliable noninvasive presurgical predictors of disease severity or progression (489-491). Liver biopsy remains the diagnostic standard (492). Severity of liver disease as determined by MELD score (Model of End-Stage Liver Disease) correlates with short-term outcomes (493). Bariatric surgery improves multiple metabolic conditions, including insulin resistance, glucose metabolism, HTN, plasma lipids, transaminases, liver steatosis, steatohepatitis, and fibrosis (494).

**R27.** (2013\*). Two recent studies illustrate a relationship of *Helicobacter pylori* with the occurrence of marginal ulcers postoperatively (495,496). Specifically, Mocanu et al (496) found a 10-fold increase in the rate of this complication in *H. pylori*-positive versus -negative patients after undergoing RYGB.

**R28.** (2013\*). Long-term studies have shown a beneficial effect of bariatric surgery on urate levels and gout incidence (497-499).

**R29.** (2008\*). Decreases in bone density over time are common after bariatric surgery, particularly in postmenopausal women (500-502). Abnormalities of bone metabolism, including secondary hyperparathyroidism and vitamin D deficiency are common in obesity both before and after bariatric surgery (503,504). Current screening recommendations for bone mineral density testing vary somewhat but generally agree that postmenopausal women and women age greater than 65 years should be screened (505).

**R30.** (2019\*). The important role of behavioral medicine in the pre-operative and continuing management of patients undergoing bariatric surgery is strengthened, particularly in the context of durable interdisciplinary team management, assessing and enhancing patient readiness for surgery, improving patient-centered care by increasing a patient's knowledge about postoperative behavioral regimens and potential challenges, and reducing risk, liability, and clinic burdens (506). Formal domains for pre-operative psychosocial evaluation are weight history, eating-disorder symptoms (night-eating syndrome, binge eating, compensatory behaviors, anorexia nervosa, etc.), psychosocial history, developmental and family history, current and past mental health treatment, cognitive functioning, personality traits and temperament, current stressors, social support, quality of life, health-related behaviors (substance abuse, smoking history, adherence, and physical activity), motivation and knowledge base (including weight-loss expectations) (337), as well as self-harm and suicide (507). Formal psychometric testing is commonly employed pre-operatively and should be performed by qualified behavioral HCP providing a written report and organizing appropriate postoperative monitoring (337). Alcohol metabolism and addiction are recognized problems that occur in patients who have undergone malabsorptive bariatric surgical procedures. In a report by Acevedo et al (508,509), SG was similar to RYGB with respect to adverse effects on a patient's response to alcohol ingestion. In fact, in these patients, there are faster and higher peak blood alcohol concentrations, resulting in underestimation of alcohol levels by breath analyzers (508).

**R31.** (2013\*). Pre-operative binge-eating disorder was associated with less weight loss after RYGB or LAGB, but patients still lost more weight than those receiving lifestyle modification alone (510). Postoperative engagement with behavioral therapy, psychological services, and spousal engagement are positive predictors of outcome for all patients undergoing bariatric surgery, and therefore advised (510-512). Bariatric surgery was associated with a slight increase in suicide and self-harm, but the absolute risks were still low (513).

**R32.** (2013\*). Recent guidelines provide an updated, initial evidence-based approach to micronutrient supplementation after bariatric surgery (448). Of note, adherence to vitamin therapy after bariatric surgery is lower than self-reports and represents a potential risk to patients' health, which needs to be promptly addressed (514-516). Iron studies including ferritin, fat-soluble vitamins other than 25-vitamin D (vitamins A, E, and K), and vitamin C levels do not need to be ordered routinely pre-operatively but may be considered in patients at risk for deficiency states related to these nutrients (517-520).

In general, thiamine deficiency occurs in 15.5 to 29% of patients with obesity (521). Thiamine testing may be considered pre-operatively in light of reports describing relatively high prevalence rates of thiamine deficiency in patients awaiting bariatric surgery (16 to 47%, depending on ethnicity), early onset Wernicke's encephalopathy (WE) 2 weeks after bariatric surgery instead of the more usual 3 months, and the potential prevention of WE with diligent pre-operative thiamine replacement protocols (522-524). In a single institution, a retrospective observational study of 400 patients undergoing bariatric surgery showed that 16.5% had clinical thiamine deficiency pre-operatively (consistent symptomatology and either low biochemical levels or significant improvement with thiamine supplementation) and 18% after RYGB (525). However, in another study of patients after SG, the pre-operative prevalence of thiamine deficiency was only 3.4%, with rates decreasing by postoperative year 2 (526). In a small (N = 22) prospective study of women undergoing LAGB, 38% had low thiamine levels (527).

**R33.** (2013\*). All patients should have age-appropriate screening for cancer according to U.S. Preventive Services Task Force recommendations (528). Mechanistic studies implicate chronic inflammation and crosstalk between adipose tissues and cancer-prone cells (529,530). Recent studies have demonstrated improved clinical oncologic metrics for certain malignancies (risk, biomarkers, survival, etc.) in general (531-534) and for breast (535) and colorectal (536-538) cancer in particular. In contrast, other studies have shown poorer prognosis in another cohort study of colorectal cancer by Tao et al (539) and in endometrial (540,541), liver (542), and pancreatic cancers (543) in patients after bariatric surgery. Esophageal carcinoma represents a unique challenge since, when diagnosed after bariatric surgery, surgical resection carries a high risk (544). Gastric carcinomas, in the gastric pouch or excluded stomach, are rare and also represent a unique clinical challenge without clear guidelines (545,546). These findings affirm the relevance and potential benefit of pre-operative screening and, when appropriate, aggressive case finding, though much more evidence is needed for more detailed recommendations. Interestingly, cancer survivors had comparable weight-loss effects after bariatric surgery to those without a history of cancer (547).

**R34.** (NEW). ERABS clinical pathways focus on obesity-related perioperative risks specific for the patient undergoing bariatric surgery and are based on the enhanced recovery after surgery (ERAS) general recommendations (Table 8). Perioperative noninvasive ventilation is associated with decreased risk for postoperative respiratory complications (548).

#### **Q5. How can care be optimized during and within 5 days of a bariatric procedure?**

**R35.** (NEW). Best practice anesthetic and intra-operative techniques, as part of an overall ERABS clinical pathway, are provided in Table 8 (549). King et al (550) found that these clinical pathways were not associated with increased postoperative day-1 discharges, but were associated with reduced perioperative opioid use, postoperative nausea, and emergency room visits within 7 days after hospital discharge. Key components of intra-operative care include: proper positioning and monitoring of patients, accounting for obesity-related changes in pharmacology, adjusting for potentially difficult tracheal intubations and airway management, and applying ventilatory strategies, including pulmonary recruitment maneuvers (PRMs) (551). Dupanovic et al (552) identified intra-operative factors with LAGB that affected postoperative outcomes: meticulous surgical technique, least number of access ports, and multimodal analgesic approach.

Laparoscopic techniques for bariatric surgery induce a CO<sub>2</sub> pneumoperitoneum, which adversely affects cardiopulmonary function that may already be compromised due to obesity. PRMs can improve anesthesia-related functional residual capacity reductions intra-operatively, but not postoperatively, in patients undergoing bariatric surgery (553,554). However, PRMs can improve postoperative pain intensity and opioid requirements after SG or RYGB (555). In a study by Eichler et al (556), intra-operative noninvasive monitoring using electrical impedance tomography (554), with increasing positive end-expiratory pressure demand during capnoperitoneum to maintain positive transpulmonary pressures throughout the respiratory cycle, was associated with improved postoperative oxygenation. In addition, intra-operative transcutaneous CO<sub>2</sub> monitoring has been found to provide a better estimate of arterial CO<sub>2</sub> partial pressure in patients undergoing laparoscopic bariatric surgery than end-tidal CO<sub>2</sub> partial pressure (557). Noninvasive hemodynamic monitoring has potential advantages, especially among patients at high risk for CVD, but at present, these methods lack sufficient accuracy and require more study in the obesity and bariatric surgery settings (558).

In an unmatched, case-controlled study, the use of the analgesia nociception index was associated with decreased intra-operative use of sufentanil, but not postoperative opiate use (559). In an observational study by Vaughns et al (560) of 26 consecutive adolescent patients undergoing

bariatric surgery, the intra-operative use of dexmedetomidine, 1.62 µg/kg (0.89 to 2.032; median total dose and interquartile range), as initial bolus and then continuous infusion was associated with lower opioid requirements intra-operatively and in the first 48 hours postoperatively. These results were affirmed in a meta-analysis involving a broader range of patients having bariatric surgery (561) and a guideline implementation study demonstrating feasibility and significant cost avoidance (562). Of note, adolescents with severe obesity have increased fentanyl clearance, underscoring the need for more pharmacologic data on this population (563). The short-acting inhalation anesthetic agents sevoflurane and desflurane are safe with bariatric surgery and may be considered as alternatives for maintenance of anesthesia (564). Postoperative bleeding is a rare but serious complication, occurring in <1% of patients, and can be prevented with a standard intra-operative protocol that increases blood pressure and reduces the pneumoperitoneum to identify possible silent bleeding sites (565). Goal-directed fluid therapy is also recommended during bariatric surgery, and the potential for excessive IV fluid administration can be mitigated using dynamic indicators, such as the Pleth Variability Index (PVI) (566).

**R36.** (NEW). A protocol-based approach with ERABS strategies is critical to improve the early postoperative care of patients undergoing bariatric surgery. These protocols continue to evolve and be applied to a growing number of programs (Table 8). In general, clinical “enhanced recovery” pathways focus on decreasing surgical stress and maintaining normal homeostasis as much as possible and avoiding the routine use of catheters, drains, and radiologic testing after surgery. These protocols also include focused education about the bariatric surgery process and are associated with decreased length of stay postoperatively (567). These protocols are based on experience in other specialties, such as orthopedic and colorectal surgery (568-571). Enhanced recovery can only be accomplished with an interdisciplinary strategy to manage key components of the early postoperative care plan to include multimodal pain management strategies (572), minimization of opioid use during and after surgery (573), goal-directed fluid management, and tight glycemic control. Ideally, ERABS is combined with pre-operative prehabilitation and comorbidity optimization, as well as evidence-based intra-operative clinical pathways (414). Implementation of ERABS in patients decreases length of hospital stay (574-578) without increasing morbidity, re-admission rates (579-584), or postdischarge resource utilization (585,586).

ERABS may also decrease costs of care in the early postoperative period (576,584,587). A meta-analysis of ERABS barriers by Ahmed et al (588), prospective cohort studies by Mannaerts et al (589) and Blanchet et al (590), and a retrospective study of consecutive patients by Matlok et al (582) affirm these correlations and find ERABS gener-

ally safe and effective. Factors that delayed discharge after SG reported by Jonsson et al (591) include pre-operative opioid use, history of psychiatric illnesses, chronic kidney disease, and revisional procedures, but not ASA class, diabetes, congestive heart failure, HTN, distance to home, and insurance status. Length of hospital stay after SG was reduced by early operating start time and treated OSA, while length of stay was increased with creatinine >1.5 mg/dL, ejection fraction <50%, and increased operative time (591). Deneuvy et al (592) found that in a French multicenter study, ERABS compliance was 79.6%, arguing for continued training and audits, with the elements least often applied being limb intermittent pneumatic compression during surgery (23.3%), multimodal analgesia (49.5%), and optimal perioperative fluid management (43.8%). On the other hand, ERABS may need to be deferred in patients with extremes of age (<18 or >60 years), poor adherence or motivation, cognitive impairment, poor social support, or location of residence at a significant distance from a hospital (593). Even though ERABS implementation is associated with improved clinical outcomes, reporting systems will need to be optimized (594).

**R37.** (NEW). Providing the patient with pre-emptive anti-emetic and nonopioid analgesic medications pre- and intra-operatively as part of a multimodal pain management strategy improves postoperative pain control and decreases opioid use (572), as well as decreases postoperative nausea and vomiting (595).

**R38.** (2013\*). Recent reviews have commented on the early postoperative dietary strategy (596,597). Patients should be allowed to start drinking clear liquids the night of surgery. Clear liquid intake and an emphasis on oral hydration should continue the day after surgery; the patient can also be advanced to full liquids as tolerated on postoperative day 1. Each of the nutritional components of ERAS, as outlined by the European Society of Parenteral and Enteral Nutrition (598), should be implemented: avoid long periods of pre-operative fasting (e.g., sips of clear liquids with carbohydrates up to 2 hours), postoperative oral feedings as soon as possible with nutrition support as needed based on early risk assessments, early recognition and correction of factors leading to catabolism and/or GI dysfunction, and early mobilization to optimize protein synthesis and muscle recovery (Table 10).

After discharge from the hospital, patients should continue drinking full liquids (stage 2) with an emphasis on protein intake and hydration. Within several days of the surgery, the patient should be tolerating at least 60 ounces (1,800 cc) of fluid daily to avoid dehydration. This should continue for 10 to 14 days until an assessment can be made by the clinical team at the initial postoperative appointment regarding their intake and suitability for diet progression. If the patient is tolerating stage 2 well, they can then be

advanced to a pureed diet (stage 3) approximately 2 weeks after surgery. This can be described to the patient as food that can be eaten without chewing, and the consistency and texture should progress gradually. Patients should continue in stage 3 for another week and, if intake is improving, they can advance on their own to soft foods (stage 4). Patients should be instructed to limit stage-4 foods to those that can be mashed or do not require excessive chewing. After 1 or 2 weeks on soft foods, most patients begin introducing some solid food and can progress to all solids as tolerated (stage 5), generally 4 to 6 weeks after surgery. Patients should be instructed that when solid food is introduced, only several bites will be tolerated until they adapt to their new anatomy and when the postoperative edema and inflammation have resolved. Typical patients should also avoid drinking 30 minutes before or after eating solid food. Typical daily calorie intake the first week after surgery is 400 kcal/day and progresses to 600 to 800 kcal/day by weeks 3 to 4. Several months after surgery, patients should consume 1,200 to 1,500 kcal/day, with most patients consuming approximately 1,500 to 1,800 kcal/day, 6 months postoperatively and long-term. Refer to Tables 10 through 12 for additional information regarding diet progression. If patients do not progress through these stages of their diet in the appropriate time periods due to nausea, vomiting, or dysphagia, careful evaluation of nutrition should be performed, and the surgeon should consider investigating potential causes (e.g., early anastomotic ulcer, stricture, and mechanical obstruction) (599).

**R39.** (2019\*). Recommendations for initial micronutrient dosing in the early postoperative period immediately following the bariatric procedure and, if applicable, during the initial hospitalization are based on pre-operative deficiency states, type of procedure performed, dietary progression protocols, and oral tolerances, with the intention to adjust in the late postoperative period based on clinical course, symptoms, and judicious biochemical testing, as outlined in subsequent recommendations (Tables 9, 11, and 12). Special attention should be made to avoid oversupplementation during this period, which could be a result of faulty a priori decision-making, various mutations/polymorphisms, altered physiology, especially decreased binding proteins, confounded or unnecessary biochemical testing, and indiscriminate/inappropriate continuation that induces other metabolic derangements (600). This includes, but is not limited to, iron (601-603), zinc (604,605), and vitamin D (606,607). With respect to routine vitamin D supplementation, patients who have had an SG or RYGB had comparable 12-month safety and effectiveness with early postoperative individualized dosing starting with only 800 IU/day and uptitrated based on serum levels or a fixed high dose with 2,000 IU/day (607). In this CPG, the latter approach is still recommended based on the weight of evidence with titration to target levels in the late postoperative period. In a randomized, prospective cohort study of 50 patients,

there were no significant differences in micronutrient deficiencies in the early postoperative period between those undergoing LSG versus RYGB (169).

**R40.** (2019\*). Intra-operative and postoperative fluid management in patients undergoing bariatric surgery should be goal directed (566). Utilizing continuous noninvasive measurements of fluid status, such as the PVI, stroke volume variation, or other technologies, results in less fluid administration during bariatric surgery than empiric calculations of volume requirements (566,608) or by monitoring urine output (609). Administration of excess IV fluids can increase the rate of postoperative nausea and length of stay after surgery (596, 610). To decrease the chances of preoperative dehydration, patients should be allowed to drink clear liquids up to 2 hours prior to surgery. This should be extended to 4 hours for patients with known gastroparesis or delayed gastric emptying (611).

**R41.** (2019\*). EN support has been used for treatment-refractory dumping syndrome after bariatric surgery (612) and leaks after SG (613). The need for EN and/or PN support in some patients with OAGB indicates the need for similar, close follow-up for nutritional problems as with other malabsorptive bariatric procedures (614). When PN support is required for patients undergoing bariatric surgery based on high nutritional risk and inadequate intestinal function, CPGs from the American Society for Parenteral and Enteral Nutrition recommend a high-nitrogen (1.2 g/kg actual or 2 to 2.5 g/kg ideal weight of amino acid), low-energy (50 to 70% estimated requirements) formulation (615). This type of formulation also avoids overfeeding in a setting where, in the absence of indirect calorimetry measurements of actual energy consumption, formulaic calculations frequently overestimate needs (616). In a randomized, controlled study of patients undergoing RYGB, pre-operative oral carbohydrate loading and perioperative peripheral PN were safe but not associated with improved body composition or clinical outcomes compared with standard nutritional management (617). Refeeding syndrome is a potential complication of PN in patients who have had severe weight loss after bariatric surgery, especially after BPD/DS (618), prompting special attention to adequate micronutrition (especially phosphate, magnesium, potassium, calcium, vitamins, and trace elements) with initial limited nonprotein calories (especially dextrose).

**R42.** (2019\*). IV insulin for tight glycemic control is associated with improved outcomes following GI and bariatric surgery (619-622). In a comprehensive review, Batterham and Cummings (623) review a broad range of mechanisms, acting in concert, that mitigate/reverse the T2D state. Within 1 week after RYGB, first-phase insulin secretion and hepatic insulin sensitivity increase, consistent with clinical findings of rapid amelioration of hyperglycemia

postoperatively (624). In fact, among patients with T2D, blood glucose levels were significantly reduced by 48 hours after SG and RYGB, regardless of diabetes medication (oral, noninsulin injectables, or insulin) (625). Moreover, glycemic control in the early postoperative period is associated with higher rates of long-term T2D remission (626). Diabetes status does not appear to be associated with postoperative infection rates during the first month after bariatric surgery (627). Patients with insulin-requiring T2D prior to surgery will have up to 87% reduction in their total daily insulin requirements by postoperative day 2 (628). These more recent findings further support the practice of holding or dramatically reducing diabetes medication in the early postoperative period, to not only decrease the risk of hypoglycemia, but also avoid unnecessary medication.

**R43.** (2013\*). ICU monitoring is recommended for those patients at high cardiopulmonary risk (629,630). Patients with left ventricular systolic dysfunction (left ventricular ejection fraction <50%) had a slight excess in early postoperative heart failure and myocardial infarction but no excess mortality at 1 year (631). In a systematic review and meta-analysis by Chang et al (632), the 30-day rate for myocardial infarction was 0.37%, with a mortality rate of 0.37%. RYGB had higher rates than SG or LAGB (632). The risk for cardiac events after bariatric surgery may be increased with OSA and this risk mitigated with the use of CPAP (633), though other studies fail to demonstrate these associations (469,470). Parenthetically, even though bariatric surgeries involving senior-level residents had more statistically significant morbidities, including postoperative cardiac events, this association is more likely related to perioperative rather than intra-operative care (634). This finding argues for greater emphasis on resident training in perioperative bariatric surgery care.

**R44.** (2019\*). Patients who use CPAP pre-operatively should have this therapy initiated as early as the postanesthesia care unit to minimize the risk of apnea, hypoxia, or other pulmonary complications (635,636). The use of CPAP immediately after bariatric surgery is not associated with increased risk of anastomotic or suture-line leaks (637). According to guidelines, patients with OSA who have had bariatric surgery should have continuous monitoring with pulse oximetry in the early postoperative period with minimization of sedatives and opioids (638,639). Since patients with OSA and adequate CPAP use are at low risk for cardiopulmonary complications after laparoscopic bariatric surgery, routine ICU admission in the immediate postoperative period is not necessary (470). However, there is a need for additional research to assess risk factors and impact of sleep-associated desaturation, which is not unusual in patients after bariatric surgery (640).

**R45.** (2019\*). VTE is a leading cause of morbidity and mortality after bariatric surgery and includes both DVT

and PE. Portal-splenic-mesenteric venous system thrombosis is a rare but potentially lethal VTE complication after bariatric surgery (641). Patients who experienced upper-extremity DVT after bariatric surgery also have been described (642). In a recent study by Helm et al (643), the postoperative incidence of VTE was 0.5%, with an average time to diagnosis of 11.6 days and 80% occurring after hospital discharge. After bariatric surgery, major complications occurred prior to VTE in 22.6% of patients, with VTE likelihood directly related to the number of complications, and an unadjusted 30-day mortality increasing 13.89-fold with VTE (643).

DVT prophylaxis is recommended for every patient after bariatric surgery (477). At a minimum, sequential compression devices and early ambulation should be utilized for all patients. Chemoprophylaxis should begin prior to surgery with unfractionated or low-molecular-weight heparin and be continued throughout the hospital stay unless there is a contra-indication (477,644). More than 80% of DVT events following bariatric surgery are diagnosed after hospital discharge (645). Therefore, the use of extended postdischarge chemoprophylaxis should be used for patients who are at high risk for DVT, such as those with a personal history of DVT, known hypercoagulable state, or limited ambulation. Risk calculators are available to guide prophylaxis regimens (645). Congestive heart failure, paraplegia, dyspnea at rest, and re-operation are associated with the highest risk of postdischarge DVT. Postoperative bleeding and subsequent transfusion after bariatric surgery are also associated with increased VTE risk, most likely due to withholding chemoprophylaxis (646).

Using risk calculators can prompt routine postdischarge chemoprophylaxis for high-risk patients (i.e., DVT risk >0.4%) (645,647). Additional risk factors for postoperative DVT are advanced age, BMI >60 kg/m<sup>2</sup>, open or revisional surgery, age >50 years, anastomotic leakage, nicotine use, past DVT/PE, venous insufficiency, hypoventilation, or thrombophilia (e.g., protein-S deficiency, which is more likely with obesity) (648,649). Serum anti-Xa levels can be used to guide low-molecular-weight heparin dosing in the prophylactic range (650-652). Fondaparinux 5 mg once daily achieves appropriate prophylactic anti-Xa levels more often than enoxaparin 40 mg twice daily after bariatric surgery (653).

Of note, patients undergoing bariatric surgery who are chronically anticoagulated pre-operatively have increased risk for postoperative complications and all-cause readmission rates (654). Whether the benefits of inferior vena cava (IVC) filter placement prior to bariatric surgery are outweighed by the risks is unclear based on the current literature; however, it is important to note that IVC filters are associated with higher rates of postoperative DVT and mortality after bariatric surgery (655-657).

**R46.** (NEW). PE is a leading cause of mortality after bariatric surgery, with an incidence of about 1% (632,658), but a leading cause of death at 20.7% (659) and accounting for 40% of all deaths within 30 days postoperatively (643). Mortality rates from PE are lower after laparoscopic, compared with open, bariatric procedures (660).

**R47.** (2019\*). Respiratory distress or failure to wean from ventilatory support should also raise suspicion for an anastomotic leak. Anastomotic or staple-line leaks can present with clinical signs of sustained resting tachycardia, hypoxia, and fever and are highly morbid events (661). There is no evidence that routine placement of a drain after bariatric surgery is beneficial. In fact, placement of a drain may increase morbidity and should only be used in select, high-risk cases (662). If a leak is suspected in a stable patient, CT imaging is a more sensitive and specific diagnostic test than an upper-GI contrast study and should be the diagnostic test of choice to evaluate all the surgical anatomy (663,664). In the setting of worrisome clinical signs and normal imaging, laparoscopic or open operative exploration is warranted to rule out GI leak (664). Nonoperative methods of GI leak treatment after both RYGB or SG include endoscopic endoluminal self-expandable stents, clips and sutures, endoscopic and percutaneously placed drains, and biologic glue/tissue sealants (665-671). Because length of hospital stay after bariatric surgery continues to decrease with the use of ERABS, some septic complications will occur after the relatively earlier hospital discharge (672). In fact, most SG leaks occur after hospital discharge. Serum markers such as CRP and procalcitonin are sensitive and specific in predicting surgical-site infections in patients after bariatric surgery (673).

**R48.** (2019\*). Rhabdomyolysis (defined as a postoperative serum creatinine kinase level >1,000 U/L) is associated with longer operative times (>230 minutes) and can be effectively treated with fluid therapy and diuretics within 24 hours of surgery (674). The development of rhabdomyolysis is also associated with increasing volumes of IV fluid after bariatric surgery, suggesting that decreasing IV fluid administration (goal-directed fluid management) may lower the risk of rhabdomyolysis (675).

#### **Q6. How can care be optimized 5 or more days after a bariatric procedure?**

**R49.** (2019\*). Recommended follow-up intervals are generally based on expert opinion (Table 9). There are very few bariatric surgery studies reporting long-term results with sufficient follow-up of patients (only 29 of 7,371 with at least 2-year follow-up and 80% of initial cohort represented), creating bias in outcome reporting (175). There are relatively few studies on the nature of retention and attrition after bariatric surgery (676). Nevertheless, among 46,381

patients who had some follow-up within 12 months after surgery (30.6% of all patients having RYGB), complete postoperative follow-up (75.6% of the 46,381 patients) was associated with greater comorbidity improvement and remission rates, compared with incomplete follow-up (677). In a review of 79 papers (out of 872 searched), with a majority representing retrospective reviews of prospectively collected clinical data, adherence with follow-up appointments was generally poor, with up to 89% attrition and worse with lesser amounts of weight loss achieved, younger age, unemployment, and lower BMI (678). Other predictors of increased adherence with 2-year follow-up were LAGB and attendance at the 6-month appointment, while dysthymia was associated with decreased follow-up (679). Similar results were found in a 5-year French cohort of 16,620 patients (680). Long-term success after bariatric surgery also depended on adherence with physical activity, vitamin supplementation, and healthy eating patterns, the last of which was impaired in patients with poorer mood, preference for sweets, and eating disorders (678).

Since increased adherence with follow-up is associated with improved outcomes, various strategies should be implemented to minimize attrition, such as the use of telemedicine (676) and better collaboration between inpatient and outpatient teams, including those with specialization in obesity medicine (677,681-683). Moreover, though there is little consensus on what defines an acceptable amount of postoperative weight regain, patients often express anxiety and a sense of failure with any amount of weight regain, leading to guilt, shame, and a reluctance to attend critical follow-up appointments. Hence, clarity is needed regarding weight regain. Notwithstanding the above, in a cohort study of 794 patients with 90% follow-up over 10 years, there was a 38% rate of band removal with higher rates for those age <40 years, BMI >50 kg/m<sup>2</sup>, women, and longer duration of time (684).

**R50.** (2013\*). The diagnosis of hyperinsulinemic hypoglycemia can be challenging due to the variability in presenting symptoms, which can be autonomic or neuroglycopenic in nature. Hyperinsulinemic hypoglycemia has been reported after SG (685), in addition to BPD/DS and RYGB. Newer studies have found an association of post-bariatric surgery hypoglycemia with weight regain (686). To confirm the diagnosis of hyperinsulinemia hypoglycemia, patients must have confirmed postprandial hypoglycemia in combination with symptoms (687). A low-carbohydrate, low-glycemic index diet with adequate protein and inclusion of heart-healthy fats along with restricting alcohol and caffeine intake recently has been shown to be an effective strategy to manage post-bariatric surgery hypoglycemia (688). In fact, most patients with post-bariatric surgery hypoglycemia will respond to dietary modification or pharmacologic intervention (687-692). As an example, continuous glucose monitoring was useful in a pregnant patient

with dumping syndrome after RYGB and poor adherence with conventional glucose monitoring (693).

**R51.** (2013\*). The beneficial role of physical activity (high-intensity interval training, moderate-intensity continuous training, etc.) in patients with obesity, especially during the active treatment phase, has been described previously (694-700). Patients who undergo weight loss, especially with bariatric procedures, are particularly susceptible to skeletal muscle loss or sarcopenia, which is associated with physical disability, poor quality of life, and increased mortality risk (701). Biweekly physical activity training sessions for 6 months after RYGB improved cardiometabolic risk factors and muscle strength, but patients did not maintain these benefits (compared with controls) in follow-up (702,703). However, physical activity was able to induce and maintain improved health-related quality of life for up to 2 years after RYGB (704). In several studies, there are positive correlations between the amount of physical activity and the amount of weight loss after bariatric surgery (705-707). In one systematic review of 50 studies, there was more physically active time (e.g., step count) during the first 6 months postoperative, but the intensity was less (708). Taking this into account, patients should be counseled on physical activity pre-operatively and long-term after bariatric surgery (709,710). The use of wearable technologies and activity monitors should be also considered as they can have a positive effect on healthy physical activity behaviors in patients with obesity (711). There are many web-based resources on general recommendations for physical activity in adults (712,713).

**R52.** (2019\*). The simple practice of self-monitoring (e.g., daily self-weighing using smart scales) may lead to improved weight-loss results (714). However, the incorporation of more sophisticated mobile technologies using a variety of delivery methods (e.g., text-messaging, e-mail, cell phone interactions, diet tracking, and virtual reality software) shows promising results (many with RCTs) in terms of additional or alternative low-cost patient-support modalities (715-726).

**R53.** (2019\*). In patients who have undergone SG, there is a potential increase in gastroesophageal reflux requiring long-term proton-pump inhibitor therapy (727-729), which can interfere with absorption of calcium, thus further increasing the risk of secondary hyperparathyroidism (729,730). Additional reviews (448,731), a cross-sectional study (732), and a prospective study (733) further delineate the effects of bariatric surgery on calcium and vitamin D status.

**R54.** (2008). Patients who have had bariatric surgery are at increased risk for fracture (approximately 1.2-fold) (47) due to bone loss (primarily related to malabsorptive

procedures and effects on protein, calcium, vitamin D, and possibly copper and vitamin K; though bone density is generally higher in patients with obesity), abnormal bone microarchitecture (independent of bone mass and primarily related to mechanical loading, physical activity, and various hormonal and other humoral factors), and increased risk of falls (734-736). In fact, the nature of decreased bone strength, independent of bone density, is an area of intense interest.

Frederiksen et al (737) utilized high-resolution peripheral quantitative computed tomography (HR-pQCT) to affirm microarchitecture changes after RYGB that suggests accelerated endosteal resorption and disintegration of trabecular structure. Screening guidelines for osteoporotic fracture for all patients may be guided by recommendations from the U.S. Preventive Services Task Force (505). Schafer et al (502) found that significant bone loss after RYGB occurred in postmenopausal women as early as 6 months postoperatively and persisted through the study duration, which was only 12 months. Using the trabecular bone score as an indirect assessment of skeletal microarchitecture, women had preserved bone microarchitecture for at least 3 years after RYGB (738). In a smaller study of both genders, bone strength by HR-pQCT was preserved for a year after bariatric surgery (LAGB, RYGB, or BPD/DS) (739). However, in another small study, bone strength declined by a year after bariatric surgery (740). Bone loss after RYGB and SG was comparable (at about 8 to 9% loss in patients with T2D) (741), though loss was greater at total hip and femoral neck with RYGB (501). In a meta-analysis of 10 studies (of 1,299 screened), bone density significantly decreased in the femoral neck, but not in the lumbar spine after bariatric surgery, compared with nonsurgical controls (742).

Indices of bone marrow adipose tissue (inversely related to bone density) may serve as a potential marker of skeletal risk in patients after bariatric surgery (501,743). Although ultrasound of the phalanges yields comparable results with DXA in patients not having bariatric surgery, results are discordant in those having bariatric surgery, most likely due to mechanical loading effects (744). In short, there are insufficient data to provide a more specific recommendation at this time, other than monitoring DXA at lumbar spine and proximal femur sites, at baseline and 2 years post-bariatric surgery, with interventions based on clinical judgment (e.g., treating patients with persistent loss and increased fracture risk) (734,745).

**R55.** (2013\*). In a large Taiwanese database (N = 2,064), bariatric surgery (primarily with malabsorptive procedures) was associated with increased fracture risk in the first 1 to 2 postoperative years (47). In a case-matched study of 120 patients using lumbar spine and total hip DXA, RYGB was associated with greater bone loss than LAGB or SG (746). However, in another study of 66 patients, bone loss

was comparable between RYGB and SG (747). Secondary hyperparathyroidism may play a significant role or be a significant marker of this bone loss process. Among 1,470 patients undergoing various bariatric surgical procedures, the overall prevalence of secondary hyperparathyroidism was 21.0% pre-operatively, 35.4% at 1 year postoperatively, and 63.3% at 5 years postoperatively, with some procedural differences in these 5-year rates: OAGB (73.6%) > RYGB (56.6%) > LAGB (38.5%) > SG (41.7%) (504). Hence, every effort should be made to screen for and appropriately treat both secondary hyperparathyroidism and osteoporosis to lower fracture risk.

There are no data on the use of antiresorptive agents specifically for management of bone loss resulting from a bariatric procedure, including both bisphosphonates and denosumab (748). The use of specific bisphosphonates in patients with chronic kidney disease is reviewed by Miller et al (749). Upper-GI adverse effects of oral bisphosphonates are discussed by Lanza et al (750). The potential for secondary hyperparathyroidism, hypocalcemia, and vitamin D insufficiency/deficiency should be strongly considered and effectively managed when starting antiresorptive agents after a bariatric procedure (748).

**R56.** (2013\*). The pathophysiology of calcium oxalate stone disease following bariatric surgery is related to hyperoxaluria, low urinary volume, and hypocitraturia (751).

