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RESEARCH

Research and Practice Innovations

Nutrition Care for Patients Undergoing Laparoscopic Sleeve Gastrectomy for Weight Loss

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ABSTRACT

Laparoscopic sleeve gastrectomy (LSG) is a bariatric surgery in which 60% to 80% of the stomach is removed longitudinally, resulting in a smaller stomach that takes the shape of a "sleeve." The mechanism for weight loss is gastric restriction and possible neurohormonal changes resulting from lower levels of ghrelin (an appetite-stimulating hormone), as a consequence of removing the gastric fundus. LSG may be more desirable than laparoscopic adjustable gastric banding because there is no foreign object inside the abdomen and no need for postsurgery appointments to adjust the band. LSG may be preferred over Roux-en-Y gastric bypass (RYGB) because LSG is a less complicated operation that does not result in dumping syndrome or malabsorption, yet weight loss is comparable to RYGB. While LSG is suggested to have advantages over the commonly performed laparoscopic adjustable gastric banding and RYGB, there are no long-term (>5 years) outcomes and few studies specific to nutrition care for LSG patients. This article will present a protocol for pre- and postsurgery nutrition care for LSG and the important role the registered dietitian plays in the multidisciplinary team. Postsurgery diet progression from liquids to solids during 6 to 8 weeks should focus on meeting protein and fluid needs. In addition, LSG patients are at risk for nutrient deficiencies due to decreased hydrochloric acid and intrinsic factor from removed parietal cells and reduced dietary intake due to decreased ghrelin levels. Therefore, LSG patients should take daily micronutrient supplements, including vitamin B-12 and potentially supplemental iron, to prevent deficiencies.

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With the rapid increase in bariatric surgery procedures as a treatment option for obesity, many registered dietitians (RDs) have become familiar with the two most frequently performed types of bariatric surgery: laparoscopic adjustable gastric banding (LAGB) and Roux-en-Y gastric bypass (RYGB). While these two types of procedures result in substantial weight loss and improvement in comorbidities (1), a new surgical option—laparoscopic sleeve gastrectomy (LSG)—is being offered by some bariatric surgeons as an alternative with potential advantages for patients.

During LSG, 60% to 80% of the stomach is removed longitudinally, resulting in a smaller stomach that takes the shape of a "sleeve" (Figure 1). Historically, LSG has been performed as a first step to reduce excess weight and comorbidities in morbidly obese patients before a more complex malabsorptive procedure, such as the biliopancreatic diversion with duodenal switch or RYGB (2). LSG has evolved as a single-stage primary procedure. The mechanism for weight loss is gastric restriction with the stomach capacity shrinking to ≤300 mL. In addition, there are neurohormonal changes with an observed reduction in levels of ghrelin, an appetite-stimulating hormone produced by the gastric fundus, which is surgically removed during LSG (3).

Potential advantages of LSG over LAGB are the lack of a foreign object inside the abdomen and no need for postsurgery appointments to adjust the band. Advantages of LSG over RYGB include preservation of the pylorus, prevention of dumping syndrome, and an absence of malabsorption. In addition, compared with RYGB, LSG is perceived to be less technically challenging from a surgical perspective (4). Excess body weight loss for LSG generally is described as superior to LAGB and comparable to RYGB. For LSG, studies indicate excess body weight loss of 61.5% at 2 years after surgery (5), while it averages 53% for LAGB and 67% for RYGB (6). While LSG is suggested to have advantages over both LAGB and RYGB, there are no long-term data (>5 years) available on LSG as a stand-alone procedure. There is no Current Procedural Terminology code for the surgery and insurance companies do not always cover LSG as a treatment for obesity (7). In addition, there are no specific nutrition guidelines for LSG (8). However, as more long-term outcomes are published and insurance coverage increases, RDs will likely encounter patients undergoing LSG.

