# Patient Experience and Perioperative Pathway in Bariatric Surgery

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**Chapter Objectives**

At the end of the chapter, the reader should be able to describe:

1. Barriers to access to bariatric care for patients
2. The importance of multidisciplinary preoperative medical and psychological assessment
3. Factors and outcomes that influence patient experience
4. Evidence for perioperative practices, including antibiotic prophylaxis, stapler selection, and bougie size
5. Evidence for enhanced recovery after surgery, including ambulation, diet, antiemetics, pain control, and VTE prophylaxis

## Introduction

Despite seemingly uniform and essential components of a bariatric surgery program, there remains significant variability in patient experience and perioperative care from one program to the next [1]. The patient experience begins as early as access to surgery, and is multifaceted, including program marketing efforts, community outreach, and network of local primary care providers and their outlook on bariatric surgery. Ultimately, bariatric surgery programs should strive for a positive patient experience that balances accessibility and efficiency with quality, maintaining standards of care and implementing evidence-based protocols or pathways for best practices. This chapter will focus on specific phases of the patient experience through a bariatric surgery program, from initial encounter through surgery, including in-depth review of various evidence-based perioperative pathways.

## Access to Care

Although bariatric surgery remains the most effective and durable therapy for obesity, patient access to care remains a significant problem. According to estimates from the American Society for Metabolic and Bariatric Surgery (ASMBS), about 15 million Americans suffer from morbid obesity, but only 1% of those eligible for treatment with bariatric surgery actually receive such therapy (in 2017, this amounted to 228,000 procedures performed) [2]. There is a lack of universal coverage for bariatric surgery as a treatment for the chronic disease that is morbid obesity, unlike other life-threatening diseases such as heart disease, cancer, and diabetes. Moreover, around 25% of those patients being evaluated for bariatric surgery are denied insurance coverage three times before obtaining approval, a majority of whom felt their health worsened over that period of time [3].

There are other factors that influence ease of access to bariatric surgery, including insurance mandates and primary care provider perceptions regarding surgery as a treatment. The most significant mandate by payers is that of preoperative weight loss with specific time periods, which is not supported by any reasonable medical evidence, but has been shown to increase patient dropout from bariatric surgery programs as wait times continue to get longer [4, 5]. Equally important is the approach to and management of obesity by the primary care provider (PCP). In a recent study surveying primary providers in a health network, the majority of PCPs believed that lifestyle modifications and dietary changes were the most effective modality for the treatment of obesity and, despite

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demonstrating appropriate knowledge of and indications for bariatric surgery, infrequently referred patients for surgical evaluation [6]. Finally, patient and family bias can negatively influence the decision to pursue bariatric surgery, with the common perceptions that such therapy is drastic in nature with concerns regarding its safety or that it demonstrates a lack of will power by taking the easy way out [7].

Most bariatric surgery programs offer an introductory information/orientation session with potential patients. This is often the first point of contact between a program and a patient. These sessions can take different forms, including in person or online, and in group forums or individual settings. Pre-surgery information sessions are essential for patient education and effective in establishing expectations, including details regarding surgery, potential complications, lifestyle changes, and nutrition counseling [8]. Additionally, online training has been shown to be as effective in engaging the patient and relaying the information as in-person sessions [9]. However, Miletics et al. published a study comparing their program's patients' progression to surgery after in-person vs. online sessions and found that patients attending in-person sessions were more likely to progress to surgery (78% attended office visits vs. 67% for online attendees, and 40% progressed to surgery vs. 30% for online) [10]. The most startling of these findings is the dramatic patient dropout from initial information session to office consultation and even more pronounced from office visit to surgery. Several factors have been identified as contributors to this phenomenon, including patient concerns regarding surgical risk and complications, self-perceived inability to make behavioral changes or suitability for surgery, impact on family life, and PCP miscommunication [11]. Certainly, these domains should be the focus of efforts to improve patient education, dissemination of information, and communication among patients and other healthcare providers alike.

## Program Pathways and Patient Experience

The American College of Surgeons (ACS) and ASMBS joined to create a combined program for accreditation of bariatric surgery centers known as the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP). This program includes a data registry for programs to track outcomes, for continual quality improvement, and for patient safety initiatives. A center may become MBSAQIP-accredited after an initial application with an extensive review process including on-site review, to ensure the proper infrastructure, resources, and practices are in place. One important component of this is the verification of bariatric-specific protocols and pathways, which help to ensure that the highest standards for the care of the bariatric patient are upheld.

## Program Progression

Patients with morbid obesity who are being evaluated for treatment through bariatric/metabolic surgery undergo a thorough multidisciplinary evaluation as an initial key step. This includes an initial medical consultation focused on a detailed history and physical examination, followed by laboratory testing and other medical workup as appropriate. Nutrition education and counseling by a registered dietitian is essential, both for formal education and for setting expectations. A psychological evaluation should be completed as well, to assess for any pathology and stability of disease, as well as to identify impediments to healthy eating behaviors and coping strategies.

Further medical evaluation may take place, mostly depending on patient symptoms and comorbid conditions. This can include screening and treatment for obstructive sleep apnea, cardiopulmonary testing as indicated, and working toward improved glycemic control for diabetics. Hematologic evaluation for personal or strong family history of venous thromboembolic events is encouraged.

Several aspects of the medical evaluation and management of the preoperative bariatric surgical patient are subject to controversy. One such area is the workup and management of patients with preoperative gastroesophageal reflux disease (GERD) who are being considered for bariatric surgery. While debate exists among experts in the field, most surgeons would advise endoscopic evaluation for patients with active reflux symptoms, and there is data to support a more thorough evaluation with manometry and pH testing for those with severe, intractable disease [12, 13]. This may help to guide selection of a specific bariatric procedure based on the results, as well as to avoid long-term complications of increased acid exposure, which has been demonstrated after sleeve gastrectomy [14].

A secondary question then becomes: should all patients undergo routine esophagogastroduodenoscopy (EGD) prior to bariatric surgery? While many surgeons argue against this practice, others strongly recommend it due to the high prevalence of abnormal pathology found on mucosal evaluation. A recent study found that 79% of preoperative bariatric surgery patients had an abnormal endoscopy, including findings such as hiatal hernia, gastritis, esophagitis, Barrett's esophagus, *H. pylori* positivity, gastric erosions, or polyps [15]. In this cohort, a majority of patients with endoscopic findings of reflux disease were asymptomatic, and furthermore, the EGD findings changed management in 10% of patients. This was further supported by another study that demonstrated lack of correlation between upper gastrointestinal symptoms and foregut pathology and argues against relying on symptoms for screening with EGD. In general, the decision to perform preoperative endoscopy should be made on an individual patient basis [16, 17].

Most bariatric programs instruct patients to initiate a very-low-calorie diet (VLCD) in the weeks leading up to surgery. While there is strong clinical evidence that these VLCDs improve perioperative outcomes related to reduction of visceral fat, decreasing liver size, and minimizing complications, several aspects of the diets are variable [18–22]. The optimal amount of caloric restriction and duration of the preoperative diet are unclear, although most will vary from 1 to 4 weeks in duration, and may be influenced by factors such as preoperative body mass index (BMI) [23, 24]. The consistency of the diet (liquids vs. solid food) can vary, although evidence suggests a VLCD that is liquid consistency results in greater weight loss and visceral fat reduction, which may lead to reduction in surgical time [25]. Some literature also suggests a correlation between immediate short-term preoperative weight loss and enhanced postoperative weight loss up to 12 months [26]. It should be noted that this finding specifically refers to the immediate preoperative period during the VLCD, as overall preoperative weight loss during a bariatric surgery program evaluation should not serve as a mandate prior to surgery [27].

## Patient Experience

Much of the investigative focus in the area of post-bariatric surgery is on disease outcome, but data on patient experience and satisfaction is lacking. Several published studies were aimed at gaining a better understanding of the patient experience from pre-surgery to long-term postoperative follow-up. One study used a novel approach, providing patients with digital cameras for photographs and narrations to document their journey [28]. Specifically, this media was used with patient interviews to understand how comorbidities, social determinants of health, communication with providers, and insurance coverage influenced the overall experience. The results highlighted several themes, including racial/ethnic standards of beauty, gender expectations, comorbidities, depression and eating disorder, and obesity discrimination, and financial hardship affecting adherence. These findings can serve as guides for shaping future improvements, including implementation of screening tools to identify barriers earlier in the patient process.

