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Bariatric Surgery in Diabetes Management
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The latest National Health and Nutrition Examination Survey data indicate that between 2009 and 2010, roughly 35% of adults (78 million) and 16.9% of children and adolescents (12.5 million) were obese.[1] Excess weight is associated with an increased prevalence of type 2 diabetes, and both diabetes and obesity are associated with an increased risk of mortality and higher health care costs.[2] Since obesity is considered a modifiable risk factor for diabetes, preventing it is ideal, but treatment for those who are currently obese is critical.

Diet, exercise, and medications are the cornerstones of therapy for type 2 diabetes, but outcomes remain disappointing.[3] Fewer than 50% of people with moderate to severe diabetes achieve and maintain therapeutic thresholds for glycemic control. Diet, exercise, and behavioral therapy are first-line treatment modalities for obesity, but results also are inadequate.[4] In addition, many diabetes medications (eg, insulin, sulfonylureas, thiazolidinediones) promote weight gain, further exacerbating obesity among people with diabetes.[5]

Types of Bariatric Surgery
The choice of surgery type for a particular patient often is discussed with diabetes resolution in mind. Because diabetes is one of the primary reasons patients elect to have bariatric surgery, surgeons typically help patients weigh the pros and cons of each type of procedure as they relate both to weight loss and the resolution of comorbid health conditions.

As of 2013, the vertical sleeve gastrectomy (VSG) is the most common bariatric procedure (42.1% of new cases), followed by the Roux-en-Y gastric bypass (RYGBP) (34.2%).[6] The adjustable gastric band (AGB) now represents only 14% of total surgeries, due to inadequate weight loss or band removal in as many as 40% to 50%, and reoperation or conversion to another surgery in about 20% to 30% of patients.[7] Some surgeons perform the biliopancreatic diversion (BPD) with or without a duodenal switch (BPD/DS), but it's less accepted because it can cause macronutrient malabsorption and serious micronutrient deficiencies; in 2013, BPD/DS represented only 1% of the 179,000 surgeries performed in the United States.[6]

The RYGBP involves the creation of a small pouch (volume of fewer than 30 mL) divided from the gastric remnant, or excluded stomach, which is joined to the jejunum through a narrow gastro-jejunal anastomosis. The biliopancreatic limb and alimentary limb are reconnected 75 to 100 cm distal to that connection. Ingested food bypasses 95% of the stomach, the entire duodenum, and a portion of the jejunum.[8]

VSG surgically restricts the stomach to a long tubular shape with a reduced volume of 150 to 200 mL while preserving the pylorus. In addition to reduced capacity, appetite hormones and gastric acid are reduced.[9] The excluded stomach, representing about 85% of the original capacity, is removed.

The BPD procedure, a distal, horizontal gastrectomy, leaves behind a functional stomach (volume of 200 to 500 mL) that is anastomosed to the distal 250 cm of small intestine. The excluded small intestine carries bile and pancreatic secretions and connects with the alimentary channel 50 cm above the ileocecal valve, which leaves 50 cm of intestine in which digestive enzymes and nutrients mix.[8]

In the BPD/DS procedure, a sleeve gastrectomy is created, and the duodenum is closed distal to the pylorus. A duodeno-ileal anastomosis (switch) also is performed, leaving 100 cm of common channel where the food, digestive enzymes, and bile mix before entering the large intestine.[8]

In gastric banding, an AGB device filled with saline is implanted around the upper part of the stomach, distal to the gastroesophageal junction. Restriction is adjusted by injecting and withdrawing saline through a port implanted in the abdomen and accessed by a needle; no manipulation of the small intestine is involved in placing the band.