This article will present a protocol for nutrition care of the LSG patient. The RD plays a vital role in the multidisciplinary team that treats the patient before and after LSG (9,10). Before surgery, the RD is involved in nutrition assessment, weight management, and education for

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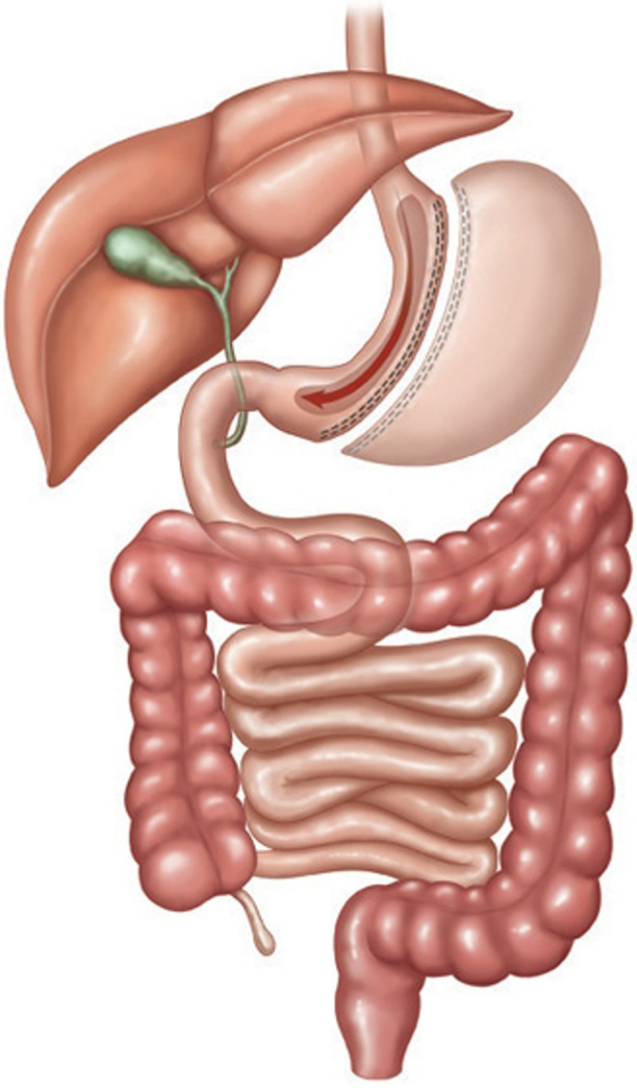

Figure 1. Sleeve gastrectomy. Courtesy Ethicon Endo-Surgery, Inc, makers of the REALIZE™ Adjustable Gastric Band.

the LSG patient. After surgery, the goals for the RD are to help the patient achieve adequate energy and nutrient intake and assist in the selection of foods that decrease gastrointestinal symptoms and maximize weight loss and maintenance (10).

PRE-LSG NUTRITION CARE

Assessment. Because of the complexity of obesity, the multitude of selection criteria, and the magnitude of postsurgery lifestyle changes, it is recommended that a multidisciplinary team screen and educate patients before weight loss surgery (11-14). Patients should undergo a complete history and physical examination by a medical professional, a psychological evaluation by a certified mental health specialist, and a nutrition assessment by an RD (10,11,13).

Potential candidates must meet specific weight criteria with body mass index (calculated as kg/m^2) ≥40, or 35 to 39.9 with comorbidities (15). Individual practices may set more specific weight requirements based on surgeon preference and access to weight-appropriate hospital equipment. In addition to the body mass index criteria, the National Institutes of Health recommends other inclusion criteria for bariatric surgery. These recommendations were expanded in 2008 by the American Association of Clinical Endocrinologists, The Obesity Society, and the American Society for Metabolic and Bariatric Surgery in their medical guidelines (10). It is suggested that patients are candidates if they have failed attempts at diet and exercise, are motivated and well-informed, are free of substantial psychological disease and uncontrolled drug or alcohol dependency, and the benefits to the patient outweigh the risks. In addition, candidates should be able to understand surgery and postsurgery lifestyle requirements (10).

RDs provide the team with valuable insight into candidates' history of failure with previous diet attempts, current and previous use of alcohol and illegal recreational drugs, disordered eating, level of motivation and readiness, and understanding of and ability to follow postsurgery guidelines (16,17). In addition, medical nutrition therapy may help patients correct micronutrient deficiencies and manage uncontrolled blood sugars and other conditions prior to surgery (10).

