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The authors reported no
potential conflict of interest
relevant to this article.

Post-bariatric surgery patients: Your role in their long-term care

Nutritional deficiencies, decreased bone mineral density, and dumping syndrome are just some of the challenges these patients face. Here's how to optimize their care.

PRACTICE RECOMMENDATIONS

- › Routinely screen bariatric surgery patients for nutritional deficiencies throughout their life. **A**
- › Avoid the use of nonsteroidal anti-inflammatory medications in patients who have had bariatric surgery because of the risk of anastomotic ulceration and leakage. **A**
- › Consider revision surgery for bariatric surgery patients with weight regain, recurrent comorbid diseases, or surgical complications. **B**
- › Counsel obese women who want to become pregnant that bariatric surgery decreases rates of future pregnancy complications. **B**

Strength of recommendation (SOR)

- A** Good-quality patient-oriented evidence
- B** Inconsistent or limited-quality patient-oriented evidence
- C** Consensus, usual practice, opinion, disease-oriented evidence, case series

More than one-third of American adults and approximately 17% of children and adolescents between the ages of 2 and 19 years are obese.^{1,2} Poor diet coupled with a sedentary lifestyle is the highest ranked cause of non-communicable disease and a leading cause of preventable death, according to the National Research Council.³

Bariatric surgery (BS) is a viable therapeutic option for obese patients who do not respond to conventional lifestyle interventions for losing weight. There are multiple gastrointestinal (GI) procedures available that are classified as either *malabsorptive* (Roux-en-Y gastric bypass [RYGB] and biliopancreatic diversion [BPD] with or without duodenal switch) or *restrictive* (laparoscopic adjustable gastric banding [LAGB] and vertical sleeve gastrectomy [VSG]).

Approximately half of the 196,000 bariatric procedures performed in the United States in 2015 were of the sleeve variety, another 23% were RYGB, and the remaining percentage was divided among the other types.⁴ Postoperative risks include nutritional deficiencies, decreased bone mineral density (BMD), dumping syndrome (when food rapidly dumps from the stomach to the intestine), and gastroesophageal reflux disease (GERD) with possible ulceration.

Despite these potential complications, a systematic review and meta-analysis found that obese people who underwent BS (gastric banding or gastric bypass) had significantly reduced risks of global, non-cardiovascular (CV), and CV mortality compared with obese controls.⁵ Helping patients to realize these benefits requires that the entire health care team—especially the family physician—is aware of the special considerations for this population.

To that end, this article reviews the details of diagnosing and managing post-surgical complications. It also addresses issues unique to managing certain subpopulations, such as post-BS patients who require revision surgery or who want to

pursue body contouring surgery; adolescents who undergo BS surgery; and women who want to get pregnant postoperatively.

Monitor patients for these post-surgery complications

Postoperative BS follow-up varies depending on location, surgeon preference, and availability of multidisciplinary resources. At our institution, patients have a minimum of 3 follow-up visits with their surgeon (during hospitalization and 2 weeks and 2 months postoperatively). This is followed by visits with Endocrinology 6 months after surgery and annually thereafter. Given the variability of follow-up, family physicians should coordinate with specialists where appropriate and be aware of postoperative complications and monitoring since it is likely they will have the most frequent contact with these patients.

Nutritional deficiencies are common and require lifelong screening

Nutritional deficiencies are the most common complications of malabsorptive BS. Guidelines from the Endocrine Society, as well as guidelines from the American Association of Clinical Endocrinologists (AACE), The Obesity Society (TOS), and the American Society for Metabolic and Bariatric Surgery (ASMBS), recommend routine lifetime screening for deficiencies after surgery.^{6,7} Complete blood cell count, electrolytes, glucose, creatinine, and liver function tests should be obtained at one, 3, 6, 12, 18, and 24 months following surgery and annually thereafter.⁶

Multiple factors contribute to nutritional and micronutrient deficiencies, including reduced oral intake of food, decreased GI absorption, food intolerance, nausea/vomiting, and nonadherence with dietary supplements.⁸ Oral supplementation should be in chewable, powder, or liquid form because pill and capsule absorption may be altered.^{8,9} Over-the-counter multivitamins may not contain the requisite daily doses recommended after BS.⁹ Patients and physicians should evaluate supplements together to ensure appropriate nutritional and micronutrient supplementation (TABLE 1^{6,8-11}).