BPD/DS, despite being performed infrequently, results in the greatest weight loss and diabetes resolution, followed by RYGBP, VSG, and the AGB.[10] Even when RYGBP and the AGB produce similar rates of weight loss, the former is more effective in the long term both at keeping weight off and resolving diabetes.[11]

While there are arguments for performing certain procedures over others both for weight-loss outcomes and diabetes resolution, these choices are dictated by insurance coverage, patient choice, surgeon preference, and options offered by various surgery centers. Insurance coverage historically has been available most for RYGBP and the AGB, although coverage for VSG is becoming more common. Few surgeons perform the BPD/DS due to issues with the more extreme malabsorption and complication rates.[12]

Earlier Intervention in Diabetes Patients With Lower BMI

Bariatric surgery generally is considered appropriate for those with a BMI greater than 35 and at least one weight-related comorbidity, such as type 2 diabetes, and for those with a BMI greater than 40 with and without comorbidities.[13]

The National Institutes of Health criteria for bariatric surgery haven't been revisited in more than 20 years but still are used to decide for which patients surgery is appropriate.[14] Approximately 6.3% of the US population has a BMI higher than 40, and 15.5% have a BMI of 35 to 40, making up 21.8% of the US population's potential candidates for bariatric surgery.[15] However, because of factors such as access to care and patient interest in pursuing surgery as a treatment option, only 1% to 2% of the morbidly obese meeting the criteria for surgery undergo the treatment.[16]

More research is becoming available to support the use of bariatric surgery in diabetes patients with a BMI below 35.[8] The first evidence that the surgery benefited people with diabetes came with the observation that those who had gastric resections with proximal intestinal reconstruction (similar to gastric bypass) for ulcers or cancer achieved rapid postoperative hyperglycemia normalization.[8] In one study, Cohen and colleagues showed significant reductions in fasting blood glucose levels in patients with diabetes with a BMI below 35 who underwent gastric bypass.[14]

In the first study to evaluate bariatric surgery as a treatment both for obesity and diabetes, Pories and colleagues established that gastric bypass is a safe and effective therapy for morbid obesity and associated comorbidities; no other therapy could produce durable and complete diabetes control.[17] Surgical intervention has since become a more common treatment option for obese patients with type 2 diabetes.

Metabolic surgery describes procedures that modify a patient's physiology for the better vs simply correcting or removing an anatomic defect.[18] In addition to treating primarily morbid obesity for those with a BMI of greater than 35 to 40, metabolic surgery has been proposed for people with co-occurring diabetes and a lower BMI range (BMI greater than 30,19 and even in those with a BMI as low as 27).[4]

Reducing the BMI requirements for surgical candidates to 30 to 35 would include another 20% of the US population. A BMI of 30 to 35 and type 2 diabetes co-occur in about 4% of the US population, so revised recommendations would have a tremendous impact.[20]

A multinational, multicenter, randomized controlled study compared lifestyle and intensive medical management with gastric bypass in 120 obese patients with poorly controlled diabetes, a BMI of 30 to 40, and a glycated hemoglobin test (hemoglobin A1c [HbA1c]) greater than 8%. The patients had been diagnosed with diabetes at least six months previously.[19]

After one year, 49% of the gastric bypass patients and 19% of the lifestyle-medication management patients achieved the HbA1c goal of less than 7%, LDL cholesterol of less than 100 mg/dL, and systolic blood pressure of less than 130 mm Hg. Moreover, the gastric bypass patients lost 26% of their initial body weight compared with 8% in the lifestyle-medical management group. Ikramuddin noted that while there were 22 serious adverse events in the surgery group, even intensive medical management of type 2 diabetes can have complications (15 serious adverse events).[19]

In another important study, 66 people with longstanding diabetes and a BMI of 30 to 35 who had gastric bypass were followed for six years. Diabetes remission, based on criteria of HbA1c of less than 6.5% without diabetes medication, occurred in 88% of patients. Glycemic improvement without meeting full remission criteria occurred in another 11%.[14]

Diabetes Resolution and Remission After Surgery

To evaluate the differences between diet and behavioral interventions and surgery, it's important to understand how diabetes resolution and remission are defined. It's difficult to compare results of different studies since many subjectively use the terms "resolution" and "remission" and use HbA1c levels ranging from less than 6% to 7%.[8]