**R57.** (2019\*). A recent review by the ASMBS (448) reported higher prevalence rates of certain nutrient deficiencies among patients with obesity considered for bariatric surgery. For example, the prevalence of pre-operative deficiencies among fat-soluble vitamins are 14% for vitamin A and 2.2% for vitamin E, but no data are available for vitamin K (448). Postoperatively within 4 years, vitamin A deficiency occurs in up to 70% of patients after RYGB and BPD/DS, whereas vitamin E and K deficiencies are uncommon. The impact of RYGB on vitamin A undernutrition is particularly severe in pregnant women (752). Micronutrient dosing strategies are outlined in Table 12. However, caution should be exercised in the interpretation of biochemical results; for example, vitamin A levels may need to be adjusted for retinol-binding protein levels and vitamin E for cholesterol levels to avoid oversupplementation (600). Additional micronutrient deficiency prevalence rates, which are discussed in subsequent recommendations, are presented by surgical procedure performed and serve to guide decision-making about appropriate biochemical testing, therapeutic dosing for prevention of deficiencies, and therapeutic dosing to manage established deficiencies (753).

**R58.** (2008\*). There are little data about essential fatty acid (EFA) status or comprehensive strategies for the work-up of fat-soluble vitamin levels after bariatric surgery. Forbes

et al (754) found transient increases in 20:4N6 (+18%) and 22:6N3 (+11%) with decreases in 20:3N6 (−47%) and 20:5N3 (−79% and −67%) at 1 and 6 months, respectively, after RYGB, but not LAGB. The 20:5N3 reduction is most concerning, since this EFA is a precursor for anti-inflammatory eicosanoids. However, the impact of these results is mitigated by decreased postoperative intake of dietary fat, decreased body fat postoperatively, and lack of data on the clinical benefit of treatment postoperatively. Topical borage oil (755), soybean oil (756), or safflower oil (756,757) are rich in EFAs and may be applied to the affected skin areas with EFA deficiency, though conclusive clinical trials, particularly with oral supplementation, are lacking, especially in patients after bariatric surgery. A rational approach of screening for multiple nonestablished fat-soluble vitamin deficiencies with at least one established or suspected EFA deficiency remains to be proven.

**R59.** (2019\*). In the recent ASMBS CPG, iron deficiency was as high as 45% of patients with obesity prior to bariatric surgery and therefore justifies a pre-operative aggressive case-finding approach, which may include ferritin levels (448). Key clinical features of iron deficiency prompting suspicion include fatigue, microcytic anemia, glossitis, and nail dystrophy. Postoperatively, iron status should continue to be monitored, but measurement of ferritin levels is less helpful, since they are confounded by inflammation, age, and infection (448). Moreover, postoperatively, iron deficiency is 14% after LAGB, 20 to 55% after RYGB, 8 to 62% after BPD/DS, and can occur despite routine supplementation, again justifying routine testing (448). Oral supplementation should be in divided doses, since malabsorption can be exacerbated with calcium supplements, decreased gastric acid, and phytate- or polyphenol-rich foods (448). Vitamin C can be provided with iron supplementation to both improve iron absorption and also decrease the risk of iron overload (758).

**R60.** (2019\*). In the recent ASMBS CPG, B12 deficiency was found in 2 to 18% of patients with obesity (6 to 30% in those on proton-pump inhibitors) prior to bariatric surgery and justifies pre-operative aggressive case finding with biochemical testing, specifically using methylmalonic acid (448,759). Two to 5 years after bariatric surgery, B12 deficiency is <20% in RYGB and 4 to 20% after SG (448). However, in a meta-analysis directly examining the two procedures, there was a decreased risk for B12 deficiency (but not anemia or iron deficiency) after SG compared with RYGB (760). Notwithstanding the paucity of information about vitamin B12 status after LAGB, global recommendations for ongoing biochemical testing and appropriate B12 supplementation in all patients undergoing bariatric surgery, especially those on folic acid supplementation, may be reasonable, since there is virtually no risk from B12 dosing.



**R61.** (2013). In the recent ASMBS CPG, folate deficiency was found in as many as 45% of patients with obesity prior to bariatric surgery and justifies aggressive case finding pre-operatively with biochemical testing, specifically using sensitive markers, such as red-blood-cell folate and homocysteine (methylmalonic acid is normal with folate deficiency and normal B12 status) (448). Up to 65% of patients after bariatric surgery have a folate deficiency, in part due to poor consumption of folate-rich foods (e.g., various beans, lentils, peas, and other vegetables and fruits) and possible multivitamin nonadherence, again justifying ongoing biochemical monitoring, especially in female patients of childbearing age (448). There remain concerns about masking B12 deficiencies (and therefore starting B12 supplementation) on higher doses of folic acid ( $\geq 1$  mg/day) that require further research, especially after bariatric surgery (761,762).

**R62.** (2013). About 10 to 12% of patients with obesity have anemia before bariatric surgery, 33 to 49% of patients have anemia within 2 years after bariatric surgery, and this postoperative prevalence is 17% after SG and 45 to 50% after the malabsorptive procedures RYGB and BPD/DS (763,764). Though iron deficiency is the most common culprit, folate and vitamin B12 deficiencies are also highly associated with anemia. Though less common, additional micronutrient deficiencies can contribute to anemia after malabsorptive bariatric surgery, namely, vitamins A, B1, D, E, and K, and zinc, selenium, and copper (764-766). Whether a nutritional anemia work-up should be expanded to checking these less common biochemical markers, and supplementing if positive, depends on clinical judgment based on other specific signs/symptoms of deficiency. The association of low protein levels with anemia may be causative in chronic disorders (767) but more of an indirect marker of poor nutrition and other contributory factors after bariatric surgery.

**R63.** (2013). Clinically significant selenium deficiency is associated with myopathy, cardiomyopathy, arrhythmia, impaired immunity, hypothyroidism, loss of skin/hair pigmentation, and encephalopathy (768). Massoure et al (769) reported heart failure in a patient 9 months after RYGB that resolved with 2  $\mu\text{g}/\text{kg}/\text{day} \times 3$  months oral selenium with furosemide and an angiotensin-converting enzyme inhibitor. Among 437 patients having LAGB or SG, selenium deficiency (below normal range 0.75 to 1.85  $\mu\text{mol}/\text{L}$ ) occurred in 2.3% of patients pre-operatively (3.2% in another, smaller study) (518), and then, while taking a multivitamin-mineral supplement, in 14.9% patients at 3 months postoperatively, 13.8% at 6 months, 13.1% at 12 months, 15.4% at 18 months, 11.4% at 24 months, and 14.3% at 36 months (765). In another study, selenium intake and markers of deficiency were most evident at 3 months after RYGB, but not LAGB, prompting recommen-

dations for routine increases in high selenium foods and use of routine multivitamin supplements with more than 55  $\mu\text{g}/\text{day}$  selenium (768). In a more recent report, Shoar et al (770) found about 50% of patients undergoing SADI-S had a selenium deficiency.

**R64.** (2019\*). At 5 years postoperatively, patients with low zinc levels after RYGB and BPD/DS are 21.15% and 44.94%, respectively (771). The amount of routine daily zinc supplementation after bariatric surgery depends on the specific procedure, ranging from 8 to 11 mg (100% of usual multivitamin-multimineral supplement zinc content) after SG or LAGB, to 8 to 22 mg (100 to 200% of usual multivitamin-multimineral supplement zinc content) after RYGB, to 16 to 22 mg (200% of usual multivitamin-multimineral supplement zinc content) after BPD/DS (448). Moreover, to avoid copper undernutrition with chronic zinc supplementation, zinc dosing should be in the range of no more than 8 to 15 mg per mg of copper supplemented (448).

**R65.** (2019\*). Copper is primarily absorbed in the duodenum, proximal jejunum, and stomach, so surgeries affecting this functional anatomy can potentially induce a low copper state. At 5 years postoperatively, patients with low copper levels after RYGB and BPD/DS were 13.48% and only 1.92%, respectively (771). This compares with patients undergoing Roux-en-Y reconstruction for gastric cancer in which copper deficiency was relatively infrequent (5.9%) and symptoms rare (772). In the same study, copper levels among those having RYGB or BPD/DS were lower with younger age, shorter follow-up ( $< 3$  years), and male gender (772). The amount of copper supplementation varies depending on the surgical procedure performed, with greater amounts required for patients after RYGB and BPD/DS and is guided by serum copper levels (448). Initial supplementation dosing ranges from 3 to 8 mg/day oral copper as gluconate or sulfate to 2 to 4 mg/day intravenously, and then titrated to normal levels and amelioration of signs/symptoms (448).

**R66.** (2019\*). In a study by Nath et al (525), 16.5% of patients after RYGB had clinical thiamine deficiency defined by the presence of consistent clinical symptoms and either low whole-blood thiamine levels or significant improvement after thiamine supplementation. Thiamine is the first vitamin depleted in patients who experience chronic nausea/vomiting or food intolerance (521). Among those with clinical thiamine deficiency, 70% had cardiac, 59% had peripheral neurologic, 14% had GI, and 5% had neuropsychiatric symptoms. Abnormal intestinal microbiota is thought to be a contributory factor to low thiamine levels after RYGB, and levels improved with antibiotics (773). Early/aggressive supplementation of thiamine in at-risk patients (those with chronic nausea/vomiting, decreased intake by mouth) can avert the adverse effects of clinically

significant thiamine deficiency. Of note, there is increased urinary thiamine excretion with both T1D (76% decreased thiamine levels) and T2D (75% decreased thiamine levels) (774). On the other hand, Aaseth et al (775) found that thiamine levels after RYGB were relatively constant up to 5 years postoperatively. Interestingly, elevated thiamine levels were found in 43% of patients already on micronutrient supplementation up to 12 months after BPD/DS in a study by Homan et al (776). Additional information on thiamine deficiency and supplementation can be found in the 2008 and 2013 versions of these guidelines (1,54).

WE has been reported after purely restrictive procedures (e.g., LAGB, SG, and IGB) and may in large part reflect pre-existing thiamine undernutrition; routine assessment of thiamine status in any patient after bariatric surgery with any early or suggestive features of WE is recommended (777-779). For example, in patients after bariatric surgery, fundoscopic exam can detect the early findings of a severe thiamine deficiency at risk for WE: retinal hemorrhage, optic disc edema, and peripapillary telangiectasia (780). An unusual presentation initially diagnosed as an ischemic stroke was described by Blum et al (781) in a patient 9 months after SG, ultimately diagnosed with WE. There are also ethnicity differences in prevalence rates of thiamine deficiency, with up to 33% in Latinos preoperatively, where the total (all ethnicities) rate was only 1.8% (732). Updated physiology, recommendations, and discussion for thiamine supplementation are provided in the ASMBS guidelines (448) and a review by Frank (782). Although evidence is limited, if IV access is not available in the acute setting, then intramuscular thiamine dosing may be considered (783).

**R67.** (NEW). Many commercial dietary supplement products are adulterated with compounds that are not included in the manufacturer's labelling. These products can have intrinsic toxicity; mitigate or intensify the desired clinical action; interact with certain foods, other supplements, or specific medications; or have unknown but potentially harmful effects (784). The best principle is for HCP and patients to discuss all supplements at each encounter. United States Pharmacopeia products, supplements that have been used in published clinical trials, or other brands that the prescribing HCP has a positive (safe and effective) experience with are preferred.

**R68.** (2013\*). In a prospective, single-center cohort study of 65 patients after SG, there was a 6% reduction in lipid-lowering medication use at 1 month and 24% at 6 months (785). The pathophysiology of bariatric surgery on lipids is complex, with salutary effects on lipid metabolism postoperatively, but also downstream effects of lipids on micronutrient status and effects of micronutrients on lipid status (435,436,786). These networked effects among obesity,

bariatric surgical disruption of GI physiology, lipid status, micronutrient status, and CVD risk will need further elucidation and research.

**R69.** (2019\*). In a meta-analysis, 32 of 57 clinical studies reported improvement of HTN in 32,628 of 51,241 patients, and 46 of these studies reported resolution of HTN in 24,902 of 49,844 patients after bariatric surgery (97). In another analysis of 23 studies with a pooled group of 1,022 patients, bariatric surgery was cardioprotective and induced a decrease in left ventricular mass, left-atrium diameter, and improvement of left-ventricular diastolic function, but without changes in left-ventricular ejection fraction (787). Renal function also improves after bariatric surgery in those patients with HTN (788). In a prospective, single-center cohort study of 65 patients after SG, there was a 12% reduction in antihypertensive medication use at 1 month and 25% at 6 months (785). One more study of 183 consecutive patients undergoing SG showed that 50% of the patients reduced blood pressure medications and 34% discontinued the medications postoperatively (789). Overall, there are reductions in CVD risk, events, and mortality after bariatric surgery (94,790). Decreased blood pressure can occur postoperatively even before appreciable weight loss, particularly in patients with orthostatic intolerance and possible dysautonomia (791).

**R70.** (NEW). The ongoing need for medications for T2D depends on the specific bariatric surgical procedure and needs to be monitored postoperatively. In a retrospective review of 400 patients in the Bariatric Outcomes Longitudinal Database, the use of oral hypoglycemic agents or insulin decreased after bariatric surgery by 18.8% and 4.2%, respectively (792). In a prospective, single-center cohort study of 65 patients having SG, there was a 50% reduction in diabetes medications (785). Among 183 patients post-SG (with 58.4% 2-year median loss of excess body weight), 78.9% and 15.8% of those with T2D had their diabetes medications discontinued or reduced, respectively (789). In a retrospective study of 79 patients undergoing LAGB and followed for 10 years, diabetes control, as well as blood pressure, lipid profile, and quality of life improved, but without significant changes in diabetes medication and with a high rate of revisional surgery (793).

**R71.** (NEW). Thyroid dosing is generally decreased after bariatric surgery due to weight loss, but some case studies have reported increased dosing with significant malabsorption (794). Several case reports have demonstrated the benefit of liquid forms of levothyroxine in postoperative patients with hypothyroidism, significant malabsorption, and difficulty normalizing elevated TSH levels (795). Liquid forms may also be indicated in those patients with swallowing difficulties after bariatric surgery (796). The

use of softgel levothyroxine may also be considered in patients with established or suspected malabsorption of tablet forms (796,797).

**R72.** (2019\*). In a retrospective review of patients with RYGB or BPD/DS, a CT is the most appropriate imaging tool to help identify an intestinal obstruction or internal hernia (798). In some cases, conclusive findings are missed on imaging, and diagnostic laparoscopy should be considered if symptoms persist. Severe abdominal pain after SG may be the result of mesenteric venous thrombosis, which is associated with shorter courses of VTE prophylaxis and best diagnosed with contrast-enhanced CT (641, 799). In a multi-institutional, matched, case-controlled study using a U.S. database from 2008-2012 (8,980 patients in the study group and 43,059 controls), there were 15 cases of inflammatory bowel disease in those with a prior history of bariatric surgery (OR, 1.93; 95% confidence interval [CI] 1.34 to 2.79) (800).

**R73.** (NEW). In a retrospective study of 919 patients undergoing SG, 13% had pre-existing GERD, and 3% developed de novo GERD, with the majority responding to proton-pump inhibitors; however 1 patient with de novo and 3 patients with pre-existing GERD required conversion to RYGB (727).

**R74.** (2019\*). Although short-term postoperative use of NSAIDs for patients after bariatric surgery is standard practice, long-term use generally should be avoided. In a retrospective review of 1,001 patients who had RYGB, NSAID and tobacco use significantly increased the risk of marginal ulceration, and upper endoscopy is useful to exclude or detect and then dilate strictures in patients who have had RYGB (801). Proton-pump inhibitor use was protective in these patients exposed to NSAIDs (801). In a retrospective cohort study of 13,082 patients having colorectal or bariatric surgery by Hakkarainen et al (802), NSAID use was associated with an increased rate of anastomotic leak. Simply providing letters or written notification to avoid or discontinue use of NSAIDs after RYGB (and other bariatric procedures by extension) is ineffective (803).

**R75.** (2019\*). Upper-GI endoscopy in the early postoperative period after RYGB is safe (485, 804). The use of GI endoscopy in patients who have had bariatric surgery is supported by the study by Wilson et al (801). Interestingly, recent data from an RCT demonstrate the utility of *intra-operative* endoscopy to detect technical defect-related leaks using the air-leak test (805).

**R76.** (NEW). In a systematic review of 41 studies involving 16,987 patients having RYGB, marginal ulcers, diagnosed by upper endoscopy, occurred in 0.6 to 25% and were associated with pouch size and position, smoking, alcohol

consumption, and NSAID use (806). In a retrospective cohort study (807) and a meta-analysis of 7 prospective cohort studies involving 2,917 (2,114 analyzed) patients (808), prophylactic administration of a proton-pump inhibitor for 90 days postoperatively was superior to 30 days in the prevention of symptomatic marginal ulcers. However, since most marginal ulcers occur within the first 12 months following surgery, extension of proton-pump inhibitor therapy for the first postoperative year should be considered in patients at high risk as a preventive measure (801).

**R77.** (2013\*). A meta-analysis of 175 studies (many were single-center retrospective reviews) on patients with inadequate weight loss after bariatric surgery demonstrated improved weight loss and reduction of comorbidities with revisional surgery (though complication rates were higher with re-operative compared with primary surgery) (275). In a 1:1 comparison case-matched analysis of primary versus revisional RYGB, comorbidity resolution and total weight loss were similar, with weight loss after revisional surgery less than after primary surgery. Revisional surgery was found to be safe (809). Among 1,300 patients having SG, conversion to RYGB was associated with a mean loss of excess weight of 61.3% after 1 year (810). Based on retrospective analysis of two cohorts, endoscopic gastrojejunostomy revision also has demonstrated greater effectiveness than medical management for weight regain after RYGB (811). Band-to-bypass conversional surgery for inadequate weight loss, symptoms, clinical goals, and/or comorbidities is effective, but due to the complex nature of the procedure, it is associated with morbidity (812). There are inadequate data for a formal recommendation about band-to-bypass conversional surgery. In a retrospective review of 1,273 patients, gastrogastic fistula occurred in 106% of those who had RYGB, generally due to gastric ischemia, fistula, or ulceration, and the majority presented with weight regain (80%) and pain (73.3%), where surgical revision was based on the anatomy: low fistula with gastric resection and gastrojejunal anastomotic revision, or high fistula with sleeve of the pouch and sleeve resection of the remnant stomach (813). Revisional surgery has also been performed to improve glycemic control in bariatric surgery patients with persistent T2D, with subsequent T2D improvement in 65 to 100% of patients (277).

**R78.** (2019\*). Evaluation with upper-GI contrast study is the primary imaging modality to detect band slippage, esophageal dilation, and in some patients, erosion (814,815).

**R79.** (2019\*). Rapid weight loss is the primary risk factor for gallstones, detected by abdominal ultrasound, after SG or RYGB (816). In general, cholecystectomy should be reserved for patients with symptomatic biliary disease, as the risk of needing a postoperative cholecystectomy is 6

to 10% (817). In asymptomatic patients with known gallstones and a history of RYGB or BPD/DS, prophylactic cholecystectomy may be considered to avoid choledocholithiasis, since traditional endoscopic retrograde cholangiopancreatography can no longer be performed in these patients (818). Since the aggregate complication risk of cholecystectomy is lower when performed prior, compared with during or after RYGB, the appropriate use of pre-operative cholecystectomy and optimization of preventive measures postoperatively are critical (819). In a retrospective review of a prospectively collected database, ursodeoxycholic acid 500 mg daily for 1 year efficiently prevented gallstones after SG, with twice daily dosing effective for RYGB (820). A meta-analysis of eight studies (retrospective, prospective cohort, and randomized controlled) with 816 patients by Magouliotis et al (821) supported the role of 500 to 600 mg/day ursodeoxycholic acid for 6 months after bariatric surgery. A more definitive, randomized, double-blind multicenter trial (N = 900 patients with SG or RYGB) assessed the efficacy of ursodeoxycholic acid 900 mg/day × 6 months on symptomatic gallstones by 24 months (822).

**R80.** (2013\*). Of note, SIBO is fairly common (15 to 17%) pre-operatively in patients who had RYGB (N = 378), rises to 40% after RYGB (but not LAGB), and may be associated with a lower overall weight loss (823,824). Thiamine deficiency is associated with SIBO after RYGB (49% of patients) due to bacterial thiaminase production in the setting of compromised thiamine transporter-1 and -2 with shortened biliopancreatic limb, relatively low intakes, and small reserves, especially with obesity, while also leading to gut dysmotility (e.g., constipation) (773,825). SIBO is also associated with severe hepatic steatosis in patients with obesity (824).

**R81.** (2008\*). Timing of repair of abdominal wall hernias is debatable, with insufficient evidence for a recommendation; strategy would depend on the hernia size, location, and type (826).

**R82.** (2013\*). Body contouring may be associated with weight-loss benefits following bariatric surgery, including an increase in total weight loss and an improvement in long-term weight-loss maintenance (827,828). Currently, an estimated 6 to 41% of patients undergo body contouring after bariatric surgery, with the large amount of variability likely caused by poor access to care due to limited insurance coverage (827,829,830). When plastic surgery practice surveys and insurance coverage requirements were analyzed by Dreifuss and Rubin (831), there were discrepancies noted regarding the criteria for panniculectomies, arguing for greater input by surgeons in the development of coverage guidelines. Correcting underlying nutritional deficiencies is important in decreasing the frequency of

complications, which can occur with body-contouring surgery (832). For example, since iron-deficiency anemias, which may be found in patients after bariatric surgery, could complicate a body-contouring procedure, the use of IV iron therapy may be needed (833). While the overall complication rate of body contouring after bariatric surgery is high, the majority of such complications are considered minor (834). In a retrospective, multiple regression analysis of 205 patients having body-contouring surgery after bariatric surgery, no main risk factors were identified (835).

#### **Q7. What are the criteria for hospital admission after a bariatric procedure?**

**R83.** (2013). There has been a notable shift in case type since 2011, with significantly increased numbers of SG (58.1% in 2016) and revisional procedures (13.9% in 2016), with SG now the most commonly performed bariatric surgery, and a decrease in RYGB (18.7% in 2016 compared with 37.5% in 2012) and a significant decline in LAGB (3.4% in 2016 compared with 35.4% in 2011) procedures (239). There has been an interval reduction in average length of stay and hospital re-admission rate. Accreditation of centers and utilization of ERABS protocols are associated with shorter lengths of stay (584,836). However, in this case, a shorter length of stay does not appear to be associated with increased re-admission rates (584). Re-admission rates within 30 days were evaluated in 130,007 patients undergoing primary bariatric surgery for a total of 4.4%. Specifically, LAGB had the lowest rate of 1.4%, followed by SG 2.8%, and RYGB 4.9% (837). The most common cause for re-admission was nausea, vomiting, fluid, electrolyte, and nutritional depletion (35.4%), followed by abdominal pain (13.5%), anastomotic leak (6.4%), and bleeding (5.8%), accounting for more than 61% of re-admissions (837). When compared with LAGB, SG and RYGB had significantly higher rates of re-admission (SG: OR, 1.89; 95% CI, 1.52 to 2.33 and RYGB: OR, 3.06; 95% CI, 2.46 to 3.81) (837). Similar trends were noted in another study, with re-admission rates highest for LRYGB at 11.6%, followed by SG with 7.6%, and LAGB with 4.5% (838). Re-admissions are highest within 30 days. Re-admissions that occur at greater than 30 days are more frequently associated with RYGB than SG and LAGB (839).

**R84.** (2008). Risk factors for re-admission are multifactorial and include longer index hospital length of stay, procedure choice, prolonged index operation, and complication during index hospitalization. Complication during index hospitalization is associated with greater need for re-admission that requires intervention such as re-operation or endoscopy (839,840). RYGB is associated with increased long-term (>30 days) re-admissions, compared with SG and LAGB (26,839,840). Race and insurance status were

also risk factors for re-admission in other studies (26). Pre-operative education, planning, and postoperative care coordination with early follow-up can reduce preventable emergency room visits and re-admissions for mild dehydration, nausea, or dietary intolerance issues (838-841). Morton et al (842) showed a reduction in 30-day re-admission rates from 8% to 2.5% over 18 months by implementation of a re-admission bundle and ongoing vigilance to re-admission.

**R85.** (2008). A recent systematic review identified 35 articles encompassing a total of 100 patients undergoing reversal of RYGB. Malnutrition was the most common indication for reversal (12.3%), followed by severe dumping syndrome (9.4%), postprandial hypoglycemia (8.5%), and excessive weight loss (8.5%) (843). Protein malnutrition and excessive weight loss remain the most common causes of reversal after BPD/DS (844).

## DISCLOSURES

### *Chair of the Task Force*

**Jeffrey I. Mechanick, MD, MACE:** Abbott Nutrition, honoraria for lectures and program development.

### *Co-Chairs of the Task Force*

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## REFERENCES

Note: Reference sources are followed by an evidence level [EL] rating of 1, 2, 3, or 4. The strongest evidence levels (EL 1 and EL 2) appear in red for easier recognition.

- Mechanick JI, Youdim A, Jones DB, et al. Clinical practice guidelines for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient—2013 update: cosponsored by American Association of Clinical Endocrinologists, the Obesity Society, and American Society for Metabolic & Bariatric Surgery. *Endocr Pract.* 2013;19:337-372.[EL 4; NE]
- NCD Risk Factor Collaboration. Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19.2 million participants. *Lancet.* 2016;387:1377-1396.[EL 2; ES]
- Kontis V, Mathers CD, Rehm J, et al. Contribution of six risk factors to achieving the 25x25 non-communicable disease mortality reduction target: a modelling study. *Lancet.* 2014;384:427-437.[EL 3; DS]
- WHO. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. Geneva, Switzerland: World Health Organization, 2013.[EL 4; NE]
- Afshin A, Forouzanfar MH, Reitsma MB, et al. Health Effects of Overweight and Obesity in 195 Countries over 25 Years. *N Engl J Med.* 2017;377:13-27.[EL 4; NE]
- Ogden CL, Carroll MD, Fryar CD, Flegal KM. Prevalence of Obesity Among Adults and Youth: United States, 2011-2014. *NCHS Data Brief.* 2015;1-8.[EL 2; ES]
- Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA.* 2014;311:806-814.[EL 2; ES]
- Flegal KM, Kruszon-Moran D, Carroll MD, Fryar CD, Ogden CL. Trends in obesity among adults in the United States, 2005 to 2014. *JAMA.* 2016;315:2284-2291.[EL 2; ES]
- Global BMI Mortality Collaboration. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. *Lancet.* 2016;388:776-786.[EL 2; MNRCT]
- Aune D, Sen A, Prasad M, et al. BMI and all cause mortality: systematic review and non-linear dose-response meta-analysis of 230 cohort studies with 3.74 million deaths among 30.3 million participants. *BMJ.* 2016;353:i2156.[EL 2; MNRCT]
- Bray GA, Kim KK, Wilding JPH. Obesity: a chronic relapsing progressive disease process. A position statement of the World Obesity Federation. *Obes Rev.* 2017;18:715-723.[EL 4; NE]
- Jensen MD, Ryan DH, Apovian CM, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. *Circulation.* 2014;129(25 suppl 2):S102-S138.[EL 4; NE]
- Garvey WT, Mechanick JI, Brett EM, et al. American Association of Clinical Endocrinologists and American College of Endocrinology comprehensive clinical practice guidelines for medical care of patients with obesity. *Endocr Pract.* 2016;22 Suppl 3:1-203.[EL 4; NE]
- Bays HE, McCarthy W, Christensen S, et al. Obesity Algorithm eBook, presented by the Obesity Medicine Association. www.obesityalgorithm.org. Available at: <https://obesitymedicine.org/obesity-algorithm/> Accessed July 24, 2019.[EL 4; NE]
- Apovian CM, Aronne LJ, Bessesen DH, et al. Pharmacological management of obesity: an Endocrine Society clinical practice guideline. *J Clin Endocrinol Metab.* 2015;100:342-362.[EL 4; NE]
- Acosta A, Streett S, Kroh MD, et al. White Paper AGA: POWER - Practice guide on obesity and weight management, education, and resources. *Clin Gastroenterol Hepatol.* 2017;15:631-649. e610.[EL 4; NE]
- Sullivan S, Edmundowicz SA, Thompson CC. Endoscopic bariatric and metabolic therapies: new and emerging technologies. *Gastroenterology.* 2017;152:1791-1801.[EL 4; NE]
- Mechanick JI, Hurley DL, Garvey WT. Adiposity-based chronic disease as a new diagnostic term: the American Association of Clinical Endocrinologists and American College of Endocrinology position statement. *Endocr Pract.* 2017;23:372-378.[EL 4; NE]
- Sharma AM, Kushner RF. A proposed clinical staging system for obesity. *Int J Obes (Lond).* 2009;33:289-295.[EL 4; NE]
- Kuk JL, Ardern CI, Church TS, et al. Edmonton Obesity Staging System: association with weight history and mortality risk. *Appl Physiol Nutr Metab.* 2011;36:570-576.[EL 2; ES]
- Padwal RS, Pajewski NM, Allison DB, Sharma AM. Using the Edmonton obesity staging system to predict mortality in a population-representative cohort of people with overweight and obesity. *Can Med Assoc J.* 2011;183:E1059-E1066.[EL 2; ES]
- Liang H, Liu Y, Miao Y, Wu H, Yang S, Guan W. The effect of socioeconomic and individual factors on acceptance levels of bariatric surgery among Chinese patients. *Surg Obes Relat Dis.* 2014;10:361-365.[EL 2; ES]
- Topart P. Comment on: the effect of socioeconomic and individual factors on acceptance levels of bariatric surgery among Chinese patients. *Surg Obes Relat Dis.* 2014;10:361-366.[EL 4; NE]
- US Food and Drug Administration. Liquid-filled intragastric balloon systems: letter to healthcare providers-potential risks. Available at <https://www.fda.gov/medical-devices/letters-health-care-providers/update-potential-risks-liquid-filled-intragastric-balloons-letter-health-care-providers-0>. Accessed March 15, 2018.[EL 4; NE]
- Igel LI, Kumar RB, Saunders KH, Aronne LJ. Practical Use of Pharmacotherapy for Obesity. *Gastroenterology.* 2017;152:1765-1779.[EL 4; NE]
- Kizy S, Jahansouz C, Downey MC, Hevelone N, Ikramuddin S, Leslie D. National trends in bariatric surgery 2012-2015: demographics, procedure selection, readmissions, and cost. *Obes Surg.* 2017;27:2933-2939.[EL 2; ES]
- Young MT, Gebhart A, Phelan MJ, Nguyen NT. Use and outcomes of laparoscopic sleeve gastrectomy vs laparoscopic gastric bypass: analysis of the American College of Surgeons NSQIP. *J Am Coll Surg.* 2015;220:880-885.[EL 2; ES]
- Madsbad S, Dirksen C, Holst JJ. Mechanisms of changes in glucose metabolism and bodyweight after bariatric surgery. *Lancet Diabetes Endocrinol.* 2014;2:152-164.[EL 4; NE]
- Rubino F, Nathan DM, Eckel RH, et al. Metabolic surgery in the treatment algorithm for type 2 diabetes: a joint statement by international diabetes organizations. *Diabetes Care.* 2016;39:861-877.[EL 4; NE]
- Warren JA, Ewing JA, Hale AL, Blackhurst DW, Bour ES, Scott JD. Cost-effectiveness of bariatric surgery: increasing the economic viability of the most effective treatment for type II diabetes mellitus. *Am Surg.* 2015;81:807-811.[EL 3; DS]
- Sjöström L, Peltonen M, Jacobson P, et al. Association of bariatric surgery with long-term remission of type 2 diabetes and with microvascular and macrovascular complications. *JAMA.* 2014;311:2297-2304.[EL 2; PCS]
- Arterburn DE, Olsen MK, Smith VA, et al. Association between bariatric surgery and long-term survival. *JAMA.* 2015;313:62-70.[EL 2; RCCS]
- Mingrone G, Panunzi S, De Gaetano A, et al. Bariatric-metabolic surgery versus conventional medical treatment in obese patients with type 2 diabetes: 5 year follow-up of an open-label, single-centre, randomised controlled trial. *Lancet.* 2015;386:964-973.[EL 1; RCT]
- Schauer PR, Bhatt DL, Kirwan JP, et al. Bariatric surgery versus intensive medical therapy for diabetes - 5-year outcomes. *N Engl J Med.* 2017;376:641-651.[EL 1; RCT]
- Cohen R, Le Roux CW, Junqueira S, Ribeiro RA, Luque A. Roux-en-Y gastric bypass in type 2 diabetes patients with mild obesity: a systematic review and meta-analysis. *Obes Surg.* 2017;27:2733-2739.[EL 1; MRCT]
- Müller-Stich BP, Senft JD, Warschkow R, et al. Surgical versus medical treatment of type 2 diabetes mellitus in nonseverely obese patients: a systematic review and meta-analysis. *Ann Surg.* 2015;261:421-429.[EL 2; MNRCT]
- Gloy VL, Briel M, Bhatt DL, et al. Bariatric surgery versus non-surgical treatment for obesity: a systematic review and meta-analysis of randomised controlled trials. *BMJ.* 2013;347:f5934.[EL 1; MRCT]
- Kwok CS, Pradhan A, Khan MA, et al. Bariatric surgery and its impact on cardiovascular disease and mortality: a systematic

