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Caring for the Orthopaedic Patient With a History of Bariatric Surgery

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Bariatric surgery is performed on the gastrointestinal tract as a solution to obesity, and prevalence of these surgical procedures continues to rise. Bariatric surgery creates restrictive and/or malabsorptive properties, causing nutritional deficits from the physiological changes in absorption and a hypoacidic environment. Although surgery induces sustained weight loss, decreases mortality, and provides resolution or improvement to comorbidities of obesity, it can also come with complications. Common long-term complications of bariatric surgery include malnutrition, anemia, impaired wound healing, and impaired bone health. It is essential that nurses and the healthcare team caring for orthopaedic individuals with a history of bariatric surgery be aware of the special needs of these individuals, especially in the promotion of bone health. Using a multidisciplinary approach for the advancement of the orthopaedic patient's health will help promote quality patient care.

Case Study

Ben, an orthopaedic nurse, received an admission from the post-anesthesia care unit. Mrs. Penny, a 43-year-old woman, had a surgical intramedullary rod placement to her right femur to stabilize a fracture sustained in a motor vehicle accident. Her hemoglobin level on admission was low, 6.7 g/dl, and she required multiple blood transfusions. Other abnormal laboratory values revealed low potassium (3.3 mEq/L), low calcium (7.8 mg/dl), and low albumin levels (2.9 g/dl).

During the patient evaluation, Ben observed that Mrs. Penny was overweight, at 5 ft. 3 in. and 169 pounds; her current body mass index (BMI) was 29.9%; skin was pale, warm, and dry; mucous membranes were moist, but pale; lips were cracked; and she had significant hair loss. Her nails could not be thoroughly assessed because she had acrylic nails with polish. She had mild edema throughout her body. Dressings to her right extremity were dry and intact. Vital signs were stable but displayed tachycardia with a pulse of 112 and oxygen saturation of 96% on 2 L of oxygen via nasal cannula. She verbalized pain to her right lower extremity, "a 4" on a scale of 1–10, and continually requested ice chips.

While reviewing Mrs. Penny's medical history, she disclosed a Roux-en-Y gastric bypass (RYGB) surgery 6 years ago. Prior to RYGB surgery, she weighed 220 pounds and was a half an inch taller, she had a BMI of 38.4%, she was a Type 2 diabetic, and she had prehypertension. Her maximum weight loss was 66 pounds 8 months after surgery. Two years after her surgery, she moved and did not seek follow-up care with a local bariatric clinic. She stopped taking nutritional supplements more than 3 years ago because she would feel nauseated after taking the supplements. She did not follow a special diet as directed. Mrs. Penny admitted that she became fatigued easily and stopped activity because of shortness of breath.

Obesity as an Epidemic

Obesity is not only an epidemic in this country but also a global concern. The American Society for Metabolic and Bariatric Surgery (ASMBS) views obesity in the United States as a substantial public health concern and an economic threat (ASMBS, 2012). In 2015, the ASMBS (2016) estimated that 196,000 bariatric surgical procedures were performed in the United States, showing a steady rise in procedures since 2011. Obesity health-related spending in 2008 doubled from previous decade and is projected to increase almost 2.5 times by 2018 (ASMBS, 2012). Globally, there has been a twofold increase in the performance of bariatric surgery (BS) compared with the prior decade (Yu, 2014). Bariatric surgery is performed as a means of sustained weight loss with multiple variations: restrictive, malabsorptive, or a combination of both.

With the prevalence of BS and individuals living longer, there are greater numbers of BS patients having elective orthopaedic surgical procedures, especially joint replacements (Kingsberg, Halpern, & Hill, 2016). Individuals may also require nonelective orthopaedic surgery. Therefore, it is likely that nurses will care for orthopaedic patients with a history of BS and will need to be knowledgeable of the effects of BS over time, including the effect on bone health and wound healing. The purpose of this article is to assist nurses and healthcare professionals to develop a multidisciplinary awareness for the care of orthopaedic patients with previous BS.