During thorough nutrition assessment and counseling, the RD can help patients fully understand factors that will affect them after surgery and determine whether LSG is the most appropriate surgery. Lifestyle factors affecting nutrition status must be understood to make an informed decision. A perceived positive benefit of LSG is no restriction of type of foods eaten because of pylorus preservation. However, decrease in hunger makes it necessary to eat regularly to maintain optimal nutritional status. A potential contraindication for LSG is the preference for and overeating of high-calorie sweets (5). For example, if a patient believes that his or her predilection for sweets might contribute to postsurgery failure, he or she may choose to have RYGB instead of LSG.

With binge-eating disorder occurring in 10% to 27% of patients seeking weight loss surgery (18), the RD is a valuable member of the multidisciplinary team that screens LSG patients for disordered eating and helps treat identified patients prior to having surgery. It is important to help patients with binge-eating disorder understand that they may have trouble with lifestyle changes after surgery that result in weight regain and educate them on how to address these problems if they do occur (19).

Physiologic factors that make a patient a better candidate for LSG vs other surgery types include stomach conditions requiring ongoing endoscopic assessment (polyps, high risk of cancer), extensive previous surgery and adhesions, inflammatory bowel disease, and the need for anticoagulants or nonsteroidal anti-inflammatory drugs for pain relief (restricted with RYGB and LAGB) (4,20,21). Contraindications to LSG include severe gastroesophageal reflux (22), severe inflammation of the esophagus or stomach, and ulcers located in the lesser curvature of the stomach (5).

There is evidence that micronutrient deficiencies are

common in morbidly obese people, even before bariatric surgery. This suggests that this population might consume excess calories from low nutrient-dense foods or might have an altered bioavailability of these nutrients. This condition has been called "high-calorie malnutrition" (23,24). A comprehensive pre-LSG protocol, therefore, should include baseline laboratory values and any preexisting nutrient deficiencies should be treated. Patients should have individualized nutrition counseling with an RD, where recommendations for food sources and nutrient supplementation are discussed (16). Typical deficiencies seen prior to bariatric surgery and of particular concern after LSG surgery include iron (16-44%) (25,26), vitamin D (33-80%) (26,27), and vitamin B-12 (13%) (25). These micronutrients should be included in biochemical monitoring before and after LSG.

Weight Management. Some insurance companies require presurgery participation in a supervised weight management program before approving coverage for bariatric surgery. While this has generated some controversy (28), most studies have shown weight loss prior to bariatric surgery decreases operating time (28,29), complications, blood loss during surgery, and postsurgery hospital stays (28). Alger-Mayer and colleagues found preoperative excess body weight loss is correlated with excess body weight loss at 3 to 4 years after surgery (30). Alvarado and colleagues noted preoperative loss of 1% of initial weight correlated with an increase of 1.8% postoperative excess body weight loss at 1 year ($P<0.05$) (31).

Ideally, pre-LSG weight management programs should promote a low-fat, reduced-energy diet and be based on the American Dietetic Association's Adult Weight Management Evidence-Based Practice Guidelines (17). Topics such as meal planning, mindful eating, portion control, and exercise are important components. Participation should be supported by use of behavioral change techniques, such as keeping a daily record of intake and setting specific, measurable goals. The use of commercial weight loss programs might fulfill this requirement if there is adequate documentation of regular participation.

In addition, very low-calorie diet meal replacement programs are often used before surgery when rapid weight loss is indicated. If weight loss is required for LSG eligibility (eg, to meet hospital equipment requirements), very-low-calorie diet meal replacement programs for up to 12 weeks are often recommended (32). Patients who have conditions that might complicate surgery, such as hepatomegaly or excessive central adiposity, may be prescribed very-low-calorie diets for several weeks prior to surgery to reduce liver volume, which improves abdominal access for the surgeon during LSG (32,33).

Education. Prior to LSG, multidisciplinary education should be designed to give patients the skills they need to decrease surgery risk as much as possible, recover rapidly from surgery, lose the desired weight in a healthful manner, and maintain their weight loss. The role of the RD is to teach and counsel the patient on what to expect after surgery; ie, lifestyle changes, postsurgery diet phases, and timing and dosage of required micronutrient supplements (10,16). Education sessions should also include goal-setting, intuitive eating, postsurgery recovery and the hospital experience, and exercise after bariatric surgery (11,16).

