Pregnancy in the Bariatric Patient

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Introduction

The prevalence of adult obesity is increasing in the United States and around the world. Bariatric surgery is proving to be the only efficacious means for treatment of obesity and obesity-related comorbidities. With the parallel rise of bariatric surgery, we are faced with more people who have undergone bariatric procedures. As nearly one in two women of childbearing age is considered either overweight or obese [1] and over 80,000 women of childbearing age are undergoing bariatric surgery each year [2–4], bariatric surgeons should be well versed on management considerations for pregnant women following bariatric surgery. It is important to provide care as a multidisciplinary team consisting of the surgeon, family physician, and the obstetricians and gynecologists, for these patients to assure a safe and healthy pregnancy.

This chapter will review the effects of bariatric surgery on pregnancy, taking care of a bariatric patient during pregnancy and delivery and dealing with complications due to bariatric surgery that may present during pregnancy.

The Effects of Bariatric Surgery on Pregnancy

Obesity during pregnancy increases the risk of various short- and long-term maternal and fetal complications such as pregnancy-induced hypertension (PIH), gestational diabetes, thrombosis, difficulty in delivery leading to higher cesarean section (CS) rates, hemorrhage, miscarriage, fetal abnormality, prematurity, macrosomia, birth injury, still birth, and maternal and neonatal death [5, 6]. The relationship between obesity and infertility is well established, as obesity can cause a state of hyperandrogenism, leading to amenorrhea and endocrine infertility [7]. The

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association between polycystic ovarian syndrome (PCOS), a common endocrine system disorder among women, which causes infertility, menstrual dysfunction, and miscarriages, and obesity is also well known [7, 8].

Bariatric surgery leads to rapid weight loss, which can reverse the mechanism of infertility. The menstrual cycle disorders may completely resolve after bariatric surgery [9]. Deitel et al. reported improvement of menstrual irregularities post-bariatric surgery (40.4% versus 4.6%, $p < 0.001$). Infertility problems were also present in 29.3% of preoperative obese women. All women who tried to conceive postoperatively were successful [10]. Milone et al. performed a systematic review and meta-analysis of the literature and reported a high incidence (58%) of infertile women who became spontaneously pregnant after bariatric surgery [11]. In addition, PCOS symptoms resolve postoperatively [12, 13]. Eid et al. reported an observational study of 24 women with diagnosis of PCOS, who underwent Roux-en-Y gastric bypass. Post-procedure menstrual cyclicity improved in all women. Twenty-one percent of women conceived naturally [13]. Studies report successful conception post-bariatric surgery to be between 15% and 44% [5, 14–16].

Although the majority of studies show that the rates of conception are improved, some studies still show that it is more difficult to conceive even after bariatric surgery when compared to the normal weight population. When compared to the general population, post-bariatric patients had a higher need for fertility treatment (6.7% versus 2.3%) [17]. Aricha-Tamir showed no difference in rates of infertility treatment prior to surgery [18]. However, the extent of weight loss may play a role in the potential for conception [19].

Timing of Pregnancy Following Bariatric Surgery

The first year following bariatric surgery is associated with an active catabolic state due to weight loss. In addition, due to decreased intake, there is a concern for nutritional instabilities. These are particularly common with malabsorptive types of bariatric surgery, such as RYGB and BPD/DS, or with non-compliance with supplements. Common deficiencies occur commonly with iron, vitamin B12, folate, vitamins K and A, and calcium, which can lead to maternal and fetal complications. Thus, the American Congress of Obstetricians and Gynecologists (ACOG) suggests a waiting period of at least 12–24 months following bariatric surgery [5] prior to pregnancy. However, data regarding the risks of conception shortly following bariatric procedures is limited and conflicting.

In a study comparing 21 patients who became pregnant within the first year after surgery compared to 13 that became pregnant over 1 year postoperatively, there was no difference in terms of fetal weight, term pregnancy, or complications [20]. A more extensive study, assessing a cohort of 286 women following RYGB, showed no difference between women who conceived during or after the first year of surgery in terms of birth weight, generational age, preeclampsia, gestational diabetes mellitus, labor induction, and need for cesarean section, among other variables [21].

Other studies have shown a higher spontaneous abortion rate and more frequent preterm deliveries [22–24] following bariatric surgery. Printen and Scott showed high rate of premature births in the first 2 years following RYGB [24]. A rate of 29% of spontaneous abortions was reported in a study of patients who conceived in the first 2 years post-procedure [23]. Given the mixed studies, a waiting period of 12–24 months should be recommended to all women who wish to conceive following bariatric surgery. If the patient becomes pregnant during that period, both the patient and the fetus should be closely monitored [5]. If nutritional supplementation is required, overall surgical weight loss may also be jeopardized.