- review and meta-analysis. *Int J Cardiol.* 2014;173:20-28.[EL 2; MNRCT]
39. Ricci C, Gaeta M, Rausa E, Asti E, Bandera F, Bonavina L. Long-term effects of bariatric surgery on type II diabetes, hypertension and hyperlipidemia: a meta-analysis and meta-regression study with 5-year follow-up. *Obes Surg.* 2015;25:397-405.[EL 2; MNRCT]
  40. Halperin F, Ding SA, Simonson DC, et al. Roux-en-Y gastric bypass surgery or lifestyle with intensive medical management in patients with type 2 diabetes: feasibility and 1-year results of a randomized clinical trial. *JAMA Surg.* 2014;149:716-726.[EL 1; RCT]
  41. Ikramuddin S, Billington CJ, Lee WJ, et al. Roux-en-Y gastric bypass for diabetes (the Diabetes Surgery Study): 2-year outcomes of a 5-year, randomised, controlled trial. *Lancet Diabetes Endocrinol.* 2015;3:413-422.[EL 1; RCT]
  42. Courcoulas AP, Belle SH, Neiberg RH, et al. Three-year outcomes of bariatric surgery vs lifestyle intervention for type 2 diabetes mellitus treatment: a randomized clinical trial. *JAMA Surg.* 2015;150:931-940.[EL 1; RCT]
  43. Cummings DE, Arterburn DE, Westbrook EO, et al. Gastric bypass surgery vs intensive lifestyle and medical intervention for type 2 diabetes: the CROSSROADS randomised controlled trial. *Diabetologia.* 2016;59:945-953.[EL 1; RCT]
  44. Kennigott HG, Clemens G, Gondan M, et al. DiaSurg 2 trial-surgical vs. medical treatment of insulin-dependent type 2 diabetes mellitus in patients with a body mass index between 26 and 35 kg/m<sup>2</sup>: study protocol of a randomized controlled multicenter trial-DRKS00004550. *Trials.* 2013;14:183.[EL 4; NE]
  45. Mechanick JI, Garber AJ, Grunberger G, Handelsman Y, Garvey WT. Dysglycemia-based chronic disease: an American Association of Clinical Endocrinologists position statement. *Endocr Pract.* 2018;24:995-1011.[EL 4; NE]
  46. Fischer DP, Johnson E, Haneuse S, et al. Association between bariatric surgery and macrovascular disease outcomes in patients with type 2 diabetes and severe obesity. *JAMA.* 2018;320:1570-1582.[EL 2; RCCS]
  47. Lu CW, Chang YK, Chang HH, et al. Fracture risk after bariatric surgery: a 12-year nationwide cohort study. *Medicine (Baltimore).* 2015;94:e2087.[EL 2; ES]
  48. Yu EW, Lee MP, Landon JE, Lindeman KG, Kim SC. Fracture risk after bariatric surgery: Roux-en-Y gastric bypass versus adjustable gastric banding. *J Bone Miner Res.* 2017;32:1229-1236.[EL 2; RCCS]
  49. Rousseau C, Jean S, Gamache P, et al. Change in fracture risk and fracture pattern after bariatric surgery: nested case-control study. *BMJ.* 2016;354:i3794.[EL 2; NCCS]
  50. Courcoulas AP, Christian NJ, Belle SH, et al. Weight change and health outcomes at 3 years after bariatric surgery among individuals with severe obesity. *JAMA.* 2013;310:2416-2425.[EL 2; PCS]
  51. Mitchell JE, Christian NJ, Flum DR, et al. Postoperative behavioral variables and weight change 3 years after bariatric surgery. *JAMA Surg.* 2016;151:752-757.[EL 2; PCS]
  52. King WC, Chen JY, Courcoulas AP, et al. Alcohol and other substance use after bariatric surgery: prospective evidence from a U.S. multicenter cohort study. *Surg Obes Relat Dis.* 2017;13:1392-1402.[EL 2; PCS]
  53. Kushner R, Brittan D, Cleek J, et al. The American Board of Obesity Medicine: five-year report. *Obesity (Silver Spring).* 2017;25:982-984.[EL 4; NE]
  54. Mechanick JI, Kushner RF, Sugerman HJ, et al. American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery medical guidelines for clinical practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. *Endocr Pract.* 2008;14(suppl 1):1-83.[EL 4; NE]
  55. Mechanick JI, Pessah-Pollack R, Camacho P, et al. American Association of Clinical Endocrinologists and American College of Endocrinology protocol for standardized production of clinical practice guidelines, algorithms, and checklists -- 2017 Update. *Endocr Pract.* 2017;23:1006-1021.[EL 4; NE]
  56. Calle EE, Thun MJ, Petrelli JM, Rodriguez C, Heath CW, Jr. Body-mass index and mortality in a prospective cohort of U.S. adults. *N Engl J Med.* 1999;341:1097-1105.[EL 2; RCCS]
  57. Kitahara CM, Flint AJ, Berrington de Gonzalez A, et al. Association between class III obesity (BMI of 40-59 kg/m<sup>2</sup>) and mortality: a pooled analysis of 20 prospective studies. *PLoS Med.* 2014;11:e1001673.[EL 2; MNRCT]
  58. Sjöström L, Narbro K, Sjöström CD, et al. Effects of bariatric surgery on mortality in Swedish obese subjects. *N Engl J Med.* 2007;357:741-752.[EL 2; PCS]
  59. Adams TD, Gress RE, Smith SC, et al. Long-term mortality after gastric bypass surgery. *N Engl J Med.* 2007;357:753-761.[EL 2; RCCS]
  60. Flum DR, Dellinger EP. Impact of gastric bypass operation on survival: a population-based analysis. *J Am Coll Surg.* 2004;199:543-551.[EL 2; RCCS]
  61. Maciejewski ML, Livingston EH, Smith VA, et al. Survival among high-risk patients after bariatric surgery. *JAMA.* 2011;305:2419-2426.[EL 2; RCCS]
  62. Pontiroli AE, Morabito A. Long-term prevention of mortality in morbid obesity through bariatric surgery: a systematic review and meta-analysis of trials performed with gastric banding and gastric bypass. *Ann Surg.* 2011;253:484-487.[EL 2; MNRCT]
  63. Buchwald H, Rudser KD, Williams SE, Michalek VN, Vagasky J, Connert JE. Overall mortality, incremental life expectancy, and cause of death at 25 years in the program on the surgical control of the hyperlipidemias. *Ann Surg.* 2010;251:1034-1040.[EL 2; PCS]
  64. Hofso D, Nordstrand N, Johnson LK, et al. Obesity-related cardiovascular risk factors after weight loss: a clinical trial comparing gastric bypass surgery and intensive lifestyle intervention. *Eur J Endocrinol.* 2010;163:735-745.[EL 2; NRCT]
  65. Sjöström L, Gummesson A, Sjöström CD et al. Effects of bariatric surgery on cancer incidence in obese patients in Sweden (Swedish Obese Subjects Study): a prospective, controlled intervention trial. *Lancet Oncol.* 2009;10:653-662.[EL 2; PCS]
  66. Adams TD, Stroup AM, Gress RE, et al. Cancer incidence and mortality after gastric bypass surgery. *Obesity (Silver Spring).* 2009;17:796-802.[EL 2; RCCS]
  67. Christou NV, Lieberman M, Sampalis F, Sampalis JS. Bariatric surgery reduces cancer risk in morbidly obese patients. *Surg Obes Relat Dis.* 2008;4:691-695.[EL 2; PCS]
  68. Padwal R, Klarenbach S, Wiebe N, et al. Bariatric surgery: a systematic review and network meta-analysis of randomized trials. *Obes Rev.* 2011;12:602-621.[EL 1; MRCT]
  69. Garb J, Welch G, Zagarins S, Kuhn J, Romanelli J. Bariatric surgery for the treatment of morbid obesity: a meta-analysis of weight loss outcomes for laparoscopic adjustable gastric banding and laparoscopic gastric bypass. *Obes Surg.* 2009;19:1447-1455.[EL 2; MNRCT]
  70. Valezi AC, Mali Junior J, de Menezes MA, de Brito EM, de Souza SA. Weight loss outcome after silastic ring Roux-en-Y gastric bypass: 8 years of follow-up. *Obes Surg.* 2010;20:1491-1495.[EL 2; PCS]
  71. Toouli J, Kow L, Ramos AC, et al. International multicenter study of safety and effectiveness of Swedish Adjustable Gastric Band in 1-, 3-, and 5-year follow-up cohorts. *Surg Obes Relat Dis.* 2009;5:598-609.[EL 2; PCS]
  72. Carlsson LM, Peltonen M, Ahlin S, et al. Bariatric surgery and prevention of type 2 diabetes in Swedish obese subjects. *N Engl J Med.* 2012;367:695-704.[EL 2; RCCS]
  73. Booth H, Khan O, Prevost T, et al. Incidence of type 2 diabetes after bariatric surgery: population-based matched cohort study. *Lancet Diabetes Endocrinol.* 2014;2:963-968.[EL 2; RCCS]
  74. Hofso D, Jenssen T, Bollerslev J, et al. Beta cell function after weight loss: a clinical trial comparing gastric bypass surgery and intensive lifestyle intervention. *Eur J Endocrinol.* 2011;164:231-238.[EL 1; RCT]
  75. Lumachi F, Marzano B, Fanti G, Basso SM, Mazza F, Chiara GB. Hypoxemia and hypoventilation syndrome improvement after laparoscopic bariatric surgery in patients with morbid obesity. *In vivo.* 2010;24:329-331.[EL 2; PCS]
  76. Tarride JE, Breau R, Sharma AM, et al. The effect of bariatric surgery on mobility, health-related quality of life, health-care resource utilization, and employment status. *Obes Surg.* 2017;27:349-356.[EL 2; PCS]
  77. Ryder JR, Edwards NM, Gupta R, et al. Changes in functional mobility and musculoskeletal pain after bariatric surgery in teens

- with severe obesity: teen-longitudinal assessment of bariatric surgery (LABS) study. *JAMA Pediatr.* 2016;170:871-877.[EL 2; PCS]
78. Vincent HK, Ben-David K, Conrad BP, Lamb KM, Seay AN, Vincent KR. Rapid changes in gait, musculoskeletal pain, and quality of life after bariatric surgery. *Surg Obes Relat Dis.* 2012;8:346-354.[EL 2; PCS]
  79. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardio-metabolic risk factors: systematic review and meta-analysis. *Obes Rev.* 2012;13:275-286.[EL 2; MNRCT]
  80. Pories WJ, Dohm LG, Mansfield CJ. Beyond the BMI: the search for better guidelines for bariatric surgery. *Obesity (Silver Spring).* 2010;18:865-871.[EL 4; NE]
  81. Hsu WC, Araneta MR, Kanaya AM, Chiang JL, Fujimoto W. BMI cut points to identify at-risk Asian Americans for type 2 diabetes screening. *Diabetes Care.* 2015;38:150-158.[EL 4; NE]
  82. Zhou BF. Effect of body mass index on all-cause mortality and incidence of cardiovascular diseases--report for meta-analysis of prospective studies open optimal cut-off points of body mass index in Chinese adults. *Biomed Environ Sci.* 2002;15:245-252.[EL 2; MNRCT]
  83. De Lorenzo A, Bianchi A, Maroni P, et al. Adiposity rather than BMI determines metabolic risk. *Int J Cardiol.* 2013;166:111-117.[EL 2; PCS]
  84. Guo F, Moellering DR, Garvey WT. The progression of cardio-metabolic disease: validation of a new cardiometabolic disease staging system applicable to obesity. *Obesity (Silver Spring).* 2014;22:110-118.[EL 2; CSS]
  85. Katzmarzyk PT, Bray GA, Greenway FL, et al. Ethnic-specific BMI and waist circumference thresholds. *Obesity (Silver Spring).* 2011;19:1272-1278.[EL 2; PCS]
  86. Flum DR, Belle SH, King WC, et al. Perioperative safety in the longitudinal assessment of bariatric surgery. *N Engl J Med.* 2009;361:445-454.[EL 2; PCS]
  87. Nguyen NT, Masoomi H, Laugenour K, et al. Predictive factors of mortality in bariatric surgery: data from the Nationwide Inpatient Sample. *Surgery.* 2011;150:347-351.[EL 3; DS]
  88. Schauer PR, Kashyap SR, Wolski K, et al. Bariatric surgery versus intensive medical therapy in obese patients with diabetes. *N Engl J Med.* 2012;366:1567-1576.[EL 1; RCT]
  89. Mingrone G, Panunzi S, De Gaetano A, et al. Bariatric surgery versus conventional medical therapy for type 2 diabetes. *N Engl J Med.* 2012;366:1577-1585.[EL 1; RCT]
  90. Serrot FJ, Dorman RB, Miller CJ, et al. Comparative effectiveness of bariatric surgery and nonsurgical therapy in adults with type 2 diabetes mellitus and body mass index <35 kg/m2. *Surgery.* 2011;150:684-691.[EL 2; PCS]
  91. Wentworth JM, Hensman T, Playfair J, et al. Laparoscopic adjustable gastric banding and progression from impaired fasting glucose to diabetes. *Diabetologia.* 2014;57:463-468.[EL 2; RCCS]
  92. Sjöholm K, Anveden A, Peltonen M, et al. Evaluation of current eligibility criteria for bariatric surgery: diabetes prevention and risk factor changes in the Swedish obese subjects (SOS) study. *Diabetes Care.* 2013;36:1335-1340.[EL 2; PCS]
  93. Magliano DJ, Barr EL, Zimmet PZ, et al. Glucose indices, health behaviors, and incidence of diabetes in Australia: the Australian Diabetes, Obesity and Lifestyle Study. *Diabetes Care.* 2008;31:267-272.[EL 2; PCS]
  94. Sjöström L, Peltonen M, Jacobson P, et al. Bariatric surgery and long-term cardiovascular events. *JAMA.* 2012;307:56-65.[EL 2; NRCT]
  95. Nordstrand N, Hertel JK, Hofso D, et al. A controlled clinical trial of the effect of gastric bypass surgery and intensive lifestyle intervention on nocturnal hypertension and the circadian blood pressure rhythm in patients with morbid obesity. *Surgery.* 2012;151:674-680.[EL 2; NRCT]
  96. Pontiroli AE, Folli F, Paganelli M, et al. Laparoscopic gastric banding prevents type 2 diabetes and arterial hypertension and induces their remission in morbid obesity: a 4-year case-controlled study. *Diabetes Care.* 2005;28:2703-2709.[EL 2; NCCS]
  97. Wilhelm SM, Young J, Kale-Pradhan PB. Effect of bariatric surgery on hypertension: a meta-analysis. *Ann Pharmacother.* 2014;48:674-682.[EL 2; MNRCT]
  98. Liu X, Lazenby AJ, Clements RH, Jhala N, Abrams GA. Resolution of nonalcoholic steatohepatitis after gastric bypass surgery. *Obes Surg.* 2007;17:486-492.[EL 2; PCS]
  99. Barker KB, Palekar NA, Bowers SP, Goldberg JE, Pulcini JP, Harrison SA. Non-alcoholic steatohepatitis: effect of Roux-en-Y gastric bypass surgery. *Am J Gastroenterol.* 2006;101:368-373.[EL 2; PCS]
  100. Mummadi RR, Kasturi KS, Chennareddygar S, Sood GK. Effect of bariatric surgery on nonalcoholic fatty liver disease: systematic review and meta-analysis. *Clin Gastroenterol Hepatol.* 2008;6:1396-1402.[EL 2; MNRCT]
  101. Kalinowski P, Paluszkiwicz R, Ziarkiewicz-Wróblewska B, et al. Liver function in patients with nonalcoholic fatty liver disease randomized to Roux-en-Y gastric bypass versus sleeve gastrectomy: a secondary analysis of a randomized clinical trial. *Ann Surg.* 2017;266:738-745.[EL 2; PHAS]
  102. Klebanoff MJ, Corey KE, Chhatwal J, Kaplan LM, Chung RT, Hur C. Bariatric surgery for nonalcoholic steatohepatitis: a clinical and cost-effectiveness analysis. *Hepatology.* 2017;65:1156-1164.[EL 3; DS]
  103. Praveen Raj P, Gomes RM, Kumar S, et al. The effect of surgically induced weight loss on nonalcoholic fatty liver disease in morbidly obese Indians: "NASHOST" prospective observational trial. *Surg Obes Relat Dis.* 2015;11:1315-1322.[EL 2; PCS]
  104. Burza MA, Romeo S, Kotronen A, et al. Long-term effect of bariatric surgery on liver enzymes in the Swedish Obese Subjects (SOS) study. *PLoS One.* 2013;8:e60495.[EL 2; PCS]
  105. Haines KL, Nelson LG, Gonzalez R, et al. Objective evidence that bariatric surgery improves obesity-related obstructive sleep apnea. *Surgery.* 2007;141:354-358.[EL 2; PCS]
  106. Zou J, Zhang P, Yu H, et al. Effect of laparoscopic Roux-en-Y gastric bypass surgery on obstructive sleep apnea in a Chinese population with obesity and T2DM. *Obes Surg.* 2015;25:1446-1453.[EL 2; PCS]
  107. Tuomilehto H, Seppä J, Uusitupa M. Obesity and obstructive sleep apnea--clinical significance of weight loss. *Sleep Med Rev.* 2013;17:321-329.[EL 4; NE]
  108. Fusco M, James S, Cornell C, Okerson T. Weight loss through adjustable gastric banding and improvement in daytime sleepiness: 2 year interim results of APEX study. *Curr Med Res Opin.* 2014;30:849-855.[EL 2; PCS]
  109. Sareli AE, Cantor CR, Williams NN, et al. Obstructive sleep apnea in patients undergoing bariatric surgery--a tertiary center experience. *Obes Surg.* 2011;21:316-327.[EL 2; PCS]
  110. Woodman G, Cywes R, Billy H, Montgomery K, Cornell C, Okerson T. Effect of adjustable gastric banding on changes in gastroesophageal reflux disease (GERD) and quality of life. *Curr Med Res Opin.* 2012;28:581-589.[EL 2; PCS]
  111. Hooper MM, Stellato TA, Hallowell PT, Seitz BA, Moskowitz RW. Musculoskeletal findings in obese subjects before and after weight loss following bariatric surgery. *Int J Obes (Lond).* 2007;31:114-120.[EL 2; PCS]
  112. Peltonen M, Lindroos AK, Torgerson JS. Musculoskeletal pain in the obese: a comparison with a general population and long-term changes after conventional and surgical obesity treatment. *Pain.* 2003;104:549-557.[EL 2; RCCS]
  113. Groen VA, van de Graaf VA, Scholtes VA, Sprague S, van Wagenveld BA, Poolman RW. Effects of bariatric surgery for knee complaints in (morbidly) obese adult patients: a systematic review. *Obes Rev.* 2015;16:161-170.[EL 2; MNRCT]
  114. Amin AK, Clayton RA, Patton JT, Gaston M, Cook RE, Brenkel IJ. Total knee replacement in morbidly obese patients. Results of a prospective, matched study. *J Bone Joint Surg Br.* 2006;88:1321-1326.[EL 2; PCS]
  115. Vazquez-Vela Johnson G, Worland RL, Keenan J, Norambuena N. Patient demographics as a predictor of the ten-year survival rate in primary total knee replacement. *J Bone Joint Surg Br.* 2003;85:52-56.[EL 2; PCS]
  116. Foran JR, Mont MA, Etienne G, Jones LC, Hungerford DS. The outcome of total knee arthroplasty in obese patients. *J Bone Joint Surg Am.* 2004;86:1609-1615.[EL 2; RCCS]
  117. Krushell RJ, Fingerroth RJ. Primary total knee arthroplasty in morbidly obese patients: a 5- to 14-year follow-up study. *J Arthroplasty.* 2007;22(6 suppl 2):77-80.[EL 2; RCCS]



118. **Winiarsky R, Barth P, Lotke P.** Total knee arthroplasty in morbidly obese patients. *J Bone Joint Surg Am.* 1998;80:1770-1774.[EL 2; RCCS]
119. **Rajgopal V, Bourne RB, Chesworth BM, MacDonald SJ, McCalden RW, Rorabeck CH.** The impact of morbid obesity on patient outcomes after total knee arthroplasty. *J Arthroplasty.* 2008;23:795-800.[EL 2; RCCS]
120. **Burgio KL, Richter HE, Clements RH, Redden DT, Goode PS.** Changes in urinary and fecal incontinence symptoms with weight loss surgery in morbidly obese women. *Obstet Gynecol.* 2007;110:1034-1040.[EL 2; PCS]
121. **Sugerman H, Windsor A, Bessos M, Kellum J, Reines H, DeMaria E.** Effects of surgically induced weight loss on urinary bladder pressure, sagittal abdominal diameter and obesity co-morbidity. *Int J Obes Relat Metab Dis.* 1998;22:230-235.[EL 2; PCS]
122. **Kuruba R, Almahmeed T, Martinez F, et al.** Bariatric surgery improves urinary incontinence in morbidly obese individuals. *Surg Obes Relat Dis.* 2007;3:586-590; discussion 590-591.[EL 2; PCS]
123. **Hunskaar S.** A systematic review of overweight and obesity as risk factors and targets for clinical intervention for urinary incontinence in women. *Neurourol Urodyn.* 2008;27:749-757.[EL 2; MNRCT]
124. **Sugerman HJ, Fairman RP, Baron PL, Kwentus JA.** Gastric surgery for respiratory insufficiency of obesity. *Chest.* 1986;90:81-86.[EL 2; PCS]
125. **Sugerman HJ, Fairman RP, Sood RK, Engle K, Wolfe L, Kellum JM.** Long-term effects of gastric surgery for treating respiratory insufficiency of obesity. *Am J Clin Nutr.* 1992;55(2 suppl):597S-601S.[EL 2; PCS]
126. **Sugerman HJ, Felton WL, 3rd, Sismanis A, Kellum JM, DeMaria EJ, Sugerman EL.** Gastric surgery for pseudotumor cerebri associated with severe obesity. *Ann Surg.* 1999;229:634-640; discussion 640-642.[EL 2; PCS]
127. **Hoang KB, Hooten KG, Muh CR.** Shunt freedom and clinical resolution of idiopathic intracranial hypertension after bariatric surgery in the pediatric population: report of 3 cases. *J Neurosurg Pediatr.* 2017;20:511-516.[EL 3; CCS]
128. **Manfield JH, Yu KK, Efthimiou E, Darzi A, Athanasiou T, Ashrafian H.** Bariatric surgery or non-surgical weight loss for idiopathic intracranial hypertension? A systematic review and comparison of meta-analyses. *Obes Surg.* 2017;27:513-521.[EL 2; MNRCT]
129. **Handley JD, Baruah BP, Williams DM, Horner M, Barry J, Stephens JW.** Bariatric surgery as a treatment for idiopathic intracranial hypertension: a systematic review. *Surg Obes Relat Dis.* 2015;11:1396-1403.[EL 2; MNRCT]
130. **Egan RJ, Meredith HE, Coulston JE, Bennetto L, Morgan JD, Norton SA.** The effects of laparoscopic adjustable gastric banding on idiopathic intracranial hypertension. *Obes Surg.* 2011;21:161-166.[EL 2; PCS]
131. **Madalosso CA, Gurski RR, Callegari-Jacques SM, Navarini D, Thiesen V, Fornari F.** The impact of gastric bypass on gastroesophageal reflux disease in patients with morbid obesity: a prospective study based on the Montreal Consensus. *Ann Surg.* 2010;251:244-248.[EL 2; PCS]
132. **Tai CM, Lee YC, Wu MS, et al.** The effect of Roux-en-Y gastric bypass on gastroesophageal reflux disease in morbidly obese Chinese patients. *Obes Surg.* 2009;19:565-570.[EL 1; RCT]
133. **Mejía-Rivas MA, Herrera-López A, Hernández-Calleros J, Herrera MF, Valdovinos MA.** Gastroesophageal reflux disease in morbid obesity: the effect of Roux-en-Y gastric bypass. *Obes Surg.* 2008;18:1217-1224.[EL 2; PCS]
134. **Nelson LG, Gonzalez R, Haines K, Gallagher SF, Murr MM.** Amelioration of gastroesophageal reflux symptoms following Roux-en-Y gastric bypass for clinically significant obesity. *Am Surg.* 2005;71:950-953; discussion 953-954.[EL 2; PCS]
135. **Pallati PK, Shaligram A, Shostrom VK, Oleynikov D, McBride CL, Goede MR.** Improvement in gastroesophageal reflux disease symptoms after various bariatric procedures: review of the Bariatric Outcomes Longitudinal Database. *Surg Obes Relat Dis.* 2014;10:502-507.[EL 2; PCS]
136. **Frezza EE, Ikramuddin S, Gourash W, et al.** Symptomatic improvement in gastroesophageal reflux disease (GERD) following laparoscopic Roux-en-Y gastric bypass. *Surg Endosc.* 2002;16:1027-1031.[EL 2; PCS]
137. **Jamal MK, DeMaria EJ, Johnson JM, et al.** Impact of major co-morbidities on mortality and complications after gastric bypass. *Surg Obes Relat Dis.* 2005;1:511-516.[EL 2; PCS]
138. **Lara MD, Kothari SN, Sugerman HJ.** Surgical management of obesity: a review of the evidence relating to the health benefits and risks. *Treat Endocrinol.* 2005;4:55-64.[EL 4; NE]
139. **Tarride JE, Breau R, Sharma AM, et al.** Erratum to: The effect of bariatric surgery on mobility, health-related quality of life, healthcare resource utilization, and employment Status. *Obes Surg.* 2017;27:1128.[EL 2; ES]
140. **Simonson DC, Halperin F, Foster K, Vernon A, Goldfine AB.** Clinical and patient-centered outcomes in obese patients with type 2 diabetes 3 years after randomization to Roux-en-Y gastric bypass surgery versus intensive lifestyle management: the SLIMM-T2D Study. *Diabetes Care.* 2018;41:670-679.[EL 1; RCT]
141. **Schauer PR, Bhatt DL, Kirwan JP, et al.** Bariatric surgery versus intensive medical therapy for diabetes--3-year outcomes. *N Engl J Med.* 2014;370:2002-2013.[EL 1; RCT]
142. **Adams TD, Davidson LE, Litwin SE, Hunt SC.** Gastrointestinal surgery: cardiovascular risk reduction and improved long-term survival in patients with obesity and diabetes. *Curr Atheroscler Rep.* 2012;14:606-615.[EL 4; NE]
143. **Heneghan HM, Nissen S, Schauer PR.** Gastrointestinal surgery for obesity and diabetes: weight loss and control of hyperglycemia. *Curr Atheroscler Rep.* 2012;14:579-587.[EL 4; NE]
144. **Ikramuddin S, Korner J, Lee WJ, et al.** Roux-en-Y gastric bypass vs intensive medical management for the control of type 2 diabetes, hypertension, and hyperlipidemia: the Diabetes Surgery Study randomized clinical trial. *JAMA.* 2013;309:2240-2249.[EL 1; RCT]
145. **Liang Z, Wu Q, Chen B, Yu P, Zhao H, Ouyang X.** Effect of laparoscopic Roux-en-Y gastric bypass surgery on type 2 diabetes mellitus with hypertension: a randomized controlled trial. *Diabetes Res Clin Pract.* 2013;101:50-56.[EL 1; RCT]
146. **Courcoulas AP, Goodpaster BH, Eagleton JK, et al.** Surgical vs medical treatments for type 2 diabetes mellitus: a randomized clinical trial. *JAMA Surg.* 2014;149:707-715.[EL 1; RCT]
147. **Ribaric G, Buchwald JN, McGlennon TW.** Diabetes and weight in comparative studies of bariatric surgery vs conventional medical therapy: a systematic review and meta-analysis. *Obes Surg.* 2014;24:437-455.[EL 2; MNRCT]
148. **Buchwald H, Estok R, Fahrbach K, et al.** Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis. *Am J Med.* 2009;122:248-256.e5.[EL 2; MNRCT]
149. **Yu J, Zhou X, Li L, et al.** The long-term effects of bariatric surgery for type 2 diabetes: systematic review and meta-analysis of randomized and non-randomized evidence. *Obes Surg.* 2015;25:143-158.[EL 2; MNRCT]
150. **Gill RS, Birch DW, Shi X, Sharma AM, Karmali S.** Sleeve gastrectomy and type 2 diabetes mellitus: a systematic review. *Surg Obes Relat Dis.* 2010;6:707-713.[EL 2; MNRCT]
151. **Li P, Fu P, Chen J, Wang LH, Wang DR.** Laparoscopic Roux-en-Y gastric bypass vs. laparoscopic sleeve gastrectomy for morbid obesity and diabetes mellitus: a meta-analysis of sixteen recent studies. *Hepatogastroenterology.* 2013;60:132-137.[EL 2; MNRCT]
152. **Cho JM, Kim HJ, Lo Menzo E, Park S, Szomstein S, Rosenthal RJ.** Effect of sleeve gastrectomy on type 2 diabetes as an alternative treatment modality to Roux-en-Y gastric bypass: systemic review and meta-analysis. *Surg Obes Relat Dis.* 2015;11:1273-1280.[EL 2; MNRCT]
153. **Yip S, Plank LD, Murphy R.** Gastric bypass and sleeve gastrectomy for type 2 diabetes: a systematic review and meta-analysis of outcomes. *Obes Surg.* 2013;23:1994-2003.[EL 2; MNRCT]
154. **Peterli R, Wölnerhanssen BK, Peters T, et al.** Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss in patients with morbid obesity: the SM-BOSS randomized clinical trial. *JAMA.* 2018;319:255-265.[EL 1; RCT]
155. **Reges O, Greenland P, Dicker D, et al.** Association of bariatric surgery using laparoscopic banding, Roux-en-Y gastric bypass, or laparoscopic sleeve gastrectomy vs usual care obesity manage-

- ment with all-cause mortality. *JAMA*. 2018;319:279-290.[EL 2; RCCS]
156. **Salminen P, Helmiö M, Ovaska J, et al.** Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss at 5 years among patients with morbid obesity: the SLEEVEPASS randomized clinical trial. *JAMA*. 2018;319:241-254.[EL 1; RCT]
  157. **Yan YX, Wang GF, Xu N, Wang FL.** Correlation between post-operative weight loss and diabetes mellitus remission: a meta-analysis. *Obes Surg*. 2014;24:1862-1869.[EL 2; MNRCT]
  158. **Chen JC, Hsu NY, Lee WJ, Chen SC, Ser KH, Lee YC.** Prediction of type 2 diabetes remission after metabolic surgery: a comparison of the individualized metabolic surgery score and the ABCD score. *Surg Obes Relat Dis*. 2018;14:640-645.[EL 2; RCCS]
  159. **Coelho D, de Godoy EP, Marreiros I, et al.** Diabetes remission rate in different BMI grades following Roux-en-Y gastric bypass [in English, Portuguese]. *Arq Bras Cir Dig*. 2018;31:e1343.[EL 2; PCS]
  160. **Ikramuddin S, Korner J, Lee WJ, et al.** Lifestyle intervention and medical management with vs without Roux-en-Y gastric bypass and control of hemoglobin A1c, LDL cholesterol, and systolic blood pressure at 5 years in the Diabetes Surgery Study. *JAMA*. 2018;319:266-278.[EL 1; RCT]
  161. **Jakobsen GS, Smastuen MC, Sandbu R, et al.** Association of bariatric surgery vs medical obesity treatment with long-term medical complications and obesity-related comorbidities. *JAMA*. 2018;319:291-301.[EL 2; PCS]
  162. **Hamman RF, Wing RR, Edelstein SL, et al.** Effect of weight loss with lifestyle intervention on risk of diabetes. *Diabetes Care*. 2006;29:2102-2107.[EL 2; PCS]
  163. **Garvey WT, Ryan DH, Henry R, et al.** Prevention of type 2 diabetes in subjects with prediabetes and metabolic syndrome treated with phentermine and topiramate extended release. *Diabetes Care*. 2014;37:912-921.[EL 1; RCT]
  164. **le Roux CW, Astrup A, Fujioka K, et al.** 3 years of liraglutide versus placebo for type 2 diabetes risk reduction and weight management in individuals with prediabetes: a randomised, double-blind trial. *Lancet*. 2017;389:1399-1409.[EL 1; RCT]
  165. **Lemanu DP, Singh PP, Rahman H, Hill AG, Babor R, MacCormick AD.** Five-year results after laparoscopic sleeve gastrectomy: a prospective study. *Surg Obes Relat Dis*. 2015;11:518-524.[EL 2; PCS]
  166. **Marceau P, Biron S, Marceau S, et al.** Long-term metabolic outcomes 5 to 20 years after biliopancreatic diversion. *Obes Surg*. 2015;25:1584-1593.[EL 2; RCCS]
  167. **Young MT, Gebhart A, Khalaf R, et al.** One-year outcomes of laparoscopic sleeve gastrectomy versus laparoscopic adjustable gastric banding for the treatment of morbid obesity. *Am Surg*. 2014;80:1049-1053.[EL 2; RCCS]
  168. **Benaiges D, Sagué M, Flores-Le Roux JA, et al.** Predictors of hypertension remission and recurrence after bariatric surgery. *Am J Hypertens*. 2016;29:653-659.[EL 2; PCS]
  169. **de Barros F, Setúbal S, Martinho JM, Monteiro AB.** Early endocrine and metabolic changes after bariatric surgery in grade III morbidly obese patients: a randomized clinical trial comparing sleeve gastrectomy and gastric bypass. *Metab Syndr Relat Disord*. 2015;13:264-271.[EL 2; PCS]
  170. **Huang CK, Garg A, Kuao HC, Chang PC, Hsin MC.** Bariatric surgery in old age: a comparative study of laparoscopic Roux-en-Y gastric bypass and sleeve gastrectomy in an Asia centre of excellence. *J Biomed Res*. 2015;29:118-124.[EL 2; RCCS]
  171. **Abbas M, Cumella L, Zhang Y, et al.** Outcomes of laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass in patients older than 60. *Obes Surg*. 2015;25:2251-2256.[EL 2; RCCS]
  172. **Pequignot A, Prevot F, Dhahri A, Rebibo L, Badaoui R, Regimbeau JM.** Is sleeve gastrectomy still contraindicated for patients aged  $\geq 60$  years? A case-matched study with 24 months of follow-up. *Surg Obes Relat Dis*. 2015;11:1008-1013.[EL 2; PCS]
  173. **Dixon JB, O'Brien PE, Playfair J, et al.** Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial. *JAMA*. 2008;299:316-323.[EL 1; RCT]
  174. **Søvik TT, Aasheim ET, Taha O, et al.** Weight loss, cardiovascular risk factors, and quality of life after gastric bypass and duodenal switch: a randomized trial. *Ann Intern Med*. 2011;155:281-291.[EL 1; RCT]
  175. **Puzziferri N, Roshek TB 3rd, Mayo HG, Gallagher R, Belle SH, Livingston EH.** Long-term follow-up after bariatric surgery: a systematic review. *JAMA*. 2014;312:934-942.[EL 2; MNRCT]
  176. **Thereaux J, Czernichow S, Corigliano N, Poitou C, Oppert JM, Bouillot JL.** Five-year outcomes of gastric bypass for super-obesity (BMI  $\geq 60$  kg/m<sup>2</sup>): a case matched study. *Surg Obes Relat Dis*. 2015;11:32-37.[EL 2; RCCS]
  177. **Sudan R, Jain-Spangler K.** Tailoring bariatric surgery: sleeve gastrectomy, Roux-en-Y gastric bypass and biliopancreatic diversion with duodenal switch. *J Laparoendosc Adv Surg Tech A*. 2018;28:956-961.[EL 2; ES]
  178. **Golomb I, Ben DM, Glass A, Kolitz T, Keidar A.** Long-term metabolic effects of laparoscopic sleeve gastrectomy. *JAMA Surg*. 2015;150:1051-1057.[EL 2; PCS]
  179. **Hussain A.** The effect of metabolic surgery on type 1 diabetes: meta-analysis. *Arch Endocrinol Metab*. 2018;62:172-178.[EL 2; MNRCT]
  180. **De Ridder RJ, Schoon EJ, Smulders JF, van Hout GC, Stockbrügger RW, Koek GH.** Review article: Non-alcoholic fatty liver disease in morbidly obese patients and the effect of bariatric surgery. *Aliment Pharmacol Ther*. 2007;26(suppl 2):195-201.[EL 4; NE]
  181. **Caiazzo R, Lassailly G, Leteurtre E, et al.** Roux-en-Y gastric bypass versus adjustable gastric banding to reduce nonalcoholic fatty liver disease: a 5-year controlled longitudinal study. *Ann Surg*. 2014;260:893-898; discussion 898-899.[EL 2; RCCS]
  182. **Lassailly G, Caiazzo R, Buob D, et al.** Bariatric surgery reduces features of nonalcoholic steatohepatitis in morbidly obese patients. *Gastroenterology*. 2015;149:379-388; quiz e315-376.[EL 2; PCS]
  183. **Dixon JB, Schachter LM, O'Brien PE, et al.** Surgical vs conventional therapy for weight loss treatment of obstructive sleep apnea: a randomized controlled trial. *JAMA*. 2012;308:1142-1149.[EL 1; RCT]
  184. **Hariri K, Kini SU, Herron DM, Fernandez-Ranvier G.** Resolution of symptomatic obstructive sleep apnea not impacted by preoperative body mass index, choice of operation between sleeve gastrectomy and Roux-en-Y gastric bypass surgery, or severity. *Obes Surg*. 2018;28:1402-1407.[EL 2; RCCS]
  185. **Abu-Abeid S, Wishnitzer N, Szold A, Liebergall M, Manor O.** The influence of surgically-induced weight loss on the knee joint. *Obes Surg*. 2005;15:1437-1442.[EL 2; PCS]
  186. **Gill RS, Al-Adra DP, Shi X, Sharma AM, Birch DW, Karmali S.** The benefits of bariatric surgery in obese patients with hip and knee osteoarthritis: a systematic review. *Obes Rev*. 2011;12:1083-1089.[EL 2; MNRCT]
  187. **Fehring TK, Odum SM, Griffin WL, Mason JB, McCoy TH.** The obesity epidemic: its effect on total joint arthroplasty. *J Arthroplasty*. 2007;22(6 suppl 2):71-76.[EL 2; RCCS]
  188. **Spicer DD, Pomeroy DL, Badenhausen WE, et al.** Body mass index as a predictor of outcome in total knee replacement. *Int Orthop*. 2001;25:246-249.[EL 2; RCCS]
  189. **Samson AJ, Mercer GE, Campbell DG.** Total knee replacement in the morbidly obese: a literature review. *ANZ J Surg*. 2010;80:595-599.[EL 2; PCS]
  190. **Kuipers BM, Kollen BJ, Bots PC, et al.** Factors associated with reduced early survival in the Oxford phase III medial unicompartment knee replacement. *Knee*. 2010;17:48-52.[EL 2; PCS]
  191. **Santaguida PL, Hawker GA, Hudak PL, et al.** Patient characteristics affecting the prognosis of total hip and knee joint arthroplasty: a systematic review. *Can J Surg*. 2008;51:428-436.[EL 2; MNRCT]
  192. **Wagner ER, Kamath AF, Fruth K, Harmsen WS, Berry DJ.** Effect of body mass index on reoperation and complications after total knee arthroplasty. *J Bone Joint Surg Am*. 2016;98:2052-2060.[EL 2; ES]
  193. **Baker P, Petheram T, Jameson S, Reed M, Gregg P, Deehan D.** The association between body mass index and the outcomes of total knee arthroplasty. *J Bone Joint Surg Am*. 2012;94:1501-1508.[EL 2; ES]