Once LSG has been determined to be the surgery of choice for the patient, the RD can educate the patient on the best diet for rapid recovery, weight loss, and maintenance. After successful completion of presurgery assessment, weight management (if required), and education, patients may progress to surgery.

POST-LSG NUTRITION CARE

Patients should schedule routine follow-up appointments with an RD after LSG. These appointments typically occur 1 to 2 weeks after surgery, at months 1, 2, 3, 6, and 9 after surgery, and then yearly (16). Patients should bring diet records to all appointments and have postoperative laboratory blood work as prescribed. The RD evaluates nutritional symptoms, food tolerance, and weight loss, and counsels the patient on nutritional adequacy of intake and diet progression (16).

In addition to helping patients meet their nutritional needs after LSG, the RD must be aware of potential symptoms that might affect ability to meet needs. Post-LSG assessment has found appetite to be greatly decreased for as long as 2 years after surgery. Patients report consuming far smaller meals than prior to surgery and feeling full on very small amounts of food (eg, 100 mL yogurt). Patients report eating more frequently than they had before LSG, as many as five to six times per day (34,35). Most foods seem to be well-tolerated, with beef being the only documented intolerance for some patients (36). Nausea and vomiting occur in as many as 36% of patients after LSG. These symptoms were associated with meal size and speed of eating and are resolved in most patients when these behaviors are addressed (34).

Sixty-seven percent of LSG patients experience gastroesophageal reflux symptoms at 1 month after LSG. This usually decreases greatly or resolves completely by 2 years post-LSG, with as few as 5% experiencing symptoms at that point (37). However, some patients who present with gastroesophageal reflux prior to surgery experience complete resolution after surgery (5,38).

Patients can expect an average excess body weight loss of 18% to 30% at 1 month post-LSG (3,35), 37% to 41% at 3 months post (35), 54% to 61% at 6 months post (3,34,35), and 58% to 70% at 1 year post (2,34,38). As patients lose substantial amounts of weight or when weight loss does not occur as expected, total energy expenditure should be reassessed using the Mifflin-St Jeor equation and patients' actual body weight (17). Resting metabolic rate measured through indirect calorimetry plus energy requirements for physical activity is the preferred method to estimate energy needs, if available (17). Some patients were found to reach their weight goal within 1 to 2 years after LSG and maintained their weight with an intake of 1,000 to 1,200 kcal/day (39).

Patients not reaching their goals might require additional visits with bariatric team members to facilitate continued weight loss (10). Patients should follow-up with their surgeons to determine whether surgical failure is responsible for the inadequate loss. Psychological evaluation is recommended to determine whether psychological factors are complicating patients' weight loss attempts (10). Through nutrition counseling sessions, the RD can assess potential modification of eating behaviors. For example, behaviors noted to interfere with weight

loss include frequent snacking and consuming soft calories (eg, milk shakes, sugar-sweetened beverages) (40). In some cases, patients might need a second bariatric surgery procedure to reach a desired weight goal (40).

Multidisciplinary support groups are an integral part of a successful postsurgery program. Support-group attenders have been shown to lose more weight than nonattenders, with a correlation between frequency of attending and amount of weight lost (41). To encourage regular attendance, LSG support groups may incorporate weight checks and the opportunity to meet with an RD or other bariatric surgery team members. For additional long-term weight maintenance support, postsurgery patients may consider attending general weight-maintenance group sessions that address diet, physical activity, and motivation, as well as social and environmental factors affecting long-term weight management (17).

Diet Progression. Figure 2 describes the diet progression protocol for LSG and provides a sample menu for each diet phase. During a 6- to 8-week period, the patient progresses through four diet phases: liquid (up to 1 week), pureed (3 to 4 weeks), soft solid (progress as tolerated) and firmer, regular foods (maintenance) (16). This slow progression is recommended because of the long surgical staple line and prevalence of nausea after LSG (34,38). However, the surgeon or RD may decide to progress the diet sooner based on the individual's needs and tolerances.