Groller et al. studied patient reports of their experience (education, satisfaction, and areas for improvement) and found that perceptions of success were based on achievement of weight goals, adherence to rules, and improvement in overall health [29]. Opportunities for improvement in the educational component included explicit discussion regarding expected outcomes, monitoring holistic transformation, cultivating an environment of peer support, and further use of technology. Overall, there appears to be a lack of uniformity when it comes to patient education curriculums, teaching style, and educator roles across bariatric centers, as quantified in a recent systematic review [30]. This study also found some consistent topics as part of bariatric center curriculums, including details on surgical procedure, nutrition education, activity, and psychosocial behaviors. The review also highlighted the setting of educational components, in that most preoperative education was done in small groups, while postoperative counseling was more individualized. Both pre- and postoperative phases commonly included lectures or discussions by healthcare experts, and written/internet aides were implemented regularly.

Long-term patient-reported outcomes are vital to our understanding of the overall patient experience and impact on quality of life after surgical intervention. In a study among Roux-en-Y gastric bypass (RYGB) patients, participants were asked to rate satisfaction and comment spontaneously on their experience, with 99% of the 155 patients reporting satisfaction with their bariatric experience [31]. Comments were rated and categorized as positive in the majority (63%), neutral (25%), or negative (12%). Interestingly, only 8% of positive comments explicitly mentioned amount of weight loss achieved, while 43% of negative comments focused on weight regain or inadequate weight loss. Twenty-five percent of positive responders spontaneously commented on undergoing surgery again or recommending to others, while 21% of negative responders expressed regret. In long-term follow-up, focused conversations on overall health improvement and quality of life, rather than strictly calculations of weight loss outcomes, may result in even greater patient satisfaction and self-reported success.

## Perioperative Care

In this section, we explore those perioperative processes of care commonly undertaken in patients undergoing bariatric surgery and the potential impact these processes can have on outcomes based on available evidence. Reviews for perioperative laboratory studies and intraoperative pathways encompassing anesthesia protocols, prophylaxis against venous thromboembolism (VTE) and wound infections, and technical details such as staple line reinforcement and bougie size are discussed in this section.

## Laboratory Studies

Routine laboratory testing for patients undergoing bariatric surgery is similar to the testing commonly performed for any patient about to undergo major surgery. In the bariatric population, however, special considerations are made to evaluate comorbidities that are commonly seen in obese patients, as well as studies that target nutritional status.

While there are no data exploring the impact of routine preoperative laboratory work such as CBC, BMP, coagulation studies including partial thromboplastin time (PTT) and prothrombin time/international normalized ratio (PT/INR), and type and screen (T&S) on surgical outcomes in patients undergoing metabolic surgery, these laboratory studies are commonly obtained prior to surgery. Screening for pregnancy in appropriate female patients must also be undertaken. Though undernourishment is a concern in the surgical patient and should be optimized preoperatively, screening laboratories such as albumin levels are seldom low in patients suffering from obesity and routine testing is likely not needed [32].

Micronutrient and vitamin deficiencies, most notably iron and vitamin D, are higher in the patient with obesity than in the general population [33]. Moreover, many of these deficiencies are further aggravated following bariatric surgery, and additional deficiencies, such as zinc deficiency, can arise [34]. Overall, postoperative vitamins and micronutrient deficiencies may be most commonly seen in patients undergoing procedures with a bypass component such as the Roux-en-Y gastric bypass (RYGB) or biliopancreatic diversion with or without duodenal switch (BPD-DS). These deficiencies are also associated the sleeve gastrectomy (SG) and include micronutrients such as zinc and iron and vitamins such as D, B1, and B12 [35–37]. While the impact of such preoperative laboratory work on patient outcomes has not been evaluated, documentation and optimization of these deficiencies prior to surgery is likely appropriate.

Patients should also be screened for substance use. While this can be accomplished by taking a thorough preoperative history, laboratory testing for nicotine may be merited particularly patients undergoing gastric bypass. Smoking is a very significant risk factor for marginal ulcer formation following gastric bypass [38]. Therefore, some surgeons advocate for urine nicotine or cotinine testing in the preoperative period, including on the day of surgery. A positive test may result in reconsideration of surgery given a patient's increased risk of recalcitrant marginal ulceration should they continue to use tobacco. Patients should be offered smoking cessation resources as appropriate.

Lastly, the presence of *Helicobacter pylori* has not been shown to be associated with postoperative complications after bariatric surgery [39]. Therefore, *H. pylori* testing may be done at the discretion of the surgeon based on specific patient factors.

## Anesthesia Protocols

Enhanced recovery after surgery (ERAS) has been shown to reduce surgical morbidity and hospital length of stay across a wide variety of procedures. For example, the American Society for Metabolic and Bariatric Surgery recently completed a large, multicenter study of data from the Metabolic and Bariatric Surgery Accreditation and Quality Improvement registry. This trial, entitled Enhanced Recovery in Bariatric Surgery (ENERGY), demonstrated that implementation of ERAS pathways for bariatric surgery resulted in decreased length of stay and opioid-sparing pain management, among other measures. In bariatric surgery, evidence-based peri- and intraoperative practices are a common part of these pathways [40].

With regard to intraoperative fluids, bariatric surgery patients do not need large volumes of fluids to maintain urine output or reduce the incidence of rhabdomyolysis [41]. When comparing low (4 ml/kg/h) versus high (10 ml/kg/h) intraoperative fluid regimens, no difference in urine output was observed. Administration of between 1 and 2 l of fluid intraoperatively is common. Following surgery, maintenance fluids can be discontinued as soon as it is feasible and the enteral route should be used.

Obese patients often have airways that can be challenging to manage, and endotracheal intubation remains the common standard for airway maintenance during bariatric surgery. Intubation can be aided by use of preoxygenation and a ramped position in which the patient's shoulders are elevated for better airway exposure [42]. Patient positioning can also improve pulmonary mechanics, with the reverse Trendelenburg position resulting in superior lung volumes. This position often aids surgical exposure as well. In general, anesthesiologists involved in the care of bariatric patients should be familiar with the challenges presented by obese patients. Obstructive sleep apnea (OSA) is also more common in obese patients. The American Society of Anesthesiologists makes the following perioperative recommendations for patients with known OSA: use of multimodal analgesia to reduce opioid use, minimization of sedative use, use of supplemental oxygen, continuation of continuous positive airway pressure (CPAP) postoperatively, and use of continuous pulse oximetry. Patients with OSA should be encouraged to receive treatment with CPAP preoperatively and to bring their CPAP machine with them at the time of surgery [43, 44].

Lastly, there is evidence to suggest that the routine use of invasive monitoring during surgery, such as central venous access or arterial lines, is not necessary and should be avoided [45]. Routine use of drains such as nasogastric tubes, closed-suction abdominal drains, and Foley catheters is generally avoided as well.

## VTE Prophylaxis

Venous thromboembolism (VTE) can be a devastating complication, and patients undergoing bariatric sur-

gery are often at increased risk. For example, there is a 37% increase in VTE risk for every 10 unit increment in BMI [46]. Nearly all health systems have institutional protocols that include the use of perioperative prophylactic anticoagulation for select patients. Adherence to evidence-based, institutional quality measures for VTE prevention is particularly important for bariatric patients, as VTE incidence, compared to other complications, has been shown to have the greatest impact on readmission and mortality [47].

All patients undergoing bariatric surgery should have lower extremity sequential compression devices (SCDs) placed prior to induction of anesthesia [48]. Additionally, chemoprophylaxis with either unfractionated heparin (UFH) or low-molecular weight heparin (LMWH) should be initiated at induction. Although this is discussed in more detail below as postoperative prophylaxis, recent data suggest that LMWH may be preferable to UFH, with a lower incidence of VTE without an increased risk of hemorrhage [49]. Postoperative VTE prophylaxis is discussed in the section below.