Bone mineral density can start to decrease soon after surgery

Studies evaluating BMD after BS have produced variable findings. In obese patients, dual-energy x-ray absorptiometry (DEXA) measurements may not be accurate due to adipose tissue artifact and table weight limits. In addition, limited data exist on the incidence of fractures after BS. Of 2 notable studies, only one, a population-based study involving 258 Minnesota residents who underwent a first bariatric surgery between 1985 and 2004, demonstrated a significantly increased incidence of fractures.^{12,13}

In addition, studies show bone turnover markers, including C-terminal telopeptide, increase as early as 3 months after BS.¹⁴ Several guidelines recommend routine BMD screening after BS (TABLE 2).^{6,7} The mechanism of bone demineralization is likely multifactorial—a function of the magnitude of the weight loss and skeletal unloading, calcium and vitamin D deficiencies, and associated secondary hyperparathyroidism.¹⁵ Treatment for secondary hyperparathyroidism is adequate supplementation with vitamin D and calcium.

■ **Optimal dosing for vitamin D** has not been determined. One recent systematic review suggests routine prophylaxis with at least 2000 international units (IU)/d and found the greatest improvement for known deficiency with doses of 1500-9100 IU/d following malabsorptive surgeries.¹¹ After laparoscopic sleeve gastrectomy, at least 1000 IU/d vitamin D is recommended.¹¹

Overall, high variability exists among patients, and an individualized approach for dosing is recommended.¹¹ Vitamin D levels should be monitored 2 and 4 weeks after initiation of treatment and every 3 months thereafter.¹¹ Normal levels of serum calcium, 25-OH vitamin D, bone-specific alkaline phosphatase, and 24-hour urinary calcium excretion indicate adequate calcium and vitamin D supplementation.⁶

Dumping syndrome can lead to hypoglycemia

Dumping syndrome is a common complication following BS, with prevalence ranging from 25% to 75%, depending upon the



Patients undergoing bariatric surgery require routine lifetime screening for nutritional deficiencies.

TABLE 1

Nutritional deficiencies after bariatric surgery^{6,8-11}

Nutrient	Prevalence of deficiency	Symptoms of deficiency	Measurement (threshold for deficiency)	Recommended frequency of screening	Recommended supplement for prevention	Recommended supplement for deficiency treatment
Protein	3%-18%	Edema, weakness, decreased muscle mass	Serum albumin (<3.5 mg/dL)	Every 6 months for 2 years, then annually*	60-120 g/d protein OR 1.1 g/kg ideal body weight [†]	1st line: Oral lactose-free supplementation rich in branched chain amino acids 2nd line: Enteral or parenteral nutrition
Calcium	10%	Low bone density, osteoporosis, paresthesia, muscle spasms, tetany	Ionized calcium (<4.48 mg/dL)	Ca and PTH every 6 months for 2 years, then annually*	1200-2000 mg/d Ca citrate or dietary [‡]	1st line: Intensify Ca and vitamin D supplementation 2nd line: IV bisphosphonates for osteoporosis
Vitamin B1 (thiamine)	49%	Dry beriberi, wet beriberi, Wernicke's encephalopathy	Serum thiamine (<10 mcg/L)	Optional screening starting at 3 months; check every 6 months for 2 years, annually thereafter	6 mg/d oral	Subclinical: 100 mg/d oral Clinical symptoms: 100-200 mg IV/IM With psychoses and Wernicke's encephalopathy: 200-300 mg/d IV for 3 days, followed by 250 mg/d IV until clinical improvement
Vitamin B12 (cobalamin)	4%-62% (post mal-absorptive procedures)	Macrocytic anemia, fatigue, glossitis, paresthesia, sensory deficits, ataxia, dementia	Serum vitamin B12 (<200 pg/mL) Serum homocysteine increases sensitivity when symptomatic (<10 mcmol/L)	Every 6 months for 2 years, then annually*	250-600 mcg/d oral OR 1000 mcg/month IM OR 3000 mcg IM every 6 months* [§]	Asymptomatic: 1000-2000 mcg/d oral OR 1000 mcg/week IM Clinical symptoms: 1000 mcg/d IM/SC for 5-7 days, then 1000 mcg/week IM/SC x 4-5 weeks, then monthly indefinitely
Folic acid	9%-38%	Macrocytic anemia, fatigue, neural tube defects	Serum folate (<4 nmol/L)	Every 6 months for 2 years, then annually*	400-1000 mcg/d oral [†]	1000 mcg/d oral
Vitamin A	8%-12.5% (RYGB); 61%-69% (BPD-DS)	Symptoms are rare, but include dry hair, decreased immunity, xerophthalmia	Serum vitamin A (<38 mcg/dL) (may be falsely low in the setting of subclinical inflammation) OR Serum RBP/TTR ratio (<0.37)	Optional annually	5000-10,000 IU/d oral	50,000 IU/d oral If corneal lesions: 50,000-100,000 IU/d IM for 2 weeks (should not exceed 10,000 IU if pregnant)

type of procedure performed.^{16,17} There are 2 types: early and late. Early dumping syndrome occurs within 30 minutes of eating. Symptoms are related to the robust release of gastrointestinal hormones caused by rapid

gastric emptying. Symptoms include nausea, abdominal pain, diarrhea, flushing, hypotension, and tachycardia.

