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Preparing for a pregnancy after bariatric surgery

Michelle A. Kominiarek

INTRODUCTION

Obesity and its associated co-morbidities are now considered epidemic in many parts of the world[1]. In the United States, 68% of the population were either overweight or obese in 2007–2008; of these individuals, obesity was more often present in women compared to men[2]. Without doubt, obesity is a complex chronic disease to which adding a pregnancy further complicates management and perinatal outcomes. For example, obese patients are more likely to have an infant with birth defects, subsequently develop diabetes or hypertension, have a stillbirth, or require cesarean delivery[3–8]. In addition, labor is prolonged, and operative complications including infections, hemorrhage and increased operating times are common[9–11].

Of all treatments currently available for obesity (diet, behavioral changes, exercise, pharmacotherapy, surgery), bariatric or weight loss surgery offers the greatest chance for success in the morbidly obese[12,13]. Moreover, bariatric surgery can resolve or improve co-morbidities such as hypertension and diabetes. Candidates for bariatric surgery are those with a body mass index (BMI) more than 40 kg/m^2 or more than 35 kg/m^2 with co-morbidities such as cardiovascular disease, diabetes, or sleep apnea. The three major types of bariatric surgery – restrictive, malabsorptive and mixed procedures – are named by the mechanism by which weight loss occurs. The specific type of surgery performed is individualized and also varies depending on hospital resources and physician expertise. However, the most common surgeries performed at present are the Roux-en-Y gastric bypass (RYGB, mixed procedure) and laparoscopic adjustable gastric banding (LAGB, restrictive procedure)[14,15]. Reflective of the growing problem and its importance to the general health of the public, the number of bariatric procedures performed increased from less than 20,000 in 1995 to more than 200,000 in 2006[16].

Of interest to clinicians focusing on women's health is that the majority of reproductive age patients (18–45 years) having bariatric surgery are female (83%)[17]. In general, pregnancies occurring after bariatric surgery have favorable outcomes[17,18], and studies suggest that co-morbidities such as diabetes and hypertensive disorders often are improved[19,20]. It is important to note that birth defects and perinatal mortality are not increased[18,21,22]. However, evidenced-based research on pregnancy outcomes after bariatric surgery is lacking, as the majority of studies are retrospective (case–control or cohort) with small numbers of patients. Nevertheless, *the keys to improving perinatal outcomes after bariatric surgery are appropriate pregnancy planning and optimizing nutrition and weight status prior to pregnancy.* This chapter addresses issues that occur in reproductive age women either planning a pregnancy or pregnant after bariatric surgery.

FERTILITY

Infertility is only one of the many comorbidities associated with obesity, with a diagnosis frequently occurring prior to bariatric surgery or weight loss. For example, in the Longitudinal Assessment of Bariatric Surgery Survey, 42% of women who tried to become pregnant prior to bariatric surgery had experienced infertility[23]. The pathophysiology behind the relationship between obesity and infertility frequently includes insulin resistance and hyperinsulinemia, altered pulsatile gonadotropin secretion, elevated leptin levels and diminished ovarian reserve[24]. Infertility in obese women is commonly related to ovulatory dysfunction, including syndromes such as polycystic ovarian syndrome. After bariatric surgery, menstrual cycle irregularities and hyperandrogenism improve[25–28]. Indeed, several reports have observed improved fertility and/or unanticipated pregnancies after bariatric surgery, especially in adolescents[26,29–32].

Despite this, future fertility may not be important to all women having bariatric surgery. Although 50% of reproductive aged women planning to have bariatric surgery would never try to become pregnant after their operations, 30% reported that a future pregnancy was important[23]. Therefore, it is important for practitioners to counsel patients *preoperatively* about reproductive changes that can occur after weight loss from bariatric surgery and to discuss contraception with all women of reproductive age regardless of whether they desire a future pregnancy. An important part of optimal care after bariatric surgery is preventing an unintentional conception postoperatively.