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Overview of Bariatric Surgical Procedures

Bariatric surgical procedures are conducted on the stomach or intestines to induce sustained weight loss. These procedures are often performed under laparoscopic technique to reduce length of stay in the hospital, reduce postoperative pain, and increase recovery time (Mandal, 2014). Although there are variations to each surgical procedure, each falls under one of three categories: restrictive, malabsorptive, or a combination of both (Isom et al., 2014). The surgical procedures are addressed later and include the laparoscopic adjustable gastric band (LAGB), laparoscopic sleeve gastrectomy (LSG), and RYGB.

Laparoscopic Adjustable Gastric Band

In LAGB surgery, an adjustable band is placed on top of the stomach and does not require a resection (see Figure 1). The band serves as a restrictive measure to reduce the functional size of the stomach, producing fullness or satiety. The surgeon inflates or deflates the band with fluid to manipulate effective weight loss. In a study of 60 LAGB patients at a 14-year follow-up, McGraw and Wool (2015) reported that 63% required an additional operation and 48% needed band removal. Because of poor long-term effects, many bariatric surgeons have reexamined their performance of this procedure.

Laparoscopic Sleeve Gastrectomy

In LSG surgery, approximately 75%–80% of the stomach is removed along the fundus and greater curvature with the pylorus preserved (see Figure 2; Lee et al., 2014). Classified as a restrictive procedure, LSG creates a high-pressure system that expedites gastric emptying. The LSG procedure is preferred for individuals with more than 60% BMI because it is an easier surgery to perform on the morbidly obese with less complexity and less time spent for the surgical procedure (McGraw & Wool, 2015). Often LSG is performed as a staged surgery, and after initial weight loss, LSG can be converted into a gastric bypass. The use of the LSG procedure had a fourfold increase from 2008 to 2011 (Yu, 2014).

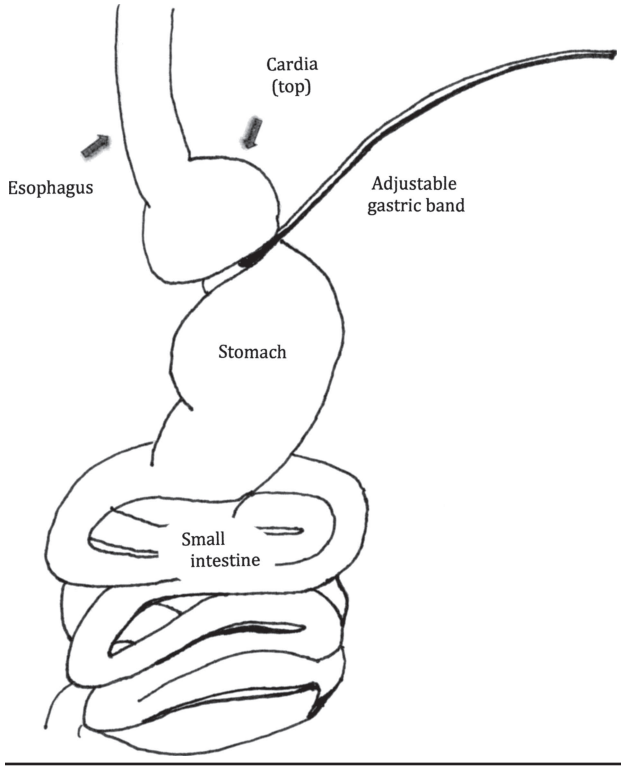

Figure 1. Laparoscopic adjustable gastric band.