According to the American Diabetes Association criteria, partial remission of diabetes occurs when a patient's HbA1c is less than 6.5% and fasting glucose is 100 to 125 mg/dL, and no antidiabetic drugs have been used for the past 12 months. Complete remission occurs when HbA1c is less than 6% and fasting glucose is less than 100 mg/dL, and no antidiabetic drugs have been used for the past 12 months.[21]

Early and late diabetes remissions are different. Early remission occurs within the first two months after surgery and lasts for at least 12 more months, while late remission begins more than two months after surgery and lasts for at least 12 more months. Patients who achieve prolonged remission (complete remission lasting more than five years) are considered cured, although relapse may occur.[21] Jimenez and colleagues defined the criteria for relapse as a fasting glucose of greater than 126 mg/dL and HbA1c greater than 6.5% after a patient has been in remission for at least 12 months following bariatric surgery.[22]

In a retrospective cohort study of 690 people with type 2 diabetes who underwent gastric bypass, 63% achieved partial or complete remission, of which 22% achieved partial remission and 78% achieved complete remission. Predictors of early and late remission were younger age, lower HbA1c, no use of insulin sensitizing agents, and high serum insulin concentrations. Seventy eight percent of those who hadn't been using insulin therapy before surgery achieved complete diabetes remission compared with 15% of insulin-dependent patients.[23]

Based on similar diabetes remission criteria, Buchwald and colleagues' meta-analysis found that roughly 78% of bariatric patients experienced complete hyperglycemia resolution, with variations by procedure.10 Remission occurred in 98.9% of those who underwent BPD, 83.7% who had RYGBP, and 47.9% who had the AGB; the sleeve wasn't included as a procedure in this analysis.[10] Schauer and colleagues discovered that those with the shortest duration of diabetes (fewer than five years), the mildest form of type 2 diabetes, and the greatest weight loss after gastric bypass were most likely to have diabetes resolution.[24]

Medical Therapy vs Bariatric Surgery

A recent systematic review and meta-analysis of randomized controlled trials comparing surgical vs nonsurgical obesity treatment evaluated 11 studies and 796 individuals. Bariatric surgery (all types included) was found to be more effective than nonsurgical obesity treatment for up to two years of follow-up. Specifically, in those treated with bariatric surgery, there was greater weight loss, higher type 2 diabetes remission, greater improvements in quality of life, and greater reductions of antidiabetic, antihypertensive, and lipid-lowering drug use.[25]

Schauer and colleagues' randomized controlled trial (the Surgical Treatment and Medications Potentially Eradicate Diabetes Efficiently—STAMPEDE) compared the efficacy of intensive medical therapy alone vs medical therapy plus gastric bypass or VSG in 150 obese individuals

with uncontrolled diabetes who had an average HbA1c greater than 9% and average disease duration of more than eight years, and who were taking an average of three antidiabetes medications. Outcomes were evaluated using a goal of HbA1c of less than 6%. After one year, 12% of those who received medical therapy, 42% of those who had gastric bypass, and 37% of those who had VSG met the intended HbA1c goal.[4] After three years, 5% of those who received medical therapy, 38% of those who had gastric bypass, and 24% of those who had VSG met the primary end point of HbA1c less than 6%.[26] Eighty percent of medical therapy patients met the goal at one year but not at three years, whereas 24% of gastric bypass and 50% of VSG patients had reached the HbA1c of less than 6% at one year but not at three years.

Mingrone and colleagues' randomized controlled trial compared the efficacy of conventional medical therapy with gastric bypass or BPD in 60 severely obese people with diabetes (average HbA1c of greater than 7% and average disease duration of more than five years). Outcomes were evaluated using a goal of HbA1c of less than 6.5% and fasting glucose of less than 100 mg/dL after two years. None of those who received medical therapy, 75% of those who had gastric bypass, and 95% of those who had BPD met the remission criteria.[27]

Mechanisms of Action

There have been several suggested mechanisms of improved glycemic control in postbariatric surgery patients. While weight loss itself, regardless of the method, does affect glycemic control, most bariatric operations ameliorate type 2 diabetes through mechanisms beyond reduced calorie intake and weight loss.[8]