Contraceptive counseling is challenging in the presence of medical conditions such as obesity. Furthermore, a few studies have raised concerns over the effectiveness of oral contraception after bariatric surgery[33–36]. However, some of these reports evaluated pregnancy outcomes after purely malabsorptive procedures such as the jejunal–ileal bypass which is no longer performed[35]. Gerrits *et al*. described 40 patients who had a malabsorptive procedure whereby two of nine women using oral contraception became pregnant in the first year[33]. Contraception failure was attributed to malabsorptive complications (patients were experiencing diarrhea, steatorrhea and vomiting concomitantly) and not to noncompliance. Another theoretical concern is use of depot medroxyprogesterone acetate (DMPA) and its effects on bone mineral density. Bone loss can occur after bariatric surgery because of vitamin deficiencies, especially in association with malabsorption. Given that patients may still be obese after bariatric surgery, this also needs to be considered in planning contraception[37]. Unfortunately, limited evidence is available regarding the use, effectiveness and safety of contraception after bariatric surgery, but it is unlikely that there is a significant decrease in efficacy for oral contraceptive pills[38]. Long-acting reversible methods (i.e. intrauterine device, DMPA, or implantable contraception) are highly efficacious and avoid the risk of venous thromboembolism, which is an important consideration if the patient is still obese.

TIMING CONCEPTION AFTER BARIATRIC SURGERY

The first 18 months after bariatric surgery are characterized by rapid weight loss. Because of this, concerns have arisen that fetal nutrition would be compromised if pregnancy occurred immediately after surgery; these concerns have been followed by recommendations to wait 12–24 months prior to conceiving after bariatric surgery[39]. However, one potential disadvantage to delaying pregnancy is the decreasing likelihood of conception with advancing maternal age. According to insurance claims data from 2002 to 2006, the median time at which women delivered after surgery was

19.6 months (mean 20.9 months, standard deviation 10.3 months and interquartile range 13.1–27.2 months)[20]. This finding suggests that many women conceived less than a year after surgery, but whether these gestations were planned or unplanned is not known.

A few studies have compared pregnancies occurring early (<12–18 months) vs. late (>18 or >24 months) after bariatric surgery. Similar outcomes were found with respect to infant birth weights, congenital anomalies and cesarean delivery rates[40–43]. In Dao's report of 21 pregnancies within 1 year of surgery and 13 pregnancies after the first year of surgery, maternal weight changes varied from weight loss (range −70 to +45 pounds, mean +4 pounds) in the pregnancies occurring early after surgery group, to excessive weight gains (13–75 pounds, mean 34 pounds) in the pregnancies occurring later. Weight gain during pregnancy may predict long-term weight status; however, studies on the impact of early vs. late pregnancy and long-term maternal outcomes such as weight loss success and development of co-morbidities are rare. The purpose of one study was to compare the need for additional surgery for a complication after a LAGB in those with and without a subsequent pregnancy. This included either band revision secondary to a complication, such as a proximal pouch dilation or band erosion, or a port complication[44]. Band revisions and weight loss (48% of excess weight lost in both groups, $p = 0.74$) were not different between the groups at 2 or 3 years after a pregnancy. However, the time between the initial LAGB operation and pregnancy was shorter for those women who required primary revisions for band complications compared to those who did not require revisions within 3 years of pregnancy (2.2 vs. 3.1 years after LAGB, $p = 0.03$). The authors of this report concluded that pregnancy probably does not have an effect on the rate of band revisions; however, a shorter period between LAGB placement and pregnancy may increase the need for further surgery to treat a band complication. No study to date has compared the impact of early vs. late pregnancy on infant and adolescent outcomes.

Haward *et al*. do not advise their patients to wait to conceive after LAGB procedures, because nutritional deficiencies are rare compared to RYGB[44], and these authors further acknowledge that delaying a pregnancy for 2 years may not be practical for all patients. Regardless, other issues must be considered in the first year after bariatric surgery, including adjusting to a new dietary regimen and a new body image as well as difficulty in distinguishing postsurgical symptoms from changes that occur commonly in pregnancy (i.e. nausea). All things being considered, consensus suggests that conception should be delayed 12–18 months after bariatric surgery to minimize complications from nutritional deficiencies and promote optimal and stable maternal weight loss[39]. In the event that an early pregnancy does occur, patients can be counseled that overall the outcomes are reassuring, based on the few published studies to date.

PLANNING A PREGNANCY

Multidisciplinary approach

Obesity, like diabetes and hypertension, is a chronic disease in which weight management is complex and challenging. As such, a multidisciplinary approach contributes to successful outcomes after bariatric surgery. A comprehensive team of health care professionals (bariatric surgeons, dieticians/nutritionists, obesity specialists and psychiatrists) should be involved in the care of the bariatric patient in both the pre- and postoperative stages. This approach should also continue during preconception and pregnancy. According to published guidelines, follow-up with team members should occur every 3 months in the first year and then yearly after a LAGB[45]. After a RYGB, follow-up should occur every 3 months in the

first year, every 6 months in the second year, and then yearly[45]. Ongoing consultation with a nutritionist is especially important to maintain healthy eating behaviors and overcome additional challenges if pregnancy is desired or occurs. Additionally, patients should also obtain a consultation from a maternal–fetal medicine specialist prior to conception to discuss the potential alterations in prenatal care and perinatal outcomes in a pregnancy after bariatric surgery.