## Antibiotic Prophylaxis

The majority of bariatric procedures involve division and/or anastomosis of bowel, which classifies them as clean-contaminated procedures. Obese patients undergoing bariatric surgery are at increased risk of surgical site infections (SSIs) after surgery, with an incidence ranging from 1% to as high as 16.5% in the literature. A retrospective review by Christou et al., for example, predicted a 4% incidence of SSI using risk stratification based on known risk factors; however, a 20% incidence was observed [50]. They importantly identified delayed administration of antibiotic prophylaxis as a risk factor for SSI. Other risk factors include BMI, smoking, obstructive sleep apnea, and increased duration of surgery [51].

Patients undergoing bariatric surgery should receive routine perioperative antibiotic prophylaxis. The agent of choice should cover both Gram-positive (e.g., staphylococci, streptococci, and enterococci), Gram-negative (e.g., *Proteus mirabilis*, *Serratia marcescens*, and *Escherichia coli*), and anaerobic (e.g., *Bacteroides fragilis*) bacteria, as these have been found to be the predominant organisms in bariatric surgery patients. For patients without a penicillin allergy, the most common antibiotic is cefazolin [52]. A common regimen for patients truly allergic to penicillin is clindamycin. In either case, antibiotics should be given no more than 30 min prior to surgical incision to achieve the desired serum concentration during surgery. Currently, there are limited data regarding the optimal dose in obese patients undergoing bariatric surgery.

## Stapler Reinforcement

Surgical staplers are universally employed in bariatric surgery, with the most common example being laparoscopic sleeve gastrectomy (LSG), in which the stomach is resected by repeated stapler firing to create a long, tubularized stomach. Staple line complications include leak and hemorrhage. For LSG, reported staple line leak rates range from 0% to 8%, and bleeding rates range between 0% and 3% [53]. There is a significant amount of debate regarding the best surgical technique by which to minimize these risks. Specifically, many surgeons have adapted different surgical techniques such as use of a staple line reinforcement product (SLR) (most commonly a bioabsorbable buttress material) or oversewing the staple line.

To date, there are no convincing data to suggest routine use of SLR. A large 2016 analysis of nearly 200,000 patients in the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) found that 80% of surgeons used SLR [54]. At the patient level, SLR was associated with a higher incidence of staple line leak (0.95% vs. 0.65%) and a lower incidence of staple line hemorrhage (0.75% vs. 1.0%). At the surgeon level, SLR also had a higher leak rate; however, the decrease in rate of hemorrhage was nonsignificant. More contemporary series comparing staple line buttressing to no buttressing have demonstrated no difference in leak rates between groups [55]. Oversewing the staple line in LSG has been shown to result in the highest burst pressure; however, this is also associated with increased operative time and has not been found to correlate with lower leak rates. Lastly, the choice of reinforcement material may affect staple line results. A 2015 meta-analysis found that buttressing the staple line of LSG with bovine pericardium resulted in the lowest leak rate (1.28%) compared to no reinforcement (2.75%) [56]. However, this material is not commonly used. Currently, the American Society for Metabolic and Bariatric Surgery recommends selective use of staple line reinforcement.

## Bougie Size

Another debated aspect of LSG is the size of the bougie which determines the size of the tubularized remnant stomach. On the one hand, too large a bougie size is associated with less weight loss after surgery. Atkins et al. compared the use of 40 French (F) and 50 F bougies in patients undergoing LSG and showed increased weight loss and comorbidity resolution at 2 years in the 40 F bougie size group [57]. There seems to be a threshold for this effect, however, as others have compared 32–42 F bougies and demonstrated no difference in weight loss or comorbidity resolution at 1 year [58]. Therefore, 50–60 F bougies are rarely used, and the use of a

bougie 40 F or smaller is generally considered to result in optimal weight loss.

Bougie size has also been shown to be associated with staple line leak rate after LSG. A 2013 systematic review of 9991 cases found that using 40 F or larger bougies was associated with decreased incidence of leak compared to smaller bougies [59]. Another review of 4999 patients reported a leak rate of 0.92% with the use of 40 F or larger bougies, compared to 2.67% with the use of bougies smaller than 40 F [60]. In those patients, there was no significant difference in weight loss between the two groups.

There is currently no agreed-upon bougie size to be used routinely in LSG. Overall, it is recommended to use a bougie size of 34 French or larger and that optimal weight loss may be compromised with bougie sizes much greater than 40 French. Smaller sizes are associated with an increased incidence of leak, and very large sizes are associated with suboptimal weight loss outcomes.

## Postoperative Care

### Early Ambulation

Early ambulation refers to mobilizing patients as early as possible after surgery, including the day of surgery (Table 41.1). Immobility is known to increase insulin resistance and decreases muscle strength, pulmonary function, and tissue oxygenation [61, 62]. Therefore, limiting a patient's bedrest following surgery can optimize recovery. In general, early ambulation is associated with shorter recovery time, shorter hospital stay, fewer postoperative complications, and improvement in overall functional status [63].

Early ambulation is feasible in bariatric surgery patients, with a 2012 study showing that implementation of a clinical pathway led to 92% of bariatric surgery patients ambulating on POD 0 [64]. Geubbels et al. compared outcomes in patients undergoing laparoscopic gastric bypass before and after implementation of a "fast track" care pathway [63]. This pathway prohibited the use of urinary catheters and ambulated patients on the day of surgery. Patients were allowed to step from the operating table into their hospital bed directly after re-emergence from anesthesia and were ambulated within 3 h of surgery. These patients had a median length of stay of 1 day compared to 3 days prior to implementing this pathway. There was an increase in post-discharge complications in the clinical pathway patients; however, this was not associated with worse outcomes. Other bariatric surgery recovery pathways have described ambulation within 4 h of surgery and then every 2 h during daytime [65]. Following laparoscopic sleeve gastrectomy, patients who engaged in a structured early ambulation protocol reported significantly lower pain scores compared to patients who ambulated less.

After bariatric surgery, patients should be encouraged to ambulate on the day of surgery and continue to ambulate regularly throughout their admission.

**Table 41.1** General principles of postoperative management after bariatric surgery

| General principle | Examples |
|---|---|
| Early ambulation | Ambulation on POD 0 |
| Early initiation of diet | NPO or bariatric clear liquid diet on POD 0 |
| | Advancing to bariatric full liquid diet on POD 1 |
| Nausea/vomiting prophylaxis | Prophylactic, scheduled use of antiemetic medication |
| Spontaneous voiding | No urinary catheter |
| | Intermittent straight catheterization if needed |
| Pain management | Multimodal pain control (acetaminophen, nonsteroidal anti-inflammatory drugs, opioids, etc.) |
| Venous thromboembolism prophylaxis | Ambulation |
| | Lower extremity compression devices |
| | Chemoprophylaxis |

### Initiation of Diet

Early initiation of diet after surgery has been shown to have a number of beneficial effects on patient recovery. Metabolically, early nutrition reduces insulin resistance and loss of muscle strength [66]. Other studies have shown that there is no clear benefit in prolonging a patient's nil by mouth (NPO) status, even after gastrointestinal surgery. In a Cochrane review and various meta-analyses, early nutrition has been associated with lower incidence of complications and reduction in mortality [67].

Early nutrition has been demonstrated to be safe and may enhance return of bowel function in patients undergoing gastrointestinal surgery [68]. Postoperative pathways described for bariatric surgery now universally include early initiation of diet. In these protocols, early diet typically ranges from more aggressive, with initiation of a clear liquid diet on the day of surgery to more conservative, with NPO on the day of surgery and initiation of clear liquids on postoperative day one. This has been associated with decreased length of hospital stay.

Patients can typically be advanced from clear liquids to a full liquid diet on POD 1. So long as patients are able to tolerate this diet, they can be discharged home and make further advances to their diet at home.

While there are no standard recommendations for protein intake following bariatric surgery, many institutions use either 60–80 g/day protein or 1–1.5 g/kg ideal body weight per day to estimate protein needs [69]. It is feasible to use

liquid protein supplements until patients are able to meet these intake goals through normal food intake [70].

