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Postoperative Pathways in Minimally Invasive Bariatric Surgery

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List of Abbreviations

ASMBS	American Society for Metabolic and Bariatric Surgery
BPD-DS	Bilio-pancreatic diversion with duodenal switch
COE	Center of excellence
IV	Intravenous
LAGB	Laparoscopic adjustable gastric banding
LRYGB	Laparoscopic Roux-en-Y gastric bypass
LSG	Laparoscopic sleeve gastrectomy
UGI	Upper gastrointestinal
VTE	Venous thromboembolism

Introduction

The emergence of the obesity epidemic and the advancement of minimally invasive techniques have made weight-loss operations some of the most commonly performed surgical procedures. It is estimated that over 100,000 patients undergo bariatric surgery yearly in the United States [1]. With the high prevalence of such operations, patients and third-party payers have come to expect high-quality results and value. Accreditation or participation in a national quality improvement program or center of excellence program is based upon specific criteria including standardization of a postoperative clinical care pathway. The goal is to generate high-quality outcomes by adhering to evidence-based practice recommendations. In many surgical specialties, implementation of clinical pathways affords the necessary high-quality results with reduction of cost through standardization of care [2]. Standardizing postoperative pathways in bariatric surgery has been shown to decrease length of stay and improve resource utilization without compromising patient outcome [3, 4]. This chapter focuses on the necessary components of postoperative bariatric care and the relevant scientific evidence upon which clinical pathways are structured.

Postoperative care of the bariatric patient begins following a standardized outpatient preoperative work-up and

standardized procedure which are described in other sections within this text. From the operating room, the patient is immediately transported to the recovery room under the supervision of one of the operating surgeons and a member of the anesthesia team. For proper communication between clinicians, operative notes and computerized orders should be completed immediately following the procedure. Such immediate postoperative orders begin the postoperative pathway.

The majority of bariatric patients will be cared for on a surgical unit or one which also has telemetry capabilities. The necessity for telemetry is often based upon the specific patient's need for increased monitoring due to elevated risk. This includes patients with severe sleep apnea, other pulmonary conditions, cardiac dysrhythmias, and opioid sensitivity. For patients with more extensive comorbidities, or those who have undergone very lengthy or difficult operations, admission to an intensive care unit may be necessary. Upon arrival to the postanesthesia care unit and upon arrival to the designated postoperative care unit, the patient should be evaluated by the attending registered nurse. The nursing staff should be highly trained in postoperative bariatric care and recognition of the initial presenting signs for potential complications. An algorithm must be in place to facilitate communication between the nursing staff and the appropriate physician should complications and concerns arise.

Postoperative Considerations

There are several important considerations in the postoperative period. These include laboratory testing, pain management, respiratory care, venous thromboembolism (VTE) prophylaxis, radiologic evaluation, diet progression, wound care, and postoperative follow-up. Some recommendations are universal to all the common present-day bariatric procedures, while other recommendations are procedure specific. These procedures include: laparoscopic Roux-en-Y gastric bypass (LRYGB), bilio-pancreatic diversion with duodenal

TABLE 1. Key postoperative bariatric care components

Post-op day #0	Laboratory studies Resume necessary home medications in IV form IV pain management IV hydration Pulmonary toilet/respiratory care VTE prophylaxis Early ambulation Incision and drain care Surgeon and anesthesia postoperative evaluation
Post-op day #1	Laboratory studies UGI contrast study (routine or selective) Bariatric clear liquid diet commencement Resume appropriate PO home medications Convert to PO pain medication Pulmonary toilet/respiratory care VTE prophylaxis Increase ambulation Incision and drain care and teaching Postoperative patient education Discharge education and discharge for purely restrictive procedures (LAGB, LSG)
Post-op day #2	Laboratory studies Increase volume of clear bariatric liquids Pulmonary toilet/respiratory care VTE prophylaxis Continue ambulation Continue postoperative patient education Discharge education

switch (BPD-DS), laparoscopic sleeve gastrectomy (LSG), and laparoscopic adjustable gastric banding (LAGB) (see Table 1).

Laboratory Tests

Blood work should be obtained immediately following surgery to assess the patient's electrolyte and blood counts. In addition, patients with super morbid obesity or extended operative times should have a creatine phosphokinase level checked to rule out the possibility of gluteal compartment syndrome and rhabdomyolysis. In such patients, early intervention could be lifesaving and decrease the potential for renal damage [5].

It is critical in the immediate postoperative period to ensure that patients are adequately hydrated. Laboratory values, along with urine output and fluid balance assessment, aid the clinician in assessing adequate hydration. Routine blood work including complete blood count, basic metabolic panel, and magnesium levels should be obtained on morning rounds during the inpatient stay. The suspicion of intraluminal or intraperitoneal hemorrhage may prompt the clinician

to order additional hematocrit levels and coagulation studies. Patients with known diabetes mellitus or elevated perioperative blood glucose should undergo glucose level testing while on NPO and when diet is begun. Insulin regimens frequently need to be adjusted due to altered dietary intake, highlighting the importance of close glucose monitoring [6].