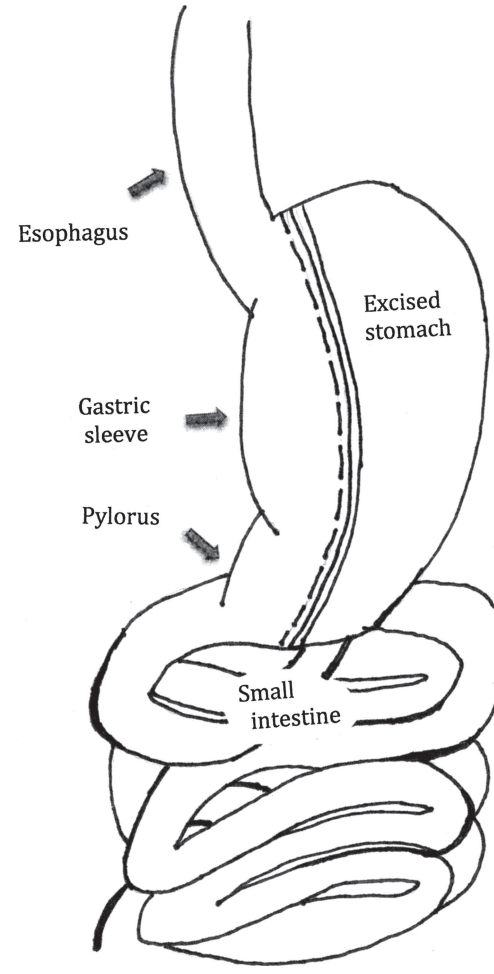

Figure 2. Laparoscopic sleeve gastrectomy.

Roux-en-Y Gastric Bypass

During RYGB, the stomach is cut, stapled, and separated, creating a pouch that is approximately 30 mL or the size of an egg (see Figure 3). The small intestine is also split and the distal jejunum is connected directly to the pouch to become the Roux limb. The anastomosis, or connection of the pouch to the distal portion of the jejunum, bypasses the distal stomach, duodenum, and proximal portion of the jejunum. Before completion of the procedure, the duodenum, or biliopancreatic limb, is reconnected to a lower segment of the small intestine to allow for digestive juices to assist with digestion of nutrients. The BMI determines the length of the limb, and the length of the limb determines the degree of malnutrition. A shorter limb is created for a BMI of less than 35% and a longer limb for a

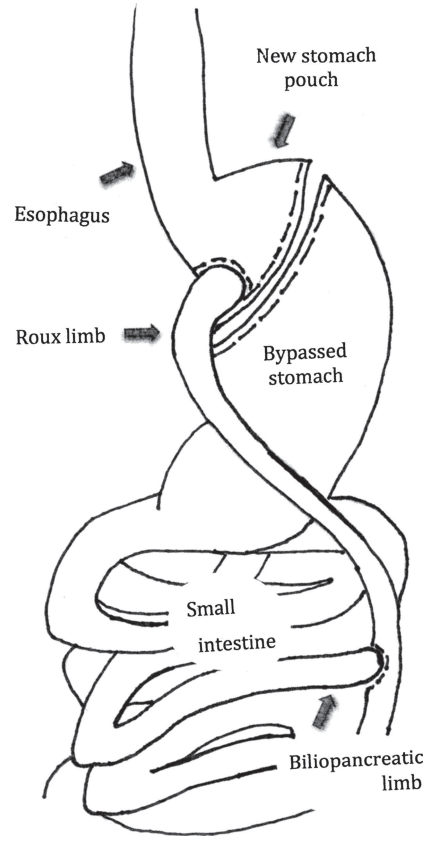

Figure 3. Roux-en-Y gastric bypass.

BMI of more than 35% (Lee et al., 2014). The creation of the altered food pathway is bypassed away from the remnant stomach, the entire duodenum, and proximal segment of the jejunum, creating both restriction and malabsorption.

Clinical practice guidelines for perioperative BS address specific care in each phase of the operative cycle, including extensive preoperative testing necessary to identify concealed comorbidities related to obesity (Mechanick et al., 2013). Postoperative care and lifetime follow-up are included in the guidelines. Lifetime follow-up is conducted at bariatric clinics that employ a multidisciplinary approach, including the expertise of the surgeon, bariatrician (a physician who focuses on medically treating obesity), nurse, dietician, physical trainer, and psychologist (McGraw & Wool, 2015).

Obesity and the Effect on Bone

Obesity is linked to multiple comorbidities such as hypertension, heart disease, diabetes, and stroke. As obese individuals seek BS, numerous problematic nutritional deficits are discovered (Kim & Brethauer, 2014). Chronic anemia is frequently found prior to BS and is attributed to a chronic state of inflammation (Kingsberg et al., 2016). Deficiencies of iron, cobalamin, folate, copper, and zinc are responsible for nutritional anemia, and deficient levels of calcium and thiamine are often exhibited prior to BS (Chan & Mike, 2014; Isom et al., 2014). Preoperative testing frequently reveals hormonal imbalances in relation to bone health as well.