Late dumping is characterized as post-prandial hypoglycemia occurring one to

TABLE 1

Nutritional deficiencies after bariatric surgery^{6,8-11} *continued*

Nutrient	Prevalence of deficiency	Symptoms of deficiency	Measurement (threshold for deficiency)	Recommended frequency of screening	Recommended supplement for prevention	Recommended supplement for deficiency treatment
Vitamin D	25%-80%	Osteomalacia, fractures, depression, myalgia, bone pain	25-OH vitamin D (<20 ng/mL)	Every 6 months for 2 years, then annually*	2000 IU/d for malabsorptive procedures 1000 IU/d for LSG 3000 IU/d for pediatric patients	1500-9100 IU/d; adjust based on individual response
Iron	17% (LSG), 30%-45% (post mal-absorptive procedures)	Microcytic anemia, fatigue, dyspnea on exertion, angular stomatitis, glossitis	Serum iron saturation <15%, total iron <40 mcg/dL	Every 6 months for 2 years, then annually*	45-65 mg/d elemental iron [§] 50-100 mg/d elemental iron for pregnant patients [†]	Calculate iron deficit; IV iron 1000 mg, then weekly 500 mg IV infusion to calculated dose
Zinc	12% (LSG); 21%-33% (RYGB); 74%-91% (BPD-DS)	Poor wound healing, skin lesions, dermatitis, diminished taste, hair loss, altered immune function, glossitis	Plasma zinc <11 mcmol/L	Optional: Every 6 months for first year, then annually	No standardized recommendation	220 mg/d zinc sulfate (50 mg elemental zinc) OR 50 mg/d zinc gluconate OR 30 mg/d zinc histidine (zinc may interfere with absorption of iron and copper)
Copper	2% (RYGB); 10%-24% (BPD-DS)	Anemia, pancytopenia, fatigue, dyspnea on exertion, spastic gait, sensory ataxia, peripheral neuropathy, paresthesias	Serum copper <11 mcmol/L (may have high false-negative rates in inflammatory state)	No routine screening recommended. Monitor closely if on zinc supplementation	2 mg/d oral	2-4.4 mg oral copper OR 2 mg IV/d copper for 5-6 days

BPD-DS, biliopancreatic diversion with duodenal switch; Ca, calcium; CRP, C-reactive protein; IM, intramuscular; IU, international units; IV, intravenous; LSG, laparoscopic sleeve gastrectomy; PTH, parathyroid hormone; RBP/TTR, retinol-binding protein to transthyretin; RYGB, Roux-en-Y gastric bypass; SC, subcutaneous.

*Recommendations after malabsorptive procedures.

[†]Dosing consistent with pregnancy recommendations.

[‡]Dosing consistent with both adolescent and pregnancy recommendations.

[§]Dosing consistent with adolescent recommendations.

3 hours after eating. Late dumping is likely caused by a combination of changes within the pancreatic beta cells and abnormal insulin response to glucose.¹⁶⁻¹⁸ Rapid gastric emptying leads to rapid release of glucose in the gut, which, in turn, leads to brisk insulin secretion. Since glucose is absorbed faster than insulin's half-life, the resulting (relatively) high levels of insulin may cause hypoglycemia.¹⁶⁻¹⁸

■ **Sigstad's scoring system** can be used to confirm suspected cases of dumping syndrome (TABLE 3^{16,17,19}). A diagnosis can also be made with an oral glucose challenge in which pulse, blood pressure, glucose, and hematocrit are measured after ingestion of 50 g glucose. The test is positive if heart rate increases by 10 beats per minute, hematocrit increases by 3% 30 minutes after ingestion, or

TABLE 2

Bone mineral density and serum marker screening recommendations^{6,7}

Guideline	Test	Frequency of testing*
2010 Endocrine Society ⁶	25 hydroxyvitamin D	Every 6 months
	Calcium	
	Phosphorus	
	Parathyroid hormone	
	Alkaline phosphatase	
	DEXA	
2013 AACE/TOS/ASMBS guidelines ⁷	24-hour urinary calcium excretion	6 months, then annually
	DEXA	2 years after all bariatric surgeries
	25 hydroxyvitamin D	Every 6-12 months
	Parathyroid hormone	Every 6-12 months

AACE, American Association of Clinical Endocrinologists; ASMBS, American Society for Metabolic and Bariatric Surgery; DEXA, dual-energy x-ray absorptiometry; TOS, The Obesity Society.