Use of Contraception

The use of contraception is an important topic for patients who are of childbearing age and are undergoing bariatric surgery. As fertility rates can improve following bariatric surgery and the recommended period of waiting for conception is 12–24 months, the use of contraception should be discussed. Malabsorption of oral contraceptives has been suggested, as there is the potential for decreased absorption and lower effectiveness [15, 25]. Thus, ACOG recommends the use of non-oral contraception, with barrier methods as one preferred method following bariatric surgery [5].

Patients should be thoroughly counseled regarding effectiveness and adverse effects of methods of contraception. Alarmingly, Mody et al. reported that only 21% of post-bariatric patients were referred to a gynecologist for contraceptive counseling [16].

Nutritional Status

Nutritional deficiencies may vary depending on the type of procedure, as they are less common during gastric-specific procedures and more common following malabsorptive procedures. Following malabsorptive procedures, nutritional deficiencies, such as iron, folate, thiamine, vitamin B 12, fat-soluble vitamins (vitamins A, D, E, K), calcium, and protein, are not infrequent. Most pregnant women are advised to take prenatal vitamins. As the nutritional requirements are higher during pregnancy, in addition to a higher incidence of nausea and vomiting, following bariatric surgery the potential for clinically relevant deficiencies is increased. These deficiencies can lead to fetal intracranial hemorrhage, neurologic and developmental impairment, neural tube defects, or vision problems [26, 27].

Supplementation of multivitamins and micronutrients is important for patients following surgery. In case of the pregnant bariatric patient, it is vital that supplementation is used and counseling is provided. Ideally, patients should be screened prior to conception for any deficiencies. In addition, in case the patient desires pregnancy or is pregnant, counseling regarding specific supplementation is necessary, as some of the supplementation may have teratogenic effects on the fetus, as in the

case of retinol-based vitamin A. Compliance is important [5]. Screening should be used with some experts suggesting monitoring for deficiencies each trimester [5]. When deficiency has been established, oral supplementation should be initiated. In case patients are not tolerating a tablet or capsule, a chewable or liquid form taken with food can be prescribed. In addition to vitamin and mineral supplementation, protein supplementation should be considered as well for patients who have lost weight or are not gaining weight or for fetal growth below the 50th percentile [28].

Complications Encountered in the Pregnant Bariatric Patient

In general, management of the bariatric pregnant patient should comprise of a multidisciplinary approach, involving surgeons, obstetricians, primary care physicians, and dietitians. Thus, both the health of the mother and the fetus can be addressed. As complications of bariatric surgery have been reported to lead to morbidity and mortality [4, 29], the bariatric surgeon should be involved early to minimize these risks.

Post-bariatric pregnant patients may develop procedure-specific complications during pregnancy. Pregnancy predisposes to increased intra-abdominal pressure, reduced gastric volume, displacement of intra-abdominal contents, and predisposition to nausea and vomiting. It is vital to distinguish between complications due to bariatric surgery and physiological manifestations of pregnancy. Nausea, vomiting, and occasional cramping/abdominal pain can be normal during pregnancy. However, the provider should have a high suspicion for complications due to history of bariatric surgery in the pregnant bariatric patient as these symptoms can represent a more serious problem that may necessitate surgical intervention. Thus, an urgent surgical consultation should be sought. The provider's suspicion should be based on the type of bariatric procedure.

Radiology Considerations in the Pregnant Bariatric Patient

Diagnosis of complications in post-bariatric patients will often involve the use of radiographic studies, including an abdominal radiograph, an upper gastrointestinal series (upper GI), and/or a computer tomography (CT scan). All of these studies have some degree of radiation exposure. Due to that many physicians will be reluctant to obtain these studies or may substitute MR imaging as appropriate.

In pregnant patients, although the use of a single diagnostic procedure may be less than 5 rads, depending on the trimester, there are concerns of radiation exposure to the fetus. Recently, ACOG published their statement on diagnostic imaging during pregnancy and lactation [30]. Growth restriction, microcephaly, and intellectual disabilities are the most common effects of radiation exposure, with minimal threshold effects between 60 and 310 mGy. A single abdominal X-ray leads to radiation exposure to the fetus of 0.1–3 mGy, and even multiple X-rays rarely amount to a 50 mGy dose which is set as the cutoff for safety. Abdominal CT exposes the fetus

to 1.3–35 mGy of radiation [30]. If concerned about an intra-abdominal complication in the pregnant post-bariatric patient, the concern for radiation exposure should not preclude further work-up, as the prompt diagnosis and treatment far outweigh any fetal risks of teratogenicity.