## Antiemetic Medication

Postoperative nausea and vomiting (PONV) is common following bariatric surgery, affecting up to 65% of patients [71]. It is more common in female patients, nonsmokers, and with use of opioids [72]. There are a number of adverse effects that patients with PONV experience, including patient discomfort, prolonged hospitalization, dehydration, intolerance of diet, and electrolyte imbalance. PONV also puts patients at risk for acute kidney injury and aspiration events [73]. Given the high incidence of PONV, antiemetic medication should be utilized prophylactically.

There is no universally agreed-upon antiemetic regimen for bariatric surgery patients. However, the use of multiple agents of different pharmacologic classes has been demonstrated to be superior to single agents alone. Bamgbade et al. showed that multimodal antiemetic therapy was associated with less PONV, decreased time in PACU, earlier oral intake of liquids, and shorter hospital length of stay following laparoscopic bariatric surgery [74]. Multimodal antiemetic therapy was also evaluated in a prospective, randomized, double-blinded trial for patients undergoing laparoscopic sleeve gastrectomy [75]. At 12–24 h after surgery, PONV was lowest in patients who received ondansetron, dexamethasone, and haloperidol (23.3%) and highest in patients who received ondansetron alone (60%) (with patients who received ondansetron and dexamethasone falling in the middle (26.7%)). Other common, easily administered antiemetic medications that can be used in the postoperative setting include prochlorperzine, aprepitant, trimethobenzamide, and diphenhydramine. Using these medications in a prophylactic fashion typically involves scheduling their administration around the clock rather than waiting for patients to develop symptoms requiring their use.

Preoperative placement of a transdermal scopolamine (TDS) patch has also been shown to reduce the incidence of PONV [76]. Patients undergoing laparoscopic gastric bypass also experienced less PONV and used fewer antiemetics when TDS was placed preoperatively [77].

## Voiding Protocols

Common indications for urinary catheter usage include acute urinary retention, urinary incontinence resulting in skin breakdown, and close monitoring of urine output [78]. However, urinary catheters also carry significant risks, including infection, bleeding, prolonged hospitalization, and patient discomfort. In weighing these risks and benefits, there is currently insufficient evidence to support the routine use of urinary catheters (e.g., Foley catheters) in patients undergoing bariatric surgery.

Schouten et al. examined 60 obese female patients undergoing laparoscopic gastric bypass surgery [79]. Despite a preoperative prevalence of urinary incontinence of 43%, only 15% of patients had urinary incontinence immediately following the operation. Within 2 h, all patients had normal micturition, and no patients had urinary retention postoperatively. A 2018 study investigating factors associated with urinary tract infection after bariatric surgery found that urinary catheter placement was a significant predictor of infection, along with operating room time, length of stay, clindamycin antibiotic prophylaxis, and bariatric revision procedures [80].

Refraining from routine urinary catheter use has been demonstrated to be safe in bariatric surgery patients. Many enhanced recovery pathways for bariatric surgery patients report not using or immediately removing a urinary catheter after surgery, and patients do not experience serious complications related to this [81]. In a study of outpatient laparoscopic sleeve gastrectomy, 821 patients were discharged on the day of surgery without the use of urinary catheters, and no readmissions were for urinary complications [82]. When not using a urinary catheter, patients can be allowed to void spontaneously. Should a patient experience postoperative urinary retention, established criteria recommend the use of clean, intermittent straight catheterization in lieu of placing an indwelling catheter until symptom resolution [78].

## Postoperative Pain Control

The World Health Organization recognizes pain relief as a fundamental human right [83]. Pain after surgery has a number of adverse effects on patients, including increased postoperative complications, decreased functional status and quality of life, and the risk of prolonged pain syndromes [84]. The same principles that are generally recommended for effective postoperative pain management apply to patients undergoing bariatric surgery.

Multimodal analgesia is the use of pharmacologic agents from different classes to achieve superior pain control and reduce side effects compared to using a single agent or class of medications alone. Commonly combined medications include local anesthetics, acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), and opioids. In patients undergoing bariatric surgery, multimodal analgesia has been shown to provide superior pain control. Specifically, intravenous acetaminophen has been demonstrated to reduce opioid use, emergency room visits, and hospital costs [85]. Reduced postoperative opioid use also results in less PONV and antiemetic medication use [86]. Intravenous NSAIDs such as

ketorolac are sometimes avoided due to the supposed increase in bleeding risk. However, a 2014 meta-analysis of 27 randomized trials found that there was no significant increase in bleeding or other adverse events in patients who received ketorolac compared to controls [87]. What's more, these patients reported superior pain control overall.

Infiltration of a local anesthetic into laparoscopic port sites provides good pain relief in patients undergoing a variety of laparoscopic procedures such as cholecystectomy, inguinal hernia repair, and gynecologic surgery [88]. To date, however, there is sparse evidence in bariatric surgery patients. Moncada et al. conducted a 2015 study that specifically investigated the use of pre-incisional infiltration of 0.25% bupivacaine into the port sites of patients undergoing laparoscopic gastric bypass or sleeve gastrectomy. They did not find any difference in pain scores at any point after surgery compared to control patients. Despite this negative finding, many surgeons continue to use this analgesic method given its good evidence in other laparoscopic procedures.

There is also evidence to support the use of epidural pain management in patients undergoing bariatric surgery. In the general surgical population, epidural analgesia provides superior pain control compared to parenteral opioids regardless of analgesic agent, catheter placement location, or type and time of pain assessment [89]. A study of 114 patients undergoing gastric bypass found that patients who received epidural analgesia reported less pain and less PONV compared to patients who received local anesthetic infiltration plus patient-controlled opioid analgesia [90].

## Venous Thromboembolism Prophylaxis

The occurrence of venous thromboembolism (VTE) after surgery is a potentially life-threatening complication. Although mortality after bariatric surgery is rare, pulmonary embolism (PE) has been reported as the most common cause of death (38.2%) [91]. The incidence of VTE following bariatric surgery ranges from 0.2% to 3.5% [92]. The rate of PE has been reported to be as high as 1.2% [46]. A recent study examining 4293 patients undergoing laparoscopic bariatric surgery over a period of 8 years at a large referral center reported an overall VTE incidence of 1.3%, a PE incidence of 0.9%, and a DVT incidence of 0.4% [93]. They also found that VTE incidence varied by procedure, with a VTE rate of 0.2% for gastric banding, 1.1% for gastric bypass, 2.9% for sleeve gastrectomy, and 6.4% for revisional procedures. In this cohort, age, body mass index (BMI), and revisional surgery were identified as risk factors for VTE.

Patients undergoing bariatric surgery are particularly at increased risk of deep venous thrombosis (DVT) and PE given their unique risk factors. Obesity itself is a risk factor for VTE [94]. Obesity is also associated with comorbidities such as diabetes mellitus, hypertension, and venous stasis, which also increase the risk of VTE [95]. Other patient-specific predictors of VTE risk in laparoscopic bariatric surgery patients include age greater than 50, male gender, chronic obstructive pulmonary disease (COPD), and congestive heart disease (CHF) [96].

The majority of VTE in bariatric surgery patients occur after hospital discharge. In the previously mentioned study, the mean time to VTE diagnosis after surgery was 24 days [93]. Prospectively collected data from almost 74,000 bariatric surgery patients demonstrated that 73% of VTE events occurred after discharge from the hospital and most occurred within the first 30 days [97]. Another study examining VTE following common bariatric surgery procedures found that the cumulative incidence of VTE at 7, 30, 90, and 180 days was 0.3%, 1.9%, 2.1%, and 2.1%, respectively [98].

In order to reduce the incidence of VTE, prophylactic measures should be utilized for all patients undergoing bariatric surgery. Lower extremity compression in the form of sequential compression devices (SCDs) is thought to reduce the risk of DVT by decreasing venous stasis. In the general surgical population, lower extremity compression has been shown to decrease the risk of DVT by 60–65%, and the complication rate is extremely low [99]. SCDs should also be used in conjunction with early ambulation for all patients undergoing bariatric surgery. In a retrospective study of 957 patients who underwent laparoscopic Roux-en-Y gastric bypass, the use of calf-length SCDs and early ambulation resulted in a 30-day DVT and PE rate of 0.31% and 0.1%, respectively [100].