*All recommendations are after malabsorptive procedures unless otherwise noted.

glucose falls below 60 mg/dL 2 to 3 hours after ingestion.¹⁷

■ **First-line treatment of dumping syndrome** consists of dietary modifications. The goal is to slow the rate of gastric emptying by eating smaller, more frequent meals; separating beverages from food; decreasing carbohydrates; and increasing fiber and protein content.

If results are suboptimal after dietary changes, medications can be prescribed including acarbose to prevent postprandial hypoglycemia; anticholinergics such as dicyclomine to slow gastric emptying; and somatostatin to decrease gastric emptying and inhibit GI hormone release.¹⁷ Lastly, for resistant and severe postprandial hypoglycemia, a few patients have undergone pancreatectomy, but only about 65% experienced improvement in symptoms and 12% developed diabetes post-surgically.²⁰

Gout attacks may initially increase, but then decrease

BS affects the incidence of gout attacks in patients with a history of gout. One comparative study of approximately 150 patients demonstrated that those with a history of gout had significantly more gout attacks in the first month after BS compared with obese patients with a history of gout undergoing other upper GI surgeries.²¹ There was no dif-

ference between malabsorptive and restrictive procedures. But after the first month, BS patients had significantly fewer gout attacks and lower uric acid levels than their obese counterparts.²¹

Protein rich diets, catabolism potentiated by aggressive caloric restriction following BS, and dehydration contribute to the initial increase. Therefore, patients who have had at least one gout attack in the year prior to surgery or who are on hypouricemic medication may benefit from at least one month of prophylactic therapy (eg, allopurinol and colchicine) after surgery.

GERD and ulceration: How to respond

Obesity is a known risk factor for GERD, but the effect of BS on GERD is uncertain and seems to vary with the procedure performed. RYGB decreases GERD and is, therefore, used as both a secondary treatment in those not responding to medications and a revision treatment for fundoplication and other types of BSs. Sleeve gastrectomy and adjustable gastric banding have mixed effects on GERD. A systematic review by de Jong et al revealed a decreased prevalence of reflux symptoms and GERD medication use after LAGB; however, during longer follow-up, 15% of previously unaffected patients reported experiencing GERD.²² The 2011 International Sleeve Gastrectomy Expert Panel Consensus

Statement retrospectively noted a postoperative incidence of GERD as high as 31%.²³

BS patients with GERD should be treated with a proton pump inhibitor. If this fails, refer patients to a gastroenterologist for further evaluation.²⁴

Ulcers after BS may be an indication for revision surgery. Data are mixed regarding increased risk of marginal ulceration from nonsteroidal anti-inflammatory drug (NSAID) use, but NSAIDs have been linked to an increased risk of anastomotic leakage.²⁵⁻²⁸ Thus, it seems prudent to avoid NSAIDs in people who have undergone BS.

Keeping watch over psychiatric comorbidities

A recent meta-analysis by Dawes et al²⁹ showed that about 23% of patients pursuing BS have a comorbid mood disorder. Specifically, the preoperative prevalence of depression (19%) and binge-eating disorder (17%) were found to be higher than rates in the general population.²⁹ The meta-analysis found improvement in the prevalence of depression with fewer symptoms and less antidepressant medication use in the first 3 years after surgery and a decrease in the rate of binge-eating disorder, although there were fewer supporting data for the latter. These findings were observed with both restrictive and malabsorptive procedures.

The data are mixed regarding rates of alcohol abuse and suicide. Further research is necessary in this field. Patients who have had BS should receive ongoing psychiatric and psychological care from a multidisciplinary team as a matter of course.

Will a second surgery be needed?