Complications Related to Laparoscopic Adjustable Gastric Banding

Although the laparoscopic adjustable gastric banding has fallen out of favor and the number of newly placed devices has significantly decreased, there are still patients who may present during pregnancy who have had this procedure. Studies have shown that LAGB is tolerable in pregnancy and babies born to women with LAGB are as healthy as children born to the general population [31]. Similar to nonpregnant patients, common complications during pregnancy following LAGB include uncontrollable nausea and vomiting, band erosion, port leaks, pouch dilation, and prolapse/slip of the band. A review of 728 pregnancies in 638 patients reported a low rate complication of 2.3% involving the band during pregnancy [32]. Most reported interventions during pregnancy involved adjustments of the band due to vomiting or risk of nutrient deficiencies [31, 33].

Pouch Dilation and Prolapse/Slip of the Band

Pouch dilation and band prolapse/slippage have been well described in pregnant women with about 1.2% incidence during pregnancy and 1.1% postpartum [32]. Symptoms tend to be nonspecific and can include abdominal pain, nausea and vomiting, and reflux. Initial evaluations usually include an abdominal X-ray but can also be performed with a fluoroscopic water-soluble contrast swallow in the nonpregnant patients. Figure 15.1 shows a normally located band.

If concerns for band prolapse, initial treatment involves desufflating the band. If symptoms persist, the surgeons can obtain an esophagogram or limited fluoroscopic water-soluble contrast swallow study. If the diagnosis is confirmed and symptoms do not resolve with desufflation, laparoscopic removal should be performed. Depending on the stage of pregnancy, the abdomen can be entered either via a Veress needle or open trocar placement. Following removal of the band, an air-leak test can be performed, which will avoid fluoroscopic testing.

Band Erosion

Although incidence in the pregnant population is not well known, band erosion in the general population is around 12% [34–36]. In the minimally symptomatic patient, removal of the band can wait. If symptomatic, the band should be removed. Although most bands can be removed laparoscopically, endoscopic removal in pregnant patients has been described [36, 37].

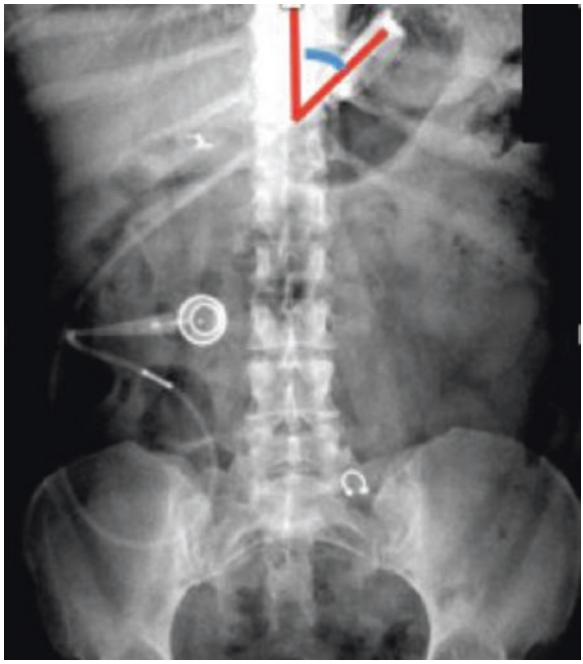

Fig. 15.1 Normal LAGB position

Complications Related to Roux-en-Y Gastric Bypass

Laparoscopic RYGB is the gold standard of bariatric procedures. Although the numbers of RYGB have steadily declined in the past several years, as the numbers of SG increase, there are still a substantial number of postoperative RYGB patients that may become pregnant. One of the reasons why SG is gaining popularity is the perceived lower long-term complication profile compared to RYGB. Common late complications are similar to those in nonpregnant patients and include small bowel obstruction, internal hernia, anastomotic strictures, marginal ulcer formation, fistula formation, and nutritional deficiencies.

Internal Hernia/Small Bowel Obstruction

Internal hernia (IH) is a well-known, serious complication and is the most common cause of small bowel obstruction (SBO) following RYGB. IH are likely due to the presence of potential mesenteric defects, although an internal hernia is possible due to an adhesive band. Either two or three potential mesenteric defects can be created, depending if the Roux limb is antecolic or retrocolic: transverse mesocolon, Petersen's space (between the Roux limb and the transverse mesocolon), and at the site of the jejunojejunostomy (JJ).