194. **Bump RC, Sugerman HJ, Fantl JA, McClish DK.** Obesity and lower urinary tract function in women: effect of surgically induced weight loss. *Am J Obstet Gynecol.* 1992;167:392-397; discussion 397-399.[EL 2; PCS]
195. **Ahroni JH, Montgomery KF, Watkins BM.** Laparoscopic adjustable gastric banding: weight loss, co-morbidities, medication usage and quality of life at one year. *Obes Surg.* 2005;15:641-647.[EL 2; RCCS]
196. **Sugerman HJ, Sugerman EL, DeMaria EJ, et al.** Bariatric surgery for severely obese adolescents. *J Gastrointest Surg.* 2003;7:102-108.[EL 2; RCCS]
197. **Parikh M, Duncombe J, Fielding GA.** Laparoscopic adjustable gastric banding for patients with body mass index of  $<$  or  $=$  35 kg/m<sup>2</sup>. *Surg Obes Relat Dis.* 2006;2:518-522.[EL 2; PCS]
198. **Choi J, Digiorgi M, Milone L, et al.** Outcomes of laparoscopic adjustable gastric banding in patients with low body mass index. *Surg Obes Relat Dis.* 2010;6:367-371.[EL 2; RCCS]
199. **Lee WJ, Chong K, Chen CY, et al.** Diabetes remission and insulin secretion after gastric bypass in patients with body mass index  $<$ 35 kg/m<sup>2</sup>. *Obes Surg.* 2011;21:889-895.[EL 2; RCCS]
200. **Demaria EJ, Winegar DA, Pate VW, Hutcher NE, Ponce J, Pories WJ.** Early postoperative outcomes of metabolic surgery to treat diabetes from sites participating in the ASMBS bariatric surgery center of excellence program as reported in the Bariatric Outcomes Longitudinal Database. *Ann Surg.* 2010;252:559-566; discussion 567.[EL 2; RCCS]
201. **Lee WJ, Ser KH, Chong K, et al.** Laparoscopic sleeve gastrectomy for diabetes treatment in nonmorbidly obese patients: efficacy and change of insulin secretion. *Surgery.* 2010;147:664-669.[EL 2; PCS]
202. **Geloneze B, Geloneze SR, Fiori C, et al.** Surgery for nonobese type 2 diabetic patients: an interventional study with duodenal-jejunal exclusion. *Obes Surg.* 2009;19:1077-1083.[EL 2; NRCT]
203. **Ramos AC, Galvão Neto MP, de Souza YM, et al.** Laparoscopic duodenal-jejunal exclusion in the treatment of type 2 diabetes mellitus in patients with BMI  $<$  30 kg/m<sup>2</sup> (LBMI). *Obes Surg.* 2009;19:307-312.[EL 2; PCS]
204. **Li Q, Chen L, Yang Z, et al.** Metabolic effects of bariatric surgery in type 2 diabetic patients with body mass index  $<$  35 kg/m<sup>2</sup>. *Diabetes Obes Metab.* 2012;14:262-270.[EL 2; MNRCT]
205. **Huang CK, Shabbir A, Lo CH, Tai CM, Chen YS, Houng JY.** Laparoscopic Roux-en-Y gastric bypass for the treatment of type II diabetes mellitus in Chinese patients with body mass index of 25-35. *Obes Surg.* 2011;21:1344-1349.[EL 2; PCS]
206. **Shah SS, Todkar JS, Shah PS, Cummings DE.** Diabetes remission and reduced cardiovascular risk after gastric bypass in Asian Indians with body mass index  $<$ 35 kg/m<sup>2</sup>. *Surg Obes Relat Dis.* 2010;6:332-338.[EL 2; PCS]
207. **Chen Y, Zeng G, Tan J, Tang J, Ma J, Rao B.** Impact of Roux-en-Y gastric bypass surgery on prognostic factors of type 2 diabetes mellitus: meta-analysis and systematic review. *Diabetes-Metab Res Rev.* 2015;31:653-662.[EL 2; MNRCT]
208. **Rao WS, Shan CX, Zhang W, Jiang DZ, Qiu M.** A meta-analysis of short-term outcomes of patients with type 2 diabetes mellitus and BMI  $\leq$  35 kg/m<sup>2</sup> undergoing Roux-en-Y gastric bypass. *World J Surg.* 2015;39:223-230.[EL 2; MNRCT]
209. **Fried M, Ribaric G, Buchwald JN, Svacina S, Dolezalova K, Scopinaro N.** Metabolic surgery for the treatment of type 2 diabetes in patients with BMI  $<$ 35 kg/m<sup>2</sup>: an integrative review of early studies. *Obes Surg.* 2010;20:776-790.[EL 2; MNRCT]
210. **Rubino F, Nathan DM, Eckel RH, et al.** Metabolic surgery in the treatment algorithm for type 2 diabetes: a joint statement by international diabetes organizations. *Surg Obes Relat Dis.* 2016;12:1144-1162.[EL 4; NE]
211. **Lee WJ, Chong K, Ser KH, et al.** Gastric bypass vs sleeve gastrectomy for type 2 diabetes mellitus: a randomized controlled trial. *Arch Surg.* 2011;146:143-148.[EL 1; RCT]
212. **Lee WJ, Wang W, Lee YC, Huang MT, Ser KH, Chen JC.** Effect of laparoscopic mini-gastric bypass for type 2 diabetes mellitus: comparison of BMI  $>$  35 and  $<$  35 kg/m<sup>2</sup>. *J Gastrointest Surg.* 2008;12:945-952.[EL 2; PCS]
213. **Cohen RV, Pinheiro JC, Schiavon CA, Salles JE, Wajchenberg BL, Cummings DE.** Effects of gastric bypass surgery in patients with type 2 diabetes and only mild obesity. *Diabetes Care.* 2012;35:1420-1428.[EL 2; PCS]
214. **Purnell JQ, Selzer F, Wahed AS, et al.** Type 2 diabetes remission rates after laparoscopic gastric bypass and gastric banding: results of the longitudinal assessment of bariatric surgery study. *Diabetes Care.* 2016;39:1101-1107.[EL 2; PCS]
215. **Buse JB, Caprio S, Cefalu WT, et al.** How do we define cure of diabetes? *Diabetes Care.* 2009;32:2133-2135.[EL 4; NE]
216. **Panunzi S, Carlsson L, De Gaetano A, et al.** Determinants of diabetes remission and glyceemic control after bariatric surgery. *Diabetes Care.* 2016;39:166-174.[EL 2; ES]
217. **Aminian A, Brethauer SA, Andalib A, et al.** Individualized metabolic surgery score: procedure selection based on diabetes severity. *Ann Surg.* 2017;266:650-657.[EL 2; RCCS]
218. **Fernández JR, Heo M, Heymsfield SB, et al.** Is percentage body fat differentially related to body mass index in Hispanic Americans, African Americans, and European Americans? *Am J Clin Nutr.* 2003;77:71-75.[EL 2; CSS]
219. **Region. WHO WP, Obesity. IAftSo.** The Asia-Pacific perspective: redefining obesity and its treatment. *Australia: Health Communications.* 2000.[EL 4; NE]
220. **Zhou BF.** Predictive values of body mass index and waist circumference for risk factors of certain related diseases in Chinese adults—study on optimal cut-off points of body mass index and waist circumference in Chinese adults. *Biomed Environ Sci.* 2002;15:83-96.[EL 2; MNRCT]
221. **Razak F, Anand SS, Shannon H, et al.** Defining obesity cut points in a multiethnic population. *Circulation.* 2007;115:2111-2118.[EL 2; PCS]
222. **Ntuk UE, Gill JM, Mackay DF, Sattar N, Pell JP.** Ethnic specific obesity cutoffs for diabetes risk: cross-sectional study of 490,288 UK biobank participants. *Diabetes Care.* 2014;37:2500-2507.[EL 2; PCS]
223. **He W, Li Q, Yang M, et al.** Lower BMI cutoffs to define overweight and obesity in China. *Obesity (Silver Spring).* 2015;23:684-691.[EL 2; ES]
224. **Gu D, He J, Duan X, et al.** Body weight and mortality among men and women in China. *JAMA.* 2006;295:776-783.[EL 2; PCS]
225. **Chen Y, Copeland WK, Vedanthan R, et al.** Association between body mass index and cardiovascular disease mortality in east Asians and south Asians: pooled analysis of prospective data from the Asia Cohort Consortium. *BMJ.* 2013;347:f5446.[EL 2; PCS]
226. **Lin WY, Tsai SL, Albu JB, et al.** Body mass index and all-cause mortality in a large Chinese cohort. *Can Med Assoc J.* 2011;183:E329-E336.[EL 2; PCS]
227. **Zheng W, McLerran DF, Rolland B, et al.** Association between body-mass index and risk of death in more than 1 million Asians. *N Engl J Med.* 2011;364:719-729.[EL 2; ES]
228. **Cerhan JR, Moore SC, Jacobs EJ, et al.** A pooled analysis of waist circumference and mortality in 650,000 adults. *Mayo Clin Proc.* 2014;89:335-345.[EL 2; ES]
229. **Ko GT, Tang JS.** Waist circumference and BMI cut-off based on 10-year cardiovascular risk: evidence for “central pre-obesity”. *Obesity (Silver Spring).* 2007;15:2832-2839.[EL 2; CSS]
230. **Bray GA.** Medical consequences of obesity. *J Clin Endocrinol Metab.* 2004;89:2583-2589.[EL 4; NE]
231. **Daniel S, Soleymani T, Garvey WT.** A complications-based clinical staging of obesity to guide treatment modality and intensity. *Curr Opin Endocrinol Diabetes Obes.* 2013;20:377-388.[EL 4; NE]
232. **Cefalu WT, Bray GA, Home PD, et al.** Advances in the science, treatment, and prevention of the disease of obesity: reflections from a Diabetes Care editors’ expert forum. *Diabetes Care.* 2015;38:1567-1582.[EL 4; NE]
233. **Ryan DH, Yockey SR.** Weight loss and improvement in comorbidity: differences at 5%, 10%, 15%, and over. *Curr Obes Rep.* 2017;6:187-194.[EL 4; NE]
234. **Garvey WT.** New tools for weight-loss therapy enable a more robust medical model for obesity treatment: rationale for a complications-centric approach. *Endocr Pract.* 2013;19:864-874.[EL 4; NE]
235. **Courcoulas AP, Christian NJ, O’Rourke RW, et al.** Preoperative factors and 3-year weight change in the Longitudinal Assessment

- of Bariatric Surgery (LABS) consortium. *Surg Obes Relat Dis.* 2015;11:1109-1118.[EL 2; PCS]
236. **Robinson AH, Adler S, Stevens HB, Darcy AM, Morton JM, Safer DL.** What variables are associated with successful weight loss outcomes for bariatric surgery after 1 year? *Surg Obes Relat Dis.* 2014;10:697-704.[EL 3; DS]
  237. **Seysseil K, Suter M, Pattou F, et al.** A predictive model of weight loss after Roux-en-Y gastric bypass up to 5 years after surgery: a useful tool to select and manage candidates to bariatric surgery. *Obes Surg.* 2018;28:3393-3399.[EL 2; ES]
  238. **Samczuk P, Luba M, Godzien J, et al.** "Gear mechanism" of bariatric interventions revealed by untargeted metabolomics. *J Pharm Biomed Anal.* 2018;151:219-226.[EL 2; CSS]
  239. **Surgery ASoMaB.** Estimate of Bariatric Surgery Numbers, 2011-2016. Accessed March 25, 2018.[EL 3; DS]
  240. **Kumar SB, Hamilton BC, Wood SG, Rogers SJ, Carter JT, Lin MY.** Is laparoscopic sleeve gastrectomy safer than laparoscopic gastric bypass? A comparison of 30-day complications using the MBSAQIP data registry. *Surg Obes Relat Dis.* 2018;14:264-269.[EL 2; ES]
  241. **Pauleau G, Goudard Y, De La Villeon B, Brardianian S, Balandraud P.** Influence of age on sleeve gastrectomy results. *J Laparoendosc Adv Surg Tech A.* 2018;28:827-832.[EL 2; CSS]
  242. **Magouliotis DE, Tasiopoulou VS, Svokos AA, Svokos KA, Sioka E, Zacharoulis D.** Single incision versus conventional laparoscopic sleeve gastrectomy for morbid obesity: a meta-analysis. *J Laparoendosc Adv Surg Tech A.* 2018;28:690-699.[EL 1; MRCT]
  243. **Avenell A, Robertson C, Skea Z, et al.** Bariatric surgery, lifestyle interventions and orlistat for severe obesity: the REBALANCE mixed-methods systematic review and economic evaluation. *Health Technol Assess.* 2018;22:1-246.[EL 2; ECON]
  244. **English WJ, DeMaria EJ, Brethauer SA, Mattar SG, Rosenthal RJ, Morton JM.** American Society for Metabolic and Bariatric Surgery estimation of metabolic and bariatric procedures performed in the United States in 2016. *Surg Obes Relat Dis.* 2018;14:259-263.[EL 2; ES]
  245. **Cobourn C, Degboe A, Super PA, et al.** Safety and effectiveness of LAP-BAND AP System: results of Helping Evaluate Reduction in Obesity (HERO) prospective registry study at 1 year. *J Am Coll Surg.* 2013;217:907-918.[EL 2; PCS]
  246. **Chang SH, Stoll CR, Song J, Varela JE, Eagon CJ, Colditz GA.** The effectiveness and risks of bariatric surgery: an updated systematic review and meta-analysis, 2003-2012. *JAMA Surg.* 2014;149:275-287.[EL 2; MNRCT]
  247. **Patti MD, Schlottmann F.** Gastroesophageal reflux after sleeve gastrectomy. *JAMA Surg.* 2018;153:1147-1148.[EL 4; NE]
  248. **Grubnik VV, Ospanov OB, Namaeva KA, Medvedev OV, Kresyun MS.** Randomized controlled trial comparing laparoscopic greater curvature plication versus laparoscopic sleeve gastrectomy. *Surg Endosc.* 2016;30:2186-2191.[EL 1; RCT]
  249. **Sullivan S, Swain JM, Woodman G, et al.** Randomized sham-controlled trial evaluating efficacy and safety of endoscopic gastric plication for primary obesity: the ESSENTIAL trial. *Obesity (Silver Spring).* 2017;25:294-301.[EL 1; RCT]
  250. **Darabi S, Talebpour M, Zeinoddini A, Heidari R.** Laparoscopic gastric plication versus mini-gastric bypass surgery in the treatment of morbid obesity: a randomized clinical trial. *Surg Obes Relat Dis.* 2013;9:914-919.[EL 1; RCT]
  251. **Pilone V, Vitiello A, Monda A, Giglio F, Forestieri P.** Laparoscopic adjustable gastric banding (LAGB) plus anterior fundoplication versus LAGB alone: a prospective comparative study. *Surg Laparosc Endosc Percutan Tech.* 2016;26:216-220.[EL 1; RCT]
  252. **Cottam A, Cottam D, Zaveri H, Surve A, Cottam S, Richards C.** Adjustable gastric banded plication versus sleeve gastrectomy: the role of gastrectomy in weight loss. *Surg Obes Relat Dis.* 2018;14:780-784.[EL 2; RCCS]
  253. **Mahawar KK, Kumar P, Carr WR, et al.** Current status of mini-gastric bypass. *J Minim Access Surg.* 2016;12:305-310.[EL 4; NE]
  254. **Ahujja A, Tantia O, Goyal G, et al.** MGB-OAGB: Effect of biliopancreatic limb length on nutritional deficiency, weight loss, and comorbidity resolution. *Obes Surg.* 2018;28:3439-3445.[EL 2; CSS]
  255. **Parmar C, Abdelhalim MA, Mahawar KK, et al.** Management of super-super obese patients: comparison between one anastomosis (mini) gastric bypass and Roux-en-Y gastric bypass. *Surg Endosc.* 2017;31:3504-3509.[EL 2; RCCS]
  256. **Almaki OM, Lee WJ, Chong K, Ser KH, Lee YC, Chen SC.** Laparoscopic gastric bypass for the treatment of type 2 diabetes: a comparison of Roux-en-Y versus single anastomosis gastric bypass. *Surg Obes Relat Dis.* 2018;14:509-515.[EL 2; RCCS]
  257. **Wang FG, Yan WM, Yan M, Song MM.** Outcomes of mini vs Roux-en-Y gastric bypass: a meta-analysis and systematic review. *Int J Surg.* 2018;56:7-14.[EL 2; MNRCT]
  258. **Saarinen T, Räsänen J, Salo J, et al.** Bile reflux scintigraphy after mini-gastric bypass. *Obes Surg.* 2017;27:2083-2089.[EL 2; ES]
  259. **Mahawar KK, Borg CM, Kular KS, et al.** Understanding objections to one anastomosis (mini) gastric bypass: a survey of 417 surgeons not performing this procedure. *Obes Surg.* 2017;27:2222-2228.[EL 2; ES]
  260. **Li YX, Fang DH, Liu TX.** Laparoscopic sleeve gastrectomy combined with single-anastomosis duodenal-jejunal bypass in the treatment of type 2 diabetes mellitus of patients with body mass index higher than 27.5 kg/m<sup>2</sup> but lower than 32.5 kg/m<sup>2</sup>. *Medicine (Baltimore).* 2018;97:e11537.[EL 2; RCCS]
  261. **Kikuchi R, Irie J, Yamada-Goto N, et al.** The impact of laparoscopic sleeve gastrectomy with duodenojejunal bypass on intestinal microbiota differs from that of laparoscopic sleeve gastrectomy in Japanese patients with obesity. *Clin Drug Investig.* 2018;38:545-552.[EL 2; PCS]
  262. **Cottam A, Cottam D, Portenier D, et al.** A matched cohort analysis of stomach intestinal pylorus saving (SIPS) surgery versus biliopancreatic diversion with duodenal switch with two-year follow-up. *Obes Surg.* 2017;27:454-461.[EL 2; RCCS]
  263. **Sánchez-Pernaute A, Herrera MA, Pérez-Aquirre ME, et al.** Single anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S). One to three-year follow-up. *Obes Surg.* 2010;20:1720-1726.[EL 2; ES]
  264. **Mitzman B, Cottam D, Goriparthi R, et al.** Stomach intestinal pylorus sparing (SIPS) surgery for morbid obesity: retrospective analyses of our preliminary experience. *Obes Surg.* 2016;26:2098-2104.[EL 2; RCCS]
  265. **Neichoy BT, Schniederjan B, Cottam DR, et al.** Stomach intestinal pylorus-sparing surgery for morbid obesity. *JSLs.* 2018;22:e2017.00063.[EL 2; RCCS]
  266. **Kim J.** American Society for Metabolic and Bariatric Surgery statement on single-anastomosis duodenal switch. *Surg Obes Relat Dis.* 2016;12:944-945.[EL 4; NE]
  267. **Topart P, Becouarn G.** The single anastomosis duodenal switch modifications: a review of the current literature on outcomes. *Surg Obes Relat Dis.* 2017;13:1306-1312.[EL 2; MNRCT]
  268. **Surve A, Zaveri H, Cottam D, Belnap L, Cottam A, Cottam S.** A retrospective comparison of biliopancreatic diversion with duodenal switch with single anastomosis duodenal switch (SIPS-stomach intestinal pylorus sparing surgery) at a single institution with two year follow-up. *Surg Obes Relat Dis.* 2017;13:415-422.[EL 2; RCCS]
  269. **Surve A, Cottam D, Sanchez-Pernaute A, et al.** The incidence of complications associated with loop duodeno-ileostomy after single-anastomosis duodenal switch procedures among 1328 patients: a multicenter experience. *Surg Obes Relat Dis.* 2018;14:594-601.[EL 2; RCCS]
  270. **Cottam A, Cottam D, Medlin W, et al.** A matched cohort analysis of single anastomosis loop duodenal switch versus Roux-en-Y gastric bypass with 18-month follow-up. *Surg Endosc.* 2016;30:3958-3964.[EL 2; RCCS]
  271. **Cottam A, Cottam D, Roslin M, et al.** A matched cohort analysis of sleeve gastrectomy with and without 300 cm loop duodenal switch with 18-month follow-up. *Obes Surg.* 2016;26:2363-2369.[EL 2; RCCS]
  272. **Zaveri H, Surve A, Cottam D, et al.** A comparison of outcomes of bariatric surgery in patient greater than 70 with 18 month of follow up. *Springerplus.* 2016;5:1740.[EL 2; RCCS]
  273. **Surve A, Zaveri H, Cottam D.** A video case report of stomach intestinal pylorus sparing surgery with laparoscopic fundoplication: a surgical procedure to treat gastrointestinal reflux disease in

- the setting of morbid obesity. *Surg Obes Relat Dis.* 2016;12:1133-1135.[EL 3; SCR]
274. **Zaveri H, Surve A, Cottam D, et al.** Stomach intestinal pylorus sparing surgery (SIPS) with laparoscopic fundoplication (LF): a new approach to gastroesophageal reflux disease (GERD) in the setting of morbid obesity. *Springerplus.* 2015;4:596.[EL 2; RCCS]
  275. **Brethauer SA, Kothari S, Sudan R, et al.** Systematic review on reoperative bariatric surgery: American Society for Metabolic and Bariatric Surgery Revision Task Force. *Surg Obes Relat Dis.* 2014;10:952-972.[EL 2; MNRCT]
  276. **Aleassa EM, Hassan M, Hayes K, Brethauer SA, Schauer PR, Aminian A.** Effect of revisional bariatric surgery on type 2 diabetes mellitus. *Surg Endosc.* 2019;33:2642-2648.[EL 2; ES]
  277. **Yan J, Cohen R, Aminian A.** Reoperative bariatric surgery for treatment of type 2 diabetes mellitus. *Surg Obes Relat Dis.* 2017;13:1412-1421.[EL 2; MNRCT]
  278. **Boru CE, Greco F, Giustacchini P, Raffaelli M, Silecchia G.** Short-term outcomes of sleeve gastrectomy conversion to R-Y gastric bypass: multi-center retrospective study. *Langenbecks Arch Surg.* 2018;403:473-479.[EL 2; ES]
  279. **Salama TM, Sabry K.** Redo surgery after failed open VBG: laparoscopic minigastric bypass versus laparoscopic Roux en Y gastric bypass--Which Is Better? *Minim Invasive Surg.* 2016;2016:48737519.[EL 1; RCT]
  280. **Conceição E, Pinto-Bastos A, de Lourdes M, Brandão I, Teixeira A, Machado PPP.** Psychological behavioral and weight-related aspects of patients undergoing reoperative bariatric surgery after gastric band: comparison with primary surgery patients. *Surg Obes Relat Dis.* 2018;14:603-610.[EL 2; ES]
  281. **Chang J, Brethauer S.** Medical devices in the treatment of obesity. *Endocrinol Metab Clin North Am.* 2016;45:657-665.[EL 4; NE]
  282. **Lall C, Cruz AA, Bura V, Rudd AA, Bosemani T, Chang KJ.** What the radiologist needs to know about gastrointestinal endoscopic surgical procedures. *Abdom Radiol (NY).* 2018;43:1482-1493.[EL 4; NE]
  283. **Papasavas P, El Chaar M, Kothari SN.** American Society for Metabolic and Bariatric Surgery position statement on vagal blocking therapy for obesity. *Surg Obes Relat Dis.* 2016;12:460-461.[EL 4; NE]
  284. **Shikora SA, Toouli J, Herrera MF, et al.** Intermittent vagal nerve block for improvements in obesity, cardiovascular risk factors, and glycemic control in patients with type 2 diabetes mellitus: 2-year results of the VBLOC DM2 study. *Obes Surg.* 2016;26:1021-1028.[EL 2; PCS]
  285. **Morton JM, Shah SN, Wolfe BM, et al.** Effect of vagal nerve blockade on moderate obesity with an obesity-related comorbid condition: the ReCharge study. *Obes Surg.* 2016;26:983-989.[EL 1; RCT]
  286. **Ikramuddin S, Blackstone RP, Brancatisano A, et al.** Effect of reversible intermittent intra-abdominal vagal nerve blockade on morbid obesity: the ReCharge randomized clinical trial. *JAMA.* 2014;312:915-922.[EL 1; RCT]
  287. **Papavramidis TS, Stavrou G, Papakostas P, et al.** Displacement of the intragastric balloon from the fundus to the antrum results in enhanced weight loss. *Obes Surg.* 2018;28:2374-2378.[EL 2; PCS]
  288. **Vargas EJ, Pesta CM, Bali A, et al.** Single fluid-filled intragastric balloon safe and effective for inducing weight loss in a real-world population. *Clin Gastroenterol Hepatol.* 2018;16:1073-1080.[EL 2; OLES]
  289. **Keren D, Rainis T.** Intragastric balloons for overweight Ppopulations—1 year post removal. *Obes Surg.* 2018;28:2368-2373.[EL 2; RCCS]
  290. **Russo T, Aprea G, Formisano C, et al.** BioEnterics Intragastric Balloon (BIB) versus Spatz Adjustable Balloon System (ABS): our experience in the elderly. *Int J Surg.* 2017;38:138-140.[EL 2; RCCS]
  291. **Alsabah S, Al Haddad E, Ekrouf S, Almulla A, Al-Subaie S, Al Kendari M.** The safety and efficacy of the procedureless intragastric balloon. *Surg Obes Relat Dis.* 2018;14:311-317.[EL 2; PCS]
  292. **Rossi A, Bersani G, Ricci G, Petrini C, DeFabritiis G, Alvisi V.** Intragastric balloon insertion increases the frequency of erosive esophagitis in obese patients. *Obes Surg.* 2007;17:1346-1349.[EL 2; PCS]
  293. **Ali MR, Moustarah F, Kim JJ.** American Society for Metabolic and Bariatric Surgery position statement on intragastric balloon therapy endorsed by the Society of American Gastrointestinal and Endoscopic Surgeons. *Sur Obes Relat Dis.* 2016;12:462-467.[EL 4; NE]
  294. **Borges AC, Almeida PC, Furlani SMT, Cury MS, Gaur S.** Intragastric balloons in high-risk obese patients in a Brazilian center: initial experience [in English, Portuguese]. *Rev Col Bras Cir.* 2018;45:e1448.[EL 2; RCCS]
  295. **Rahman AA, Loi K.** Gastric perforation as a complication of intragastric balloon. *Surg Obes Relat Dis.* 2018;14:719-722.[EL 3; SCR]
  296. **Dayan D, Sagie B, Fishman S.** Late intragastric balloon nduced gastric perforation. *Obes Surg.* 2016;26:1138-1140.[EL 3; SCR]
  297. **Issa I, Taha A, Azar C.** Acute pancreatitis caused by intragastric balloon: a case report. *Obes Res Clin Pract.* 2016;10:340-343.[EL 3; SCR]
  298. **Tate CM, Geliebter A.** Intragastric balloon treatment for obesity: FDA afety Updates. *Adv Ther.* 2018;35:1-4.[EL 4; NE]
  299. **DeAsis FJ, Denham W, Linn JG, Haggerty SP, Ujiki MB.** Primary obesity surgery endoluminal. *Surg Endosc.* 2017;31:951.[EL 3; SCR]
  300. **Kumar N, Abu Dayyeh BK, Lopez-Nava Breviere G, et al.** Endoscopic sutured gastropasty: procedure evolution from first-in-man cases through current technique. *Surg Endosc.* 2018;32:2159-2164.[EL 2; PCS]
  301. **Graus Morales J, Crespo Pérez L, Marques A, et al.** Modified endoscopic gastropasty for the treatment of obesity. *Surg Endosc.* 2018;32:3936-3942.[EL 2; PCS]
  302. **Novikov AA, Afaneh C, Saumoy M, et al.** Endoscopic sleeve gastropasty, laparoscopic sleeve gastrectomy, and laparoscopic band for weight loss: how do they compare? *J Gastroint Surg.* 2018;22:267-273.[EL 2; PCS]
  303. **Sartoretto A, Sui Z, Hill C, et al.** Endoscopic sleeve gastropasty (ESG) is a reproducible and effective endoscopic bariatric therapy suitable for widespread clinical adoption: a large, international multicenter study. *Obes Surg.* 2018;28:1812-1821.[EL 2; RCCS]
  304. **Li SH, Wang YJ, Zhang ST.** Development of bariatric and metabolic endoscopy. *Chinese Med J (Engl).* 2018;131:88-94.[EL 4; NE]
  305. **Koehestanie P, de Jonge C, Berends FJ, Janssen IM, Bouvy ND, Greve JW.** The effect of the endoscopic duodenal-jejunal bypass liner on obesity and type 2 diabetes mellitus, a multicenter randomized controlled trial. *Ann Surg.* 2014;260:984-992.[EL 1; RCT]
  306. **Muñoz R, Dominguez A, Muñoz F, et al.** Baseline glycated hemoglobin levels are associated with duodenal-jejunal bypass liner-induced weight loss in obese patients. *Surg Endosc.* 2014;28:1056-1062.[EL 2; PCS]
  307. **Vilarrasa N, de Gordejuela AG, Casajoana A, et al.** Endobarrier® in grade I obese patients with long-standing type 2 diabetes: role of gastrointestinal hormones in glucose metabolism. *Obes Surg.* 2017;27:569-577.[EL 2; PCS]
  308. **Koehestanie P, Betzel B, Dogan K, et al.** The feasibility of delivering a duodenal-jejunal bypass liner (EndoBarrier) endoscopically with patients under conscious sedation. *Surg Endosc.* 2014;28:325-330.[EL 2; PCS]
  309. **Riedel N, Laubner K, Lautenbach A, et al.** Longitudinal evaluation of efficacy, safety and nutritional status during one-year treatment with the duodenal-jejunal bypass liner. *Sur Obes Relat Dis.* 2018;14:769-779.[EL 2; PCS]
  310. **Jirapinyo P, Haas AV, Thompson CC.** Effect of the duodenal-jejunal bypass liner on glycemic control in patients with type 2 diabetes with obesity: a meta-analysis with secondary analysis on weight loss and hormonal changes. *Diabetes Care.* 2018;41:1106-1115.[EL 2; MNRCT]
  311. **Rajagopalan H, Cherrington AD, Thompson CC, et al.** Endoscopic duodenal mucosal resurfacing for the treatment of type 2 diabetes: 6-month interim analysis from the first-in-human proof-of-concept study. *Diabetes Care.* 2016;39:2254-2261.[EL 2; PCS]
  312. **Livingston EH.** Pitfalls in using BMI as a selection criterion for bariatric surgery. *Curr Opin Endocrinol Diabetes Obes.* 2012;19:347-351.[EL 4; NE]