As mentioned earlier, a benefit of early ambulation is prevention of VTE. Frantzides et al. compared VTE rates in patients who received SCDs and VTE chemoprophylaxis with low-molecular-weight heparin (LMWH) to patients who received SCDs and early ambulation [101]. In the first group, the rate of DVT and PE was 1.6% and 1.1%, respectively. In the patients receiving SCDs and early ambulation, the DVT and PE rate was 0.4% and 0%, respectively. Early ambulation has many benefits and is recommended for all patients undergoing bariatric surgery. Both mechanical VTE prophylaxis and early ambulation are recommended by the American Society of Metabolic and Bariatric Surgeons (ASMBS) [70].

The use of pharmacologic VTE prophylaxis in the form of unfractionated heparin (UFH) or LMWH is common [102]. In the general surgical population, both UFH and LMWH have been shown to reduce the risk of VTE, with risk reductions ranging from 41% to 71% [103, 104]. There is a paucity of data in the bariatric surgery population specifically comparing VTE chemoprophylaxis with other options. One multicenter retrospective cohort study compared 30-day postoperative VTE rates in patients receiving VTE chemoprophylaxis and SCDs to patients who received SCDs alone

and found VTE rates of 0.47% and 0.25%, respectively [105]. This led the authors to conclude that adding chemoprophylaxis to routine use of SCDs may not be indicated in bariatric surgery patients. Another study compared patients who all received SCDs and LMWH to patients who received SCDs but only received LMWH if they had a personal or family history of VTE or hypercoagulable state [101]. The second group had lower rates of DVT and PE and also a lower incidence of postoperative bleeding requiring transfusion. Nevertheless, it is generally felt that the use of VTE chemoprophylaxis is appropriate in bariatric surgery patients unless there is reason to believe a patient is at increased risk of bleeding complications.

In selecting a chemoprophylaxis regimen, both UFH and LMWH are acceptable agents, although LMWH may be preferred. A 2012 study by Birkmeyer et al. compared VTE events in bariatric surgery patients receiving UFH and LMWH [49]. They demonstrated a 66% decrease in VTE risk in patients who received LMWH; however, subgroup analysis of only patients who were at high VTE risk did not demonstrate a significant difference in VTE risk between patients receiving UFH and LMWH.

Vena cava filters (VCFs) are not commonly used as a means of VTE prophylaxis in bariatric surgery patients. A 2013 propensity-matched cohort study found that bariatric surgery patients who underwent VCF placement preoperatively experienced more complications without any appreciable benefit [106]. Other cohort studies have argued that VCF placement is a safe alternative for high-risk bariatric surgery patients (e.g., prior history of VTE) [107]. Currently, there is no robust data to support the use of VCFs in patients undergoing bariatric surgery. As such, the current professional society guidelines recommend the alternatives discussed above instead of VCF.

Since the majority of VTE occur after patients leave the hospital, an important consideration is the use of post-discharge VTE prophylaxis. To date, one study has demonstrated benefit from the use of post-discharge prophylaxis. Raftopoulos et al. compared patients who received LMWH during hospital admission only to patients who received LMWH during hospital admission and for 10 days after discharge [108]. They reported a 30-day VTE rate of 4.5% in patients who received in-hospital prophylaxis only compared to a 0% VTE rate in patients who also received post-discharge prophylaxis. While these data are encouraging, more studies are needed to evaluate the risks and benefits of routine post-discharge VTE prophylaxis. Currently, extended prophylaxis is recommended for patients who are at high risk of VTE. This includes patients with a history of VTE, high BMI (>55), male gender, surgery duration >3 h, known thrombophilia, or nonambulatory patients [46]. For these patients, VTE chemoprophylaxis should be continued for 2–4 weeks following hospital discharge. Risk calculators have been developed by both the Michigan Bariatric Surgery Collaborative and the Cleveland Clinic to assist surgeons in determining an individual patient's risk of post-discharge VTE [46, 109].

Lastly, portomesenteric vein thrombosis (PVT) is an uncommon complication after bariatric surgery that deserves mention. The first systematic review of PVT compiled studies describing this entity in 110 patients [110]. The incidence of PVT was 0.3%, and it was most common after laparoscopic sleeve gastrectomy compared to other bariatric procedures. Significant preoperative risk factors included oral contraceptive pills, active smoking, previous surgery, and history of coagulopathy. The consequences of PVT can include ascites, esophageal varices, and bowel infarction [111]. Due to its rarity, surgeons need to maintain a high index of suspicious for PVT in patients who do not recover as expected from bariatric surgery. The main treatment is immediate anticoagulation with UFH or LMWH, which may result in recanalization in over 80% of cases. However, currently there is no consensus regarding the optimal duration of therapy.

In summary, patients undergoing laparoscopic bariatric surgery are at increased risk of VTE. Therefore, a multimodal approach to VTE prophylaxis is recommended. This includes SCDs, early ambulation, and chemoprophylaxis.

## Question Section

1. Some surgeons recommend preoperative esophagogastroduodenoscopy prior to bariatric surgery for the following reason:
   A. Patients with asymptomatic esophageal and gastric disease have worse outcomes.
   B. Detection and treatment of *H. pylori* prior to surgery are associated with a decreased incidence of postoperative complications.
   C. In patients with abnormal endoscopic findings, these results help inform perioperative management.
   D. There is a high prevalence of abnormal pathology found on endoscopy, with the majority of bariatric patients have abnormal endoscopic findings preoperatively.
2. Typical enhanced recovery pathways following bariatric surgery involve the following recommendations regarding initiation of diet:
   A. Early nutrition (on POD 0 or 1) is associated with higher incidence of complications.
   B. Patients should routinely have a nasogastric tube placed intraoperatively, and diet should not be resumed until it is removed.
   C. Initiation of a clear liquid diet on POD 0 is safe in bariatric surgery patients.
   D. Patients should be kept NPO until return of bowel function.

3. The bariatric surgery patient is at increased risk of venous thromboembolism (VTE). As such, it is critical that appropriate measures be taken to prevent this complication. This includes:
   A. Extended chemoprophylaxis for patients who are at high risk of VTE, such as patients with a known thrombophilia.
   B. In-hospital chemoprophylaxis only, as the majority of VTEs occur prior to discharge.
   C. Ambulation and sequential compression devices only, as pharmacologic anticoagulation increases bleeding risk after surgery.
   D. Placement of a vena cava filter preoperatively for average-risk patients.
4. Screening for substance abuse is a critical part of the preoperative evaluation of bariatric surgery patients. This is particularly true in patients being considered for Roux-en-Y gastric bypass for the following reason:
   A. These patients are at increased risk for substance relapse following surgery compared to other bariatric procedures.
   B. Smoking can result in ulceration after surgery that is resistant to medical therapy.
   C. Alcohol use is a risk factor for *H. pylori* infection, which is associated with increased postoperative complications.
   D. This procedure has a higher risk of opioid dependence compared to other bariatric procedures.