Pories first commented on the surprising speed of normalization of glucose metabolism that occurred in patients in the days to weeks following gastric bypass before they had achieved rapid weight loss.[17] Schauer found that one-third of patients with type 2 diabetes who had gastric bypass were discharged from their average three-day hospital stays with normal blood sugars and no need for diabetes medications.[24]

However, not all surgeries produce these effects. In the large Swedish Obese Subjects study, Sjöström and colleagues didn't observe the rapid diabetes remission following the purely restrictive operations although improvements were seen with these procedures after weight loss was achieved.[28] The adjustable gastric band and the no-longer-performed vertical banded gastroplasty are considered purely restrictive as they only create a smaller-volume stomach, whereas the gastric bypass, sleeve gastrectomy, and BPD/DS are thought of as combination procedures of varying amounts of restriction, malabsorption, and neurohormonal effects.

The hindgut theory (or lower intestine hypothesis) suggests that rerouting food through an altered gastrointestinal (GI) tract results in increased delivery of incompletely digested nutrients to the distal jejunum, which overstimulates L cells.[29] Secretion of the hormone glucagonlike peptide-1 (GLP-1) from L cells slows gastric emptying and has appetite-suppressing effects.[30]

After gastric bypass and BPD/DS, by which food is rerouted through intestinal bypass, there's an increased secretion of GLP-1 after meal intake, resulting in stimulation of insulin release by

pancreatic beta cells and normalized plasma glucose. This response occurs early after surgery, lasts months to years after surgery, and is independent of weight loss.[22] GLP-1 also increases to a lesser extent with the sleeve gastrectomy, even though the intestine is left intact.[31]

In people with diabetes who were randomized to gastric bypass or diet, those in the surgery group, after losing an average of 20 lbs, had greater improvements in glucose tolerance, elevated GLP-1 levels, and an increased incretin effect than did those in the diet group after similar weight loss.[32] Euglycemia, enhanced insulin sensitivity, and an exaggerated GLP-1 response were maintained in a sample of people with diabetes 10 years after gastric bypass, suggesting durability of the phenomenon.[33]

Jimenez and colleagues believe that enhanced GLP-1 response after eating isn't sufficient to maintain the normal glucose tolerance long term. They suggest that beta-cell function is an important factor in determining diabetes remission, and those with preserved beta-cell function are more likely than others to remain in remission long term.[22]

The foregut theory (or upper intestine hypothesis) suggests that surgically bypassing the duodenum and proximal jejunum from contact with nutrients inhibits the release of a signal responsible for insulin resistance and type 2 diabetes.[34] Excluding the upper intestine reduces the secretion of both ghrelin from the stomach and duodenum and glucose-dependent insulinotropic polypeptide (GIP) from the duodenum.

Ghrelin, an enteric peptide hormone, is a known appetite stimulant produced by the stomach and duodenum; after gastric bypass and sleeve gastrectomy, ghrelin levels typically are suppressed. Depending on the surgeon's technique, the vagus nerve, which innervates the stomach and stimulates ghrelin production, may or may not be severed, and that variable is associated with the variation in ghrelin levels between studies.[35]

GIP is secreted by K cells in the duodenum and jejunum, is elevated in obesity and diabetes, and contributes to insulin resistance.[30] Bypassing the duodenum and jejunum with gastric bypass and BPD/DS keeps the K cells from being exposed to nutrients and in most studies is shown to result in a beneficial decrease in GIP.

Better beta-cell function at the time of surgery is believed to maximize the effect of the surgery-altered secretion of gut peptides that enhance beta-cell insulin secretion.[35] Still and colleagues suggest that an increased duration of diabetes negatively affects beta-cell function, which is an important factor in determining long-term diabetes remission after bariatric surgery.[23] Presurgery beta-cell glucose sensitivity was a positive predictor of diabetes remission in bypass and sleeve patients.[36] Cohen and colleagues suggest that gastric bypass can reverse the progressive beta-cell failure seen in patients with type 2 diabetes.[14]