The main focus for the first month is making sure the patient consumes enough protein and fluids (42). Although not common, bariatric surgery patients may become protein-energy malnourished because of their limited caloric intake after surgery (16). There are no standard recommendations for protein intake after bariatric surgery, but many centers use either 60 to 80 g/day protein or 1 to 1.5 g/kg ideal body weight per day to estimate protein needs (10,16). For LSG patients, 1.1 g/kg ideal body weight can be used to estimate daily protein needs to encourage adequate intake of protein. Patients are encouraged to meet these needs by consuming liquid protein supplements and other high-protein products daily. Protein supplements are recommended until the patient is able to take in enough food sources of protein to meet daily needs.

Adequate hydration is crucial for all patients during rapid weight loss (10). To maintain adequate hydration following LSG, fluids should be consumed slowly and in sufficient amounts, with a goal of >1.5 L per day (10). Patients should be instructed to consume liquids and solids separately, waiting at least 30 minutes between eating and drinking. This helps the patient avoid gastrointestinal symptoms, leaves space for nutrient-rich foods, and prevents decreased satiety over time.

Whole-grain starches, fruits, vegetables, dairy or substitutes, and healthful fats should be added as tolerated. The nutritional goal is for patients to consume a balanced diet that includes adequate servings from all of the food groups and limits or excludes added sugar, concentrated sweets, fruit juice, fried foods, carbonation, caffeine, and alcohol (16). Patients are counseled to meet minimal needs for carbohydrate (130 g/day) and fat (20 g/day) based on the Dietary Reference Intakes for adults (46). Although the initial focus after LSG is to consume adequate protein and fluid, it is recommended that patients reach these fat and carbohydrate goals as soon as they are able after surgery.

Micronutrient Supplementation. LSG patients are potentially at high risk for nutrient deficiencies for several reasons: their substantially reduced dietary intake, decreased hydrochloric acid and intrinsic factor, potential nausea and vomiting soon after surgery, poor food choices, and food avoidance because of intolerance. Therefore, it is necessary for LSG patients to take daily micronutrient supplements to prevent any deficiencies (47,48).

Studies are inconclusive on how LSG affects the rate of the flow of food through the gastrointestinal system (49,50); however, LSG significantly reduces stomach size and works to induce weight loss through restriction. Removing most of the stomach, including the fundus and much of the body of the stomach, reduces production of intrinsic factor and hydrochloric acid. Intrinsic factor is necessary to release 99% of vitamin B-12 contained in food; therefore, vitamin B-12 deficiencies should be expected with LSG (51,52). Reduction in hydrochloric acid can potentially affect iron absorption (38,52). Deficiencies in vitamin B-12 and iron have been noted at 1 year and 3 years post-LSG (38).

Figure 3 lists the micronutrient supplements recommended for LSG patients postoperatively, the recommended dosage and timing, and the laboratory tests to determine nutrient adequacy. These recommendations serve as general guidelines because individual requirements may vary, depending on pre- and postsurgery laboratory values.

Because of reduced dietary intake, LSG patients require life-long vitamin/mineral supplementation (53), as well as on-going monitoring by their medical team to prevent nutrient deficiencies. If nutrient deficiencies are left untreated, malnutrition and possibly irreversible symptoms/complications can result.

CONCLUSIONS

Clearly, more research is needed to elucidate the best nutrition care for patients who undergo LSG for weight loss. Until evidence-based nutrition guidelines for LSG are developed, RDs must rely on the limited literature specific to nutrition care of the LSG patient (8), as well as the published nutrition guidelines for the more popular weight loss procedures (10,16). As with any type of bariatric surgery, the RD plays a vital role in the multidisciplinary team that both adequately prepares the LSG patient for surgery and provides follow-up care to optimize health and weight loss success. Before surgery, the RD works with the patient to improve diet quality, while at the same time teaching the patient weight management techniques to optimize health and surgery risk. After surgery, the RD helps the patient choose foods that decrease gastrointestinal symptoms and plan meals to achieve individual goals for weight loss and maintenance (16).