Obesity is associated with structural changes in bone mineral homeostatic hormones and micronutrients (Kim & Brethauer, 2014). Hypogonadism, or insufficient sex hormones, is a common finding in the obese, as estrogen originates from adipose tissue (Kim & Brethauer, 2014; Stein & Silverberg, 2014). Vitamin D is essential in the absorption process of calcium and phosphorus from ingested nutrients and the renal reabsorption of calcium. Because of vitamin D deficiencies, 25% of preoperative BS patients display subclinical calcium levels. Despite the integral role of vitamin D, deficiencies have been identified in up to 80% of obese preoperative BS patients (Isom et al., 2014). This deficiency is attributed to an inadequate dietary intake, decreased mobility, lack of sunlight, and insufficient bioavailability of the fat-soluble vitamin D isolated into adipose tissue (Stein & Silverberg, 2014). Vitamin D deficiencies are associated with increased infection rates and altered immune systems; therefore, it is judicious to be proactive with all insufficiencies (Krishnan, 2015).

Recurrent in obesity are increased parathyroid hormone (PTH) levels, causing primary or secondary hyperparathyroidism (Kim & Brethauer, 2014; Stein & Silverberg, 2014; Yu, 2014). Parathyroid hormone regulates calcium, vitamin D, and phosphorus in bone and blood. It signals osteoclasts to reabsorb bone and release calcium into the bloodstream when serum calcium levels are low. There is a connection between increased PTH levels and BMI (Kim & Brethauer, 2014). Consequences of chronic vitamin D deficiency precipitated from elevated PTH levels may present as cortical bone loss and metabolic bone diseases such as osteoporosis and osteomalacia. Obesity appears to have some protective benefits to different sites in the skeleton such as the femur due to increases in weight bearing (Kim & Brethauer, 2014). These benefits, however, may be restricted by existing hyperparathyroidism and vitamin D deficiencies (Kim & Brethauer, 2014; Stein & Silverberg, 2014). In addition, the obese have a higher fracture risk with falls, therefore, injury as a result of falling (Stein & Silverberg, 2014).

Effects of Bariatric Surgery

Bariatric surgery is described as metabolic surgery because of the hormonal changes associated with weight loss (Isom et al., 2014; Yu, 2014). Hormonal changes, such as a decrease in ghrelin, an appetite-stimulating hormone, and promotion of better control of glucose metabolism are benefits of BS. The surgery may also lower hemoglobin A_{1c}, low-density lipoprotein cholesterol, and systolic blood pressure values (Isom et al., 2014). Bariatric surgery provides sustained weight loss, decrease in mortality, and resolution of, or improvement in, comorbidity diseases related to obesity such as obstructive sleep apnea and osteoarthritis. Advantages of BS and weight loss also come with common long-term complications including malnutrition, anemia, impaired wound healing, and impaired bone health.

Malnutrition

Physiological changes created in the gastrointestinal (GI) tract during BS cause malabsorption of nutrients,

especially proteins, needed for sufficient energy (Isom et al., 2014). In addition, bypassing the remnant stomach or removing up to 80% of the stomach creates a hypoacidic environment. Many nutrients require an acidic environment for bioavailability as well as for transport during absorption. Malabsorptive procedures such as RYGB have greater issues with malnutrition than with LSG (van Rutte, Aarts, Smulders, & Nienhuijs, 2014).

Chronic Anemia

Anemia is the most common long-term complication of BS (Isom et al., 2014) and occurs when the demands of metabolism exceed the supply from compromised absorption. The significance of the anemia leads to an increased workload on the heart, having to pump faster to circulate less volume of blood. A low hemoglobin level results in less oxygen-carrying capacity for the body. Without proper oxygenation, wound healing will be compromised, which leads to a higher risk of infection. Low compliance to dietary supplementation from unwanted side effects adds to anemia. Furthermore, many BS patients develop intolerances to red meat and often continue poor eating habits (van Rutte et al., 2014).