Pain Management

Inadequate pain control in the postoperative period may lead to patient discomfort, dissatisfaction, and increased length of stay. It can also limit the patient's ability to take deep breaths and attain early ambulation. This can consequently contribute to other complications such as atelectasis, pneumonia, and VTE. Tachycardia may result, which can unnecessarily confound the clinical picture for the surgeon and trigger an unnecessary work-up. There must be a balance between appropriate pain management and over-sedation of the patient. Clinicians and ancillary staff must have a high index of suspicion for over-sedation and the potential cardiopulmonary consequences.

Intravenous (IV) opioids may be scheduled or delivered by patient controlled anesthesia depending on the surgeon's preference. Adjuncts to this may include IV administration of acetaminophen and ketorolac if not contraindicated. Once a clear liquid diet is started, conversion to oral pain medication is appropriate with use of IV opioids for breakthrough pain only. Strategic administration of local anesthetics using continuous delivery catheters has also been utilized by some in efforts to decrease opioid use. Abdominal binders and icing may assist in ameliorating postoperative discomfort.

Respiratory Care

The postoperative respiratory care of the bariatric patient is of paramount importance. Immediately upon arrival to the floor, patients should be provided with an incentive spirometry device and be instructed on spirometer utilization as well as coughing and deep breathing. This aggressive pulmonary toilet routine can decrease pulmonary complications such as atelectasis and pneumonia [7]. A dedicated respiratory therapist plays an important role in the pulmonary toilet regimen.

Many bariatric patients suffer from obstructive sleep apnea and proper utilization of their own CPAP or BiPAP machines is essential at all times while sleeping. Oxygen supplementation may also be necessary and O₂ saturations should be monitored in patients with known obstructive sleep apnea or other pulmonary symptoms requiring O₂. This can be done safely on a monitored floor [8].

Venous Thromboembolism Prophylaxis

Bariatric patients are predisposed to develop venous thrombosis leading to pulmonary embolism [9, 10]. Laparoscopic bariatric procedures are often associated with prolonged operative times, steep reverse Trendelenburg positioning, pneumoperitoneum pressures up to 18 mmHg, and decreased perioperative mobility. These factors further contribute to the increased risk of VTE in bariatric surgical patients. Although VTE may be infrequent, it still remains a significant postoperative cause of death in this patient population, making VTE prophylaxis crucial [11].

Preoperatively, patients may benefit from 5,000 units of subcutaneous heparin prior to inducing general anesthesia [12]. Postoperative recommendations include early ambulation, sequential venous compression devices, and aggressive hydration [13]. Additionally, chemoprophylaxis may be considered and is an acceptable practice. However, there is no level I evidence to substantiate additional benefits of chemoprophylaxis over its risks in bariatric surgery patients. Continuation of anticoagulation for approximately 1 or 2 weeks following discharge has been considered and employed in high-risk patients with super morbid obesity, known hypercoagulable state, or history of VTE [14].

Radiological Evaluation

In some practices, upper gastrointestinal (UGI) contrast study is performed routinely on postoperative day 1 to evaluate the integrity and patency of the gastrojejunostomy in LRYGB and the duodenojejunostomy in BPD-DS or the patency of a sleeve gastrectomy. A delayed film may also be performed to assess the patency of the jejunojunction. However, the utility of *routine* UGI contrast studies has come into question. Several authors advocate the use of *selective* UGI contrast studies based upon each patient's clinical status, symptoms, and drain amylase level [15]. Following purely restrictive procedures, such as the LAGB and LSG, an UGI contrast study is often employed to rule out obstruction and to obtain a baseline radiograph of band position. However, some have advocated that the utility of UGI contrast studies in LAGB may be limited [16].

Dietary Progression

Patients generally remain on NPO with IV hydration on the night of surgery and are started on a bariatric clear liquid diet on postoperative day 1 [6]. For patients undergoing a routine UGI contrast study, diet is started after the study is determined to show no complication. The bariatric clear liquid diet consists of no added sugar liquids with minimal gastrointestinal residue and no carbonation or caffeine [6]. Fluid intake is usually regulated during the inpatient postoperative stay to ensure that patients are able to tolerate diet before advancement. The familiarity of the bedside nurse and patient with the dietary restrictions is essential. Patient education regarding further diet progression following discharge from the hospital should be provided. Also, patients may be encouraged to record fluid intake and keep a diet journal to improve compliance. The traditional diet advancement after discharge involves clear to full liquid, pureed, soft, and finally to a regular maintenance bariatric diet [17]. As diet is advanced, patients should continue to eat small, balanced meals with adequate protein intake in the range of 60 g/day up to 1.5 g/kg/day based on ideal body weight [6]. Commencement of vitamin and trace element education should also start before discharge.