313. Piché MÈ, Auclair A, Harvey J, Marceau S, Poirier P. How to choose and use bariatric surgery in 2015. *Can J Cardiol.* 2015;31:153-166.[EL 4; NE]
314. Haskins IN, Nowacki AS, Khorgami Z, et al. Should recent smoking be a contraindication for sleeve gastrectomy? *Surg Obes Relat Dis.* 2017;13:1130-1135.[EL 2; ES]
315. Rebecchi F, Allaix ME, Giaccone C, Ugliono E, Scozzari G, Morino M. Gastroesophageal reflux disease and laparoscopic sleeve gastrectomy: a physiopathologic evaluation. *Ann Surg.* 2014;260:909-914; discussion 914-915.[EL 2; PCS]
316. Casillas RA, Um SS, Zelada Getty JL, Sachs S, Kim BB. Revision of primary sleeve gastrectomy to Roux-en-Y gastric bypass: indications and outcomes from a high-volume center. *Surg Obes Relat Dis.* 2016;12:1817-1825.[EL 2; RCCS]
317. Gagner M, Hutchinson C, Rosenthal R. Fifth International Consensus Conference: current status of sleeve gastrectomy. *Surg Obes Relat Dis.* 2016;12:750-756.[EL 4; NE]
318. Surgeons. ACo. Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program. Available at <https://www.facs.org/quality-programs/mbsaqip>. Accessed March 25, 2018.[EL 4; NE]
319. Young MT, Jafari MD, Gebhart A, Phelan MJ, Nguyen NT. A decade analysis of trends and outcomes of bariatric surgery in Medicare Beneficiaries. *J Am Coll Surg.* 2014;219:480-488.[EL 2; ES]
320. Doumouras AG, Saleh F, Anvari S, Gmora S, Anvari M, Hong D. The effect of health system factors on outcomes and costs after bariatric surgery in a universal healthcare system: a national cohort study of bariatric surgery in Canada. *Surg Endosc.* 2017;31:4816-4823.[EL 2; PCS]
321. Kuo LE, Simmons KD, Kelz RR. Bariatric centers of excellence: effect of centralization on access to care. *J Am Coll Surg.* 2015;221:914-922.[EL 3; DS]
322. Borbély Y, Juillard O, Altmeier J, Kröll D, Nett PC. Perioperative outcome of laparoscopic sleeve gastrectomy for high-risk patients. *Surg Obes Relat Dis.* 2017;13:155-160.[EL 2; PCS]
323. Davis C, Tait G, Carroll J, Wijeyesundera DN, Beattie WS. The revised cardiac risk index in the new millennium: a single-centre prospective cohort re-evaluation of the original variables in 9,519 consecutive elective surgical patients. *Can J Anaesth.* 2013;60:855-863.[EL 2; PCS]
324. Andersson C, Wissenberg M, Jørgensen ME, et al. Age-specific performance of the revised cardiac risk index for predicting cardiovascular risk in elective noncardiac surgery. *Circ Cardiovasc Qual Outcomes.* 2015;8:103-108.[EL 2; PCS]
325. Roshanov PS, Walsh M, Devereaux PJ, et al. External validation of the Revised Cardiac Risk Index and update of its renal variable to predict 30-day risk of major cardiac complications after non-cardiac surgery: rationale and plan for analyses of the VISION study. *BMJ Open.* 2017;7:e013510.[EL 2; PCS]
326. Gupta PK, Gupta H, Sundaram A, et al. Development and validation of a risk calculator for prediction of cardiac risk after surgery. *Circulation.* 2011;124:381-387.[EL 2; ES]
327. Peterson B, Ghahramani M, Harris S, et al. Usefulness of the myocardial infarction and cardiac arrest calculator as a discriminator of adverse cardiac events after elective hip and knee surgery. *Am J Cardiol.* 2016;117:1992-1995.[EL 2; RCCS]
328. Bhatti JA, Nathens AB, Thiruchelvam D, Grantcharov T, Goldstein BI, Redelmeier DA. Self-harm emergencies after bariatric surgery: a population-based cohort study. *JAMA Surg.* 2016;151:226-232.[EL 2; RCCS]
329. Dawes AJ, Maggard-Gibbons M, Maher AR, et al. Mental health conditions among patients seeking and undergoing bariatric surgery: a meta-analysis. *JAMA.* 2016;315:150-163.[EL 2; MNRCT]
330. Lagerros YT, Brandt L, Hedberg J, Sundbom M, Bodén R. Suicide, self-harm, and depression after gastric bypass surgery: a nationwide cohort study. *Ann Surg.* 2017;265:235-243.[EL 2; RCCS]
331. Meany G, Conceição E, Mitchell JE. Binge eating, binge eating disorder and loss of control eating: effects on weight outcomes after bariatric surgery. *Eur Eat Disord Rev.* 2014;22:87-91.[EL 2; MNRCT]
332. Mitchell JE, King WC, Courcoulas A, et al. Eating behavior and eating disorders in adults before bariatric surgery. *Int J Eat Disord.* 2015;48:215-222.[EL 2; RCCS]
333. Morgan DJ, Ho KM. Incidence and risk factors for deliberate self-harm, mental illness, and suicide following bariatric surgery: a state-wide population-based linked-data cohort study. *Ann Surg.* 2017;265:244-252.[EL 2; RCCS]
334. Müller A, Mitchell JE, Sondag C, de Zwaan M. Psychiatric aspects of bariatric surgery. *Curr Psychiatry Rep.* 2013;15:397.[EL 4; NE]
335. Peterhänsel C, Wagner B, Dietrich A, Kersting A. Obesity and co-morbid psychiatric disorders as contraindications for bariatric surgery? A case study. *Int J Surg Case Rep.* 2014;5:1268-1270.[EL 3; SCR]
336. Rigby A, Miller E, Isaiah J. Preoperative risk factors for suicide in candidates for weight loss surgery. *Bar Surg Prac and Pat Care.* 2017;12:10-15.[EL 2; RCCS]
337. Sogg S, Lauretti J, West-Smith L. Recommendations for the presurgical psychosocial evaluation of bariatric surgery patients. *Surg Obes Relat Dis.* 2016;12:731-749.[EL 4; NE]
338. Wimmelmann CL, Dela F, Mortensen EL. Psychological predictors of weight loss after bariatric surgery: a review of the recent research. *Obes Res Clin Pract.* 2014;8:e299-e313.[EL 4; NE]
339. Charalampakis V, Tahrani AA, Helmy A, Gupta JK, Singhal R. Polycystic ovary syndrome and endometrial hyperplasia: an overview of the role of bariatric surgery in female fertility. *Euro J Obstet Gynecol Reprod Biol.* 2016;207:220-226.[EL 4; NE]
340. Palli SR, Rizzo JA, Heidrich N. Bariatric surgery coverage: a comprehensive budget impact analysis from a payer perspective. *Obes Surg.* 2018;28:1711-1723.[EL 3; DS]
341. Myers VH, McVay MA, Adams CE, et al. Actual medical and pharmacy costs for bariatric surgery: 6-year follow-up. *South Med J.* 2012;105:530-537.[EL 3; DS]
342. Bruschi Kelles SM, Machado CJ, Barreto SM. Before-and-after study: does bariatric surgery reduce healthcare utilization and related costs among operated patients? *Int J Technol Assess Health Care.* 2015;31:407-413.[EL 3; DS]
343. Shah N, Greenberg JA, Levenson G, Funk LM. Predictors of high cost after bariatric surgery: a single institution review. *Surgery.* 2016;160:877-884.[EL 2; RCCS]
344. Weber CE, Talbot LJ, Geller JM, Kuo MC, Wai PY, Kuo PC. Comparing 20 years of national general surgery malpractice claims data: obesity versus morbid obesity. *Am J Surg.* 2013;205:293-297; discussion 297.[EL 3; DS]
345. Larsen AT, Højgaard B, Ibsen R, Kjellberg J. The socioeconomic impact of bariatric surgery. *Obes Surg.* 2018;28:338-348.[EL 3; DS]
346. Klebanoff MJ, Chhatwal J, Nudel JD, Corey KE, Kaplan LM, Hur C. Cost-effectiveness of bariatric surgery in adolescents with obesity. *JAMA Surg.* 2017;152:136-141.[EL 2; ES]
347. Woolford SJ, Clark SJ, Butchart A, Geiger JD, Davis MM, Fagerlin A. To pay or not to pay: public perception regarding insurance coverage of obesity treatment. *Obesity (Silver Spring).* 2013;21:E709-E714.[EL 2; ES]
348. Hayes S, Napolitano MA, Lent MR, et al. The effect of insurance status on pre- and post-operative bariatric surgery outcomes. *Obes Surg.* 2015;25:191-194.[EL 2; RCCS]
349. Campbell J, McGarry LA, Shikora SA, Hale BC, Lee JT, Weinstein MC. Cost-effectiveness of laparoscopic gastric banding and bypass for morbid obesity. *Am J Manag Care.* 2010;16:e174-e187.[EL 3; DS]
350. Neumann PJ, Cohen JT, Weinstein MC. Updating cost-effectiveness--the curious resilience of the \$50,000-per-QALY threshold. *N Engl J Med.* 2014;371:796-797.[EL 4; NE]
351. Weiner JP, Goodwin SM, Chang HY, et al. Impact of bariatric surgery on health care costs of obese persons: a 6-year follow-up of surgical and comparison cohorts using health plan data. *JAMA Surg.* 2013;148:555-562.[EL 2; PCS]
352. Broderick RC, Fuchs HF, Harnsberger CR, et al. Increasing the value of healthcare: improving mortality while reducing cost in bariatric surgery. *Obes Surg.* 2015;25:2231-2238.[EL 2; ES]
353. Flanagan E, Ghaderi I, Overby DW, Farrell TM. Reduced Survival in Bariatric Surgery Candidates Delayed or Denied by

- Lack of Insurance Approval. *Am Surg.* 2016;82:166-170.[EL 2; RCCS]
354. **Wilson ER, Kyle TK, Nadglowski JF Jr, Stanford FC.** Obesity coverage gap: Consumers perceive low coverage for obesity treatments even when workplace wellness programs target BMI. *Obesity (Silver Spring).* 2017;25:370-377.[EL 2; RCCS]
355. **Yang YT, Pomeranz JL.** States variations in the provision of bariatric surgery under Affordable Care Act exchanges. *Surg Obes Relat Dis.* 2015;11:715-720.[EL 4; NE]
356. **English W, Williams B, Scott J, Morton J.** Covering bariatric surgery has minimal effect on insurance premium costs within the Affordable Care Act. *Surg Obes Relat Dis.* 2016;12:1045-1050.[EL 3; DS]
357. **Jensen-Otsu E, Ward EK, Mitchell B, et al.** The effect of Medicaid status on weight loss, hospital length of stay, and 30-day readmission after laparoscopic Roux-en-Y gastric bypass surgery. *Obes Surg.* 2015;25:295-301.[EL 2; RCCS]
358. **Balash PR, Wilson NA, Bruns NE, et al.** Insurance status and outcomes in laparoscopic adjustable gastric banding. *Surg Laparosc Endosc Percutan Tech.* 2014;24:457-460.[EL 2; RCCS]
359. **Scally CP, Thumma JR, Birkmeyer JD, Dimick JB.** Impact of surgical quality improvement on payments to medicare patients. *Ann Surg.* 2015;262:249-252.[EL 3; DS]
360. **Grenda TR, Pradarelli JC, Thumma JR, Dimick JB.** Variation in hospital episode costs with bariatric surgery. *JAMA Surg.* 2015;150:1109-1115.[EL 3; DS]
361. **Keating CL, Peeters A, Swinburn BA, Carter R, Moodie ML.** Pharmaceutical utilisation and costs before and after bariatric surgery. *Int J Obes (Lond).* 2013;37:1467-1472.[EL 3; DS]
362. **Altieri MS, Yang J, Telem DA, et al.** Lap band outcomes from 19,221 patients across centers and over a decade within the state of New York. *Surg Endosc.* 2016;30:1725-1732.[EL 2; ES]
363. **Ibrahim AM, Thumma JR, Dimick JB.** Reoperation and medicare expenditures after laparoscopic gastric band surgery. *JAMA Surg.* 2017;152:835-842.[EL 2; RCCS]
364. **Silva CF, Cohen L, Sarmento LD, et al.** Effects of long-term roux-en-Y gastric bypass on body weight and clinical metabolic comorbidities in bariatric surgery service of a university hospital [in English, Portuguese]. *Arq Bras Cir Dig.* 2016;29(suppl 1):20-23.[EL 2; RCCS]
365. **Ikramuddin S, Korner J, Lee WJ, et al.** Durability of addition of Roux-en-Y gastric bypass to lifestyle intervention and medical management in achieving primary treatment goals for uncontrolled type 2 diabetes in mild to moderate obesity: a randomized control trial. *Diabetes Care.* 2016;39:1510-1518.[EL 1; RCT]
366. **Mehaffey JH, LaPar DJ, Clement KC, et al.** 10-year outcomes after Roux-en-Y gastric bypass. *Ann Surg.* 2016;264:121-126.[EL 2; RCCS]
367. **Maciejewski ML, Arterburn DE, Van Scoyoc L, et al.** Bariatric surgery and long-term durability of weight loss. *JAMA Surg.* 2016;151:1046-1055.[EL 2; RCCS]
368. **Faria GFR, Nunes S, Simonson DC.** Quality of life after gastric sleeve and gastric bypass for morbid obesity. *Porto Biomed J.* 2017;2:40-46.[EL 2; MNRCT]
369. **Pernar LIM, Robertson FC, Tavakkoli A, Sheu EG, Brooks DC, Smink DS.** An appraisal of the learning curve in robotic general surgery. *Surg Endosc.* 2017;31:4583-4596.[EL 2; MNRCT]
370. **Starnes CC, Gochnour DC, Hall B, Wilson EB, Snyder BE.** The economy of motion of the totally robotic gastric bypass: technique, learning curve, and outcomes of a fellowship-trained, robotic bariatric surgeon. *J Laparoendosc Adv Surg Tech A.* 2015;25:411-418.[EL 2; RCCS]
371. **Bindal V, Gonzalez-Heredia R, Masrur M, Elli EF.** Technique evolution, learning curve, and outcomes of 200 robot-assisted gastric bypass procedures: a 5-year experience. *Obes Surg.* 2015;25:997-1002.[EL 2; RCCS]
372. **Beitner M, Luo Y, Kurian M.** Procedural changes to decrease complications in laparoscopic gastric bypass. *J Soc Laparoendosc Surg.* 2015;19:e2014.00256.[EL 2; RCCS]
373. **Shen SC, Tsai CY, Liao CH, Liu YY, Yeh TS, Liu KH.** Learning curve of laparoscopic Roux-en-Y gastric bypass in an Asian low-volume bariatric unit. *Asian J Surg.* 2018;41:170-175.[EL 2; RCCS]
374. **Rausa E, Bonavina L, Asti E, Gaeta M, Ricci C.** Rate of death and complications in laparoscopic and open Roux-en-Y gastric bypass. A meta-analysis and meta-regression analysis on 69,494 patients. *Obes Surg.* 2016;26:1956-1963.[EL 2; MNRCT]
375. **Papadimitriou G, Vardas K, Alfaras K, Alfaras P.** Laparoscopic adjustable gastric band: 4-year experience and learning curve. *J Soc Laparoendosc Surg.* 2015;19:e2013.00363.[EL 2; RCCS]
376. **Moon RC, Stephenson D, Royall NA, Teixeira AF, Jawad MA.** Robot-assisted versus laparoscopic sleeve gastrectomy: learning curve, perioperative, and short-term outcomes. *Obes Surg.* 2016;26:2463-2468.[EL 2; RCCS]
377. **Cesana G, Cioffi S, Giorgi R, et al.** Proximal leakage after laparoscopic sleeve gastrectomy: an analysis of preoperative and operative predictors on 1738 consecutive procedures. *Obes Surg.* 2018;28:627-635.[EL 2; RCCS]
378. **Major P, Wysocki M, Dworak J, et al.** Analysis of laparoscopic sleeve gastrectomy learning curve and its influence on procedure safety and perioperative complications. *Obes Surg.* 2018;28:1672-1680.[EL 2; RCCS]
379. **Geubbels N, de Brauw LM, Acherman YI, van de Laar AW, Wouters MW, Bruin SC.** The preceding surgeon factor in bariatric surgery: a positive influence on the learning curve of subsequent surgeons. *Obes Surg.* 2015;25:1417-1424.[EL 2; RCCS]
380. **Padin EM, Santos RS, Fernández SG, et al.** Impact of three-dimensional laparoscopy in a bariatric surgery program: influence in the learning curve. *Obes Surg.* 2017;27:2552-2556.[EL 2; RCCS]
381. **Major P, Wysocki M, Dworak J, Pedziwiatr M, Małczak P, Budzyński A.** Are bariatric operations performed by residents safe and efficient? *Surg Obes Relat Dis.* 2017;13:614-621.[EL 2; RCCS]
382. **van Rijswijk AS, Moes DE, Geubbels N, et al.** Can a laparoscopic Roux-en-Y gastric bypass be safely performed by surgical residents in a bariatric center-of-excellence? The learning curve of surgical residents in bariatric surgery. *Surg Endosc.* 2018;32:1012-1020.[EL 2; RCCS]
383. **Doumouras AG, Saleh F, Anvari S, Gmora S, Anvari M, Hong D.** Mastery in bariatric surgery: the long-term surgeon learning curve of Roux-en-Y gastric bypass. *Ann Surg.* 2018;267:489-494.[EL 2; RCCS]
384. **Dallal RM, Pang J, Soriano I, Cottam D, Lord J, Cox S.** Bariatric-related medical malpractice experience: survey results among ASMBS members. *Surg Obes Relat Dis.* 2014;10:121-124.[EL 2; CSS]
385. **Telem DA, Yang J, Altieri M, Talamini M, Zhang Q, Pryor AD.** Hospital charge and health-care quality in bariatric surgery. *Am Surg.* 2017;83:170-175.[EL 3; DS]
386. **Kwon S, Wang B, Wong E, Alfonso-Cristancho R, Sullivan SD, Flum DR.** The impact of accreditation on safety and cost of bariatric surgery. *Surg Obes Relat Dis.* 2013;9:617-622.[EL 3; DS]
387. **Scally CP, Shih T, Thumma JR, Dimick JB.** Impact of a National Bariatric Surgery Center of Excellence program on Medicare expenditures. *J Gastrointest Surg.* 2016;20:708-714.[EL 3; DS]
388. **Nicholas LH, Dimick JB.** Bariatric surgery in minority patients before and after implementation of a centers of excellence program. *JAMA.* 2013;310:1399-1400.[EL 3; DS]
389. **Bae J, Shade J, Abraham A, et al.** Effect of mandatory centers of excellence designation on demographic characteristics of patients who undergo bariatric surgery. *JAMA Surg.* 2015;150:644-648.[EL 3; DS]
390. **Tunis SR, Messner DA.** Medicare policy on bariatric surgery: decision making in the face of uncertainty. *JAMA.* 2013;310:1339-1340.[EL 4; NE]
391. **Jacques L, Jensen TS, Schafer J, Paserchia L, O'Connor D.** Decision memo for bariatric surgery for the treatment of morbid obesity-facility certification requirement (CAG-00250R3). In: (CMS). CfMMS, ed. <https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=266>. Accessed 25 March 2018.[EL 4; NE]
392. **Funk LM, Jolles S, Fischer LE, Voils CI.** Patient and referring practitioner characteristics associated with the likelihood of undergoing bariatric surgery: a systematic review. *JAMA Surg.* 2015;150:999-1005.[EL 2; MNRCT]

393. **Garvey WT, Mechanick JI, Brett EM, et al.** American Association of Clinical Endocrinologists and American College of Endocrinology comprehensive clinical practice guidelines for medical care of patients with obesity--executive summary. *Endocr Pract.* 2016;22:842-884.[EL 4; NE]
394. **Colquitt JL, Pickett K, Loveman E, Frampton GK.** Surgery for weight loss in adults. *Cochrane Database Syst Rev.* 2014;CD003641.[EL 2; MNRCT]
395. **Abraham CR, Werter CR, Ata A, et al.** Predictors of hospital readmission after bariatric surgery. *J Am Coll Surg.* 2015;221:220-227.[EL 2; ES]
396. **Sanni A, Perez S, Medbery R, et al.** Postoperative complications in bariatric surgery using age and BMI stratification: a study using ACS-NSQIP data. *Surg Endosc.* 2014;28:3302-3309.[EL 3; DS]
397. **Nguyen NT, Nguyen B, Smith B, Reavis KM, Elliott C, Hohmann S.** Proposal for a bariatric mortality risk classification system for patients undergoing bariatric surgery. *Surg Obes Relat Dis.* 2013;9:239-246.[EL 3; DS]
398. **Saleh F, Kim SJ, Okrainec A, Jackson TD.** Bariatric surgery in patients with reduced kidney function: an analysis of short-term outcomes. *Surg Obes Relat Dis.* 2015;11:828-835.[EL 2; ES]
399. **Jamal MH, Corcelles R, Daigle CR, et al.** Safety and effectiveness of bariatric surgery in dialysis patients and kidney transplantation candidates. *Surg Obes Relat Dis.* 2015;11:419-423.[EL 2; ES]
400. **Qin C, Luo B, Aggarwal A, De Oliveira G, Kim JY.** Advanced age as an independent predictor of perioperative risk after laparoscopic sleeve gastrectomy (LSG). *Obes Surg.* 2015;25:406-412.[EL 3; DS]
401. **Aminian A, Brethauer SA, Sharafkhan M, Schauer PR.** Development of a sleeve gastrectomy risk calculator. *Surg Obes Relat Dis.* 2015;11:758-764.[EL 3; DS]
402. **Marek RJ, Ben-Porath YS, Dulmen M, Ashton K, Heinberg LJ.** Using the presurgical psychological evaluation to predict 5-year weight loss outcomes in bariatric surgery patients. *Surg Obes Relat Dis.* 2017;13:514-521.[EL 2; PCS]
403. **Konttinen H, Peltonen M, Sjöström L, Carlsson L, Karlsson J.** Psychological aspects of eating behavior as predictors of 10-y weight changes after surgical and conventional treatment of severe obesity: results from the Swedish Obese Subjects intervention study. *Am J Clin Nutr.* 2015;101:16-24.[EL 2; RCCS]
404. **Kaplan JA, Schechter SC, Rogers SJ, Lin MYC, Posselt AM, Carter JT.** Expanded indications for bariatric surgery: should patients on chronic steroids be offered bariatric procedures? *Surg Obes Relat Dis.* 2017;13:35-40.[EL 3; DS]
405. **Andalib A, Aminian A, Khorgami Z, et al.** Early postoperative outcomes of primary bariatric surgery in patients on chronic steroid or immunosuppressive therapy. *Obes Surg.* 2016;26:1479-1486.[EL 3; DS]
406. **Love KM, Mehaffey JH, Safavian D, et al.** Bariatric surgery insurance requirements independently predict surgery dropout. *Surg Obes Relat Dis.* 2017;13:871-876.[EL 2; RCCS]
407. **Mahoney ST, Tawfik-Sexton D, Strassie PD, Farrell TM, Duke MC.** Effects of education and health literacy on postoperative hospital visits in bariatric surgery. *J Laparoendosc Adv Surg Tech A.* 2018;28:1100-1104.[EL 2; ES]
408. **Khorgami Z, Andalib A, Aminian A, Kroh MD, Schauer PR, Brethauer SA.** Predictors of readmission after laparoscopic gastric bypass and sleeve gastrectomy: a comparative analysis of ACS-NSQIP database. *Surg Endosc.* 2016;30:2342-2350.[EL 3; DS]
409. **Horwitz D, Saunders JK, Ude-Welcome A, Parikh M.** Insurance-mandated medical weight management before bariatric surgery. *Surg Obes Relat Dis.* 2016;12:496-499.[EL 2; RCCS]
410. **Conaty EA, Bonamici NJ, Gitelis ME, et al.** Efficacy of a required preoperative weight loss program for patients undergoing bariatric surgery. *J Gastrointest Surg.* 2016;20:667-673.[EL 2; RCCS]
411. **Keith CJ Jr, Goss LE, Blackledge CD, Stahl RD, Grams J.** Insurance-mandated preoperative diet and outcomes after bariatric surgery. *Surg Obes Relat Dis.* 2018;14:631-636.[EL 2; RCCS]
412. **Deb S, Voller L, Palisch C, et al.** Influence of weight loss attempts on bariatric surgery outcomes. *Am Surg.* 2016;82:916-920.[EL 2; PCS]
413. **Watanabe A, Seki Y, Haruta H, Kikkawa E, Kasama K.** Preoperative weight loss and operative outcome after laparoscopic sleeve gastrectomy. *Obes Surg.* 2017;27:2515-2521.[EL 2; PCS]
414. **Sinha A, Jayaraman L, Punhani D, Chowbey P.** Enhanced recovery after bariatric surgery in the severely obese, morbidly obese, super-morbidly obese and super-super morbidly obese using evidence-based clinical pathways: a comparative study. *Obes Surg.* 2017;27:560-568.[EL 2; RCCS]
415. **Mechanick JI, Kushner R.** *Lifestyle Medicine - A Manual for Clinical Practice.* New York, NY:Springer. 2016:1-8.[EL 4; NE]
416. **Gilbertson NM, Paisley AS, Kranz S, et al.** Bariatric surgery resistance: using preoperative lifestyle medicine and/or pharmacology for metabolic responsiveness. *Obes Surg.* 2017;27:3281-3291.[EL 4; NE]
417. **Kalarchian MA, Marcus MD, Courcoulas AP, Cheng Y, Levine MD.** Preoperative lifestyle intervention in bariatric surgery: a randomized clinical trial. *Surg Obes Relat Dis.* 2016;12:180-187.[EL 1; RCT]
418. **Handelsman Y, Bloomgarden ZT, Grunberger G, et al.** American Association of Clinical Endocrinologists and American College of Endocrinology--clinical practice guidelines for developing a diabetes mellitus comprehensive care plan--2015. *Endocr Pract.* 2015;21(suppl 1):1-87.[EL 4; NE]
419. **American Diabetes Association.** Glycemia targets: standards of medical care in diabetes - 2018. *Diabetes Care.* 2018;41(suppl 1):S55-S64.[EL 4; NE]
420. **Garber AJ, Abrahamson MJ, Barzilay JI, et al.** Consensus statement by the American Association of Clinical Endocrinologists and American College of Endocrinology on the comprehensive type 2 diabetes management algorithm--2018 executive summary. *Endocr Pract.* 2018;24:91-120.[EL 4; NE]
421. **Underwood P, Askari R, Hurwitz S, Chamarthi B, Garg R.** Preoperative A1C and clinical outcomes in patients with diabetes undergoing major noncardiac surgical procedures. *Diabetes Care.* 2014;37:611-616.[EL 2; ES]
422. **Houlden RL, Yen JL, Moore S.** Effectiveness of an interprofessional glycemic optimization clinic on preoperative glycated hemoglobin levels for adult patients with type 2 diabetes undergoing bariatric surgery. *Can J Diabetes.* 2018;42:514-519.[EL 2; RCCS]
423. **de Oliveira VLP, Martins GP, Mottin CC, Rizzolli J, Friedman R.** Predictors of long-term remission and relapse of type 2 diabetes mellitus following gastric bypass in severely obese patients. *Obes Surg.* 2018;28:195-203.[EL 2; RCCS]
424. **English TM, Malkani S, Kinney RL, Omer A, Dziejewin MB, Perugini R.** Predicting remission of diabetes after RYGB surgery following intensive management to optimize preoperative glucose control. *Obes Surg.* 2015;25:1-6.[EL 2; RCCS]
425. **Biro SM, Olson DL, Garren MJ, Gould JC.** Diabetes remission and glycemic response to pre-bariatric surgery diet. *J Surg Res.* 2013;185:1-5.[EL 2; RCCS]
426. **Pilla SJ, Maruthur NM, Schweitzer MA, et al.** The role of laboratory testing in differentiating type 1 diabetes from type 2 diabetes in patients undergoing bariatric surgery. *Obes Surg.* 2018;28:25-30.[EL 2; RCCS]
427. **Fierabracci P, Pinchera A, Martinelli S, et al.** Prevalence of endocrine diseases in morbidly obese patients scheduled for bariatric surgery: beyond diabetes. *Obes Surg.* 2011;21:54-60.[EL 2; PCS]
428. **Valdés S, Maldonado-Araque C, Lago-Sampedro A, et al.** Reference values for TSH may be inadequate to define hypothyroidism in persons with morbid obesity: Diabetes study. *Obesity (Silver Spring).* 2017;25:788-793.[EL 2; ES]
429. **Ruiz-Tovar J, Boix E, Galindo I, et al.** Evolution of subclinical hypothyroidism and its relation with glucose and triglycerides levels in morbidly obese patients after undergoing sleeve gastrectomy as bariatric procedure. *Obes Surg.* 2014;24:791-795.[EL 2; RCCS]
430. **Fierabracci P, Martinelli S, Tamperi A, et al.** Weight loss and variation of levothyroxine requirements in hypothyroid obese patients after bariatric surgery. *Thyroid.* 2016;26:499-503.[EL 2; PCS]