Impaired Wound Healing

The wound healing process follows a precise sequence (Krishnan, 2015). Alterations caused by inadequate nutrition can impede healing. If energy or protein stores are insufficient, the body experiences inadequate tissue nourishment or perfusion. Malnutrition develops and uses lean body tissue to meet its healing demands, extending the inflammatory phase of healing and increasing the risk of infection (Krishnan, 2015). Collagen, necessary for tensile strength in a wound, is decreased in individuals with BS. The healing time of individuals with BS is double that of non-BS individuals (Kingsberg et al., 2016).

Energy requirements of the body depend on numerous factors such as age, gender, and comorbidities. The nutritional status and BMI play a role in wound healing as well. A post-BS patient, specifically an RYGB patient, will have varied responses to antibiotics due to physiological changes in intestinal absorption and specific drug solubility (Krishnan, 2015). Wound healing necessitates appropriate hydration and circulating volume for oxygenation of tissue, often lacking in anemia.

Impaired Bone Health

A benefit of BS is rapid weight loss; however, this adversely affects bone mass because an increase in bone turnover leads to a decrease in bone mineral density (BMD). Bone loss is common, and BMD diagnostic testing is recommended postoperatively to diagnose and initiate interventions for osteoporosis (Berarducci, 2007). After BS, gut hormone fluctuations that improve comorbidities may also have detrimental effects on the skeleton. Leptin, a hormone opposite of ghrelin, contributes to increased osteoclast action (Stein & Silverberg, 2014). Adiponectin, a protein hormone that regulates glucose and fatty acids, appears to have an inverse relationship with fat mass. After BS, adiponectin increases and total body BMD decreases. Gut hormone peptide YY increases with certain BS procedures and has an inverse relationship with osteoblasts. Maintaining lower levels of insulin after BS yields increased osteoclast activity and impedes the activity of osteoblasts. In addition, the body metabolizes bile acids differently after BS, contributing to changes in gut hormones (Yu, 2014).

Nutritional Deficits Leading to Metabolic Bone Diseases

The cycle of calcium homeostasis is a complicated process that integrates bone reabsorption, gut absorption, and renal reabsorption by communication between the brain, muscles, bone, and gut (Kim & Brethauer, 2014). Manipulation of the GI tract during BS affects bone metabolism through calcium malabsorption and secondary hyperparathyroidism (Yu, 2014). The roles of calcium, vitamin D, and PTH remain noteworthy factors throughout the post-BS life span. Vitamin D deficiencies stem from the late mixing of bile acids, pancreatic enzymes, and ingested nutrients. Malabsorptive surgical procedures impair the body's ability to absorb fats; therefore, the fat-soluble vitamins A, D, E, K, and zinc become deficient (Isom et al., 2014). Calcium, absorbed in the bypassed duodenum and proximal jejunum, is contingent on the already inadequate levels of vitamin D for absorption. Requiring an acidic environment, calcium deficiency is often compounded by the frequent use of proton pump inhibitors in BS (Stein & Silverberg, 2014). Numerous studies report an increase in PTH levels after BS, and, even with vigorous calcium supplementation, calcium malabsorption persists (Stein & Silverberg, 2014).

Changes in bone and bone homeostasis are specific to BS procedure types. Each BS variation produces contrasting amounts of weight loss and degrees of malabsorption (Kim & Brethauer, 2014; Stein & Silverberg, 2014; Yu, 2014). The LAGB procedure has the least amount of skeletal changes aside from the weight loss effects. The LSG procedure exhibits less bone loss than malabsorptive procedures but continues to manifest calcium and vitamin D deficiencies. The RYGB procedure may result in poor bone strength and mineralization, with cortical porosity increasing up to 30% (Yu, 2014). A study performed by Hsin et al. (2015) concluded that bone loss at the femoral neck and hips was present in all types of BS patients despite adequate supplementation. The RYGB procedure had significantly greater bone loss than LAGB and LSG. Protein malnutrition adds to bone loss after BS (Kim & Brethauer, 2014). Severe protein malnutrition as indicated by a low serum albumin level can predict bone loss (Huo et al., 2015).