Revision surgery. In 2015, about 14% of the almost 200,000 BSs performed were revisions.⁴ Revision surgery is indicated in BS patients with weight regain, recurrent comorbid diseases (eg, diabetes, hypertension), or complications of primary BS. Restrictive procedures have a higher revision rate than malabsorptive procedures, primarily due to a higher rate of weight regain.^{6,30}

Because revision surgery is associated

TABLE 3

Sigstad scoring system for dumping syndrome^{16,17,19}

Postprandial symptoms	Score*
Shock	+5
Fainting, syncope, unconsciousness	+4
Desire to lie down	+4
Dyspnea	+3
Weakness	+3
Sleepiness, apathy	+3
Palpitations	+3
Restlessness	+2
Dizziness	+2
Headaches	+1
Warm, clammy skin or pallor	+1
Nausea	+1
Abdominal fullness	+1
Borborygmi (abdominal rumbling/gurgling)	+1
Eructation (belching)	-1
Vomiting	-4

*A score of >7 is suggestive of dumping syndrome. A score of <4 is suggestive of an alternate diagnosis.

with more complications and possibly longer hospital stays than primary BS, it should be performed by a bariatric surgeon with extensive experience.^{30,31} Restrictive revisions are typically converted to malabsorptive procedures. Cost is a limiting factor as many patients' insurance coverage is limited to one BS per lifetime.

Body contouring. Body contouring surgery (BCS) can improve physical and mental well-being and may be a protective factor for weight regain after bariatric surgery.³² Despite its desirability—particularly to women, adolescents, and those with large decreases in body mass index (BMI)—few patients can afford BCS since it is rarely covered by insurance.

Complications of BCS vary, but are most commonly infection and wound dehiscence. This is, in part, due to poorer wound healing in BS patients compared to those with nonsurgical massive weight loss. The cause of poor wound healing is thought to be secondary to nutritional deficiencies and the catabolic state induced by post-surgical weight loss. Recommendations for BCS include weight stability for more than one year after BS, age >16 years, excess skin causing

➤
Monitor vitamin D levels 2 and 4 weeks after initiation of treatment and every 3 months thereafter.

significant functional impairment, non-smoking status, and presence of good social support.³³

Bariatric surgery in adolescents is on the rise

Children in the highest body mass index quartile have more than twice the death rate of those in the lowest BMI quartile.³⁴ Thus, it is not surprising that the rate of BS in adolescents is increasing.⁷ BS in this age group is successful for weight loss and improvement of comorbid conditions, with relatively low complication rates.³⁵ Options include malabsorptive and restrictive procedures, although gastric banding has not been approved by the US Food and Drug Administration for patients under the age of 18 years.

After BS, adolescent girls should be counseled regarding the possibility of pregnancy (restoration of fertility) and appropriate contraception. Adolescent patients require nutritional supplementation after BS as indicated in **TABLE 1**.^{6,8-11}

When determining which adolescents to refer for BS, we recommend the following criteria:³⁵⁻³⁸

- failure of a minimum 6-month trial of a staged treatment approach, as recommended by Barlow et al,³⁶ including diet, exercise, and pharmacologic treatment
- BMI ≥ 35 with type 2 diabetes or severe sleep apnea (apnea hypopnea index [AHI] > 15)³⁷
- BMI ≥ 40 with mild sleep apnea (AHI > 5), hypertension, or pre-diabetes³⁷
- Tanner stage IV or V
- at least 95% skeletal growth (for malabsorptive surgery).³⁷ This can be determined using an estimated adult height from mid-parental height formula and assessing growth plate closure with hand radiographs for bone age
- appropriate maturity level permitting adherence
- good psychological support
- a multidisciplinary team for postoperative and long-term follow-up care.

Planning for the future:

Exploring the possibility of pregnancy

Obesity is the primary cause of maternal and fetal morbidity during pregnancy. It is asso-

ciated with increased rates of early miscarriage, congenital defects, macrosomia, and fetal death. Maternal risks of obesity include: gestational hypertension, gestational diabetes mellitus (GDM), and pre-eclampsia. Obese mothers also have a higher incidence of failed induction, caesarean section, and breastfeeding failure.^{10,39} Given that half of all BSs are performed in women of reproductive age, this population deserves special consideration.¹⁰

A recent meta-analysis by Galazis et al⁴⁰ concluded that BS performed prior to pregnancy led to decreased rates of preeclampsia, GDM, large neonates, preterm birth, and neonatal intensive care unit admission. Perinatal mortality did not increase after BS. However, BS led to higher rates of maternal anemia. There was no significant difference between groups in incidence of cesarean section.

The post BS female patient should be advised to use a reliable form of contraception for a minimum of 12 to 18 months after surgery.^{6,10,39} Involve high-risk obstetric specialists during pregnancies. Diet should be supplemented as indicated in **TABLE 1**.^{6,8-11} **JFP**

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