## References


1. Telem DA, Majid SF, Powers K, DeMaria E, Morton J, Jones DB. Assessing national provision of care: variability in bariatric clinical care pathways. Surg Obes Relat Dis. 2017;13(2):281–4.
2. Access to Care Fact Sheet: American Society for Metabolic and Bariatric Surgery; Available from: https://asmbs.org/resources/access-to-care-fact-sheet.
3. Media Release: American Society for Metabolic and Bariatric Surgery; Available from: http://www.medicalnewstoday.com/articles/111681.php.
4. Jamal MK, DeMaria EJ, Johnson JM, Carmody BJ, Wolfe LG, Kellum JM, et al. Insurance-mandated preoperative dietary counseling does not improve outcome and increases dropout rates in patients considering gastric bypass surgery for morbid obesity. Surg Obes Relat Dis. 2006;2(2):122–7.
5. Alvarez R, Bonham AJ, Buda CM, Carlin AM, Ghaferi AA, Varban OA. Factors associated with long wait times for bariatric surgery. Ann Surg. 2018. http://doi:10.1097/SLA.0000000000002826. [Epub ahead of print]
6. Falvo AM, Hite Philp F, Eid GM. Primary care provider management of patients with obesity at an integrated health network: a survey of practices, views, and knowledge. Surg Obes Relat Dis. 2018;14:1149.
7. Shubeck S, Dimick JB, Telem DA. Long-term outcomes following bariatric surgery. JAMA. 2018;319(3):302–3.
8. Sherf-Dagan S, Hod K, Mardy-Tilbor L, Gliksman S, Ben-Porat T, Sakran N, et al. The effect of pre-surgery information online lecture on nutrition knowledge and anxiety among bariatric surgery candidates. Obes Surg. 2018;28(7):1876–85.
9. Eaton L, Walsh C, Magnuson T, Schweitzer M, Lidor A, Nguyen H, et al. On-line bariatric surgery information session as effective as in-person information session. Surg Obes Relat Dis. 2012;8(2):225–9.. discussion 9
10. Miletics M, Claros L, Stoltzfus J, Davis T, Chaar ME. Progression to surgery: online versus live seminar. Surg Obes Relat Dis. 2018;14(3):382–5.
11. Yang K, Zhang B, Kastanias P, Wang W, Okraniec A, Sockalingam S. Factors leading to self-removal from the bariatric surgery program after attending the orientation session. Obes Surg. 2017;27(1):102–9.
12. Tolone S, Limongelli P, del Genio G, Brusciano L, Rossetti G, Amoroso V, et al. Gastroesophageal reflux disease and obesity: do we need to perform reflux testing in all candidates to bariatric surgery? Int J Surg. 2014;12(Suppl 1):S173–7.
13. Tolone S, Savarino E, de Bortoli N, Frazzoni M, Furnari M, d'Alessandro A, et al. Esophagogastric junction morphology assessment by high resolution manometry in obese patients candidate to bariatric surgery. Int J Surg. 2016;28(Suppl 1):S109–13.
14. Georgia D, Stamatina T, Maria N, Konstantinos A, Konstantinos F, Emmanouil L, et al. 24-h multichannel intraluminal impedance PH-metry 1 year after Laparoscopic sleeve gastrectomy: an objective assessment of gastroesophageal reflux disease. Obes Surg. 2017;27(3):749–53.
15. D'Silva M, Bhasker AG, Kantharia NS, Lakdawala M. High-percentage pathological findings in obese patients suggest that esophago-gastro-duodenoscopy should be made mandatory prior to bariatric surgery. Obes Surg. 2018;28:2753.
16. Carabotti M, Avallone M, Cereatti F, Paganini A, Greco F, Scirocco A, et al. Usefulness of upper gastrointestinal symptoms as a driver to prescribe gastroscopy in obese patients candidate to bariatric surgery. A prospective study. Obes Surg. 2016;26(5):1075–80.
17. Asge Standards Of Practice C, Evans JA, Muthusamy VR, Acosta RD, Bruining DH, Chandrasekhara V, et al. The role of endoscopy in the bariatric surgery patient. Surg Obes Relat Dis. 2015;11(3):507–17.
18. Van Nieuwenhove Y, Dambrauskas Z, Campillo-Soto A, van Dielen F, Wiezer R, Janssen I, et al. Preoperative very low-calorie diet and operative outcome after laparoscopic gastric bypass: a randomized multicenter study. Arch Surg. 2011;146(11):1300–5.
19. Alami RS, Morton JM, Schuster R, Lie J, Sanchez BR, Peters A, et al. Is there a benefit to preoperative weight loss in gastric bypass patients? A prospective randomized trial. Surg Obes Relat Dis. 2007;3(2):141–5.. discussion 5–6
20. Pilone V, Tramontano S, Renzulli M, Romano M, Cobellis L, Berselli T, et al. Metabolic effects, safety, and acceptability of very low-calorie ketogenic dietetic scheme on candidates for bariatric surgery. Surg Obes Relat Dis. 2018;14:1013.
21. Holderbaum M, Casagrande DS, Sussenbach S, Buss C. Effects of very low calorie diets on liver size and weight loss in the preoperative period of bariatric surgery: a systematic review. Surg Obes Relat Dis. 2018;14(2):237–44.
22. Edholm D, Kullberg J, Karlsson FA, Haenni A, Ahlstrom H, Sundbom M. Changes in liver volume and body composition during 4 weeks of low calorie diet before laparoscopic gastric bypass. Surg Obes Relat Dis. 2015;11(3):602–6.
23. Holderbaum MS, Buss C. Dietary management in the immediate preoperative period of bariatric surgery: a national overview : bariatric preoperative diets. Obes Surg. 2018;28(6):1688–96.
24. Baldry EL, Leeder PC, Idris IR. Pre-operative dietary restriction for patients undergoing bariatric surgery in the UK: observational study of current practice and dietary effects. Obes Surg. 2014;24(3):416–21.