Bone loss from decreased bone formation, or skeletal unloading, has been reported in all weight loss cases (Berarducci, 2007; Stein & Silverberg, 2014). The hip is a large weight-bearing joint affected by extreme weight loss with BS from skeletal unloading. Stein and Silverberg (2014) suggest a correlation between weight bearing and PTH, thus hypothesizing a reason for an absence of significant change in the spine. Bone loss occurs with age, steroid dependency, harmful lifestyle

Table 1. History and Physical Assessments to Conduct for Common Complications in Individuals With a History of Bariatric Surgery

Complications	Subjective	Objective
Malnutrition	• Do you follow a special diet? • What do you eat in a typical day? • Have you experienced any recent weight gain or loss?	• Height • Weight • BMI • Condition of hair, skin, and nails
Anemia	• Have you ever been told you are anemic? • Do you fatigue easily with activity? • Do you take vitamins and/or supplements? If so, what kind, frequency, and amount?	• Vital signs • Color of skin and mucous membranes • Hemoglobin and hematocrit levels
Impaired wound healing	• Have you ever experienced a wound that does not heal or heals slowly? When? Location? Please describe.	• Condition of the wound • White blood cell count
Impaired bone health	• Have you experienced any broken bones? When? Location? How it occurred? • Have you fallen recently? When? • Have you been told that you have bone loss? When? Please describe. • Have you experienced a loss in height? Compare driver's license with recorded measured height.	• Serum albumin level • Results of any diagnostic testing assessing BMD such as a dual-energy x-ray absorptiometry and bone loss markers

Note. BMI = body mass index; BMD = bone mineral density.

choices, and alterations in sex hormones such as hypogonadism and menopause. Estradiol and adipocytic hormones follow extensive variances in body composition (Yu, 2014). These changes, as seen in extreme weight loss, lead to appreciable alterations in microarchitecture of bone and BMD (Kim & Brethauer, 2014).

Bone health is a concern for individuals of all ages having BS, especially young adolescents and the elderly. Advanced age, coupled with low estrogen levels, leads to elevated risk for fractures and metabolic bone disease. Currently, 10% of BS patients exceed the age of 60 years (Yu, 2014). Bone loss markers, such as urinary deoxypyridinoline and serum osteocalcin, in the postmenopausal population double those of premenopausal women, generating fear of extreme bone loss exacerbated by BS. Adolescents are at a high risk for bone loss because this age has yet to attain their peak bone mass (Stein & Silverberg, 2014; Yu, 2014). Long-term implications of bone loss are an important area for research as the BS population ages.

Implications for Nursing Care

The role of the orthopaedic nurse is crucial in the care of individuals with a history of BS and includes conducting assessments, evaluating laboratory values, performing a nutritional assessment, developing patient education, and coaching (see Tables 1 and 2). Nurses working with orthopaedic patients should be aware of the common complications of malnutrition, chronic anemia, impaired wound healing, and nutritional deficits that may lead to metabolic bone disease such as osteoporosis. These health implications affect the care of this BS population. For example, fatigue and increased shortness of breath with activity may become an impediment to rehabilitation after orthopaedic injury.

Individuals with BS need much encouragement to adhere to the challenges of the postoperative lifestyle modifications. Compliance with follow-up and supplementation, especially iron, needs to be stressed to promote health. Individuals with BS often report unwanted GI side effects and cost concerns for purchasing reliable supplements (Isom et al., 2014). With administration of parenteral forms of iron products, assessments should be conducted for potential iron overload and anaphylactic-type or hypotensive reactions (Chan & Mike, 2014). Use of nonsteroidal anti-inflammatory medications should be avoided to protect the lining of the gastric pouch (Kingsberg et al., 2016). Pain medications, such as acetaminophen or tramadol, are suggested alternatives. Erosion of anastomotic sites may occur from

Table 2. Resources for Nurses Caring for Obese Individuals or Individuals With a History of Bariatric Surgery

