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CASE REPORT

Small Bowel Obstruction and Internal Hernias during Pregnancy after Gastric Bypass Surgery

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Abstract Small bowel obstruction (SBO) is a recognized complication of Roux-en-Y gastric bypass (RYGB) surgery. Internal hernia (IH) a potential problem associated with RYGB, can have severe consequences if not diagnosed. We present two cases of SBO due to IH during pregnancy after laparoscopic RYGB (LRYGB). Both patients underwent an antecolic, antegastric LRYGB. In both patients a Petersen's type IH was found. We reviewed the cases reported in the literature of SBO during pregnancy after RYGB. IH should always be ruled out in pregnant patients with previous RYGB and abdominal pain. Prompt surgical intervention is mandatory for a good outcome.

Keywords Gastric bypass · Internal hernia · Pregnancy · Bariatric surgery · Laparoscopic · Morbid obesity · Small bowel obstruction

Introduction

About 6.9% of women in the USA are morbidly obese with a body mass index (BMI)>40 kg/m^2 [1]. Women constitute more than 70% of the patients undergoing bariatric surgery yearly [2], and most of them are of childbearing age [3]. Importantly, weight loss in morbidly obese women may result in a decreased rate of infertility and in increased sexual activity following bariatric surgery [4].

Small bowel obstruction (SBO) is a recognized complication of Roux-en-Y gastric bypass (RYGB) surgery. Internal hernias (IH) are an important cause of SBO, particularly after Laparoscopic Roux-en-Y Gastric Bypass (LRYGB). An IH is defined as intermittent or persistent herniation of a viscus through an opening within the peritoneal space [5]. The location of the IH depends on the RYGB technique [6, 7]. IH have an incidence of 1–4.7% after open RYGB surgery [8, 9]. LRYGB demonstrates a similar or even higher rate of SBO (0.6–7.3%) [6, 10–12], with most of the cases occurring secondary to IH [12]. SBO is an uncommon complication during pregnancy, and its occurrence after RYGB is rare. However, early recognition with a low threshold to operate must be entertained to avoid potential maternal–fetal complications [13, 14].

We present two cases of SBO due to IH in pregnant women after LRYGB. We review the incidence and outcomes of SBO during pregnancy after RYGB in the cases reported in the literature. Early detection, diagnostic techniques, treatment, and prevention are discussed.

Case 1

A 25-year-old women (gravida 3, para 2–0–0–2) with a 32-week pregnancy presented with abdominal pain. She had undergone an antecolic, antegastric LRYGB in an outside hospital 17 months before admission. This was her first pregnancy after LRYGB. Her early antenatal course had been uneventful. She presented after 5 days of postprandial epigastric abdominal pain, nausea, and vomiting. She was admitted for intravenous hydration, she

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improved, and was discharged. A day later she returned and ultimately was transferred to our hospital for evaluation 9 days after her initial presentation.

On physical examination, her vital signs were within normal limits. Her abdominal examination was consistent with a 32-week gravid uterus. Her abdomen was tender at the epigastrium and in the left upper quadrant, with no guarding or rebound. The maternal fetal medicine service was consulted. Fetal heart tones and movements were normal. Laboratory evaluation included a WBC 3,500 cells/μL; platelets, 515,000/μL; hemoglobin, 9.3 g/dL; lipase, 264 units/L; and albumin, 3 gm/dL.

An abdominal CT scan with oral and IV contrast was performed. A preliminary radiologic reading described a distended proximal small bowel, a partial SBO, and a moderate right hydronephrosis compatible with hydronephrosis of pregnancy with no specific mention of IH. Bariatric consultation was obtained and signs consistent with IH were noted on the CT scan (Fig. 1). The patient was consented for surgery. She started having contractions shortly before surgery. Standard administration of betamethasone to promote fetal lung maturity was given. Sequential compression devices were used for thromboprophylaxis. Antibiotic prophylaxis was also administered.