431. **Gkotsina M, Michalaki M, Mamali I, et al.** Improved levothyroxine pharmacokinetics after bariatric surgery. *Thyroid.* 2013;23:414-419.[EL 2; CSS]
432. **Jellinger PS, Handelsman Y, Rosenblit PD, et al.** American Association of Clinical Endocrinologists and American College of Endocrinology guidelines for management of dyslipidemia and prevention of cardiovascular disease. *Endocr Pract.* 2017;23(suppl 2):1-87.[EL 4; NE]
433. **Jacobson TA, Ito MK, Maki KC, et al.** National Lipid Association recommendations for patient-centered management of dyslipidemia: part 1--executive summary. *J Clin Lipidol.* 2014;8:473-488.[EL 4; NE]
434. **Jacobson TA, Maki KC, Orringer CE, et al.** National Lipid Association Recommendations for Patient-Centered Management of Dyslipidemia: Part 2. *J Clin Lipidol.* 2015;9(6 suppl):S1-S122.1.[EL 4; NE]
435. **Bays HE, Jones PH, Jacobson TA, et al.** Lipids and bariatric procedures part 1 of 2: scientific statement from the National Lipid Association, American Society for Metabolic and Bariatric Surgery, and Obesity Medicine Association: executive summary. *J Clin Lipidol.* 2016;10:15-32.[EL 4; NE]
436. **Bays H, Kothari SN, Azagury DE, et al.** Lipids and bariatric procedures part 2 of 2: scientific statement from the American Society for Metabolic and Bariatric Surgery (ASMBS), the National Lipid Association (NLA), and Obesity Medicine Association (OMA). *Surg Obes Relat Dis.* 2016;12:468-495.[EL 4; NE]
437. **Hayoz C, Hermann T, Raptis DA, Brönnimann A, Peterli R, Zuber M.** Comparison of metabolic outcomes in patients undergoing laparoscopic Roux-en-Y gastric bypass versus sleeve gastrectomy--a systematic review and meta-analysis of randomised controlled trials. *Swiss Med Wkly.* 2018;148:w14633.[EL 1; MRCT]
438. **Chalut-Carpentier A, Pataky Z, Golay A, Bobbioni-Harsch E.** Involvement of dietary Fatty acids in multiple biological and psychological functions, in morbidly obese subjects. *Obes Surg.* 2015;25:1031-1038.[EL 2; RCCS]
439. **Heffron SP, Parikh A, Volodarskiy A, et al.** Changes in lipid profile of obese patients following contemporary bariatric surgery: a meta-analysis. *Am J Med.* 2016;129:952-959.[EL 2; MNRCT]
440. **Honka H, Koffert J, Hannukainen JC, et al.** The effects of bariatric surgery on pancreatic lipid metabolism and blood flow. *J Clin Endocrinol Metab.* 2015;100:2015-2023.[EL 2; PCS]
441. **Lima KV, Lima RP, Gonçalves MC, et al.** High frequency of serum chromium deficiency and association of chromium with triglyceride and cholesterol concentrations in patients awaiting bariatric surgery. *Obes Surg.* 2014;24:771-776.[EL 2; CSS]
442. **Kominiarek MA, Junghelm ES, Hoeger KM, Rogers AM, Kahan S, Kim JJ.** American Society for Metabolic and Bariatric Surgery position statement on the impact of obesity and obesity treatment on fertility and fertility therapy endorsed by the American College of Obstetricians and Gynecologists and the Obesity Society. *Surg Obes Relat Dis.* 2017;13:750-757.[EL 4; NE]
443. **Coupaye M, Legardeur H, Sami O, Calabrese D, Mandelbrot L, Ledoux S.** Impact of Roux-en-Y gastric bypass and sleeve gastrectomy on fetal growth and relationship with maternal nutritional status. *Sur Obes Relat Dis.* 2018;14:1488-1494.[EL 2; RCCS]
444. **Mead NC, Sakkatos P, Sakellaropoulos GC, Adonakis GL, Alexandrides TK, Kalfarentzos F.** Pregnancy outcomes and nutritional indices after 3 types of bariatric surgery performed at a single institution. *Sur Obes Relat Dis.* 2014;10:1166-1173.[EL 2; RCCS]
445. **Carreau AM, Nadeau M, Marceau S, Marceau P, Weisnagel SJ.** Pregnancy after bariatric surgery: balancing risks and benefits. *Can J Diabetes.* 2017;41:432-438.[EL 4; NE]
446. **Johansson K, Cnattingius S, Näslund I, et al.** Outcomes of pregnancy after bariatric surgery. *N Engl J Med.* 2015;372:814-824.[EL 2; RCCS]
447. **Yau PO, Parikh M, Saunders JK, Chui P, Zablocki T, Welcome AU.** Pregnancy after bariatric surgery: the effect of time-to-conception on pregnancy outcomes. *Surg Obes Relat Dis.* 2017;13:1899-1905.[EL 2; CSS]
448. **Parrott J, Frank L, Rabena R, Craggs-Dino L, Isom KA, Greiman L.** American Society for Metabolic and Bariatric Surgery integrated health nutritional guidelines for the surgical weight loss patient 2016 update: micronutrients. *Surg Obes Relat Dis.* 2017;13:727-741.[EL 4; NE]
449. **Cobin RH, Goodman NF.** American Association of Clinical Endocrinologists and American College of Endocrinology position statement on menopause--2017 update. *Endocr Pract.* 2017;23:869-880.[EL 4; NE]
450. **Peragallo Urrutia R, Coeytaux RR, McBroom AJ, et al.** Risk of acute thromboembolic events with oral contraceptive use: a systematic review and meta-analysis. *Obstet Gynecol.* 2013;122:380-389.[EL 2; MNRCT]
451. **Skubleny D, Switzer NJ, Gill RS, et al.** The impact of bariatric surgery on polycystic ovary syndrome: a systematic review and meta-analysis. *Obes Surg.* 2016;26:169-176.[EL 2; MNRCT]
452. **Kaur Y, de Souza RJ, Gibson WT, Meyre D.** A systematic review of genetic syndromes with obesity. *Obes Rev.* 2017;18:603-634.[EL 2; MNRCT]
453. **Neocleous V, Shammas C, Phelan MM, et al.** A novel MC4R deletion coexisting with FTO and MC1R gene variants, causes severe early onset obesity. *Hormones (Athens).* 2016;15:445-452.[EL 3; SCR]
454. **Pigeyre M, Yazdi FT, Kaur Y, Meyre D.** Recent progress in genetics, epigenetics and metagenomics unveils the pathophysiology of human obesity. *Clin Science (Lond).* 2016;130:943-986.[EL 4; NE]
455. **Kumar S, Kelly AS.** Review of childhood obesity: from epidemiology, etiology, and comorbidities to clinical assessment and treatment. *Mayo Clin Proc.* 2017;92:251-265.[EL 4; NE]
456. **Müller HL.** Craniopharyngioma and hypothalamic injury: latest insights into consequent eating disorders and obesity. *Curr Opin Endocrinol Diabetes Obes.* 2016;23:81-89.[EL 4; NE]
457. **Wijnen M, Olsson DS, van den Heuvel-Eibrink MM, et al.** Efficacy and safety of bariatric surgery for craniopharyngioma-related hypothalamic obesity: a matched case-control study with 2 years of follow-up. *Int J Obes.* 2017;41:210-216.[EL 2; RCCS]
458. **Fleisher LA, Fleischmann KE, Auerbach AD, et al.** 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2014;130:2215-2245.[EL 4; NE]
459. **Feely MA, Collins CS, Daniels PR, Kebede EB, Jatoti A, Mauck KF.** Preoperative testing before noncardiac surgery: guidelines and recommendations. *Am Fam Physician.* 2013;87:414-418.[EL 4; NE]
460. **Kristensen SD, Knuuti J, Saraste A, et al.** 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management: the joint task force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA). *Eur Heart J.* 2014;35:2383-2431.[EL 4; NE]
461. **Corso R, Russotto V, Gregoretti C, Cattano D.** Perioperative management of obstructive sleep apnea: a systematic review. *Minerva Anestesiol.* 2018;84:81-93.[EL 2; MNRCT]
462. **Devaraj U, Rajagopala S, Kumar A, Ramachandran P, Devereaux PJ, D'Souza GA.** Undiagnosed obstructive sleep apnea and postoperative outcomes: a prospective observational study. *Respiration.* 2017;94:18-25.[EL 2; PCS]
463. **Nepomnashy D, Hesham W, Erickson B, MacDonald J, Iorio R, Brams D.** Sleep apnea: is routine preoperative screening necessary? *Obes Surg.* 2013;23:287-291.[EL 2; CSS]
464. **Ravesloot MJ, van Maanen JP, Hilgevoord AA, van Wagenveld BA, de Vries N.** Obstructive sleep apnea is underrecognized and underdiagnosed in patients undergoing bariatric surgery. *Eur Arch Otorhinolaryngol.* 2012;269:1865-1871.[EL 2; ES]
465. **Kapur VK, Auckley DH, Chowdhuri S, et al.** Clinical practice guideline for diagnostic testing for adult obstructive sleep apnea: an American Academy of Sleep Medicine clinical practice guideline. *J Clin Sleep Med.* 2017;13:479-504.[EL 4; NE]
466. **Reed K, Pengo MF, Steier J.** Screening for sleep-disordered breathing in a bariatric population. *J Thorac Dis.* 2016;8:268-275.[EL 2; ES]

467. **de Raaff CA, Pierik AS, Coblijn UK, de Vries N, Bonjer HJ, van Wagenveld BA.** Value of routine polysomnography in bariatric surgery. *Surg Endosc.* 2017;31:245-248.[EL 2; CSS]
468. **Shearer E, Magee CJ, Lacasia C, Raw D, Kerrigan D.** Obstructive sleep apnea can be safely managed in a level 2 critical care setting after laparoscopic bariatric surgery. *Surg Obes Relat Dis.* 2013;9:845-849.[EL 2; ES]
469. **de Raaff CA, Coblijn UK, de Vries N, van Wagenveld BA.** Is fear of postoperative cardiopulmonary complications after bariatric surgery in patients with obstructive sleep apnea justified? A systematic review. *Am J Surg.* 2016;211:793-801.[EL 2; MNRCT]
470. **Goucham AB, Coblijn UK, Hart-Sweet HB, de Vries N, Lagarde SM, van Wagenveld BA.** Routine postoperative monitoring after bariatric surgery in morbidly obese patients with severe obstructive sleep apnea: ICU admission is not necessary. *Obes Surg.* 2016;26:737-742.[EL 2; CSS]
471. **Khan A, King WC, Patterson EJ, et al.** Assessment of obstructive sleep apnea in adults undergoing bariatric surgery in the longitudinal assessment of bariatric surgery-2 (LABS-2) study. *J Clin Sleep Med.* 2013;9:21-29.[EL 2; ES]
472. **Lockhart EM, Willingham MD, Abdallah AB, et al.** Obstructive sleep apnea screening and postoperative mortality in a large surgical cohort. *Sleep Med.* 2013;14:407-415.[EL 2; PCS]
473. **Haskins IN, Amdur R, Vaziri K.** The effect of smoking on bariatric surgical outcomes. *Surg Endosc.* 2014;28:3074-3080.[EL 2; ES]
474. **Morgan DJ, Ho KM.** The anaesthetic assessment, management and risk factors of bariatric surgical patients requiring postoperative intensive care support: a state-wide, five-year cohort study. *Anaesth Intensive Care.* 2016;44:237-244.[EL 2; PCS]
475. **Devlin CA, Smeltzer SC.** Temporary perioperative tobacco cessation: a literature review. *AORN J.* 2017;106:415-423.e5.[EL 4; NE]
476. **Veldheer S, Yingst J, Rogers AM, Foulds J.** Completion rates in a preoperative surgical weight loss program by tobacco use status. *Surg Obes Relat Dis.* 2017;13:842-847.[EL 2; ES]
477. **American Society for Metabolic and bariatric Surgery Clinical Issues Committee.** ASMBS updated position statement on prophylactic measures to reduce the risk of venous thromboembolism in bariatric surgery patients. *Surg Obes Relat Dis.* 2013;9:493-497.[EL 4; NE]
478. **Bartlett MA, Mauck KF, Daniels PR.** Prevention of venous thromboembolism in patients undergoing bariatric surgery. *Vasc Health Risk Manag.* 2015;11:461-477.[EL 2; MNRCT]
479. **Zanotti D, Elkalaawy M, Hashemi M, Jenkinson A, Adamo M.** Current status of preoperative oesophago-gastro-duodenoscopy (OGD) in Bariatric NHS Units-a BOMSS survey. *Obes Surg.* 2016;26:2257-2262.[EL 2; ES]
480. **Lee J, Wong SK, Liu SY, Ng EK.** Is preoperative upper gastrointestinal endoscopy in obese patients undergoing bariatric surgery mandatory? an Asian perspective. *Obes Surg.* 2017;27:44-50.[EL 2; ES]
481. **Mohan P, Kalayarasan R, Anand S.** Role of preoperative endoscopy in bariatric surgery. *Indian J Gastroenterol.* 2017;36:334-335.[EL 4; NE]
482. **Bennett S, Gostimir M, Shorr R, Mallick R, Mamazza J, Neville A.** The role of routine preoperative upper endoscopy in bariatric surgery: a systematic review and meta-analysis. *Surg Obes Relat Dis.* 2016;12:1116-1125.[EL 2; MNRCT]
483. **Parikh M, Liu J, Vieira D, et al.** Preoperative endoscopy prior to bariatric surgery: a systematic review and meta-analysis of the literature. *Obes Surg.* 2016;26:2961-2966.[EL 2; MNRCT]
484. **ASGE Standards of Practice Committee, Evans J, Muthusamy V, et al.** The role of endoscopy in the bariatric surgery patient. *Gastrointest Endosc.* 2015;29:1007-1017.[EL 4; NE]
485. **Abd Ellatif ME, Alfalah H, Asker WA, et al.** Place of upper endoscopy before and after bariatric surgery: a multicenter experience with 3219 patients. *World J Gastrointest Endosc.* 2016;8:409-417.[EL 2; ES]
486. **Yormaz S, Yilmaz H, Alptekin H, et al.** Does digestive symptoms require esophago gastroscopy prior to bariatric procedure? Assessment of 6 years' experience. *Ann Ital Chir.* 2017;6.[EL 2; ES]
487. **Wolter S, Duprée A, Miro J, et al.** Upper gastrointestinal endoscopy prior to bariatric surgery-mandatory or expendable? an analysis of 801 cases. *Obes Surg.* 2017;27:1938-1943.[EL 2; ES]
488. **Xanthakos SA, Jenkins TM, Kleiner DE, et al.** High prevalence of nonalcoholic fatty liver disease in adolescents undergoing bariatric surgery. *Gastroenterology.* 2015;149:623-634.e8.[EL 2; PCS]
489. **Petrick A, Benotti P, Wood GC, et al.** Utility of ultrasound, transaminases, and visual inspection to assess nonalcoholic fatty liver disease in bariatric surgery patients. *Obes Surg.* 2015;25:2368-2375.[EL 2; CSS]
490. **Naveau S, Lamouri K, Pourcher G, et al.** The diagnostic accuracy of transient elastography for the diagnosis of liver fibrosis in bariatric surgery candidates with suspected NAFLD. *Obes Surg.* 2014;24:1693-1701.[EL 2; CSS]
491. **de Cleva R, Duarte LF, Crenitte MRF, de Oliveira CPM, Pajecik D, Santo MA.** Use of noninvasive markers to predict advanced fibrosis/cirrhosis in severe obesity. *Surg Obes Relat Dis.* 2016;12:862-867.[EL 2; CSS]
492. **Barbois S, Arvieux C, Leroy V, Reche F, Stürm N, Borel AL.** Benefit-risk of intraoperative liver biopsy during bariatric surgery: review and perspectives. *Surg Obes Relat Dis.* 2017;13:1780-1786.[EL 2; MNRCT]
493. **Elnahas A, Nguyen GC, Okrainec A, Quereshey F, Jackson TD.** The effect of underlying liver disease on short-term outcomes following bariatric surgery. *Surg Endosc.* 2014;28:2708-2712.[EL 2; ES]
494. **Aguilar-Olivos NE, Almeda-Valdes P, Aguilar-Salinas CA, Uribe M, Méndez-Sánchez N.** The role of bariatric surgery in the management of nonalcoholic fatty liver disease and metabolic syndrome. *Metabolism.* 2016;65:1196-1207.[EL 2; ES]
495. **Schulman AR, Abougergi MS, Thompson CC.** *H. pylori* as a predictor of marginal ulceration: a nationwide analysis. *Obesity (Silver Spring).* 2017;25:522-526.[EL 2; ES]
496. **Mocanu V, Dang JT, Switzer N, et al.** The effect of *Helicobacter pylori* on postoperative outcomes in patients undergoing bariatric surgery: a systematic review and meta-analysis. *Obes Surg.* 2018;28:567-573.[EL 2; MNRCT]
497. **Maglio C, Peltonen M, Neovius M, et al.** Effects of bariatric surgery on gout incidence in the Swedish Obese Subjects study: a non-randomised, prospective, controlled intervention trial. *Ann Rheum Dis.* 2017;76:688-693.[EL 2; NRCT]
498. **Choi HK, Zhang Y.** Bariatric surgery as urate-lowering therapy in severe obesity. *Ann Rheum Dis.* 2014;73:791-793.[EL 4; NE]
499. **Nielsen SM, Bartels EM, Henriksen M, et al.** Weight loss for overweight and obese individuals with gout: a systematic review of longitudinal studies. *Ann Rheum Dis.* 2017;76:1870-1882.[EL 2; MNRCT]
500. **Kim J, Brethauer S.** Metabolic bone changes after bariatric surgery. *Surg Obes Relat Dis.* 2015;11:406-411.[EL 4; NE]
501. **Bredella MA, Greenblatt LB, Eajazi A, Torriani M, Yu EW.** Effects of Roux-en-Y gastric bypass and sleeve gastrectomy on bone mineral density and marrow adipose tissue. *Bone.* 2017;95:85-90.[EL 2; ES]
502. **Schafer AL, Kazakia GJ, Vittinghoff E, et al.** Effects of gastric bypass surgery on bone mass and microarchitecture occur early and particularly impact postmenopausal women. *J Bone Miner Res.* 2018;33:975-986.[EL 2; PCS]
503. **Kalani A, Bami H, Tiboni M, Jaeschke R, Adachi JD, Lau AN.** The effect of bariatric surgery on serum 25-OH vitamin D levels: a systematic review and meta-analysis. *Obes Sci Pract.* 2017;3:319-332.[EL 2; MNRCT]
504. **Wei JH, Lee WJ, Chong K, et al.** High incidence of secondary hyperparathyroidism in bariatric patients: comparing different procedures. *Obes Surg.* 2018;28:798-804.[EL 2; PCS]
505. **Viswanathan M, Reddy S, Berkman N, et al.** Screening to prevent osteoporotic fractures: an evidence review for the U.S. Preventive Services Task Force. *AHRQ Publication.* Available at: www.ahrq.gov2017.[EL 2; MNRCT]
506. **Sogg S, Friedman KE.** Getting off on the right foot: the many roles of the psychosocial evaluation in the bariatric surgery practice. *Eur Eat Disord Rev.* 2015;23:451-456.[EL 4; NE]

507. **Castaneda D, Popov VB, Wander P, Thompson CC.** Risk of suicide and self-harm is increased after bariatric surgery—a systematic review and meta-analysis. *Obes Surg.* 2019;29:322-333.[EL 2; MNRCT]
508. **Acevedo MB, Eagon JC, Bartholow BD, Klein S, Bucholz KK, Pepino MY.** Sleeve gastrectomy surgery: when 2 alcoholic drinks are converted to 4. *Sur Obes Relat Dis.* 2018;14:277-283.[EL 2; NRCT]
509. **Ibrahim N, Alameddine M, Brennan J, Sessine M, Holliday C, Ghaferi AA.** New onset alcohol use disorder following bariatric surgery. *Surg Endosc.* 2019;33:2521-2530.[EL 2; PCS]
510. **Chao AM, Wadden TA, Faulconbridge LF, et al.** Binge-eating disorder and the outcome of bariatric surgery in a prospective, observational study: two-year results. *Obesity (Silver Spring).* 2016;24:2327-2333.[EL 2; ES]
511. **Peacock JC, Zizzi SJ.** Survey of bariatric surgical patients' experiences with behavioral and psychological services. *Surg Obes Relat Dis.* 2012;8:777-783.[EL 2; ES]
512. **Wallwork A, Tremblay L, Chi M, Sockalingam S.** Exploring partners' experiences in living with patients who undergo bariatric surgery. *Obes Surg.* 2017;27:1973-1981.[EL 2; ES]
513. **Neovius M, Bruze G, Jacobson P, et al.** Risk of suicide and non-fatal self-harm after bariatric surgery: results from two matched cohort studies. *Lancet Diabetes Endocrinol.* 2018;6:197-207.[EL 2; PCS]
514. **Modi AC, Zeller MH, Xanthakos SA, Jenkins TM, Inge TH.** Adherence to vitamin supplementation following adolescent bariatric surgery. *Obesity (Silver Spring).* 2013;21:E190-E195.[EL 2; ES]
515. **Chan L, Zheng W, Colovos T.** Assessing micronutrient adherence after bariatric surgery: an exploratory study. *J Obes Bariatrics.* 2015;2:8.[EL 2; ES]
516. **Stein J, Stier C, Raab H, Weiner R.** Review article: the nutritional and pharmacological consequences of obesity surgery. *Aliment Pharmacol Ther.* 2014;40:582-609.[EL 2; MNRCT]
517. **Wolf E, Utech M, Stehle P, Büsing M, Stoffel-Wagner B, Ellinger S.** Preoperative micronutrient status in morbidly obese patients before undergoing bariatric surgery: results of a cross-sectional study. *Surg Obes Relat Dis.* 2015;11:1157-1163.[EL 2; CSS]
518. **Lefebvre P, Letois F, Sultan A, Nocca D, Mura T, Galtier F.** Nutrient deficiencies in patients with obesity considering bariatric surgery: a cross-sectional study. *Surg Obes Relat Dis.* 2014;10:540-546.[EL 2; CSS]
519. **Thibault R, Huber O, Azagury DE, Pichard C.** Twelve key nutritional issues in bariatric surgery. *Clin Nutr.* 2016;35:12-17.[EL 4; NE]
520. **Nicoletti CF, Lima TP, Donadelli SP, Salgado W Jr, Marchini JS, Nonino CB.** New look at nutritional care for obese patient candidates for bariatric surgery. *Surg Obes Relat Dis.* 2013;9:520-525.[EL 2; ES]
521. **Kerns JC, Arundel C, Chawla LS.** Thiamin deficiency in people with obesity. *Adv Nutr.* 2015;6:147-153.[EL 2; MNRCT]
522. **Carrodeguas L, Kaidar-Person O, Szomstein S, Antozzi P, Rosenthal R.** Preoperative thiamine deficiency in obese population undergoing laparoscopic bariatric surgery. *Surg Obes Relat Dis.* 2005;1:517-522; discussion 522.[EL 2; ES]
523. **Al-Fahad T, Ismael A, Soliman MO, Khourshed M.** Very early onset of Wernicke's encephalopathy after gastric bypass. *Obes Surg.* 2006;16:671-672.[EL 3; SCR]
524. **Maguire D, Talwar D, Shiels PG, McMillan D.** The role of thiamine dependent enzymes in obesity and obesity related chronic disease states: a systematic review. *Clin Nutr ESPEN.* 2018;25:8-17.[EL 2; MNRCT]
525. **Nath A, Tran T, Shope TR, Koch TR.** Prevalence of clinical thiamine deficiency in individuals with medically complicated obesity. *Nutr Res.* 2017;37:29-36.[EL 2; ES]
526. **Pellitero S, Martínez E, Puig R, et al.** Evaluation of vitamin and trace element requirements after sleeve gastrectomy at long term. *Obes Surg.* 2017;27:1674-1682.[EL 2; ES]
527. **Aron-Wisniewsky J, Verger EO, Bounaix C, et al.** Nutritional and protein deficiencies in the short term following both gastric bypass and gastric banding. *PLoS One.* 2016;11:e0149588.[EL 2; ES]
528. **Force.** USPST. Recommendations for Primary Care Practice. Available at <https://www.uspreventiveservicestaskforce.org/Page/Name/recommendations>. Accessed April 21, 2018.[EL 4; NE]
529. **Himbert C, Delphan M, Scherer D, Bowers LW, Hursting S, Ulrich CM.** Signals from the adipose microenvironment and the obesity-cancer link—a systematic review. *Cancer Prev Res (Phila).* 2017;10:494-506.[EL 2; MNRCT]
530. **Lashinger LM, Ford NA, Hursting SD.** Interacting inflammatory and growth factor signals underlie the obesity-cancer link. *J Nutr.* 2014;144:109-113.[EL 4; NE]
531. **Schauer DP, Feigelson HS, Koebnick C, et al.** Association between weight loss and the risk of cancer after bariatric surgery. *Obesity (Silver Spring).* 2017;25(suppl 2):S52-S57.[EL 2; ES]
532. **Farey JE, Fisher OM, Levert-Mignon AJ, Forner PM, Lord RV.** Decreased levels of circulating cancer-associated protein biomarkers following bariatric surgery. *Obes Surg.* 2017;27:578-585.[EL 2; PCS]
533. **Hunsinger MA, Wood GC, Still C, et al.** Maximizing weight loss after Roux-en-Y gastric bypass may decrease risk of incident organ cancer. *Obes Surg.* 2016;26:2856-2861.[EL 2; ES]
534. **Casagrande DS, Rosa DD, Umpierre D, Sarmiento RA, Rodrigues CG, Schaun BD.** Incidence of cancer following bariatric surgery: systematic review and meta-analysis. *Obes Surg.* 2014;24:1499-1509.[EL 1; MRCT]
535. **Winder AA, Kularatna M, MacCormick AD.** Does bariatric surgery affect the incidence of breast cancer development? A systematic review. *Obes Surg.* 2017;27:3014-3020.[EL 2; MNRCT]
536. **Afshar S, Kelly SB, Seymour K, Lara J, Woodcock S, Mathers JC.** The effects of bariatric surgery on colorectal cancer risk: systematic review and meta-analysis. *Obes Surg.* 2014;24:1793-1799.[EL 2; MNRCT]
537. **Hussan H, Stanich PP, Gray DM, 2nd, et al.** Prior bariatric surgery is linked to improved colorectal cancer surgery outcomes and costs: a propensity-matched analysis. *Obes Surg.* 2017;27:1047-1055.[EL 3; DS]
538. **Afshar S, Malcomson F, Kelly SB, Seymour K, Woodcock S, Mathers JC.** Biomarkers of colorectal cancer risk decrease 6 months after Roux-en-Y gastric bypass surgery. *Obes Surg.* 2018;28:945-954.[EL 3; DS]
539. **Tao W, Konings P, Hull MA, Adami HO, Mattsson F, Lagergren J.** Colorectal cancer prognosis following obesity surgery in a population-based cohort study. *Obes Surg.* 2017;27:1233-1239.[EL 2; ES]
540. **Linkov F, Goughnour SL, Ma T, et al.** Changes in inflammatory endometrial cancer risk biomarkers in individuals undergoing surgical weight loss. *Gynecol Oncol.* 2017;147:133-138.[EL 2; ES]
541. **Anveden A, Taube M, Peltonen M, et al.** Long-term incidence of female-specific cancer after bariatric surgery or usual care in the Swedish Obese Subjects Study. *Gynecol Oncol.* 2017;145:224-229.[EL 2; PCS]
542. **Yang B, Yang HP, Ward KK, Sahasrabudhe VV, McGlynn KA.** Bariatric surgery and liver cancer in a consortium of academic medical centers. *Obes Surg.* 2016;26:696-700.[EL 3; DS]
543. **Xu M, Jung X, Hines OJ, Eibl G, Chen Y.** Obesity and pancreatic cancer: overview of epidemiology and potential prevention by weight loss. *Pancreas.* 2018;47:158-162.[EL 4; NE]
544. **Burton PR, Ooi GJ, Laurie C, et al.** Diagnosis and management of oesophageal cancer in bariatric surgical patients. *J Gastrointest Surg.* 2016;20:1683-1691.[EL 2; ES]
545. **Dantas AC, Santo MA, de Cleva R, Sallum RA, Cecconello I.** Influence of obesity and bariatric surgery on gastric cancer. *Cancer Biol Med.* 2016;13:269-276.[EL 4; NE]
546. **Orlando G, Pilone V, Vitiello A, et al.** Gastric cancer following bariatric surgery: a review. *Surg Laparosc Endosc Percutan Tech.* 2014;24:400-405.[EL 4; NE]
547. **Philip EJ, Torghabeh MH, Strain GW.** Bariatric surgery in cancer survivorship: does a history of cancer affect weight loss outcomes? *Surg Obes Relat Dis.* 2015;11:1105-1108.[EL 2; ES]
548. **Carron M, Zarantonello F, Tellaroli P, Ori C.** Perioperative noninvasive ventilation in obese patients: a qualitative review and meta-analysis. *Surg Obes Relat Dis.* 2016;12:681-691.[EL 2; MNRCT]

549. **Bellamy MC, Margaron MP.** Designing intelligent anesthesia for a changing patient demographic: a consensus statement to provide guidance for specialist and non-specialist anesthetists written by members of and endorsed by the Society for Obesity and Bariatric Anaesthesia (SOBA). *Perioper Med (Lond)*. 2013;2:12. [EL 4; NE]
550. **King AB, Spann MD, Jablonski P, Wanderer JP, Sandberg WS, McEvoy MD.** An enhanced recovery program for bariatric surgical patients significantly reduces perioperative opioid consumption and postoperative nausea. *Sur Obes Relat Dis*. 2018;14:849-856. [EL 2; ES]
551. **Soleimanpour H, Safari S, Sanaie S, Nazari M, Alavian SM.** Anesthetic considerations in patients undergoing bariatric surgery: a review article. *Anesth Pain Med*. 2017;7:e57568. [EL 2; MNRCT]
552. **Dupanovic M, Krebill R, Dupanovic I, Nachtigal J, Rockford M, Orr W.** Perioperative factors affecting ambulatory outcomes following laparoscopic-adjustable gastric banding. *Turkish J Anaesthesiol Reanim*. 2017;45:282-288. [EL 2; ES]
553. **Defresne AA, Hans GA, Goffin PJ, et al.** Recruitment of lung volume during surgery neither affects the postoperative spirometry nor the risk of hypoxaemia after laparoscopic gastric bypass in morbidly obese patients: a randomized controlled study. *Br J Anaesth*. 2014;113:501-507. [EL 1; RCT]
554. **Stankiewicz-Rudnicki M, Gaszynski W, Gaszynski T.** Assessment of ventilation distribution during laparoscopic bariatric surgery: an electrical impedance tomography study. *BioMed Res Int*. 2016;2016:7423162. [EL 1; RCT]
555. **Pasquier EK, Andersson E.** Pulmonary recruitment maneuver reduces pain after laparoscopic bariatric surgery: a randomized controlled clinical trial. *Sur Obes Relat Dis*. 2018;14:386-392. [EL 1; RCT]
556. **Eichler L, Truskowska K, Dupree A, Busch P, Goetz AE, Zöllner C.** Intraoperative ventilation of morbidly obese patients guided by transpulmonary pressure. *Obes Surg*. 2018;28:122-129. [EL 2; OLES]
557. **Liu S, Sun J, Chen X, Yu Y, Liu X, Liu C.** The application of transcutaneous CO2 pressure monitoring in the anesthesia of obese patients undergoing laparoscopic bariatric surgery. *PLoS One*. 2014;9:e91563. [EL 2; ES]
558. **Schraverus P, Kuijpers MM, Coumou J, Boly CA, Boer C, van Kralingen S.** Level of agreement between cardiac output measurements using Nexfin(R) and thermodilution in morbidly obese patients undergoing laparoscopic surgery. *Anaesthesia*. 2016;71:1449-1455. [EL 2; CSS]
559. **Le Gall L, David A, Carles P, et al.** Benefits of intraoperative analgesia guided by the Analgesia Nociception Index (ANI) in bariatric surgery: an unmatched case-control study. *Anaesth Crit Care Pain Med*. 2019;38:35-39. [EL 2; RCCS]
560. **Vaughns JD, Martin C, Nelson J, Nadler E, Quezado ZM.** Dexmedetomidine as an adjuvant for perioperative pain management in adolescents undergoing bariatric surgery: an observational cohort study. *J Pediatr Surg*. 2017;52:1787-1790. [EL 2; ES]
561. **Singh PM, Panwar R, Borle A, Mulier JP, Sinha A, Goudra B.** Perioperative analgesic profile of dexmedetomidine infusions in morbidly obese undergoing bariatric surgery: a meta-analysis and trial sequential analysis. *Surg Obes Relat Dis*. 2017;13:1434-1446. [EL 1; MRCT]
562. **Alhammad AM, Baghdady NA, Mullin RA, Greenwood BC.** Evaluation of the impact of a prescribing guideline on the use of intraoperative dexmedetomidine at a tertiary academic medical center. *Saudi Pharm J*. 2017;25:144-147. [EL 2; ES]
563. **Vaughns JD, Ziesenitz VC, Williams EF, et al.** Use of fentanyl in adolescents with clinically severe obesity undergoing bariatric surgery: a pilot study. *Paediatr Drugs*. 2017;19:251-257. [EL 2; OLES]
564. **Ozdogan HK, Cetinkunar S, Karateke F, Cetinalp S, Celik M, Ozyazici S.** The effects of sevoflurane and desflurane on the hemodynamics and respiratory functions in laparoscopic sleeve gastrectomy. *J Clin Anesth*. 2016;35:441-445. [EL 2; NRCT]
565. **De Angelis F, Abdelgawad M, Rizzello M, Mattia C, Silecchia G.** Perioperative hemorrhagic complications after laparoscopic sleeve gastrectomy: four-year experience of a bariatric center of excellence. *Surg Endosc*. 2017;31:3547-3551. [EL 2; CSS]
566. **Demirel I, Bolat E, Altun AY, Özdemir M, Bıstaş A.** Efficacy of goal-directed fluid therapy via pleth variability index during laparoscopic Roux-en-Y gastric bypass surgery in morbidly obese patients. *Obes Surg*. 2018;28:358-363. [EL 1; RCT]
567. **Sheaffer WW, Day RW, Harold KL, et al.** Decreasing length of stay in bariatric surgery: the power of suggestion. *Am J Surg*. 2018;215:452-455. [EL 2; ES]
568. **Thorell A, MacCormick AD, Awad S, et al.** Guidelines for perioperative care in bariatric surgery: enhanced recovery after surgery (ERAS) society recommendations. *World J Surg*. 2016;40:2065-2083. [EL 4; NE]
569. **Ruiz-Tovar J, Royo P, Muñoz JL, Duran M, Redondo E, Ramirez JM.** Implementation of the Spanish National Enhanced Recovery Program (ERAS) in bariatric surgery: a pilot study. *Surg Laparosc Endosc Percutan Tech*. 2016;26:439-443. [EL 2; PCS]
570. **Lemanu DP, Srinivasa S, Singh PP, Johannsen S, MacCormick AD, Hill AG.** Optimizing perioperative care in bariatric surgery patients. *Obes Surg*. 2012;22:979-990. [EL 4; NE]
571. **Quezada N, Maiz C, Daroch D, et al.** Effect of early use of covered self-expandable endoscopic stent on the treatment of postoperative stapler line leaks. *Obes Surg*. 2015;25:1816-1821. [EL 2; ES]
572. **Bambgade OA, Oluwale O, Khaw RR.** Perioperative analgesia for fast-track laparoscopic bariatric surgery. *Obes Surg*. 2017;27:1828-1834. [EL 2; ES]
573. **Mansour MA, Mahmoud AA, Gedday M.** Nonopioid versus opioid based general anesthesia technique for bariatric surgery: a randomized double-blind study. *Saudi J Anaesth*. 2013;7:387-391. [EL 1; RCT]
574. **Singh PM, Panwar R, Borle A, et al.** Efficiency and safety effects of applying ERAS protocols to bariatric surgery: a systematic review with meta-analysis and trial sequential analysis of evidence. *Obes Surg*. 2017;27:489-501. [EL 1; MRCT]
575. **Loots E, Sartorius B, Paruk IM, Clarke DL.** The successful implementation of a modified Enhanced Recovery After Surgery (ERAS) program for bariatric surgery in a South African teaching hospital. *Surg Laparosc Endosc Percutan Tech*. 2018;28:26-29. [EL 2; ES]
576. **Simonelli V, Goergen M, Orlando GG, et al.** Fast-Ttack in bariatric and metabolic surgery: feasibility and cost analysis through a matched-cohort study in a single centre. *Obes Surg*. 2016;26:1970-1977. [EL 2; ES]
577. **Proczko M, Kaska L, Twardowski P, Stepianiak P.** Implementing enhanced recovery after bariatric surgery protocol: a retrospective study. *J Anesth*. 2016;30:170-173. [EL 2; ES]
578. **Ronellenfitch U, Schwarzbach M, Kring A, Kienle P, Post S, Hasenberg T.** The effect of clinical pathways for bariatric surgery on perioperative quality of care. *Obes Surg*. 2012;22:732-739. [EL 2; ES]
579. **Khorgami Z, Petrosky JA, Andalib A, Aminian A, Schauer PR, Brethauer SA.** Fast track bariatric surgery: safety of discharge on the first postoperative day after bariatric surgery. *Surg Obes Relat Dis*. 2017;13:273-280. [EL 2; ES]
580. **Hahl T, Peromaa-Haavisto P, Tarkiainen P, Knutar O, Victorzon M.** Outcome of laparoscopic gastric bypass (LRYGB) with a program for Enhanced Recovery After Surgery (ERAS). *Obes Surg*. 2016;26:505-511. [EL 2; ES]
581. **Barreca M, Renzi C, Tankel J, Shalhoub J, Sengupta N.** Is there a role for enhanced recovery after laparoscopic bariatric surgery? Preliminary results from a specialist obesity treatment center. *Surg Obes Relat Dis*. 2016;12:119-126. [EL 2; ES]
582. **Matok M, Pędziwiatr M, Major P, Kłęk S, Budzyński P, Małczak P.** One hundred seventy-nine consecutive bariatric operations after introduction of protocol inspired by the principles of enhanced recovery after surgery (ERAS(R)) in bariatric surgery. *Med Sci Monit*. 2015;21:791-797. [EL 2; ES]
583. **Awad S, Carter S, Purkayastha S, et al.** Enhanced recovery after bariatric surgery (ERABS): clinical outcomes from a tertiary referral bariatric centre. *Obes Surg*. 2014;24:753-758. [EL 2; ES]
584. **Lemanu DP, Singh PP, Berridge K, et al.** Randomized clinical trial of enhanced recovery versus standard care after laparoscopic sleeve gastrectomy. *Br J Surg*. 2013;100:482-489. [EL 1; RCT]
585. **Rickey J, Gersin K, Yang W, Stefanidis D, Kuwada T.** Early discharge in the bariatric population does not increase post-