25. Faria SL, Faria OP, de Almeida Cardeal M, Ito MK. Effects of a very low calorie diet in the preoperative stage of bariatric surgery: a randomized trial. Surg Obes Relat Dis. 2015;11(1):230–7.
26. Hutcheon DA, Hale AL, Ewing JA, Miller M, Couto F, Bour ES, et al. Short-term preoperative weight loss and postoperative outcomes in bariatric surgery. J Am Coll Surg. 2018;226(4):514–24.
27. Kim JJ, Rogers AM, Ballem N, Schirmer B, American Society for M, Bariatric Surgery Clinical Issues C. ASMBS updated position statement on insurance mandated preoperative weight loss requirements. Surg Obes Relat Dis. 2016;12(5):955–9.
28. Johnson LP, Asigbee FM, Crowell R, Negrini A. Pre-surgical, surgical and post-surgical experiences of weight loss surgery patients: a closer look at social determinants of health. Clin Obes. 2018;8(4):265–74.
29. Groller KD, Teel C, Stegenga KH, El Chaar M. Patient perspectives about bariatric surgery unveil experiences, education, satisfaction, and recommendations for improvement. Surg Obes Relat Dis. 2018;14(6):785–96.
30. Groller KD. Systematic review of patient education practices in weight loss surgery. Surg Obes Relat Dis. 2017;13(6):1072–85.
31. Turrentine FE, Mehaffey JH, Mehaffey RL, Mullen MG, Schirmer BD, Hallowell PT. Patient reported outcomes 10 years after Roux-en-Y gastric bypass. Obes Surg. 2017;27(9):2253–7.
32. Toh SY, Zarshenas N, Jorgensen J. Prevalence of nutrient deficiencies in bariatric patients. Nutrition. 2009;25(11–12):1150–6.
33. 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(3):540–6.
34. Mingrone G, Bornstein S, Le Roux CW. Optimisation of follow-up after metabolic surgery. Lancet Diabetes Endocrinol. 2018;6(6):487–99.
35. Gloy VL, Briel M, Bhatt DL, Kashyap SR, Schauer PR, Mingrone G, et al. Bariatric surgery versus non-surgical treatment for obesity: a systematic review and meta-analysis of randomised controlled trials. BMJ. 2013;347:f5934.
36. Pellitero S, Martinez E, Puig R, Leis A, Zavala R, Granada ML, et al. Evaluation of vitamin and trace element requirements after sleeve gastrectomy at long term. Obes Surg. 2017;27(7):1674–82.
37. Salle A, Demarsy D, Poirier AL, Lelievre B, Topart P, Guilloteau G, et al. Zinc deficiency: a frequent and underestimated complication after bariatric surgery. Obes Surg. 2010;20(12):1660–70.
38. Azagury DE, Abu Dayyeh BK, Greenwalt IT, Thompson CC. Marginal ulceration after Roux-en-Y gastric bypass surgery: characteristics, risk factors, treatment, and outcomes. Endoscopy. 2011;43(11):950–4.
39. Almazeedi S, Al-Sabah S, Alshammari D, Alqinai S, Al-Mulla A, Al-Murad A, et al. The impact of helicobacter pylori on the complications of laparoscopic sleeve gastrectomy. Obes Surg. 2014;24(3):412–5.
40. Thorell A, MacCormick AD, Awad S, Reynolds N, Roulin D, Demartines N, et al. Guidelines for perioperative care in bariatric surgery: enhanced recovery after surgery (ERAS) society recommendations. World J Surg. 2016;40(9):2065–83.
41. 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(6):709–15.
42. Collins JS, Lemmens HJ, Brodsky JB, Brock-Utne JG, Levitan RM. Laryngoscopy and morbid obesity: a comparison of the "sniff" and "ramped" positions. Obes Surg. 2004;14(9):1171–5.
43. Telem DA, Jones DB, Schauer PR, Brethauer SA, Rosenthal RJ, Provost D, et al. Updated panel report: best practices for the surgical treatment of obesity. Surg Endosc. 2018;32:4158.
44. Committee ACI. Peri-operative management of obstructive sleep apnea. Surg Obes Relat Dis. 2012;8(3):e27–32.
45. Telem DA, Gould J, Pesta C, Powers K, Majid S, Greenberg JA, et al. American Society for Metabolic and Bariatric Surgery: care pathway for laparoscopic sleeve gastrectomy. Surg Obes Relat Dis. 2017;13(5):742–9.
46. Finks JF, English WJ, Carlin AM, Krause KR, Share DA, Banerjee M, et al. Predicting risk for venous thromboembolism with bariatric surgery: results from the Michigan bariatric surgery collaborative. Ann Surg. 2012;255(6):1100–4.
47. Daigle CR, Brethauer SA, Tu C, Petrick AT, Morton JM, Schauer PR, et al. Which postoperative complications matter most after bariatric surgery? Prioritizing quality improvement efforts to improve national outcomes. Surg Obes Relat Dis. 2018;14(5):652–7.
48. American Society for M, Bariatric Surgery Clinical Issues C. ASMBS updated position statement on prophylactic measures to reduce the risk of venous thromboembolism in bariatric surgery patients. Surg Obes Relat Dis. 2013;9(4):493–7.
49. Birkmeyer NJ, Finks JF, Carlin AM, Chengelis DL, Krause KR, Hawasli AA, et al. Comparative effectiveness of unfractionated and low-molecular-weight heparin for prevention of venous thromboembolism following bariatric surgery. Arch Surg. 2012;147(11):994–8.
50. Christou NV, Jarand J, Sylvestre JL, McLean AP. Analysis of the incidence and risk factors for wound infections in open bariatric surgery. Obes Surg. 2004;14(1):16–22.
51. Chopra T, Zhao JJ, Alangaden G, Wood MH, Kaye KS. Preventing surgical site infections after bariatric surgery: value of perioperative antibiotic regimens. Expert Rev Pharmacoecon Outcomes Res. 2010;10(3):317–28.
52. ASHP Therapeutic Guidelines on Antimicrobial Prophylaxis in Surgery. American Society of Health-System Pharmacists. Am J Health Syst Pharm. 1999;56(18):1839–88.
53. Bransen J, Gilissen LP, van Rutte PW, Nienhuijs SW. Costs of leaks and bleeding after sleeve Gastrectomies. Obes Surg. 2015;25(10):1767–71.
54. Berger ER, Clements RH, Morton JM, Huffman KM, Wolfe BM, Nguyen NT, et al. The impact of different surgical techniques on outcomes in laparoscopic sleeve Gastrectomies: the first report from the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP). Ann Surg. 2016;264(3):464–73.
55. Timucin Aydin M, Aras O, Karip B, Memisoglu K. Staple line reinforcement methods in laparoscopic sleeve gastrectomy: comparison of burst pressures and leaks. JSLS. 2015;19(3):e2015.
56. Shikora SA, Mahoney CB. Clinical benefit of gastric staple line reinforcement (SLR) in gastrointestinal surgery: a meta-analysis. Obes Surg. 2015;25(7):1133–41.
57. Atkins ER, Preen DB, Jarman C, Cohen LD. Improved obesity reduction and co-morbidity resolution in patients treated with 40-French bougie versus 50-French bougie four years after laparoscopic sleeve gastrectomy. Analysis of 294 patients. Obes Surg. 2012;22(1):97–104.
58. Spivak H, Rubin M, Sadot E, Pollak E, Feygin A, Goitein D. Laparoscopic sleeve gastrectomy using 42-French versus 32-French bougie: the first-year outcome. Obes Surg. 2014;24(7):1090–3.
59. Parikh M, Issa R, McCrillis A, Saunders JK, Ude-Welcome A, Gagner M. Surgical strategies that may decrease leak after laparoscopic sleeve gastrectomy: a systematic review and meta-analysis of 9991 cases. Ann Surg. 2013;257(2):231–7.
60. Yuval JB, Mintz Y, Cohen MJ, Rivkind AI, Elazary R. The effects of bougie caliber on leaks and excess weight loss following laparoscopic sleeve gastrectomy. Is there an ideal bougie size? Obes Surg. 2013;23(10):1685–91.
61. Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. Am J Surg. 2002;183(6):630–41.
62. Lassen K, Soop M, Nygren J, Cox PB, Hendry PO, Spies C, et al. Consensus review of optimal perioperative care in colorectal surgery: Enhanced Recovery After Surgery (ERAS) Group recommendations. Arch Surg. 2009;144(10):961–9.