Optimizing nutrition

Optimizing nutrition is undoubtedly one of the most important aspects of planning of pregnancy after bariatric surgery. In addition to following an appropriate diet, measuring vitamin and mineral levels, and supplementing with appropriate dietary additives can help this process. Malabsorptive procedures limit nutrient absorption by bypassing sections of the small intestine. Since purely malabsorptive surgeries are rarely performed today, it now is uncommon to see protein deficiency after bariatric procedures. The RYGB creates a small gastric pouch (restrictive portion) that empties into the distal jejunum, bypassing portions of the stomach, duodenum and portions of the jejunum (malabsorptive portion). Micronutrient (folate, vitamins D and B12, calcium, iron and copper) deficiencies are more common among mixed procedures than restrictive procedures such as the LAGB. In the LAGB, a fluid-filled band is placed around the stomach just below the gastroesophageal junction, thus reducing stomach volume. *All patients are advised to take daily vitamin and mineral supplements after bariatric surgery, regardless of the type of procedure. These supplements are usually sufficient to maintain normal levels and avoid deficiencies*. This prescriptive advice is lifetime in duration. It is important to remember, however, that deficiencies still can occur as a result of decreased intake and/or intolerance to certain foods or malabsorption from the bypass of important small bowel segments. Unfortunately, only 14–59% of all bariatric surgery patients continue to take the multivitamin supplement long term[46,47]. As such, early identification, appropriate treatment and routine prophylactic supplementation of deficiencies are important in the successful short- and long-term management of bariatric surgery patients. To date, recommendations for vitamin testing and treatment published for non-pregnant patients are based on expert opinion and observational research rather than evidence from trials.

The specter of specific deficiencies is increasingly important when preparing for pregnancy, and appropriate folic acid and vitamin B12 intake during the preconception period and early gestation is crucial as is noted in Chapter 22 in order to prevent spina bifida and other birth defects[48]. The same can be said for iron deficiency anemia which can be associated with preterm delivery and low infant birth weight[49]. Laboratory testing for patients after a RYGB includes a complete blood count, electrolytes, glucose, iron studies, ferritin, vitamin B12, folate and 25-hydroxyvitamin D[50]. If the vitamin D level is low, then parathyroid hormone levels should be investigated as well. Table 1 suggests an approach to treat deficiencies both prior to and during pregnancy in patients who have had bariatric surgery. Levels have been modified from studies pertaining to non-pregnant patients[50]. It should be noted that only one daily multivitamin is recommended during pregnancy to avoid excessive vitamin A doses that may occur with two daily multivitamins. In pregnancy, a minimum of 60 g of protein per day is recommended regardless of the type of bariatric surgery. Interested readers should consult Chapter 22 for a more complete discussion of supplementation in pregnancy and the preconception period.

Special considerations

Some of the common and expected physiological and anatomical changes of pregnancy

Table 1 Routine nutrient supplementation after bariatric surgery

*Non-pregnant population**	*During pregnancy*
Multivitamin 1–2 daily	One prenatal vitamin daily
Calcium citrate (1200–2000 mg/day) with vitamin D (400–800 U/day)	Calcium citrate (1200 mg/day) with vitamin D (400–800 U/day)
Folic acid 400 μg/day in multivitamin	Folic acid 400 μg/day in prenatal vitamin, replace with additional doses if deficiency confirmed
Elemental iron with vitamin C (40–65 mg/day)	Elemental iron (40–65 mg/day) plus prenatal vitamin, replace with additional doses if deficiency confirmed
Vitamin B12 ≥350 μg/day orally or 1000 μg/month intramuscularly or 3000 μg every 6 months intramuscularly or 500 μg/week intranasally	Vitamin B12 ≥350 μg/day orally, replace with additional doses if deficiency confirmed