- discharge resource utilization. *Surg Endosc.* 2017;31:618-624.[EL 2; ES]
586. **Małczak P, Pisarska M, Piotr M, Wysocki M, Budzyński A, Pędziwiatr M.** Enhanced recovery after bariatric surgery: systematic review and meta-analysis. *Obes Surg.* 2017;27:226-235.[EL 1; MRCT]
587. **Stowers MD, Lemanu DP, Hill AG.** Health economics in Enhanced Recovery After Surgery programs. *Can J Anaesth.* 2015;62:219-230.[EL 2; MNRCT]
588. **Ahmed OS, Rogers AC, Bolger JC, Mastrosimone A, Robb WB.** Meta-analysis of enhanced recovery protocols in bariatric surgery. *J Gastrointest Surg.* 2018;22:964-972.[EL 1; MRCT]
589. **Mannaerts GH, van Mil SR, Stepaniak PS, et al.** Results of implementing an Enhanced Recovery After Bariatric Surgery (ERABS) protocol. *Obes Surg.* 2016;26:303-312.[EL 2; ES]
590. **Blanchet MC, Gignoux B, Matussière Y, et al.** Experience with an Enhanced Recovery After Surgery (ERAS) Program for Bariatric Surgery: comparison of MGB and LSG in 374 patients. *Obes Surg.* 2017;27:1896-1900.[EL 2; ES]
591. **Jonsson A, Lin E, Patel L, et al.** Barriers to enhanced recovery after surgery after laparoscopic sleeve gastrectomy. *J Am Coll Surg.* 2018;226:605-613.[EL 2; ES]
592. **Deneuvy A, Slim K, Sodji M, Blanc P, Gallet D, Blanchet MC.** Implementation of enhanced recovery programs for bariatric surgery. Results from the Francophone large-scale database. *Surg Obes Relat Dis.* 2018;14:99-105.[EL 3; DS]
593. **Alvarez A, Goudra BG, Singh PM.** Enhanced recovery after bariatric surgery. *Curr Opin Anaesthesiol.* 2017;30:133-139.[EL 4; NE]
594. **Etzioni DA, Wasif N, Dueck AC, et al.** Association of hospital participation in a surgical outcomes monitoring program with inpatient complications and mortality. *JAMA.* 2015;313:505-511.[EL 2; ES]
595. **Bangbade OA, Oluwale O, Khaw RR.** Perioperative antiemetic therapy for fast-track laparoscopic bariatric surgery. *Obes Surg.* 2018;28:1296-1301.[EL 2; PCS]
596. **Major P, Wysocki M, Torbicz G, et al.** Risk factors for prolonged length of hospital stay and readmissions after laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass. *Obes Surg.* 2018;28:323-332.[EL 2; PHAS]
597. **Major P, Stefura T, Małczak P, et al.** Postoperative care and functional recovery after laparoscopic sleeve gastrectomy vs. laparoscopic Roux-en-Y gastric bypass among patients under ERAS protocol. *Obes Surg.* 2018;28:1031-1039.[EL 2; ES]
598. **Weimann A, Braga M, Carli F, et al.** ESPEN guideline: clinical nutrition in surgery. *Clin Nutr.* 2017;36:623-650.[EL 4; NE]
599. **Sherf Dagan S, Goldenshluger A, Globus I, et al.** Nutritional recommendations for adult bariatric surgery patients: clinical practice. *Adv Nutr.* 2017;15:382-394.[EL 4; NE]
600. **Cuesta M, Pelaz L, Pérez C, et al.** Fat-soluble vitamin deficiencies after bariatric surgery could be misleading if they are not appropriately adjusted. *Nutr Hosp.* 2014;30:118-123.[EL 2; ES]
601. **Velazquez A, Apovian CM, Istfan NW.** The complexities of iron deficiency in patients after bariatric surgery. *Am J Med.* 2017;130:e293-e294.[EL 4; NE]
602. **Cepeda-Lopez AC, Allende-Labastida J, Melse-Boonstra A, et al.** The effects of fat loss after bariatric surgery on inflammation, serum hepcidin, and iron absorption: a prospective 6-mo iron stable isotope study. *Am J Clin Nutr.* 2016;104:1030-1038.[EL 2; ES]
603. **Gerhard GS, Chokshi R, Still CD, et al.** The influence of iron status and genetic polymorphisms in the HFE gene on the risk for postoperative complications after bariatric surgery: a prospective cohort study in 1,064 patients. *Patient Saf Surg.* 2011;5:1.[EL 2; ES]
604. **Fiske DN, McCoy HE 3rd, Kitchens CS.** Zinc-induced sideroblastic anemia: report of a case, review of the literature, and description of the hematologic syndrome. *Am J Hematol.* 1994;46:147-150.[EL 3; SCR]
605. **Sheqwara J, Alkhatib Y.** Sideroblastic anemia secondary to zinc toxicity. *Blood.* 2013;122:311.[EL 3; SCR]
606. **Kaur P, Mishra SK, Mithal A.** Vitamin D toxicity resulting from overzealous correction of vitamin D deficiency. *Clin Endocrinol (Oxf).* 2015;83:327-331.[EL 2; ES]
607. **Flores L, Moizé V, Ortega E, et al.** Prospective study of individualized or high fixed doses of vitamin D supplementation after bariatric surgery. *Obes Surg.* 2015;25:470-476.[EL 2; PCS]
608. **Jain AK, Dutta A.** Stroke volume variation as a guide to fluid administration in morbidly obese patients undergoing laparoscopic bariatric surgery. *Obes Surg.* 2010;20:709-715.[EL 2; ES]
609. **Matot I, Paskaleva R, Eid L, et al.** Effect of the volume of fluids administered on intraoperative oliguria in laparoscopic bariatric surgery: a randomized controlled trial. *Arch Surg.* 2012;147:228-234.[EL 1; RCT]
610. **Muñoz JL, Gabaldón T, Miranda E, et al.** Goal-directed fluid therapy on laparoscopic sleeve gastrectomy in morbidly obese patients. *Obes Surg.* 2016;26:2648-2653.[EL 2; ES]
611. **Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures: An Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration.** *Anesthesiology.* 2017;126:376-393.[EL 4; NE]
612. **van Beek AP, Emous M, Laville M, Tack J.** Dumping syndrome after esophageal, gastric or bariatric surgery: pathophysiology, diagnosis, and management. *Obes Rev.* 2017;18:68-85.[EL 2; MNRCT]
613. **Nimeri A, Ibrahim M, Maasher A, Al Hadad M.** Management algorithm for leaks following laparoscopic sleeve gastrectomy. *Obes Surg.* 2016;26:21-25.[EL 2; ES]
614. **Bétry C, Disse E, Chambrier C, et al.** Need for intensive nutrition care after bariatric surgery. *J Parenter Enteral Nutr.* 2017;41:258-262.[EL 3; CCS]
615. **Beebe ML, Crowley N.** Can hypocaloric, high-protein nutrition support be used in complicated bariatric patients to promote weight loss? *Nutr Clin Pract.* 2015;30:522-529.[EL 4; NE]
616. **Pompilio CE, Pelosi P, Castro MG.** The bariatric patient in the intensive care unit: pitfalls and management. *Curr Atheroscler Rep.* 2016;18:55.[EL 4; NE]
617. **Azagury DE, Ris F, Pichard C, Volonté F, Karsegard L, Huber O.** Does perioperative nutrition and oral carbohydrate load sustainably preserve muscle mass after bariatric surgery? A randomized control trial. *Surg Obes Relat Dis.* 2015;11:920-926.[EL 1; RCT]
618. **Chiappetta S, Stein J.** Refeeding syndrome: an important complication following obesity surgery. *Obes Facts.* 2016;9:12-16.[EL 3; SCR]
619. **Umpierrez GE, Isaacs SD, Bazargan N, You X, Thaler LM, Kitabchi AE.** Hyperglycemia: an independent marker of in-hospital mortality in patients with undiagnosed diabetes. *J Clin Endocrinol Metab.* 2002;87:978-982.[EL 2; RCCS]
620. **Frisch A, Chandra P, Smiley D, et al.** Prevalence and clinical outcome of hyperglycemia in the perioperative period in noncardiac surgery. *Diabetes Care.* 2010;33:1783-1788.[EL 2; PCS]
621. **Kotagal M, Symons RG, Hirsch IB, et al.** Perioperative hyperglycemia and risk of adverse events among patients with and without diabetes. *Ann Surg.* 2015;261:97-103.[EL 2; PCS]
622. **Blackstone R, Dieran J, Davis M, Rivera L.** Continuous perioperative insulin infusion therapy for patients with type 2 diabetes undergoing bariatric surgery. *Surg Endosc.* 2007;21:1316-1322.[EL 2; RCCS]
623. **Batterham RL, Cummings DE.** Mechanisms of diabetes improvement following bariatric/metabolic surgery. *Diabetes Care.* 2016;39:893-901.[EL 4; NE]
624. **Martinussen C, Bojsen-Møller KN, Dirksen C, et al.** Immediate enhancement of first-phase insulin secretion and unchanged glucose effectiveness in patients with type 2 diabetes after Roux-en-Y gastric bypass. *Am J Physiol Endocrinol Metab.* 2015;308:E535-E544.[EL 2; ES]
625. **de Oliveira LF, Tisott CG, Silvano DM, Campos CM, do Nascimento RR.** Glycemic behavior in 48 hours postoperative period of patients with type 2 diabetes mellitus and non diabetic submitted to bariatric surgery [in English, Portuguese]. *Arq Bras Cir Dig.* 2015;28 Suppl 1:26-30.[EL 2; ES]
626. **Zaman JA, Shah N, Levenson GE, Greenberg JA, Funk LM.** The effects of optimal perioperative glucose control on morbidly obese patients undergoing bariatric surgery. *Surg Endosc.* 2017;31:1407-1413.[EL 2; ES]

627. Lyons T, Neff KJ, Benn J, Chuah LL, le Roux CW, Gilchrist M. Body mass index and diabetes status do not affect postoperative infection rates after bariatric surgery. *Surg Obes Relat Dis.* 2014;10:291-297.[EL 2; ES]
628. Diemer DM, Terry KL, Matthews M, Romich E, Saran H, Lansang MC. Postoperative insulin requirements in bariatric surgery. *Endocr Pract.* 2017;23:1369-1374.[EL 2; ES]
629. Morgan DJ, Ho KM, Armstrong J, Baker S. Incidence and risk factors for intensive care unit admission after bariatric surgery: a multicentre population-based cohort study. *Br J Anaesth.* 2015;115:873-882.[EL 2; ES]
630. Penna GLdA, Vaz IP, Fonseca EC, Kalichshtein M, Nobre GF. Immediate postoperative of bariatric surgery in the intensive care unit versus an inpatient unit. A retrospective study with 828 patients. *Rev Bras Ter Intensiva.* 2017;29:325-330.[EL 2; ES]
631. Vest AR, Patel P, Schauer PR, et al. Clinical and echocardiographic outcomes after bariatric surgery in obese patients with left ventricular systolic dysfunction. *Circ Heart Fail.* 2016;9:e002260.[EL 2; ES]
632. Chang SH, Freeman NLB, Lee JA, et al. Early major complications after bariatric surgery in the USA, 2003-2014: a systematic review and meta-analysis. *Obes Rev.* 2018;19:529-537.[EL 2; MNRCT]
633. Dalmar A, Singh M, Pandey B, et al. The beneficial effect of weight reduction on adverse cardiovascular outcomes following bariatric surgery is attenuated in patients with obstructive sleep apnea. *Sleep.* 2018;41.[EL 2; ES]
634. Haskins IN, Kudsi J, Hayes K, Amdur RL, Lin PP, Vaziri K. The effect of resident involvement on bariatric surgical outcomes: an ACS-NSQIP analysis. *J Surg. Res.* 2018;223:224-229.[EL 2; ES]
635. Kong WT, Chopra S, Kopf M, et al. Perioperative risks of untreated obstructive sleep apnea in the bariatric surgery patient: a retrospective study. *Obes Surg.* 2016;26:2886-2890.[EL 2; ES]
636. Baltieri L, Santos LA, Rasera I Jr, Montebelo MI, Pazzianotto-Forti EM. Use of positive pressure in the bariatric surgery and effects on pulmonary function and prevalence of atelectasis: randomized and blinded clinical trial [in English, Portuguese]. *Arq Bras Cir Dig.* 2014;27(suppl 1):26-30.[EL 1; RCT]
637. de Raaff CAL, Kalf MC, Coblijn UK, et al. Influence of continuous positive airway pressure on postoperative leakage in bariatric surgery. *Surg Obes Relat Dis.* 2018;14:186-190.[EL 2; ES]
638. de Raaff CAL, de Vries N, van Wagenveld BA. Obstructive sleep apnea and bariatric surgical guidelines: summary and update. *Curr Opin Anaesthesiol.* 2018;31:104-109.[EL 4; NE]
639. de Raaff CAL, Gorter-Stam MAW, de Vries N, et al. Perioperative management of obstructive sleep apnea in bariatric surgery: a consensus guideline. *Surg Obes Relat Dis.* 2017;13:1095-1109.[EL 4; NE]
640. Wickerts L, Forsberg S, Bouvier F, Jakobsson J. Monitoring respiration and oxygen saturation in patients during the first night after elective bariatric surgery: a cohort study. *F1000Res.* 2017;6:735.[EL 2; ES]
641. Rottenstreich A, Elazary R, Kalish Y. Abdominal thrombotic complications following bariatric surgery. *Surg Obes Relat Dis.* 2017;13:78-84.[EL 2; ES]
642. Safdie FM, Dip F, Ardila-Gatas J, et al. Incidence and clinical implications of upper extremity deep vein thrombosis after laparoscopic bariatric procedures. *Obes Surg.* 2015;25:1098-1101.[EL 2; ES]
643. Helm MC, Simon K, Higgins R, Kindel TL, Gould JC. Perioperative complications increase the risk of venous thromboembolism following bariatric surgery. *Am J Surg.* 2017;214:1135-1140.[EL 3; DS]
644. Venclauskas L, Maleckas A, Arcelus JI. European guidelines on perioperative venous thromboembolism prophylaxis: surgery in the obese patient. *Eur J Anaesthesiol.* 2018;35:147-153.[EL 4; NE]
645. Aminian A, Andalib A, Khorgami Z, et al. Who should get extended thromboprophylaxis after bariatric surgery?: A risk assessment tool to guide indications for post-discharge pharmacoprophylaxis. *Ann Surg.* 2017;265:143-150.[EL 3; DS]
646. Nielsen AW, Helm MC, Kindel T, et al. Perioperative bleeding and blood transfusion are major risk factors for venous thromboembolism following bariatric surgery. *Surg Endosc.* 2018;32:2488-2495.[EL 3; DS]
647. Haskins IN, Amdur R, Sarani B, Vaziri K. Congestive heart failure is a risk factor for venous thromboembolism in bariatric surgery. *Surg Obes Relat Dis.* 2015;11:1140-1145.[EL 3; DS]
648. Jamal MH, Corcelles R, Shimizu H, et al. Thromboembolic events in bariatric surgery: a large multi-institutional referral center experience. *Surg Endosc.* 2015;29:376-380.[EL 2; ES]
649. Hölländer SW, Sift A, Hess S, Kligen HJ, Djalali P, Birk D. Identifying the bariatric patient at risk for pulmonary embolism: prospective clinical trial using duplex sonography and blood screening. *Obes Surg.* 2015;25:2011-2017.[EL 2; NRCT]
650. Steib A, Degirmenci SE, Junke E, et al. Once versus twice daily injection of enoxaparin for thromboprophylaxis in bariatric surgery: effects on antifactor Xa activity and procoagulant microparticles. A randomized controlled study. *Surg Obes Relat Dis.* 2016;12:613-621.[EL 1; RCT]
651. Celik F, Huitema AD, Hooijberg JH, van de Laar AW, Brandjes DP, Gerdes VE. Fixed-dose enoxaparin after bariatric surgery: the influence of body weight on peak anti-Xa levels. *Obes Surg.* 2015;25:628-634.[EL 2; ES]
652. Mushtaq A, Vaughns JD, Ziesenitz VC, Nadler EP, van den Anker JN. Use of Enoxaparin in obese adolescents during bariatric surgery—a pilot study. *Obes Surg.* 2015;25:1869-1874.[EL 3; DS]
653. Steele KE, Canner J, Prokopowicz G, et al. The EFFORT trial: Preoperative enoxaparin versus postoperative fondaparinux for thromboprophylaxis in bariatric surgical patients: a randomized double-blind pilot trial. *Surg Obes Relat Dis.* 2015;11:672-683.[EL 1; RCT]
654. Sharma G, Hanipah ZN, Aminian A, et al. Bariatric surgery in patients on chronic anticoagulation therapy. *Obes Surg.* 2018;28:2225-2232.[EL 2; ES]
655. Kaw R, Pasupuleti V, Wayne Overby D, et al. Inferior vena cava filters and postoperative outcomes in patients undergoing bariatric surgery: a meta-analysis. *Surg Obes Relat Dis.* 2014;10:725-733.[EL 1; MRCT]
656. Birkmeyer NJ, Finks JF, English WJ, et al. Risks and benefits of prophylactic inferior vena cava filters in patients undergoing bariatric surgery. *J Hosp Med.* 2013;8:173-177.[EL 2; ES]
657. Rowland SP, Dharmarajah B, Moore HM, et al. Inferior vena cava filters for prevention of venous thromboembolism in obese patients undergoing bariatric surgery: a systematic review. *Ann Surg.* 2015;261:35-45.[EL 2; MNRCT]
658. Stein PD, Matta F. Pulmonary embolism and deep venous thrombosis following bariatric surgery. *Obes Surg.* 2013;23:663-668.[EL 3; DS]
659. Omalu BI, Ives DG, Buhari AM, et al. Death rates and causes of death after bariatric surgery for Pennsylvania residents, 1995-2004. *Arch Surg.* 2007;142:923-928; discussion 929.[EL 2; ES]
660. Podnos YD, Jimenez JC, Wilson SE, Stevens CM, Nguyen NT. Complications after laparoscopic gastric bypass: a review of 3464 cases. *Arch Surg.* 2003;138:957-961.[EL 2; MNRCT]
661. Quartararo G, Facchiano E, Scaringi S, Liscia G, Lucchese M. Upper gastrointestinal series after Roux-en-Y gastric bypass for morbid obesity: effectiveness in leakage detection. a systematic review of the literature. *Obes Surg.* 2014;24:1096-1101.[EL 2; MNRCT]
662. Doumouras AG, Maeda A, Jackson TD. The role of routine abdominal drainage after bariatric surgery: a metabolic and bariatric surgery accreditation and quality improvement program study. *Surg Obes Relat Dis.* 2017;13:1997-2003.[EL 2; ES]
663. Bingham J, Shawhan R, Parker R, Wigboldy J, Sohn V. Computed tomography scan versus upper gastrointestinal fluoroscopy for diagnosis of staple line leak following bariatric surgery. *Am J Surg.* 2015;209:810-814; discussion 814.[EL 2; ES]
664. Kim J, Azagury D, Eisenberg D, DeMaria E, Campos GM. ASMBS position statement on prevention, detection, and treatment of gastrointestinal leak after gastric bypass and sleeve gastrectomy, including the roles of imaging, surgical exploration, and nonoperative management. *Surg Obes Relat Dis.* 2015;11:739-748.[EL 4; NE]
665. Juza RM, Haluck RS, Pauli EM, Rogers AM, Won EJ, LynSue JR. Gastric sleeve leak: a single institution's experience with early combined laparoendoscopic management. *Surg Obes Relat Dis.* 2015;11:60-64.[EL 2; ES]

666. Klimczak T, Klimczak J, Szewczyk T, Janczak P, Jurałowicz P. Endoscopic treatment of leaks after laparoscopic sleeve gastrectomy using MEGA esophageal covered stents. *Surg Endosc.* 2018;32:2038-2045.[EL 2; ES]
667. Shehab HM, Hakky SM, Gawdat KA. An endoscopic strategy combining mega stents and over-the-scope clips for the management of post-bariatric surgery leaks and fistulas (with video). *Obes Surg.* 2016;26:941-948.[EL 2; ES]
668. Guzaiz N, Arabi M, Khankan A, et al. Gastroesophageal stenting for the management of post sleeve gastrectomy leak. A single institution experience. *Saudi Med J.* 2016;37:1339-1343.[EL 2; ES]
669. Aydin MT, Alahdab YÖ, Aras O, et al. Endoscopic stenting for laparoscopic sleeve gastrectomy leaks. *Ulus Cerrahi Derg.* 2016;32:275-280.[EL 2; ES]
670. Pequignot A, Fuks D, Verhaeghe P, et al. Is there a place for pigtail drains in the management of gastric leaks after laparoscopic sleeve gastrectomy? *Obes Surg.* 2012;22:712-720.[EL 2; ES]
671. Casella G, Soricelli E, Rizzello M, et al. Nonsurgical treatment of staple line leaks after laparoscopic sleeve gastrectomy. *Obes Surg.* 2009;19:821-826.[EL 2; ES]
672. Spaniolas K, Kasten KR, Sippey ME, Pender JR, Chapman WH, Pories WJ. Pulmonary embolism and gastrointestinal leak following bariatric surgery: when do major complications occur? *Surg Obes Relat Dis.* 2016;12:379-383.[EL 3; DS]
673. Muñoz JL, Ruiz-Tovar J, Miranda E, et al. C-reactive protein and procalcitonin as early markers of septic complications after laparoscopic sleeve gastrectomy in morbidly obese patients with an enhanced recovery after surgery program. *J Am Coll Surg.* 2016;222:831-837.[EL 2; PCS]
674. Tolone S, Pilone V, Musella M, et al. Rhabdomyolysis after bariatric surgery: a multicenter, prospective study on incidence, risk factors, and therapeutic strategy in a cohort from South Italy. *Surg Obes Relat Dis.* 2016;12:384-390.[EL 2; ES]
675. Matlok M, Major P, Malczak P, et al. Reduction of the risk of rhabdomyolysis after bariatric surgery with lower fluid administration in the perioperative period: a cohort study. *Pol Arch Med Wewn.* 2016;126:237-242.[EL 2; CSS]
676. Gourash WF, Lockhart JS, Kalarchian MA, Courcoulas AP, Nolfi D. Retention and attrition in bariatric surgery research: an integrative review of the literature. *Surg Obes Relat Dis.* 2016;12:199-209.[EL 2; MNRCT]
677. Schwoerer A, Kasten K, Celio A, Pories W, Spaniolas K. The effect of close postoperative follow-up on co-morbidity improvement after bariatric surgery. *Surg Obes Relat Dis.* 2017;13:1347-1352.[EL 2; ES]
678. Hood MM, Corsica J, Bradley L, Wilson R, Chirinos DA, Vivo A. Managing severe obesity: understanding and improving treatment adherence in bariatric surgery. *J Behav Med.* 2016;39:1092-1103.[EL 4; NE]
679. Sala M, Haller DL, Laferrère B, Homel P, McGinty JJ. Predictors of attrition before and after bariatric surgery. *Obes Surg.* 2017;27:548-551.[EL 2; ES]
680. Thereaux J, Lesuffleur T, Païta M, et al. Long-term follow-up after bariatric surgery in a national cohort. *Bri J Surg.* 2017;104:1362-1371.[EL 2; ES]
681. Kumar RB, Aronne LJ. Review of multimodal therapies for obesity treatment: including dietary, counseling strategies, and pharmacologic interventions. *Tech Gastrointest Endosc.* 2017;19:12-17.[EL 4; NE]
682. Still CD, Wood GC, Chu X, et al. Clinical factors associated with weight loss outcomes after Roux-en-Y gastric bypass surgery. *Obesity (Silver Spring).* 2014;22:888-894.[EL 2; ES]
683. Schwartz J, Chaudhry UI, Suzo A, et al. Pharmacotherapy in conjunction with a diet and exercise program for the treatment of weight recidivism or weight loss plateau post-bariatric surgery: a retrospective review. *Obes Surg.* 2016;26:452-458.[EL 2; ES]
684. Tammaro P, Hansel B, Police A, et al. Laparoscopic adjustable gastric banding: predictive factors for weight loss and band removal after more than 10 years' follow-up in a single university unit. *World J Surg.* 2017;41:2078-2086.[EL 2; ES]
685. Capristo E, Panunzi S, De Gaetano A, et al. Incidence of hypoglycemia after gastric bypass vs sleeve gastrectomy: a randomized trial. *J Clin Endocrinol Metab.* 2018;103:2136-2146.[EL 1; RCT]
686. Varma S, Clark JM, Schweitzer M, Magnuson T, Brown TT, Lee CJ. Weight regain in patients with symptoms of post-bariatric surgery hypoglycemia. *Surg Obes Relat Dis.* 2017;13:1728-1734.[EL 2; ES]
687. Eisenberg D, Azagury DE, Ghiassi S, Grover BT, Kim JJ. ASMBS Position Statement on Postprandial Hyperinsulinemic Hypoglycemia after Bariatric Surgery. *Sur Obes Relat Dis.* 2017;13:371-378.[EL 4; NE]
688. Suhl E, Anderson-Haynes S-E, Mulla C, Patti M-E. Medical nutrition therapy for post-bariatric hypoglycemia: practical insights. *Sur Obes Relat Dis.* 2017;13:888-896.[EL 4; NE]
689. Hanipah ZN, Bucak E, Punchai S, et al. The incidence and clinical features of hypoglycemia after bariatric surgery. *Surg Obes Relat Dis.* 2016;12:S72.[EL 4; NE]
690. Patti ME, Li P, Goldfine AB. Insulin response to oral stimuli and glucose effectiveness increased in neuroglycopenia following gastric bypass. *Obesity.* 2015;23:798-807.[EL 2; PCS]
691. Lee CJ, Wood GC, Lazo M, et al. Risk of post-gastric bypass surgery hypoglycemia in nondiabetic individuals: a single center experience. *Obesity (Silver Spring).* 2016;24:1342-1348.[EL 2; ES]
692. Michaels AD, Hunter Mehaffey J, Brenton French W, Schirmer BD, Kirby JL, Hollowell PT. Hypoglycemia Following Bariatric Surgery: Our 31-Year Experience. *Obes Surg.* 2017;27:3118-3123.[EL 2; ES]
693. Novodvorsky P, Walkinshaw E, Rahman W, et al. Experience with FreeStyle Libre Flash glucose monitoring system in management of refractory dumping syndrome in pregnancy shortly after bariatric surgery. *Endocrinol Diabetes Metab Case Rep.* 2017;2017.[EL 3; SCR]
694. Bell JA, Hamer M, van Hees VT, Singh-Manoux A, Kivimäki M, Sabia S. Healthy obesity and objective physical activity. *Am J Clin Nutr.* 2015;102:268-275.[EL 2; PCS]
695. Chin SH, Kahathuduwa CN, Binks M. Physical activity and obesity: what we know and what we need to know. *Obes Rev.* 2016;17:1226-1244.[EL 4; NE]
696. Wewege M, van den Berg R, Ward RE, Keech A. The effects of high-intensity interval training vs. moderate-intensity continuous training on body composition in overweight and obese adults: a systematic review and meta-analysis. *Obes Rev.* 2017;18:635-646.[EL 1; RCT]
697. Helmrich SP, Ragland DR, Leung RW, Paffenbarger RS Jr. Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. *N Engl J Med.* 1991;325:147-152.[EL 2; ES]
698. Hu FB, Sigal RJ, Rich-Edwards JW, et al. Walking compared with vigorous physical activity and risk of type 2 diabetes in women: a prospective study. *JAMA.* 1999;282:1433-1439.[EL 2; PCS]
699. Manson JE, Rimm EB, Stampfer MJ, et al. Physical activity and incidence of non-insulin-dependent diabetes mellitus in women. *Lancet.* 1991;338:774-778.[EL 2; PCS]
700. Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc.* 2009;41:998-1005.[EL 2; PCS]
701. Volcan CS, Lebrun A, Maitre S, et al. Predictive score of sarcopenia occurrence one year after bariatric surgery in severely obese patients. *PLoS One.* 2018;13:e0197248.[EL 2; PCS]
702. Mundbjerg LH, Stolberg CR, Bladbjerg EM, Funch-Jensen P, Juhl CB, Gram B. Effects of 6 months supervised physical training on muscle strength and aerobic capacity in patients undergoing Roux-en-Y gastric bypass surgery: a randomized controlled trial. *Clin Obes.* 2018;8:227-235.[EL 1; RCT]
703. Mundbjerg LH, Stolberg CR, Cecere S, et al. Supervised physical training improves weight loss after Roux-en-Y gastric bypass surgery: a randomized controlled trial. *Obesity (Silver Spring).* 2018;26:828-837.[EL 1; RCT]
704. Stolberg CR, Mundbjerg LH, Bladbjerg EM, Funch-Jensen P, Gram B, Juhl CB. Physical training following gastric bypass: effects on physical activity and quality of life—a randomized controlled trial. *Qual Life Res.* 2018;27:3113-3122.[EL 1; RCT]
705. Jacobi D, Ciangura C, Couet C, Oppert JM. Physical activity and weight loss following bariatric surgery. *Obes Rev.* 2011;12:366-377.[EL 2; MNRCT]