The precise mechanisms that mediate diabetes remission after certain bariatric surgeries aren't well defined, but it's clear that rearranging the anatomy of the GI tract can exert antidiabetes effects beyond reduced caloric intake and weight loss.[8] Karra and colleagues suggest that the key mechanism is increased hindgut stimulation due to enhanced nutrient

delivery and exaggerated release of hindgut hormones (GLP-1 and peptide YY).[29] Peterli and colleagues believe that neither the foregut nor the hindgut intestinal hypothesis can fully account for improvement in glucose homeostasis; rather, balance between hormones involved in the foregut (eg, ghrelin, GIP) and hindgut (eg, GLP-1, peptide YY) hypotheses are key to understanding the improved glucose homeostasis.[37] In addition, while the sleeve gastrectomy isn't considered a malabsorptive procedure since there isn't a rerouting of small intestines, a recent systematic review and meta-analysis found no significant differences in type 2 diabetes with gastric bypass and sleeve gastrectomy.[31]

Reactive Hypoglycemia and Nutrition Intervention

While RDs may be involved in helping patients decide which surgery to undergo or understand how the surgery ameliorates diabetes, their most probable role is in postoperative care. RDs can help with the intervention of postoperative complications such as malnutrition, vitamin and mineral deficiencies, and eating behavior disturbances. Clinical practice guidelines endorsed by the American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery outline the postoperative nutrition guidelines including energy intake, macronutrient breakdown, and micronutrient supplementation for bariatric patients.[38] Pertaining specifically to glucose control, however, dumping syndrome and reactive hypoglycemia are the most common postop complications requiring RD involvement. Moreover, if patients' weight regain promotes relapses to diabetes or poor glucose control, RDs play a crucial role in counseling them about eating behaviors to prevent or counteract weight regain.

If the pylorus is bypassed or gastric innervation is disrupted during surgery, rapid emptying of gastric contents into the small intestine leads to GI and vasomotor symptoms known as dumping syndrome. Dumping syndrome is characterized by adrenergic symptoms such as palpitations, sweats, tremors, anxiety, and neuroglycopenic symptoms, including extreme hunger, numbness, confusion, and fainting.[39]

Early dumping syndrome occurs about 15 minutes after eating and typically is caused by postmeal fluid shifts into the proximal small bowel in response to hyperosmolar loads (typically from eating or drinking added sugars) and associated with the release of the vasodilator serotonin.[40]

Late dumping syndrome occurs roughly 1.5 to 3 hours after eating and may be related to consuming high-glucose foods, leading to an excessive insulin response that causes transient hypoglycemia.[40] This reactive hypoglycemia (also called postprandial hypoglycemia, hyperinsulinemic hypoglycemia, or noninsulinoma pancreatogenous hypoglycemia) is commonly thought to begin late after gastric bypass and late after food ingestion, but it also has been reported early after surgery and soon after eating.[39]

Dietary modification should focus on eliminating simple sugars, concentrated sweets, high-fat foods, alcohol, and possibly lactose.[41] Helping patients plan low-volume, high-protein, carbohydrate-controlled mini meals to be spaced equally throughout the day and advising them to separate food and fluid intake by 30 to 60 minutes may help.[42] Consuming soluble fiber from guar gum, glucomannan, and pectin may help delay gastric emptying and increase

small intestine transit time, slowing glucose absorption.[41] Alpha-glucosidase inhibitors such as the prescription medication acarbose also may slow carbohydrate digestion, which can decrease the postprandial glucose and insulin response.[40]

In more complicated or severe cases, other health care professionals should be involved in treating reactive hypoglycemia. Dietitians would be part of a multidisciplinary team involved in hypoglycemia management. Physicians might consider treatments such as somatostatin analogs (eg, octreotide), pancreatic resection, reversal of the gastric bypass, or feeding into the excluded remnant stomach, which have variable results.[39] In these rare cases, patients likely will be evaluated for nesidioblastosis (acquired hyperinsulinism with beta-cell hyperplasia) and even may undergo subtotal pancreatectomy.[40]