Table 15.1 Common findings concerning for internal hernia prebsent on CT scans

Swirled appearance of mesenteric fat or vessels
Mushroom shape of hernia
Tubular distal mesenteric fat surrounded by bowel loops
Small bowel obstruction
Clustered loops of small bowel
Small bowel other than duodenum posterior to the superior mesenteric artery
Right-sided location of the distal jejunal anastomosis

IH has an incidence of up to 16% in some series [38]. Since delay of diagnosis is associated with bowel necrosis and high mortality, patients presenting with abdominal pain and/or emesis must be urgently evaluated. However, pregnancy presents a challenge as these symptoms can be common. A literature review showed that internal hernia following RYGB presents in pregnant patients at a young age with most patients waiting at least 2 days prior to seeking help [39]. It is important that this patient population is aware of the morbidity and mortality of IH and the importance of consulting for abdominal pain. In addition, initial vital signs and laboratory studies can be normal in some cases; thus emergency department physicians and obstetricians should be aware of the potential of internal hernia.

We have previously created an algorithmic approach to expedite the diagnosis of internal hernia. Initial work-up includes laboratory studies, such as CBC with differential, chemistries, and lactic acid. Persistently elevated WBC, neutrophilia, and lactic acid despite fluid resuscitation are worrisome for intra-abdominal pathology and may require further investigation. If laboratory studies are normal or improve following fluid resuscitation, further work-up is dependent on the physical exam. If the patient presents with benign abdomen, further studies can be used. If patient presents with peritonitis, the emergent operative treatment should be planned.

In case of a benign abdomen, initial work-up can include a plain abdominal radiograph, which can provide some important findings, such as dilated bowel loops, paucity of intestinal air, or intraluminal air-fluid levels. If any of these are present, an emergent surgical exploration is needed. If no specific findings are seen on the plain abdominal radiograph, further studies are warranted. In the early pregnancy (first trimester), the patient can be either observed with serial abdominal exams or an MRI can be performed. In second or third trimester, computed tomography (CT) of the abdomen and pelvis can be performed. Several findings on CT scan can be worrisome for the presence of an internal hernia. These include small bowel loops in the upper quadrants, small bowel mesentery crossing the transverse mesocolon, twisting, swirling, crowding, and engorgement of the main mesenteric trunk [40–42]. Lockhart et al. examined the findings of 18 patients with surgically proven internal hernia and compared to 18 controls. The scans were reviewed by three radiologists for the findings of the findings based on Table 15.1. The authors concluded that the presence of a mesenteric swirl is the best indicator of an internal hernia [43].

A previous study performed by our group examined the sensitivity and specificity of CT scans in detection of internal hernia. Laboratory studies and CT scan findings were examined in 50 patients. The sensitivity and specificity of CT scans to detect an internal hernia were 76% and 60%, respectively. When we combined CT scan findings with the presence of neutrophilia, the sensitivity increased to 96% [44].

Marginal Ulceration

Marginal ulcer is a common complication following RYGB with a reported incidence of up to 16% [45–48]. While the presence of a marginal ulcer can be the cause of abdominal pain, dysphagia, nausea, and vomiting, it may lead to perforation, which is a surgical emergency as it can be the cause of morbidity and mortality to both mother and fetus. The incidence of marginal ulcer or perforation is not well documented in the pregnant population, but the incidence is about 1% per year in the general population [49].

Evaluation of the pregnant patient who presents with symptoms concerning for a marginal ulcer is performed with an endoscopy with *H. pylori* testing or biopsies if indicated. If diagnosis is confirmed, in most cases patients are treated conservatively. However, although the usual therapy in the general population is proton pump inhibitors (PPI) and cytoprotective agents, such as misoprostol, these are not recommended in pregnancy or for women who are breastfeeding. While some state that PPIs are safe in pregnancy [50], a meta-analysis, which examined 1530 pregnant women taking PPIs, reported an odds ratio of 1.12 (95% CI 0.84–1.45) for congenital malformations, without any significant difference in the odds ratios for spontaneous abortion or preterm delivery [51]. Safety of omeprazole, a common PPI used to treat marginal ulcers, has not been studied in this population. Alternatively, cimetidine or ranitidine (histamine-receptor antagonists) can be used.

In the case of perforation, surgery is mandatory in order to decrease both morbidity and mortality for mother and fetus. Fluid resuscitation and correction of electrolyte imbalance should be done prior to surgery. In the case of a duodenal perforation, Graham patch closure is the preferred treatment. In case of premature labor in the preterm patient, intramuscular steroid administration for fetal lung maturation should be considered [52].