706. **King WC, Chen JY, Bond DS, et al.** Objective assessment of changes in physical activity and sedentary behavior: pre- through 3 years post-bariatric surgery. *Obesity (Silver Spring)*. 2015;23:1143-1150.[EL 2; ES]
707. **Mundi MS, Lorentz PA, Swain J, Grothe K, Collazo-Clavell M.** Moderate physical activity as predictor of weight loss after bariatric surgery. *Obes Surg*. 2013;23:1645-1649.[EL 2; ES]
708. **Herring LY, Stevinson C, Davies MJ, et al.** Changes in physical activity behaviour and physical function after bariatric surgery: a systematic review and meta-analysis. *Obes Rev*. 2016;17:250-261.[EL 1; MRCT]
709. **Creel DB, Schuh LM, Reed CA, et al.** A randomized trial comparing two interventions to increase physical activity among patients undergoing bariatric surgery. *Obesity (Silver Spring)*. 2016;24:1660-1668.[EL 1; RCT]
710. **King WC, Bond DS.** The importance of preoperative and post-operative physical activity counseling in bariatric surgery. *Exerc Sport Sc Rev*. 2013;41:26-35.[EL 4; NE]
711. **de Vries HJ, Kooiman TJ, van Ittersum MW, van Brussel M, de Groot M.** Do activity monitors increase physical activity in adults with overweight or obesity? A systematic review and meta-analysis. *Obesity (Silver Spring)*. 2016;24:2078-2091.[EL 1; MRCT]
712. **Garber CE, Blissmer B, Deschenes MR, et al.** American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc*. 2011;43:1334-1359.[EL 4; NE]
713. **Services. USDHHS.** Appendix 1. Physical activity guidelines for Americans. Available at <https://health.gov/dietaryguidelines/2015/guidelines/appendix-1/>. Accessed March 24, 2018.[EL 4; NE]
714. **Steinberg DM, Tate DF, Bennett GG, Ennett S, Samuel-Hodge C, Ward DS.** The efficacy of a daily self-weighting weight loss intervention using smart scales and e-mail. *Obesity (Silver Spring)*. 2013;21:1789-1797.[EL 2; NRCT]
715. **Svetkey LP, Batch BC, Lin PH, et al.** Cell phone intervention for you (CITY): A randomized, controlled trial of behavioral weight loss intervention for young adults using mobile technology. *Obesity (Silver Spring)*. 2015;23:2133-2141.[EL 1; RCT]
716. **Turner-McGrievy GM, Wilcox S, Boutté A, et al.** The dietary intervention to enhance tracking with mobile devices (DIET Mobile) study: a 6-month randomized weight loss trial. *Obesity (Silver Spring)*. 2017;25:1336-1342.[EL 1; RCT]
717. **Spring B, Pellegrini CA, Pfammatter A, et al.** Effects of an abbreviated obesity intervention supported by mobile technology: the ENGAGED randomized clinical trial. *Obesity (Silver Spring)*. 2017;25:1191-1198.[EL 1; RCT]
718. **Zwickert K, Rieger E, Swinbourne J, et al.** High or low intensity text-messaging combined with group treatment equally promote weight loss maintenance in obese adults. *Obes Res Clin Pract*. 2016;10:680-691.[EL 1; RCT]
719. **Spring B, Duncan JM, Janke EA, et al.** Integrating technology into standard weight loss treatment: a randomized controlled trial. *JAMA Int Med*. 2013;173:105-111.[EL 1; RCT]
720. **Thomas JG, Bond DS.** Review of innovations in digital health technology to promote weight control. *Curr Diab Rep*. 2014;14:485.[EL 4; NE]
721. **Levine DM, Savarimuthu S, Squires A, Nicholson J, Jay M.** Technology-assisted weight loss interventions in primary care: a systematic review. *Journal of general internal medicine*. 2015;30:107-117.[EL 1; MRCT]
722. **Sockalingam S, Cassin SE, Wnuk S, et al.** A pilot study on telephone cognitive behavioral therapy for patients six-months post-bariatric surgery. *Obes Surg*. 2017;27:670-675.[EL 2; ES]
723. **Sullivan DK, Goetz JR, Gibson CA, et al.** Improving weight maintenance using virtual reality (Second Life). *J Nutr Educ Beh*. 2013;45:264-268.[EL 1; RCT]
724. **Elvin-Walsh L, Ferguson M, Collins PF.** Nutritional monitoring of patients post-bariatric surgery: implications for smartphone applications. *J Hum Nutr Diet*. 2018;31:141-148.[EL 2; ES]
725. **Sharman M, Hensher M, Wilkinson S, et al.** What are the support experiences and needs of patients who have received bariatric surgery? *Health Expect*. 2017;20:35-46.[EL 2; ES]
726. **Bond DS, Graham TJ.** Measurement and intervention on physical activity and sedentary behaviours in bariatric surgery patients: emphasis on mobile technology. *Eur Eat Disord Rev*. 2015;23:470-478.[EL 2; ES]
727. **Hendricks L, Alvarenga E, Dhanabalsamy N, Lo Menzo E, Szomstein S, Rosenthal R.** Impact of sleeve gastrectomy on gastroesophageal reflux disease in a morbidly obese population undergoing bariatric surgery. *Surg Obes Relat Dis*. 2016;12:511-517.[EL 2; ES]
728. **Thereaux J, Lesuffleur T, Czernichow S, et al.** Do sleeve gastrectomy and gastric bypass influence treatment with proton pump inhibitor 4 years after surgery? A nationwide cohort. *Surg Obes Relat Dis*. 2017;13:951-959.[EL 2; ES]
729. **Alexandrou A, Tsoka E, Armeni E, et al.** Determinants of secondary hyperparathyroidism in bariatric patients after Roux-en-Y gastric bypass or sleeve gastrectomy: a pilot study. *Int J Endocrinol*. 2015;2015:984935.[EL 2; ES]
730. **Eusebi LH, Rabitti S, Artesiani ML, et al.** Proton pump inhibitors: risks of long-term use. *J Gastroenterol Hepatol*. 2017;32:1295-1302.[EL 4; NE]
731. **Gletsu-Miller N, Wright BN.** Mineral malnutrition following bariatric surgery. *Adv Nutr (Bethesda)*. 2013;4:506-517.[EL 4; NE]
732. **Peterson LA, Cheskin LJ, Furtado M, et al.** Malnutrition in bariatric surgery candidates: multiple micronutrient deficiencies prior to surgery. *Obes Surg*. 2016;26:833-838.[EL 2; ES]
733. **Caron M, Hould FS, Lescelleur O, et al.** Long-term nutritional impact of sleeve gastrectomy. *Surg Obes Relat Dis*. 2017;13:1664-1673.[EL 4; NE]
734. **Gregory NS.** The effects of bariatric surgery on bone metabolism. *Endocrinol Metab Clin North Am*. 2017;46:105-116.[EL 4; NE]
735. **Muschitz C, Kocijan R, Haschka J, et al.** The impact of vitamin D, calcium, protein supplementation, and physical exercise on bone metabolism after bariatric surgery: The BABS study. *J Bone Miner Res*. 2016;31:672-682.[EL 1; RCT]
736. **Schafer AL, Weaver CM, Black DM, et al.** Intestinal calcium absorption decreases dramatically after gastric bypass surgery despite optimization of vitamin D status. *J Bone Miner Res*. 2015;30:1377-1385.[EL 2; PCS]
737. **Frederiksen KD, Hanson S, Hansen S, et al.** Bone structural changes and estimated strength after gastric bypass surgery evaluated by HR-pQCT. *Calcif Tissue Int*. 2016;98:253-262.[EL 2; PCS]
738. **Marengo AP, Guerrero Pérez F, San Martín L, et al.** Is Trabecular bone score valuable in bone microstructure assessment after gastric bypass in women with morbid obesity? *Nutrients*. 2017;9.[EL 2; PCS]
739. **Scibora LM, Buchwald H, Petit MA, Hughes J, Ikramuddin S.** Bone strength is preserved following bariatric surgery. *Obes Surg*. 2015;25:263-270.[EL 2; ES]
740. **Yu EW, Boussein ML, Roy AE, et al.** Bone loss after bariatric surgery: discordant results between DXA and QCT bone density. *J Bone Miner Res*. 2014;29:542-550.[EL 2; ES]
741. **Maghrabi AH, Wolski K, Abood B, et al.** Two-year outcomes on bone density and fracture incidence in patients with T2DM randomized to bariatric surgery versus intensive medical therapy. *Obesity (Silver Spring)*. 2015;23:2344-2348.[EL 1; RCT]
742. **Ko BJ, Myung SK, Cho KH, et al.** Relationship between bariatric surgery and bone mineral density: a meta-analysis. *Obes Surg*. 2016;26:1414-1421.[EL 2; MNRCT]
743. **Yu EW, Greenblatt L, Ejazi A, Torriani M, Bredella MA.** Marrow adipose tissue composition in adults with morbid obesity. *Bone*. 2017;97:38-42.[EL 2; ES]
744. **Lima TP, Nicoletti CF, Marchini JS, Junior WS, Nonino CB.** Effect of weight loss on bone mineral density determined by ultrasound of phalanges in obese women after Roux-en-y gastric bypass: conflicting results with dual-energy X-ray absorptiometry. *J Clin Densitom*. 2014;17:473-478.[EL 2; ES]
745. **Scibora LM.** Skeletal effects of bariatric surgery: examining bone loss, potential mechanisms and clinical relevance. *Diabetes Obes Metab*. 2014;16:1204-1213.[EL 4; NE]
746. **Hsin MC, Huang CK, Tai CM, Yeh LR, Kuo HC, Garg A.** A case-matched study of the differences in bone mineral density 1 year after 3 different bariatric procedures. *Surg Obes Relat Dis*. 2015;11:181-185.[EL 2; ES]



747. **Vilarrasa N, de Gordejuela AG, Gomez-Vaquero C, et al.** Effect of bariatric surgery on bone mineral density: comparison of gastric bypass and sleeve gastrectomy. *Obes Surg.* 2013;23:2086-2091. [EL 2; ES]
748. **Stein EM, Silverberg SJ.** Bone loss after bariatric surgery: causes, consequences and management. *Lancet Diabetes Endocrinol.* 2014;2:165-174. [EL 4; NE]
749. **Miller PD, Jamal SA, Evenepoel P, Eastell R, Boonen S.** Renal safety in patients treated with bisphosphonates for osteoporosis: a review. *J Bone Miner Res.* 2013;28:2049-2059. [EL 4; NE]
750. **Lanza FL.** Gastrointestinal adverse effects of bisphosphonates: etiology, incidence and prevention. *Treat Endocrinol.* 2002;1:37-43. [EL 4; NE]
751. **Gonzalez RD, Canales BK.** Kidney stone risk following modern bariatric surgery. *Curr Urol Rep.* 2014;15:401. [EL 4; NE]
752. **Cruz S, Machado S, Cruz S, Pereira S, Saboya C, Ramalho A.** Comparative study of the nutritional status of vitamin A in pregnant women and in women who became pregnant or did not after Roux-en-Y gastric bypass. *Nutr Hosp.* 2018;35:421-427. [EL 2; CSS]
753. **Via MA, Mechanick JI.** Nutritional and micronutrient care of bariatric surgery patients: current evidence update. *Curr Obes Rep.* 2017;6:286-296. [EL 3; CCS]
754. **Forbes R, Gasevic D, Watson EM, et al.** Essential fatty acid plasma profiles following gastric bypass and adjusted gastric banding bariatric surgeries. *Obes Surg.* 2016;26:1237-1246. [EL 2; ES]
755. **Foster RH, Hardy G, Alany RG.** Borage oil in the treatment of atopic dermatitis. *Nutrition.* 2010;26:708-718. [EL 1; MRCT]
756. **Marcason W.** Can cutaneous application of vegetable oil prevent an essential fatty acid deficiency? *J Am Diet Assoc.* 2007;107:1262. [EL 4; NE]
757. **Lee EJ, Gibson RA, Simmer K.** Transcutaneous application of oil and prevention of essential fatty acid deficiency in preterm infants. *Arch Dis Child.* 1993;68:27-28. [EL 4; NE]
758. **He H, Qiao Y, Zhang Z, et al.** Dual action of vitamin C in iron supplement therapeutics for iron deficiency anemia: prevention of liver damage induced by iron overload. *Food Funct.* 2018;9:5390-5401. [EL 3; BR]
759. **Smelt HJ, Pouwels S, Smulders JF.** Different supplementation regimes to treat perioperative vitamin B12 deficiencies in bariatric surgery: a systematic review. *Obes Surg.* 2017;27:254-262. [EL 2; MNRCT]
760. **Kwon Y, Kim HJ, Lo Menzo E, Park S, Szomstein S, Rosenthal RJ.** Anemia, iron and vitamin B12 deficiencies after sleeve gastrectomy compared to Roux-en-Y gastric bypass: a meta-analysis. *Surg Obes Relat Dis.* 2014;10:589-597. [EL 1; MRCT]
761. **Brouwer I, Verhoef P.** Folic acid fortification: is masking of vitamin B-12 deficiency what we should really worry about? *Am J Clin Nutr.* 2007;86:897-898. [EL 2; ES]
762. **Wilson RD; Genetics Committee, Wilson RD, et al.** Pre-conception folic acid and multivitamin supplementation for the primary and secondary prevention of neural tube defects and other folic acid-sensitive congenital anomalies. *J Obstet Gynaecol Can.* 2015;37:534-552. [EL 2; MNRCT]
763. **Lupoli R, Lembo E, Saldalamacchia G, Avola CK, Angrisani L, Capaldo B.** Bariatric surgery and long-term nutritional issues. *World J Diabetes.* 2017;8:464-474. [EL 4; NE]
764. **Weng TC, Chang CH, Dong YH, Chang YC, Chuang LM.** Anaemia and related nutrient deficiencies after Roux-en-Y gastric bypass surgery: a systematic review and meta-analysis. *BMJ Open.* 2015;5:e006964. [EL 2; MNRCT]
765. **Papamargaritis D, Aasheim ET, Sampson B, le Roux CW.** Copper, selenium and zinc levels after bariatric surgery in patients recommended to take multivitamin-mineral supplementation. *J Trace Elem Med Biol.* 2015;31:167-172. [EL 2; ES]
766. **Semba RD, Ricks MO, Ferrucci L, Xue QL, Guralnik JM, Fried LP.** Low serum selenium is associated with anemia among older adults in the United States. *Eur J Clin Nutr.* 2009;63:93-99. [EL 3; DS]
767. **Kurnick JE, Ward HP, Pickett JC.** Mechanism of the anemia of chronic disorders: correlation of hematocrit value with albumin, vitamin B12, transferrin, and iron stores. *Arch Intern Med.* 1972;130:323-326. [EL 2; ES]
768. **Freeth A, Prajuabansri P, Victory JM, Jenkins P.** Assessment of selenium in Roux-en-Y gastric bypass and gastric banding surgery. *Obes Surg.* 2012;22:1660-1665. [EL 2; ES]
769. **Massoure PL, Camus O, Fourcade L, Simon F.** Bilateral leg oedema after bariatric surgery: a selenium-deficient cardiomyopathy. *Obes Res Clin Pract.* 2017;11:622-626. [EL 3; SCR]
770. **Shoar S, Poliakin L, Rubenstein R, Saber AA.** Single snastomosis duodeno-ileal switch (SADIS): a systematic review of efficacy and safety. *Obes Surg.* 2018;28:104-113. [EL 2; MNRCT]
771. **Balsa JA, Botella-Carretero JI, Gómez-Martín JM, et al.** Copper and zinc serum levels after derivative bariatric surgery: differences between Roux-en-Y gastric bypass and biliopancreatic diversion. *Obes Surg.* 2011;21:744-750. [EL 2; ES]
772. **Nakagawa M, Kojima K, Inokuchi M, et al.** Assessment of serum copper state after gastrectomy with Roux-en-Y reconstruction for gastric cancer. *Digest Surg.* 2015;32:301-305. [EL 2; PCS]
773. **Lakhani SV, Shah HN, Alexander K, Finelli FC, Kirkpatrick JR, Koch TR.** Small intestinal bacterial overgrowth and thiamine deficiency after Roux-en-Y gastric bypass surgery in obese patients. *Nutr Res.* 2008;28:293-298. [EL 2; ES]
774. **Thornalley PJ, Babaei-Jadidi R, Al Ali H, et al.** High prevalence of low plasma thiamine concentration in diabetes linked to a marker of vascular disease. *Diabetologia.* 2007;50:2164-2170. [EL 2; PCS]
775. **Aaseth E, Fagerland MW, Aas AM, et al.** Vitamin concentrations 5 years after gastric bypass. *Eur J Clin Nutr.* 2015;69:1249-1255. [EL 2; ES]
776. **Homan J, Betzel B, Aarts EO, et al.** Vitamin and mineral deficiencies after biliopancreatic diversion and biliopancreatic diversion with duodenal wwitch—the rule rather than the exception. *Obes Surg.* 2015;25:1626-1632. [EL 2; ES]
777. **Milone M, Velotti N, Musella M.** Wernicke encephalopathy following laparoscopic sleeve gastrectomy—a call to evaluate thiamine deficiencies after restrictive bariatric procedures. *Obes Surg.* 2018;28:852-853. [EL 4; NE]
778. **Dirani M, Chahine E, Dirani M, Kassir R, Chouillard E.** More than a case report? Should Wernicke encephalopathy after sleeve gastrectomy be a concern? *Obes Surg.* 2017;27:2684-2687. [EL 3; SCR]
779. **Pardo-Aranda F, Perez-Romero N, Osorio J, et al.** Wernicke's encephalopathy after sleeve gastrectomy: literature review. *Int J Surg Case Rep.* 2016;20:92-95. [EL 3; SCR]
780. **Lawton AW, Frisard NE.** Visual loss, retinal hemorrhages, and optic disc edema resulting from thiamine deficiency following bariatric surgery complicated by prolonged vomiting. *Ochsner J.* 2017;17:112-114. [EL 3; SCR]
781. **Blum A, Ovadia M, Rosen G, Sinsolo C.** Immediate recovery of an "ischemic stroke" following treatment with intravenous thiamine (vitamin B1). *Isr Med Assoc J.* 2014;16:518-519. [EL 3; SCR]
782. **Frank LL.** Thiamin in clinical practice. *J Parenter Enteral Nutr.* 2015;39:503-520. [EL 4; NE]
783. **Nishimoto A, Usery J, Winton JC, Twilla J.** High-dose parenteral thiamine in treatment of Wernicke's encephalopathy: case series and review of the literature. *In Vivo.* 2017;31:121-124. [EL 2; RCCS]
784. **Mechanick JI, Brett EM, Chausmer AB, Dickey RA, Wallach S.** American Association of Clinical Endocrinologists medical guidelines for the clinical use of dietary supplements and nutraceuticals. *Endocr Pract.* 2003;9:417-470. [EL 4; NE]
785. **Dillon C, Peddle J, Twells L, et al.** Rapid reduction in use of anti-diabetic medication after laparoscopic sleeve gastrectomy: the Newfoundland and Labrador Bariatric Surgery Cohort (BaSCo) study. *Can J Hosp Pharm.* 2015;68:113-120. [EL 2; PCS]
786. **O'Kane M, Parretti HM, Hughes CA, et al.** Guidelines for the follow-up of patients undergoing bariatric surgery. *Clin Obes.* 2016;6:210-224. [EL 4; NE]
787. **Cuspidi C, Rescaldani M, Tadic M, Sala C, Grassi G.** Effects of bariatric surgery on cardiac structure and function: a systematic review and meta-analysis. *Am J Hypertens.* 2014;27:146-156. [EL 2; MNRCT]
788. **Neff KJ, Baud G, Raverdy V, et al.** Renal function and remission of hypertension after bariatric surgery: a 5-year prospective cohort study. *Obes Surg.* 2017;27:613-619. [EL 2; PCS]

789. **Moloney BM, Hynes DA, Kelly ME, et al.** The role of laparoscopic sleeve gastrectomy as a treatment for morbid obesity; review of outcomes. *Ir J Med Sci.* 2017;186:143-149.[EL 2; MNRCT]
790. **Mor A, Omotosho P, Torquati A.** Cardiovascular risk in obese diabetic patients is significantly reduced one year after gastric bypass compared to one year of diabetes support and education. *Surg Endosc.* 2014;28:2815-2820.[EL 2; PCS]
791. **Ponnusamy V, Owens AP, Purkayastha S, Iodice V, Mathias CJ.** Orthostatic intolerance and autonomic dysfunction following bariatric surgery: a retrospective study and review of the literature. *Auton Neurosci.* 2016;198:1-7.[EL 2; RCCS]
792. **Kennedy AL, Nelson T, Pettine S, Miller BF, Hamilton KL, Donovan EL.** Medication use following bariatric surgery: factors associated with early discontinuation. *Obes Surg.* 2014;24:696-704.[EL 2; ES]
793. **Wentworth JM, Cheng C, Laurie C, et al.** Diabetes outcomes more than a decade following sustained weight loss after laparoscopic adjustable gastric band surgery. *Obes Surg.* 2018;28:982-989.[EL 2; ES]
794. **Gadiraju S, Lee CJ, Cooper DS.** Levothyroxine dosing following bariatric surgery. *Obes Surg.* 2016;26:2538-2542.[EL 2; MNRCT]
795. **Pirola I, Formenti AM, Gandossi E, et al.** Oral liquid L-thyroxine (L-t4) may be better absorbed compared to L-T4 tablets following bariatric surgery. *Obes Surg.* 2013;23:1493-1496.[EL 3; CCS]
796. **Vita R, Fallahi P, Antonelli A, Benvenga S.** The administration of L-thyroxine as soft gel capsule or liquid solution. *Expert Opin Drug Deliv.* 2014;11:1103-1111.[EL 4; NE]
797. **Virili C, Trimboli P, Romanelli F, Centanni M.** Liquid and softgel levothyroxine use in clinical practice: state of the art. *Endocrine.* 2016;54:3-14.[EL 2; MNRCT]
798. **Karila-Cohen P, Cuccioli F, Tammaro P, et al.** Contribution of computed tomographic imaging to the management of acute abdominal pain after gastric bypass: correlation between radiological and surgical findings. *Obes Surg.* 2017;27:1961-1972.[EL 2; ES]
799. **Dane B, Clark J, Megibow A.** Multidetector computed tomography evaluation of mesenteric venous thrombosis following laparoscopic bariatric surgery. *J Comput Assist Tomogr.* 2017;41:56-60.[EL 3; CCS]
800. **Ungaro R, Fausel R, Chang HL, et al.** Bariatric surgery is associated with increased risk of new-onset inflammatory bowel disease: case series and national database study. *Aliment Pharmacol Ther.* 2018;47:1126-1134.[EL 2; RCCS]
801. **Wilson JA, Romagnuolo J, Byrne TK, Morgan K, Wilson FA.** Predictors of endoscopic findings after Roux-en-Y gastric bypass. *Am J Gastroenterol.* 2006;101:2194-2199.[EL 2; ES]
802. **Hakkarainen TW, Steele SR, Bastaworouf A, et al.** Nonsteroidal anti-inflammatory drugs and the risk for anastomotic failure: a report from Washington State's Surgical Care and Outcomes Assessment Program (SCOAP). *JAMA Surg.* 2015;150:223-228.[EL 2; ES]
803. **Yska JP, Gertsen S, Flapper G, Emous M, Wilffert B, van Roon EN.** NSAID use after bariatric surgery: a randomized controlled intervention study. *Obes Surg.* 2016;26:2880-2885.[EL 1; RCT]
804. **Sharma G, Ardila-Gatas J, Boules M, et al.** Upper gastrointestinal endoscopy is safe and feasible in the early postoperative period after Roux-en-Y gastric bypass. *Surgery.* 2016;160:885-891.[EL 3; DS]
805. **Valenzuela-Salazar C, Rojano-Rodríguez ME, Romero-Loera S, et al.** Intraoperative endoscopy prevents technical defect related leaks in laparoscopic Roux-en-Y gastric bypass: a randomized control trial. *Int J Surg.* 2018;50:17-21.[EL 1; RCT]
806. **Coblijn UK, Goucham AB, Lagarde SM, Kuiken SD, van Wagenveld BA.** Development of ulcer disease after Roux-en-Y gastric bypass, incidence, risk factors, and patient presentation: a systematic review. *Obes Surg.* 2014;24:299-309.[EL 2; MNRCT]
807. **Kang X, Zurita-Macias L, Hong D, Cadeddu M, Anvari M, Gmora S.** A comparison of 30-day versus 90-day proton pump inhibitor therapy in prevention of marginal ulcers after laparoscopic Roux-en-Y gastric bypass. *Surg Obes Relat Dis.* 2016;12:1003-1007.[EL 2; ES]
808. **Ying VW, Kim SH, Khan KJ, et al.** Prophylactic PPI help reduce marginal ulcers after gastric bypass surgery: a systematic review and meta-analysis of cohort studies. *Surg Endosc.* 2015;29:1018-1023.[EL 2; MNRCT]
809. **Chowbey PK, Soni V, Kantharia NS, Khullar R, Sharma A, Bajjal M.** Laparoscopic Roux-en-Y gastric bypass: outcomes of a case-matched comparison of primary versus revisional surgery. *J Minim Access Surg.* 2018;14:52-57.[EL 2; ES]
810. **AlSabah S, Alsharqawi N, Almulla A, et al.** Approach to poor weight loss after laparoscopic sleeve gastrectomy: re-sleeve vs. gastric bypass. *Obes Surg.* 2016;26:2302-2307.[EL 2; ES]
811. **Hedberg HM, Trenk A, Kuchta K, Linn JG, Carbray J, Ujiki MB.** Endoscopic gastrojejunostomy revision is more effective than medical management alone to address weight regain after RYGB. *Surg Endosc.* 2018;32:1564-1571.[EL 2; ES]
812. **Carroll J, Kwok M, Patel B, Hopkins G.** Revision gastric bypass after laparoscopic adjustable gastric band: a 10-year experience at a public teaching hospital. *ANZ J Surg.* 2018;88:E361-E365.[EL 2; ES]
813. **Chahine E, Kassir R, Dirani M, Joumaa S, Debs T, Chouillard E.** Surgical management of gastrogastic gistula after Roux-en-Y gastric bypass: 10-year experience. *Obes Surg.* 2018;28:939-944.[EL 2; ES]
814. **Keane T, Margulis AR, Dakin GF, Pomp A.** Imaging of patients after the Lap-Band System application. *Abdom Imaging.* 2012;37:690-696.[EL 2; ES]
815. **Carucci LR, Turner MA, Szucs RA.** Adjustable laparoscopic gastric banding for morbid obesity: imaging assessment and complications. *Radiol Clin North Am.* 2007;45:261-274.[EL 4; NE]
816. **Coupaye M, Castel B, Sami O, Tuyeras G, Msika S, Ledoux S.** Comparison of the incidence of cholelithiasis after sleeve gastrectomy and Roux-en-Y gastric bypass in obese patients: a prospective study. *Surg Obes Relat Dis.* 2015;11:779-784.[EL 2; ES]
817. **Altieri MS, Yang J, Nie L, Docimo S, Talamini M, Pryor AD.** Incidence of cholecystectomy after bariatric surgery. *Surg Obes Relat Dis.* 2018;14:992-996.[EL 2; ES]
818. **Tustumi F, Bernardo WM, Santo MA, Ceconello I.** Cholecystectomy in patients submitted to bariatric procedure: a systematic review and meta-analysis. *Obes Surg.* 2018;28:3312-3320.[EL 2; MNRCT]
819. **Wanjura V, Szabo E, Osterberg J, Ottosson J, Enochsson L, Sandblom G.** Morbidity of cholecystectomy and gastric bypass in a national database. *Bri J Surg.* 2018;105:121-127.[EL 3; DS]
820. **Coupaye M, Calabrese D, Sami O, Msika S, Ledoux S.** Evaluation of incidence of cholelithiasis after bariatric surgery in subjects treated or not treated with ursodeoxycholic acid. *Surg Obes Relat Dis.* 2017;13:681-685.[EL 2; ES]
821. **Magouliotis DE, Tasiopoulou VS, Svokos AA, et al.** Ursodeoxycholic acid in the prevention of gallstone formation after bariatric surgery: an updated systematic review and meta-analysis. *Obes Surg.* 2017;27:3021-3030.[EL 1; MRCT]
822. **Boerlage TCC, Haal S, Maurits de Brauw L, et al.** Ursodeoxycholic acid for the prevention of symptomatic gallstone disease after bariatric surgery: study protocol for a randomized controlled trial (UPGRADE trial). *BMC Gastroenterol.* 2017;17:164.[EL 1; RCT]
823. **Sabate JM, Coupaye M, Ledoux S, et al.** Consequences of Small Intestinal Bacterial Overgrowth in Obese Patients Before and After Bariatric Surgery. *Obes Surg.* 2017;27:599-605.[EL 2; ES]
824. **Sabaté JM, Jouët P, Harnois F, et al.** High prevalence of small intestinal bacterial overgrowth in patients with morbid obesity: a contributor to severe hepatic steatosis. *Obes Surg.* 2008;18:371-377.[EL 2; ES]
825. **Shah HN, Bal BS, Finelli FC, Koch TR.** Constipation in patients with thiamine deficiency after Roux-en-Y gastric bypass surgery. *Digestion.* 2013;88:119-124.[EL 2; ES]
826. **Sait MS, Som R, Borg CM, Chang A, Ramar S.** Best evidence topic: Should ventral hernia repair be performed at the same time as bariatric surgery? *Ann Med Surg (Lond).* 2016;11:21-25.[EL 2; MRCT]
827. **Altieri MS, Yang J, Park J, et al.** Utilization of Body Contouring Procedures Following Weight Loss Surgery: a Study of 37,806 Patients. *Obes Surg.* 2017;27:2981-2987.[EL 3; DS]
828. **Agarwal S, Shenaq D, Teven CM, Prachand V, Roughton M, Zachary L.** Body contouring after obesity surgery is associated with a weight loss benefit among patients. *J Plast Reconstr Aesthet Surg.* 2017;70:1186-1190.[EL 2; ES]

829. **Aherrera AS, Pandya SN.** A cohort analysis of postbariatric panniculectomy--current trends in surgeon reimbursement. *Ann Plast Surg.* 2016;76:99-101.[EL 2; ES]
830. **Lazzati A, Katsahian S, Maladry D, Gerard E, Gaucher S.** Plastic surgery in bariatric patients: a nationwide study of 17,000 patients on the national administrative database. *Surg Obes Relat Dis.* 2018;14:646-651.[EL 2; RCCS]
831. **Dreifuss SE, Rubin JP.** Insurance coverage for massive weight loss panniculectomy: a national survey and implications for policy. *Surg Obes Relat Dis.* 2016;12:412-416.[EL 3; ECON]
832. **Agha-Mohammadi S, Hurwitz DJ.** Enhanced recovery after body-contouring surgery: reducing surgical complication rates by optimizing nutrition. *Aesthetic Plast Surg.* 2010;34:617-625.[EL 3; DS]
833. **Montano-Pedroso JC, Bueno Garcia E, Alcantara Rodrigues de Moraes M, Francescato Veiga D, Masako Ferreira L.** Intravenous iron sucrose versus oral iron administration for the postoperative treatment of post-bariatric abdominoplasty anaemia: an open-label, randomised, superiority trial in Brazil. *Lancet Haematol.* 2018;5:e310-e320.[EL 2; OLES]
834. **García Botero A, García Wenninger M, Fernández Loaiza D.** Complications after body contouring surgery in postbariatric patients. *Ann Plast Surg.* 2017;79:293-297.[EL 2; ES]
835. **Parvizi D, Friedl H, Wurzer P, et al.** A multiple regression analysis of postoperative complications after body-contouring surgery: a retrospective analysis of 205 patients. *Obes Surg.* 2015;25:1482-1490.[EL 2; ES]
836. **Nguyen NT, Nguyen B, Nguyen VQ, Ziogas A, Hohmann S, Stamos MJ.** Outcomes of bariatric surgery performed at accredited vs nonaccredited centers. *J Am Coll Surg.* 2012;215:467-474. [EL 3; DS]
837. **Berger ER, Huffman KM, Fraker T, et al.** Prevalence and risk factors for bariatric surgery readmissions: findings from 130,007 admissions in the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program. *Ann Surg.* 2018;267:122-131. [EL 3; DS]
838. **Garg T, Rosas U, Rogan D, et al.** Characterizing readmissions after bariatric surgery. *J Gastrointest Surg.* 2016;20:1797-1801. [EL 2; ES]
839. **Garg T, Rosas U, Rivas H, Azagury D, Morton JM.** National prevalence, causes, and risk factors for bariatric surgery readmissions. *Am J Surg.* 2016;212:76-80.[EL 2; ES]
840. **Telem DA, Yang J, Altieri M, et al.** Rates and risk factors for unplanned emergency department utilization and hospital readmission following bariatric surgery. *Ann Surg.* 2016;263:956-960.[EL 3; DS]
841. **Garg T, Birge K, Ulysses R, Azagury D, Rivas H, Morton JM.** A postoperative nutritional consult improves bariatric surgery outcomes. *Surg Obes Relat Dis.* 2016;12:1052-1056.[EL 2; ES]
842. **Morton J.** The first metabolic and bariatric surgery accreditation and quality improvement program quality initiative: decreasing readmissions through opportunities provided. *Surg Obes Relat Dis.* 2014;10:377-378.[EL 4; NE]
843. **Shoar S, Nguyen T, Ona MA, et al.** Roux-en-Y gastric bypass reversal: a systematic review. *Surg Obes Relat Dis.* 2016;12:1366-1372.[EL 2; MNRCT]
844. **Topart PA, Becouarn G.** Revision and reversal after biliopancreatic diversion for excessive side effects or ineffective weight loss: a review of the current literature on indications and procedures. *Surg Obes Relat Dis.* 2015;11:965-972.[EL 2; MNRCT]
845. **O'Brien PE, Hindle A, Brennan L, et al.** Long-term outcomes after bariatric surgery: a systematic review and meta-analysis of weight loss at 10 or more years for all bariatric procedures and a single-centre review of 20-year outcomes after adjustable gastric banding. *Obes Surg.* 2019;29:3-14.[EL 2; MNRCT]
846. **López-Nava G, Bautista-Castaño, Jimenez A, de Grado T, Fernandez-Corbelle JP.** The Primary Obesity Surgery Endolumenal (POSE) procedure: one-year patient weight loss and safety outcomes. *Surg Obes Relat Dis.* 2015;11:861-865.[EL 2; PCS]
847. **Shhikora SA, Wolfe BM, Apovian CM, et al.** Sustained weight loss with vagal nerve blockade but not with sham: 18-month results of the ReCharge Trial. *J Obes.* 2015;2015:365604.[EL 2; OLES]
848. **Apovian CM, Shah SN, Wolfe BM, et al.** Two-year outcomes of vagal nerve blocking (vBloc) for the treatment of obesity in the ReCharge Trial. *Obes Surg.* 2017;27:169-176.[EL 2; OLES]
849. **Ponce J, Woodman G, Swain J, et al.** The REDUCE pivotal trial: a prospective, randomized controlled pivotal trial of a dual intra-gastric balloon for the treatment of obesity. *Sur Obes Relat Dis.* 2015;11:874-881.[EL 1; RCT]
850. **ASGE Bariatric Endoscopy Task Force and ASGE Technology Committee, Abu Dayyeh BK, Kumar N, et al.** ASGE Bariatric Endoscopy Task Force systematic review and meta-analysis assessing the ASGE PIVI thresholds for adopting endoscopic bariatric therapies. *Gastrointest Endosc.* 2015;82:425-438.[EL 2; MNRCT]
851. **Thompson CC, Abu Dayyeh BK, Kushner R, et al.** Percutaneous gastrostomy device for the treatment of class II and class III obesity: results of a randomized controlled trial. *Am J Gastroenterol.* 2017;112:447-457.[EL 1; RCT]
852. **Haskins O.** TransPyloric Shuttle demonstrates weight loss. *Bariatric News.* Available at <https://bariatricnews.net/?q=node/1236>, 2013 Nov 20 [EL 4; NE]
853. **Lopez-Nava G, Sharaiha RZ, Vargas EJ, et al.** Endoscopic sleeve gastroplasty for obesity: a multicenter study of 248 patients with 24 months follow-up. *Obes Surg.* 2017;27:2649-2655.[EL 2; RCCS]
854. **Abdelbaki TN, Huang CK, Ramos A, Neto MG, Talebpour M, Saber AA.** Gastric plication for morbid obesity: a systematic review. *Obes Surg.* 2012;22:1633-1639.[EL 2; MNRCT]
855. **Grant MC, Gibbons MM, Ko CY, et al.** Evidence review conducted for the agency for healthcare research and quality safety program for improving surgical care and recovery: focus on anesthesiology for bariatric surgery. *Anesth Analg.* 2019;129:51-60. [EL 4; NE]
856. **Ljungqvist O, Scott M, Fearon KC.** Enhanced recovery after surgery: a review. *JAMA Surg.* 2017;152:292-298.[EL 4; NE]
857. **Kushner R, Cummings S, Herron DM.** Bariatric surgery: post-operative nutritional management. In: J.A. Melin (ed.); *UpToDate.* Retrieved March 1, 2019.[EL 4; NE]
858. **Aills L, Blankenship L, Buffington C, Furtado M, Parrott J.** ABMBS allied health nutritional guidelines for the surgical weight loss patient. *Surg Obes Relat Dis.* 2008;4 (5 suppl):S73-S108.[EL 4; NE]
859. *Academy of Nutrition and Dietetics Pocket Guide to Bariatric Surgery.* 2nd ed. Cummings S, Isom KA, eds. Chicago, IL: Academy of Nutrition and Dietetics; 2015.[EL 4; NE]