Recurrence/Relapse

While diabetes remission rates with bariatric surgery are impressive, in a subset of patients who experience remission after surgery, diabetes does recur. DiGiorgi and colleagues followed 42 gastric bypass patients for three years after surgery and found diabetes recurrence in 24% of patients, most often in those with a lower preoperative BMI (48 vs 53). Recurrence was considered if HbA1c was greater than 6% and fasting glucose was greater than 124 mg/dL or the person had resumed taking diabetes medication after a period of resolution.[43]

The authors suggested that individuals with diabetes with a lower BMI produce less insulin or become insulin resistant with only minimal weight gain. Those who experienced recurrence also regained more weight after surgery. Since weight regain is associated with increased caloric intake, the increased demand for insulin may have reduced insulin sensitivity. In general, the more severe the diabetes in terms of duration and insulin requirement, the less likely it is that full remission will occur after bariatric surgery.[43]

Chikunguwo and colleagues found that 89% of 177 people with both obesity and diabetes had complete remission of their diabetes at some point after gastric bypass surgery 5 to 16 years earlier; in 43% of these patients, the disease recurred, which correlated with some weight regain.[44] Durability of diabetes remission correlates with the type of preoperative diabetes therapy, as those treated with diet or oral hypoglycemic agents were more likely to achieve remission, while those treated with insulin were more likely to relapse. The authors suggested that while the mechanism still is unclear, those who need insulin therapy may be those for whom weight loss is insufficient to compensate for the decreased insulin secretory capacity.[44] In addition, the mechanism that results in early or short-term diabetes remission may be different from that which mediates long-term remission.

These findings underlie the importance of bariatric surgery for people with diabetes and suggest that it isn't always just the heaviest, sickest patients who should undergo these procedures. Even less obese patients who present with diet-controlled diabetes may be good surgical candidates. Dietitians who work with diabetes patients should keep abreast of the literature in this field so they can present patients with evidence to help them decide what their best options are for controlling diabetes and their weight.

Dietitians should work closely with patients who have had bariatric surgery to promote long-term weight maintenance and initiate early intervention if patients begin to regain weight. For people with diabetes who have achieved remission, weight maintenance takes on added importance as it may keep diabetes in remission.

Advising Patients

The recently published American Association of Clinical Endocrinologists' Comprehensive Diabetes Management Algorithm and Consensus Statement[45] is a practical, evidence-based guide for health care providers who manage diabetes patients. They focus on glycemic control to reduce microvascular complications and obesity as an underlying risk factor for diabetes and macrovascular complications. Weight loss is recommended for all overweight and obese patients with diabetes or prediabetes to lower glycemia, improve lipid profile, and reduce blood pressure.[45]

This complications-centric algorithm for caring for overweight or obese diabetes patients is designed to help clinicians evaluate and stage patients for insulin resistance or cardiometabolic disease or biomechanical complications of excess body weight. Clinicians can use it to help determine therapeutic goals and decide on the intensity of treatment needed to help patients meet weight-loss targets.

Counseling by physicians or RDs, Internet-based programs, and structured multidisciplinary programs to promote therapeutic lifestyle changes are appropriate for all patients. Interventions such as weight-loss medications (eg, phentermine, orlistat, lorcaserin, phentermine/topiramate extended release, and/or any of the newly available drugs) are advised for patients with BMIs greater than 27 and who have comorbidities. Surgical therapy (eg, AGB, VSG, and gastric bypass) is recommended for those with BMIs higher than 35 and who have comorbidities, especially when therapeutic goals haven't been reached using other methods. The guidelines recommend periodic target reassessment and modifications of the therapy modality or intensities to achieve greater weight loss.

Based on the most recent evidence, weight loss appears to be one of the most effective treatments both for type 2 diabetes and severe obesity. Schauer suggested that if weight loss is achieved early in the disease process, patients will have a better chance of diabetes resolution.[24] At this time, bariatric surgery is the most effective treatment for sustaining weight loss in the morbidly obese, and bariatric surgery should be considered as a treatment option for morbidly obese patients with type 2 diabetes who are appropriate surgical candidates.