Fetal heart monitoring was used throughout the procedure. We performed an exploratory laparotomy through a midline incision. We found herniation of the entire small bowel and a segment of the transverse colon through Petersen's defect (Fig. 2), along with a patent jejunojejunostomy defect. The bowel was reduced and the Roux limb was dusky but with no frank ischemia. The gastroscope was introduced to evaluate the Roux limb and to decompress it.

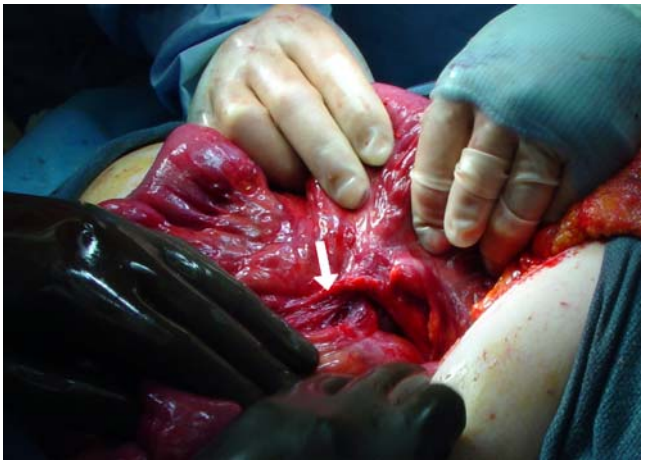

Fig. 2 An operative photograph shows the small bowel herniated through Petersen's defect (*arrow*)

The mucosa did not appear dusky or ischemic. After closing the Petersen's defect and the jejunojejunostomy mesenteric defect, we introduced a nasojejunal tube into the Roux limb.

Postoperatively, the patient had contractions every 5 min, and was started on magnesium for tocolysis. The magnesium was discontinued after 48 h, with no further contractions. Total parenteral nutrition (TPN) was started postoperatively and continued until postoperative day (POD) 4 when bowel function started. On POD 6, she developed pyelonephritis that was treated with intravenous antibiotics. She made a full postoperative recovery and was discharged home on POD 11. The patient had a normal spontaneous vaginal delivery at 37 weeks' gestation.