Obesity

National Heart, Lung, and Blood Institute (2013). *Managing overweight and obesity in adults: Systematic evidence review from the Obesity Panel, 2013*

https://www.nhlbi.nih.gov/health-pro/guidelines/in-develop/obesity-evidence-review

Obesity and bariatrics

American Nurses Association (n.d.). *Bariatrics and obesity*

http://www.nursingworld.org/MainMenuCategories/ThePracticeofProfessionalNursing/Improving-Your-Practice/Diversity-Awareness/Obesity

Bariatric surgery

American Society for Metabolic and Bariatric Surgery (n.d.). *About*

https://asmbs.org/about

National Institute of Diabetes and Digestive and Kidney Disease (n.d.). *Bariatric Surgery*

https://www.niddk.nih.gov/health-information/health-topics/weight-control/bariatric-surgery/Pages/overview.aspx

antiresorptive agents and need to be administered with caution (Yu, 2014). Hypocalcemia and tetany may occur with intravenous administration of antiresorptive agents without adequate vitamin D and calcium levels (Stein & Silverberg, 2014).

Despite age, all BS patients are at high risk for falls and fractures from falls due to skeletal fragility. Prevention of falls and promotion of safety need to be emphasized, as well as coordination with physical therapy, to initiate exercise regimens to alleviate bone loss and stimulate bone health. Once a learning needs assessment is conducted, patient education needs to be tailored to the individual patient in conjunction with the healthcare team.

Case Study Revisited

Mrs. Penny presented to the orthopaedic unit with severe anemia. Some blood loss was expected with her injury and surgery, but her admission hemoglobin level of 6.7 g/dl was significantly low. Ben's nursing assessment revealed further signs of anemia including pale skin, pale mucous membranes, and tachycardia. Her symptoms included fatigue and frequent rests with activity. Malnutrition was evidenced by anemia, low serum albumin level, the fact that she was approximately 30 pounds overweight, had significant hair loss, and had mild, nonpitting edema throughout her torso and extremities.

Mrs. Penny's surgical history of an RYGB procedure resolved her preoperative comorbidities of Type 2 diabetes and prehypertension. Without proper follow-up care in a bariatric clinic, she had developed complications. Her anemia and malnutrition could impact both wound and bone healing.

When the multidisciplinary team rounded that morning, Ben shared his concerns because he identified that Mrs. Penny's care needs a multidisciplinary approach. The team ordered a physical therapy consult to implement strengthening exercises and reduce bone loss. The nurse evaluated Mrs. Penny on her knowledge of fall risks and focused on fall prevention. Discussion of antibiotic dosing specific to an RYGB patient occurred with the pharmacist. Specific laboratory results were reviewed such as a complete blood cell count and complete metabolic panel and further testing was ordered. A dietician spoke to Mrs. Penny about her current dietary intake and previous attempts with supplementation. The dietician and the pharmacist collaborated regarding parenteral supplementation. Prior to discharge, the nurses and the dietician would work together to provide specific nutritional teaching, and a consult would be placed to a local bariatric clinic for follow-up care.

Conclusion

Factors of malnutrition, anemia, impaired wound healing, and bone metabolism are troublesome when present independently; however, when these factors exist collectively, manifestations are aggravated. Detection of high-risk patients calls for aggressive monitoring and treatment, with timely interventions before signs of malnutrition, anemia, poor wound healing, and bone demineralization develop. In the presence of bone loss, a more extensive laboratory workup with serial BMD monitoring should be considered. Treatment is guided and adjusted to remedy nutritional deficits, promote preventative measures, and educate to achieve and maintain optimal health in the BS population.

Bariatric surgery affects many aspects of patient care. Employing a multidisciplinary approach ensures that the needs of the patient are addressed with the expertise of each team member. Bariatric centers include care provided by a surgeon, bariatrician, nurse, dietician, physical trainer, and psychologist. Bariatric treatment centers provide lifelong follow-up, including periodic monitoring of laboratory values, individualized and correlated, with vitamin and nutrient supplementation. While in the acute care setting, the orthopaedic nurse must assume numerous roles in the care of the BS population. A solid knowledge base of BS is imperative to deliver effective, high-quality care.

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