Recently, the specialty fields of bariatric surgery and diabetes management have begun converging. In addition to the integral role that dietitians play in helping all bariatric patients on their journey to a healthier lifestyle, working with diabetes patients who are considering bariatric surgery adds another level of complexity. Dietitians in both fields will be expected to play a critical role in helping patients decide the treatment course that's right for their diabetes and/or obesity, prepare for the lifestyle and dietary changes required to manage diabetes and their weight, and manage nutritional complications such as reactive hyperglycemia or diabetes relapse.

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Click here for tip sheet "Nutrition Tips for Reactive Hypoglycemia After Bariatric Surgery."

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Examination

1. Diabetes remission rates are highest in the following bariatric procedure types in order of greatest to least):
A. biliopancreatic diversion/duodenal switch (BPD/DS), Roux-en-Y gastric bypass (RYGBP), vertical sleeve gastrectomy (VSG), adjustable gastric band (AGB)
B. BPD/DS, VSG, RYGBP, AGB
C. RYGBP, BPD/DS, VSG, AGB
D. RYGBP, VSG, BPD/DS, AGB

2. Which bariatric procedure has the greatest rates of resolution of hyperglycemia?
A. AGB
B. BPD/DS
C. RYGBP
D. VSG

3. The hindgut or lower intestine hypothesis suggests that rerouting food through the altered gastrointestinal tract results in increased delivery of incompletely digested nutrients to the distal jejunum. Which of the following slows gastric emptying and suppresses appetite?
A. Ghrelin
B. Glucose-dependent insulinotropic polypeptide
C. Glucagonlike peptide-1
D. Insulin

4. What dietary modifications in the diet can you suggest to someone who has had gastric bypass and is complaining of symptoms consistent with late dumping syndrome?
A. Eat higher volume meals less often.
B. Eat lower volume meals spaced equally throughout the day.
C. Eat more protein and no carbohydrates.
D. Eat more carbohydrates and no fat.

5. How can consuming soluble fiber from guar gum, glucomannan, or pectin help a patient with reactive hypoglycemia manage his or her blood sugar levels?
A. Soluble fiber increases carbohydrate digestion.
B. Soluble fiber increases postprandial glucose and insulin response.
C. Soluble fiber delays gastric emptying.
D. Soluble fiber decreases small intestine transit time.

6. Which of the following can you tell a patient who has diabetes and a BMI of 31 about bariatric surgery?
A. Bariatric surgery is being considered for people with a BMI between 30 and 35.
B. Bariatric surgery is being proposed for people with diabetes and a BMI of 30 to 35.
C. Bariatric surgery is only for those with the most severe form of diabetes.
D. Bariatric surgery is only for those with a BMI higher than 40.

7. Using the American Association of Clinical Endocrinologists diabetes management algorithm for a person with diabetes who also is overweight, at what BMI should bariatric surgery be considered?
A. 27
B. 30
C. 35
D. 40

8. A patient considering bariatric surgery visits you to discuss diabetes remission after surgery. What can you tell her about current treatment for diabetes and the likelihood of permanent diabetes remission and relapse?
A. Treatment with diet or oral hypoglycemic agents is more likely to result in remission.
B. Treatment with diet or oral hypoglycemic agents is more likely to result in relapse.
C. Treatment with insulin is more likely to result in remission.
D. Treatment with insulin is less likely to result in relapse.

9. What helpful advice can an RDN give to a patient who's overweight and has diabetes?
A. I'm not a bariatric dietitian, so I don't know what to tell you about surgery and diabetes.
B. The sooner you can lose weight, the more likely your diabetes will resolve permanently.
C. Get your diabetes under control, then we can discuss bariatric surgery.
D. Don't worry about your diet. If you have bariatric surgery, your blood sugars automatically will be under control.

10. What can you tell your patient about the BPD procedure?
A. It involves removing the functional stomach.
B. It leaves 200 cm of small intestine for digestive enzymes and nutrients to mix.
C. All obese diabetes patients should undergo the procedure.
D. It has the highest percentage of diabetes remission.