*Adapted from Mechanick JI, Kushner RF, Sugerman HJ, *et al.* American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic and Bariatric Surgery Medical Guidelines for Clinical Practice for the Perioperative Nutritional, Metabolic, and Nonsurgical Support of the Bariatric Surgery Patient. Perioperative bariatric guidelines. *Obesity* 2009;17:s1–s7050, with permission

include more frequent emesis and displacement of abdominal organs. These possibilities prompt specialized pregnancy management after LAGB, also called active management of the band[31,44,46,51,52]. Adjusting the amount of fluid in the band (the maximum capacity of the band is approximately 10–14 ml) can either narrow or widen the gastric opening thus affecting caloric intake and absorption. One difference noted in these studies was that excessive weight gains occurred in those who had all the fluid removed from the band (had the band completely deflated) during the pregnancy compared to those that retained some or all of the fluid. There is no optimal means to manage bands during pregnancy, so therapy is individualized in consultation with a bariatric surgeon.

WHAT TO EXPECT DURING AND AFTER A PREGNANCY

Several case reports and case series report serious complications of bariatric surgery during pregnancy, including intestinal obstruction, anastomotic leaks, band erosions or migration in LAGB and gastrointestinal hemorrhage[53–56]. One study reported that band migration may be more common in pregnancy, as its occurrence was 2.4% over the gestational period (approximately 40 weeks) vs. 6% over 10 years in non-pregnant patients[57]. Two maternal deaths during pregnancy have been reported[58,59]. Surgical complications may be difficult to diagnose during pregnancy as a result of the physiological changes that occur and a misplaced reluctance to perform appropriately indicated imaging studies during pregnancy. Clinicians should counsel their patients about common pregnancy complaints (nausea, vomiting, abdominal pain) which may signal a surgical complication and have a low threshold to intervene for a suspected surgical complication.

Dumping syndrome can occur after RYGB when refined sugars or high glycemic carbohydrates are ingested. Symptoms include abdominal cramping, nausea, vomiting and diarrhea. In addition, hypoglycemia can occur resulting in tachycardia, palpitations, anxiety

and diaphoresis. Unfortunately, screening for gestational diabetes with the 50 g glucola may precipitate this syndrome. As such, alternative methods to diabetes screening are recommended including home glucose monitoring with fasting and 2-hour postprandial blood sugars for 1 week during the 24–28 weeks of pregnancy.

Pregnancy has never been a time for weight loss, and no recommendations for caloric restriction during pregnancy have been forthcoming even if the patient is still overweight or obese. Close monitoring of maternal weight gains or losses is recommended with targeted weight gains as suggested by the Institute of Medicine[60]. If there is a concern regarding abnormal fetal growth, repeated ultrasound examinations should be used for evaluation.

Prior bariatric surgery should not affect the delivery timing, labor course, or delivery route. Nor is it an indication *per se* for a cesarean delivery. If a patient had complications from bariatric surgery that required surgical revision, then an intraoperative consultation with a bariatric surgeon is recommended in the event of a cesarean delivery.

Many patients remain obese after bariatric surgery. Furthermore, in reports of pregnancy after bariatric surgery, high rates (up to 80%) of obesity were reported[43,46,51]. As such, clinicians should also counsel patients who are still obese after bariatric surgery separately on the risks of obesity in pregnancy (often defined as a prepregnancy BMI >30 kg/m^2). Continued nutritional monitoring and supplementation is important in the postpartum bariatric surgery patient as several case reports describe nutritional deficiencies and failure to thrive in breastfed infants[61–64].

CONCLUSION AND FUTURE DIRECTIONS

Counseling the patient contemplating a pregnancy or currently pregnant after bariatric surgery is becoming common, but it is a complex issue with minimal evidence-based medicine available for guidance or support. Key issues include increased fertility after bariatric surgery and assessing nutritional status (folate, iron, vitamin D and B12 and calcium). Although it seems logical to conclude that perinatal outcomes would be improved with an optimal prepregnancy BMI, whether weight loss prior to pregnancy improves future perinatal outcomes has only been studied with respect to bariatric surgery patients. Indeed, the best choice of bariatric surgery procedure (restrictive vs. mixed) for a woman considering a pregnancy after bariatric surgery is not known. Given the present trends in obesity as well as the increasing numbers of bariatric surgery procedures, clinicians will be providing care for more bariatric surgery patients in the future. Knowledge of the procedures, outcomes and pregnancy after bariatric surgery is important to provide optimal care and counseling. As is often the case, however, as medicine approaches new frontiers, further studies are needed to determine the best management in pregnancy as well as short- and long-term maternal and infant outcomes.

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