Because LSG is essentially a restrictive procedure, the postoperative nutritional recommendations are similar to those for the more popular restrictive procedure, LAGB. However, because the parietal cells that produce hydrochloric acid and intrinsic factor are removed in LSG, micronutrients that are not routinely supplemented in LAGB, such as vitamin B-12, should be carefully supple-

Length of time	Up to 1 week	3-4 weeks (remainder of month 1)	From 2 to 4 weeks	Maintenance
Texture	Liquid	Pureed	Soft solid	Firmer, regular foods
Important nutrients	Protein and fluids	Protein and fluids: Start adding new foods from different food groups	Protein and fluids: Focus on getting foods from each food group	Protein, fluid, carbohydrate, fat: balanced diet rich in fruits, vegetables, whole grains, low-fat dairy, and lean protein
Sample foods	Chicken broth, reduced-fat or nonfat milk or soymilk, sugar-free gelatin, protein shakes, and other protein supplements	Pureed chicken, turkey, or fish, tuna fish with light mayonnaise, peeled, pureed fruits and vegetables, pudding, oatmeal, yogurt	Soft-cooked vegetables, moist preparation cooked meats, soft-cooked noodles, canned fruits	Whole-grain toast, crackers, tender chicken, turkey and fish, legumes, raw and cooked vegetables and fruit, lean red meat as tolerated
Foods to avoid (not commonly tolerated)	Thick (viscous) fluids or lumpy liquids (such as cream soups with pieces of food)	Tough meats, fibrous vegetables, fruits and vegetables with thick skins	Tough meats, fibrous vegetables, fruits and vegetables with thick skins or large seeds	Untoasted breads, tough meats, fibrous vegetables, fruits with tough skins
1-Day sample menus	7 AM: chewable MVI[a], sublingual vitamin B-12, 12 oz reduced-fat milk+20 g protein from sugar-free vanilla whey protein powder 9 AM: 8 oz water 12 PM: chewable calcium citrate 8 oz light drinkable yogurt 3 PM: 8 oz water 4 PM: 8 oz light cranberry juice+10 g protein from sugar-free unflavored whey protein powder 6 PM: chewable calcium citrate 12 oz cream of chicken soup, made with reduced-fat milk, strained 9 PM: chewable MVI, chewable iron if indicated 8 oz reduced-fat milk+10 g protein from sugar-free fruit flavored whey protein powder Totals 64 oz fluid, 76 g protein	7 AM: chewable MVI, sublingual vitamin B-12, 8 oz reduced-fat milk+4 oz light yogurt blended with 4 frozen strawberries 9 AM: 8 oz water 12 PM: chewable calcium citrate 2 Tbsp instant cream of wheat cooked in 12 oz chicken broth, mix in 10 g protein from unflavored whey protein powder 2 PM: 6 oz water 4 PM: 6 oz low-sodium vegetable juice 6 PM: chewable calcium citrate 8 oz light cream of chicken soup blended with 1 oz canned, drained chicken breast, ¼ cup baby food sweet potatoes, 2 tsp canola oil and 2 oz reduced-fat milk 9 PM: chewable MVI, chewable iron if indicated 8 oz reduced-fat milk+20 g protein from sugar-free vanilla whey protein powder Totals 58 oz fluid, 71 g protein	7 AM: chewable MVI, sublingual vitamin B-12, 1 large egg mixed with 1 oz reduced-fat milk, scrambled in 1 tsp canola oil, 4 oz light yogurt 8 AM: 16 oz water 12 PM: chewable calcium citrate 8 oz light vegetable soup with 1 oz chopped, canned chicken breast, ½ cup unsweetened applesauce 2 AM: 12 oz reduced-fat milk 6 PM: chewable calcium citrate 2 oz poached salmon, ½ cup mashed sweet potato, ⅓ cup soft cooked green beans, 1 Tbsp light margarine 7 PM: 12 oz water 9 PM: chewable MVI, chewable iron if indicated, 8 oz reduced-fat milk+20 g protein from sugar-free chocolate whey protein powder blended with ½ medium banana Totals 58 oz fluid, 80 g protein	7 AM: chewable MVI, sublingual vitamin B-12, 1 large egg mixed with 1 oz reduced-fat milk, scrambled in 1 tsp canola oil, sprinkle with ½ oz shredded light cheese, 1 slice light whole-grain toast, 2 tsp light margarine 8 AM: 16 oz water 12 PM: chewable calcium citrate 12 oz light vegetable soup with 2 oz diced, cooked chicken breast, ½ cup diced mixed fruit 2 PM: 12 oz reduced-fat milk 4 PM: 16 oz water 6 PM: chewable calcium citrate 2 oz lean turkey burger, 1 cup whole grain noodles, ½ cup steamed spinach, 1 tsp extra virgin olive oil 7 PM: 1 cup fresh, sliced strawberries 9 PM: chewable MVI, chewable iron if indicated 8 oz reduced-fat milk Totals 1,180 kcal, 60 oz fluid, 82 g protein, 132 g carbohydrate, 36 g fat