Incision and Drain Care

As with any surgical intervention, incisional care is of high importance. All laparoscopic incisions should be carefully examined by the clinicians on a daily basis to ensure early identification of any wound infection or dehiscence. Nursing staff should be educated on early signs and symptoms of wound infection, proper drain care, and expected drain color and consistency. When a drain is present, output, color, and consistency should be accurately recorded.

TABLE 2. Potential nutritional deficiencies and postoperative monitoring after bariatric surgery [6, 17]

Nutritional deficiency	Laboratory test	Considerations
Vitamin A	Retinol	Deficiency is more likely in BPD-DS
Vitamin B1 (thiamine)	Serum thiamine	Have high index of suspicion in patients with symptoms consistent of Wernicke's encephalopathy (which may result in irreversible neurologic deficits)
Vitamin B9 (folate)	RBC folate	Must check RBC folate. A serum folate level reflects PO folate intake
Vitamin B12 (cobalamin)	Serum B12	Deficiency is common and most likely in LRYGB
Vitamin D	25 (OH) vit D	Deficiency is more likely in LRYGB and BPD-DS
Vitamin K	PT	More common in BPD-DS
Iron	Ferritin, serum iron, total iron body content	Deficiency is common
Zinc	Plasma zinc	More likely in LRYGB and BPD-DS
Protein	Serum albumin, serum total protein	

Discharge Instructions

Prior to discharge, the patient and caretakers should undergo a thorough educational session with the bariatric case manager. This gives the bariatric team a unique opportunity to reinforce the important concepts related to proper dietary compliance as well as the instructions related to home incision and drain care. Patients should be educated regarding appropriate postoperative activity and restrictions. Teaching should also include the signs and symptoms of anastomotic leak, VTE, and other potential complications. Medications and foods that need to be resumed, adjusted, or avoided can be reviewed at this time. The patient's postoperative office follow-up should be confirmed. Due to the possibility of rapid improvement in comorbidities, patients are instructed to also follow up closely with their primary care providers for medication adjustment and monitoring.

Post-hospitalization Follow-Up

The first follow-up visit, usually 1 week following the operation, serves to ensure that the patient has done well in the immediate postoperative period. It gives the clinician a chance to reevaluate the incisions, ensure the patient is adequately hydrated, and discuss the patient's current symptoms. The clinician can then determine if the patient needs further investigation for cardiac, pulmonary, hematologic, or gastrointestinal complications. Any sutures and drains are usually removed at this point. This office visit also serves as an opportunity to discuss diet progression, medication adjustment, vitamin supplementation, and activity status. A registered dietitian is involved in reinforcing the components of diet advancement and commencing nutritional supplementation.

After the first postoperative visit, bariatric patients follow up at regular intervals over the next 18 months. Visits usually occur at 1, 3, 6, 9, 12, and 18 months postoperatively with some variation amongst programs. This allows physicians to

monitor weight loss, evaluate for potential complications, and provide nutritional, medical, and psychiatric support from a focused bariatric standpoint. During these visits, the patients should have appropriate laboratory studies to address potential protein, vitamin, and trace element deficiencies (see Table 2). Patients may have expected symptoms related to normal adjustment to their new anatomic and physiologic alterations. However, patients should also be monitored for early complications in this time period. These include pneumonia, anemia, VTE, anastomotic stricture, and marginal ulceration amongst others. Guidance and reassurance by the physician regarding the patient's expected weight loss may be provided. The steepness of the weight-loss curve can be discussed to help the patient understand the weight-loss expectations.

Specifically for the LAGB patient, postoperative office follow-up is more intense during the first year. Office visits may occur monthly to adjust the degree of band restriction as needed [18]. After the first year, adjustments are often spread out over longer intervals.

At 1 year to 18 months, the patient's weight loss begins to stabilize, and from this time a recommended yearly evaluation should occur. It is at this point that patients may consider body contouring, and appropriate referrals can be made. Annual follow-ups play an important role in ensuring patient compliance with diet, vitamin supplementation, and exercise regimens. A focused bariatric dietician and psychologist may be helpful and can be offered as needed. If available, a regularly scheduled bariatric support group may also serve to benefit and motivate patients. The patient should be encouraged to follow up with the bariatric office annually and indefinitely.

Conclusion

As the prevalence of obesity and its surgical treatments have increased, so have the efforts to improve postoperative outcomes. Utilization of evidence-based best practices remains of paramount importance and the implementation of

standardized postoperative pathways may consistently provide a way to ensure optimal outcomes. Programs should strive to structure postoperative clinical pathways supported by the best available evidence.

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