Anastomotic Strictures and Leaks

While anastomotic strictures can present in pregnancy, anastomotic leaks are not common, as most occur early following surgery. Although not described in the literature, as it can lead to high morbidity and mortality, it should be considered in the pregnant bariatric patient. Leaks can be managed with surgery, stenting, or percutaneous drainage.

Anastomotic strictures can present during pregnancy, although true incidence is not known. In case of a stricture at the gastrojejunostomy (GJ) anastomosis, it can be managed by endoscopic dilation with a CRE balloon inflated to 18 mm. Multiple dilation procedures can be necessary and are not contraindicated during pregnancy. Persistent strictures may require conservative treatment during pregnancy and surgical intervention following delivery.

Complications Related to Sleeve Gastrectomy

Sleeve gastrectomy (SG) has gained popularity, as it is currently the most commonly performed procedure in the United States. Although it has a relatively low complication rate, complications can occur, such as reflux and strictures.

Gastroesophageal Reflux (GERD)

The presence of reflux following SG is a highly debated topic. Reflux is a common symptom in pregnancy, and prevalence increases with gestational age [53]. Reflux occurs in approximately 30–80% of pregnant women [54]. It is usually a de novo problem that arises during pregnancy and resolves with delivery.

The predominant mechanism of pregnancy-induced reflux is due to a decrease in the lower esophageal sphincter pressure caused by hormones during pregnancy, especially progesterone. Other contributing factors include an altered mucosal barrier, an increased intra-abdominal pressure, and impaired clearance of refluxate. Sleeve gastrectomy has also postulated to be refluxogenic [55, 56]. Several mechanisms have been proposed that lead to increased reflux after sleeve: dissection of the phrenoesophageal ligament and angle of His, intact or incompetent pylorus with narrowing of the gastric tube, intrathoracic sleeve migration, narrowing of the incisura, or fundus regrowth [57–60]. These factors confound to increase the incidence of reflux in pregnancy.

Initial treatment of reflux in pregnancy includes lifestyle and dietary modifications. Most women with mild symptoms do well following lifestyle modifications. If symptoms persist, first-line medications include antacids, either magnesium- or aluminum-containing products, or sucralfate. Sodium bicarbonate containing antacids can lead to metabolic alkalosis; thus it should be avoided. For persistent symptoms, histamine-receptor antagonists, preferably ranitidine, may be used, while PPIs are only reserved for women with intractable symptoms (discussed above). Nizatidine should be avoided during lactation [54]. The preferred PPI is lansoprazole. If symptoms are persistent, the endoscopy should be performed, but it should be delayed until the second trimester to avoid any effects from anesthetic agents [54]. Figure 15.2 shows a proposed algorithm for treatment of reflux of patients.

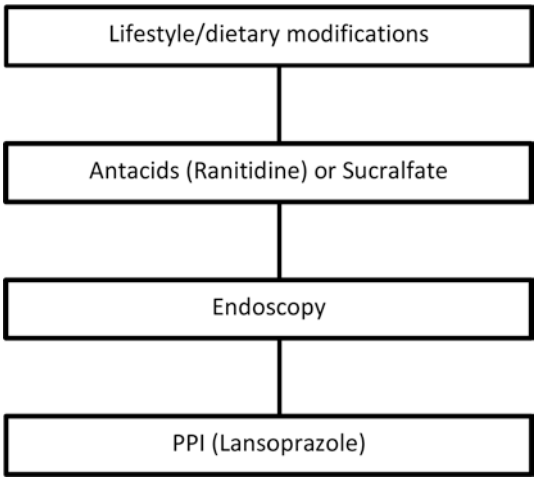

Fig. 15.2 Algorithm for management of reflux in the post-bariatric pregnant patient

Stricture

Strictures following SG can be caused by kinking or twisting, ischemia, or a leak. Strictures generally present with an inability to tolerate oral nutrition. Treatment of strictures in SG patients who are pregnant should involve a temporizing approach, such as endoscopic stenting or placement of supplemental feeding tubes. Definitive repair is delayed until postpartum or at a minimum the second trimester.

Conclusions

There are many considerations for bariatric surgical patients who become pregnant. A good understanding of nutrition and possible complications is important to safely manage these patients. There are certain complications that need to be considered when encountering these patients, as these can affect both mother and fetus. An integrated multidisciplinary approach is needed, including the obstetrician, primary care physician, nutritionist, and surgeon.

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