Figure 2. Diet progression after laparoscopic sleeve gastrectomy (16,39,42-45). Sample menus are based on needs of 168-cm patient. Ideal body weight (IBW) based on body mass index (calculated as kg/m^2) between 20 and 25 is 56 to 70 kg. Protein needs: 56 to 70 kg×1.1 g/kg IBW=62 to 77 g protein/day; fluid needs ≥1.5 L (51 oz)/day. Dietary analysis completed on FoodWorks (version 8.02, 2006, The Nutrition Company, Long Valley, NJ). Timing of meals is arbitrary, but provides an example of how to space liquids, solids, and supplements throughout the day, and should be based on patient's schedule. Patients will be able to eat less frequently as their intake at each meal increases. [a]MVI=multivitamin/mineral supplement.

Supplement	Recommended daily amount	Timing	Sample timing chart	Laboratory tests to determine adequacy
Chewable MVI[a] (bariatric formula that includes iron, copper, and zinc)	200% DV[b] of at least ⅔ of nutrients	• Separate and take with meal, protein drink, or milk to improve tolerance • Do not take with calcium to improve iron absorption • Separate calcium and iron by 2-4 hours	7:00 AM 9:00 PM	• Serum thiamin • Total plasma vitamin B-6 • Red blood cell folate • Plasma retinol (vitamin A) • Plasma α-tocopherol (vitamin E) • Prothrombin time (vitamin K) • Plasma zinc • Serum copper
Chewable or liquid calcium citrate with vitamin D	1,000-1,500 mg calcium (total of ≥1,700 mg calcium from supplement and food sources not to exceed 2,500 mg/day) 400-800 mg vitamin D_3	• Do not take with iron • Separate calcium and MVI/iron by 2-4 hours	12:00 PM 6:00 PM (up to 500-600 mg each time)	• 25-hydroxyvitamin D • Intact parathyroid hormone • Serum calcium • Serum phosphorus
Sublingual vitamin B-12	500 μg	May take with MVI	7:00 AM	• Serum B-12 • Methylmalonic acid • Homocysteine
Chewable elemental iron	MVI provides 200% DV, supplement to 325 mg elemental if exhibiting clinical indications of anemia	• Do not take with calcium to improve iron absorption • Separate calcium and iron by 2-4 hours	9:00 PM	• Ferritin • Serum iron • Total iron-binding capacity • Complete blood count

Figure 3. Micronutrient supplement recommendations after laparoscopic sleeve gastrectomy (16,42,44,45). The registered dietitian (RD) monitors dietary calcium intake and increases recommended dosage if patient has limited intake of calcium-rich foods. [a]MVI=multivitamin/mineral supplement. [b]DV=daily value. RD monitors laboratory values for vitamin B-12 and decreases recommended dosage if patient has adequate levels.

mented and monitored. One other important difference between LSG and LAGB is the potential reduction in ghrelin seen with LSG. Because ghrelin is an appetite-stimulating hormone, LSG may result in early satiety and inadequate intake of energy and nutrients.

LSG is far from commonplace at this time, but RDs will likely encounter patients undergoing LSG as more long-term outcomes are published and subsequently, insurance coverage increases. In the meantime, RDs should take this opportunity to learn about LSG as an important new tool in bariatric surgery and its potential nutrition implications.

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