63. Geubbels N, Bruin SC, Acherman YI, van de Laar AW, Hoen MB, de Brauw LM. Fast track care for gastric bypass patients decreases length of stay without increasing complications in an unselected patient cohort. Obes Surg. 2014;24(3):390–6.
64. Ronellenfitsch 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(5):732–9.
65. Awad S, Carter S, Purkayastha S, Hakky S, Moorthy K, Cousins J, et al. Enhanced recovery after bariatric surgery (ERABS): clinical outcomes from a tertiary referral bariatric centre. Obes Surg. 2014;24(5):753–8.
66. Melnyk M, Casey RG, Black P, Koupparis AJ. Enhanced recovery after surgery (ERAS) protocols: time to change practice? Can Urol Assoc J. 2011;5(5):342–8.
67. Andersen HK, Lewis SJ, Thomas S. Early enteral nutrition within 24h of colorectal surgery versus later commencement of feeding for postoperative complications. Cochrane Database Syst Rev. 2006;(4):CD004080.
68. 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(1):119–26.
69. Snyder-Marlow G, Taylor D, Lenhard MJ. Nutrition care for patients undergoing laparoscopic sleeve gastrectomy for weight loss. J Am Diet Assoc. 2010;110(4):600–7.
70. Mechanick JI, Youdim A, Jones DB, Garvey WT, Hurley DL, McMahon MM, 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. Obesity (Silver Spring). 2013;21(Suppl 1):S1–27.
71. Halliday TA, Sundqvist J, Hultin M, Wallden J. Post-operative nausea and vomiting in bariatric surgery patients: an observational study. Acta Anaesthesiol Scand. 2017;61(5):471–9.
72. Gan TJ, Diemunsch P, Habib AS, Kovac A, Kranke P, Meyer TA, et al. Consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg. 2014;118(1):85–113.
73. Therneau IW, Martin EE, Sprung J, Kellogg TA, Schroeder DR, Weingarten TN. The role of Aprepitant in prevention of postoperative nausea and vomiting after bariatric surgery. Obes Surg. 2018;28(1):37–43.
74. Bamgbade OA, Oluwole O, Khaw RR. Perioperative antiemetic therapy for fast-track laparoscopic bariatric surgery. Obes Surg. 2018;28(5):1296–301.
75. Benevides ML, Oliveira SS, de Aguilar-Nascimento JE. The combination of haloperidol, dexamethasone, and ondansetron for prevention of postoperative nausea and vomiting in laparoscopic sleeve gastrectomy: a randomized double-blind trial. Obes Surg. 2013;23(9):1389–96.
76. Antor MA, Uribe AA, Erminy-Falcon N, Werner JG, Candiotti KA, Pergolizzi JV, et al. The effect of transdermal scopolamine for the prevention of postoperative nausea and vomiting. Front Pharmacol. 2014;5:55.
77. Dearing DD, Martin D, Powell WJ, Lourie DJ. Transdermal scopolamine reduces incidence of postoperative nausea and vomiting in laparoscopic Roux-en-Y gastric bypass patients. Surg Obes Relat Dis. 2007;3(3):288.
78. Meddings J, Saint S, Fowler KE, Gaies E, Hickner A, Krein SL, et al. The Ann Arbor criteria for appropriate urinary catheter use in hospitalized medical patients: results obtained by using the RAND/UCLA appropriateness method. Ann Intern Med. 2015;162(9 Suppl):S1–34.
79. Schouten R, van Dijke JC, Van 't Hof G, Feskens PB. Prevalence and risk factors of urinary incontinence and bladder retention in gastric bypass surgery: a cross-sectional study. Obes Surg. 2013;23(6):760–3.
80. Helmen ZM, Helm MC, Helm JH, Nielsen A, Kindel T, Higgins R, et al. Predictors of postoperative urinary tract infection after bariatric surgery. Obes Surg. 2018;28(7):1950–4.
81. Singh PM, Panwar R, Borle A, Goudra B, Trikha A, van Wagensveld BA, 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(2):489–501.
82. Lalezari S, Musielak MC, Broun LA, Curry TW. Laparoscopic sleeve gastrectomy as a viable option for an ambulatory surgical procedure: our 52-month experience. Surg Obes Relat Dis. 2018;14(6):748–50.
83. International Pain Summit Of The International Association For The Study Of P. Declaration of Montreal: declaration that access to pain management is a fundamental human right. J Pain Palliat Care Pharmacother. 2011;25(1):29–31.
84. Chou R, Gordon DB, de Leon-Casasola OA, Rosenberg JM, Bickler S, Brennan T, et al. Management of postoperative pain: a clinical practice guideline from the American pain society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on regional anesthesia, executive Committee, and administrative council. J Pain. 2016;17(2):131–57.
85. El Chaar M, Stoltzfus J, Claros L, Wasylik T. IV acetaminophen results in lower hospital costs and emergency room visits following bariatric surgery: a double-blind, prospective, randomized trial in a single accredited bariatric center. J Gastrointest Surg. 2016;20(4):715–24.
86. Ziemann-Gimmel P, Hensel P, Koppman J, Marema R. Multimodal analgesia reduces narcotic requirements and antiemetic rescue medication in laparoscopic Roux-en-Y gastric bypass surgery. Surg Obes Relat Dis. 2013;9(6):975–80.
87. Gobble RM, Hoang HL, Kachniarz B, Orgill DP. Ketorolac does not increase perioperative bleeding: a meta-analysis of randomized controlled trials. Plast Reconstr Surg. 2014;133(3):741–55.
88. Gerges FJ, Kanazi GE, Jabbour-Khoury SI. Anesthesia for laparoscopy: a review. J Clin Anesth. 2006;18(1):67–78.
89. Block BM, Liu SS, Rowlingson AJ, Cowan AR, Cowan JA Jr, Wu CL. Efficacy of postoperative epidural analgesia: a meta-analysis. JAMA : J Am Med Assoc. 2003;290(18):2455–63.
90. Schumann R, Shikora S, Weiss JM, Wurm H, Strassels S, Carr DB. A comparison of multimodal perioperative analgesia to epidural pain management after gastric bypass surgery. Anesth Analg. 2003;96(2):469–74.. table of contents
91. Morino M, Toppino M, Forestieri P, Angrisani L, Allaix ME, Scopinaro N. Mortality after bariatric surgery: analysis of 13,871 morbidly obese patients from a national registry. Ann Surg. 2007;246(6):1002–7.. discussion 7–9
92. Stein PD, Matta F. Pulmonary embolism and deep venous thrombosis following bariatric surgery. Obes Surg. 2013;23(5):663–8.
93. Jamal MH, Corcelles R, Shimizu H, Kroh M, Safdie FM, Rosenthal R, et al. Thromboembolic events in bariatric surgery: a large multi-institutional referral center experience. Surg Endosc. 2015;29(2):376–80.
94. Stein PD, Beemath A, Olson RE. Obesity as a risk factor in venous thromboembolism. Am J Med. 2005;118(9):978–80.
95. Ageno W, Becattini C, Brighton T, Selby R, Kamphuisen PW. Cardiovascular risk factors and venous thromboembolism: a meta-analysis. Circulation. 2008;117(1):93–102.
96. 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(5):1140–5.
97. Winegar DA, Sherif B, Pate V, DeMaria EJ. Venous thromboembolism after bariatric surgery performed by Bariatric Surgery Center

of Excellence Participants: analysis of the bariatric outcomes longitudinal database. Surg Obes Relat Dis. 2011;7(2):181–8.
98. Froehling DA, Daniels PR, Mauck KF, Collazo-Clavell ML, Ashrani AA, Sarr MG, et al. Incidence of venous thromboembolism after bariatric surgery: a population-based cohort study. Obes Surg. 2013;23(11):1874–9.
99. Bartlett MA, Mauck KF, Daniels PR. Prevention of venous thromboembolism in patients undergoing bariatric surgery. Vasc Health Risk Manag. 2015;11:461–77.
100. Clements RH, Yellumahanthi K, Ballem N, Wesley M, Bland KI. Pharmacologic prophylaxis against venous thromboembolic complications is not mandatory for all laparoscopic Roux-en-Y gastric bypass procedures. J Am Coll Surg. 2009;208(5):917–21.. discussion 21–3
101. Frantzides CT, Welle SN, Ruff TM, Frantzides AT. Routine anticoagulation for venous thromboembolism prevention following laparoscopic gastric bypass. JSLS. 2012;16(1):33–7.
102. Pryor HI 2nd, Singleton A, Lin E, Lin P, Vaziri K. Practice patterns in high-risk bariatric venous thromboembolism prophylaxis. Surg Endosc. 2013;27(3):843–8.
103. Gould MK, Garcia DA, Wren SM, Karanicolas PJ, Arcelus JI, Heit JA, et al. Prevention of VTE in nonorthopedic surgical patients: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2012;141(2 Suppl):e227S–e77S.
104. Mismetti P, Laporte S, Darmon JY, Buchmuller A, Decousus H. Meta-analysis of low molecular weight heparin in the prevention of venous thromboembolism in general surgery. Br J Surg. 2001;88(7):913–30.
105. Gagner M, Selzer F, Belle SH, Bessler M, Courcoulas AP, Dakin GF, et al. Adding chemoprophylaxis to sequential compression might not reduce risk of venous thromboembolism in bariatric surgery patients. Surg Obes Relat Dis. 2012;8(6):663–70.
106. Birkmeyer NJ, Finks JF, English WJ, Carlin AM, Hawasli AA, Genaw JA, et al. Risks and benefits of prophylactic inferior vena cava filters in patients undergoing bariatric surgery. J Hosp Med. 2013;8(4):173–7.
107. Overby DW, Kohn GP, Cahan MA, Dixon RG, Stavas JM, Moll S, et al. Risk-group targeted inferior vena cava filter placement in gastric bypass patients. Obes Surg. 2009;19(4):451–5.
108. Raftopoulos I, Martindale C, Cronin A, Steinberg J. The effect of extended post-discharge chemical thromboprophylaxis on venous thromboembolism rates after bariatric surgery: a prospective comparison trial. Surg Endosc. 2008;22(11):2384–91.
109. Aminian A, Andalib A, Khorgami Z, Cetin D, Burguera B, Bartholomew J, 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(1):143–50.
110. Shoar S, Saber AA, Rubenstein R, Safari S, Brethauer SA, Al-Thani H, et al. Portomesentric and splenic vein thrombosis (PMSVT) after bariatric surgery: a systematic review of 110 patients. Surg Obes Relat Dis. 2018;14(1):47–59.
111. Ming Tan SB, Greenslade J, Martin D, Talbot M, Loi K, Hopkins G. Portomesenteric vein thrombosis in sleeve gastrectomy: a 10-year review. Surg Obes Relat Dis. 2018;14(3):271–5.