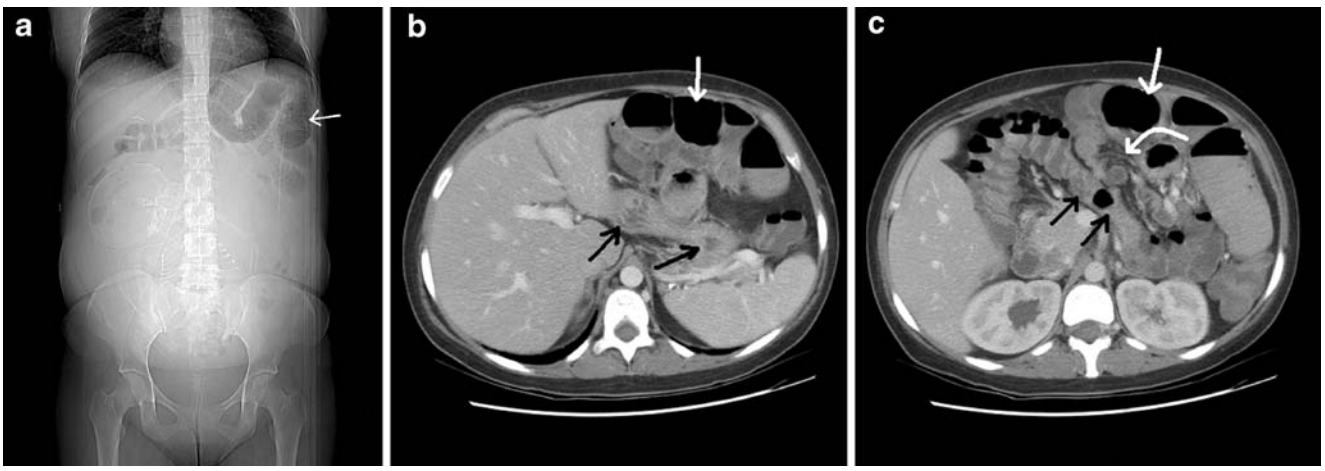

Fig. 1 **a** CT scan scout shows a closed-loop obstruction with a cluster of small-bowel loops in the left upper quadrant (*white arrow*). **b** Transverse CT scan shows a closed-loop obstruction with a dilated cluster of small-bowel loops adjacent to the anterior abdominal wall (*white arrow*) and the remnant stomach displaced posteriorly (*black arrow*). **c** Transverse CT scan shows a cluster of dilated bowel segments (*white straight arrow*) and decompressed, distal small-bowel loops. The transverse colon is herniated through Petersen's defect (*black arrows*). A mesenteric swirl formed around the superior mesenteric artery (*curved arrow*)

Case 2

A 27-year-old women (gravida 4, para 2–0–1–2) with a 30-week pregnancy presented with abdominal pain. She underwent an antecolic, antegastric LRYGB in an outside hospital 28 months before admission. This was her first pregnancy after LRYGB. The patient had a history of intermittent midabdominal pain since her LRYGB. Her early antenatal course had been uneventful. At admission she presented with severe abdominal pain for 48 h prior to evaluation. The patient developed preterm contractions. Standard administration of betamethasone to promote fetal lung maturity was given. An abdominal CT scan was obtained. The preliminary radiologic reading reported small bowel mesenteric edema in the left upper abdomen, most likely due to partial obstruction or obstruction of the superior mesenteric vein due to folding of the small bowel mesentery, with no specific mention of IH. She was transferred to our hospital for evaluation.

On physical examination, vital signs were normal. The abdominal examination was consistent with a 30-week gravid uterus. Abdomen was tender at the epigastric and left upper quadrant regions with no guarding or rebound. Fetal heart tones and movements were normal. The laboratory evaluation included a WBC, 15,500 cells/μL and hemoglobin, 7.4 g/dL. She was transfused with 2 units of packed red blood cells. The low hemoglobin was attributed to iron deficiency anemia. Bariatric consultation was obtained and signs consistent with IH were noted on the CT scan (Fig. 3).

The patient was prepared for surgery in the same manner as described for patient 1. A significant portion of the small bowel, including the jejunojejunostomy, was herniated through Petersen's defect. Additionally, there was small bowel herniated through the jejunojejunostomy mesenteric defect. The small bowel appeared entirely viable after reduction. Both defects were closed and a nasojejunal tube was positioned with its tip in the Roux limb.

Postoperatively, the patient began having regular uterine contractions and her cervix changed from 1 cm dilation to 2 cm with 50% effacement. Nifedipine and continuous fetal heart monitoring were used for 2 days until no further uterine contractions were noted. Twice daily we performed fetal heart rate nonstress testing, with no evidence of decelerations or fetal compromise. The patient was discharged home on POD 5. At 40 weeks' gestation, she had vaginal delivery of a normal baby.

Discussion

Causes of SBO after gastric bypass include IH, adhesions, abdominal wall hernias, anastomotic strictures, volvulus, and intussusception [15]. Complications of bariatric surgery should always be considered when evaluating postoperative pregnant patients. SBO after LRYGB as a consequence of IH has been noted to occur in 2.6–5% of the cases [6, 16, 17]. Some series have suggested that IH are more common after LRYGB as compared with RYGB [7, 16]. The reason for this difference may be related to fewer postoperative intra-abdominal adhesions with LRYGB [18], thus reducing the fixation of the small bowel [16]. The majority of IH occur months or years after surgery. It has been postulated that the decreases in intra-abdominal fat with weight loss causes widening of the mesenteric defects. SBO during the first three postoperative months tends to be related to problems with the surgical technique [10].

The three discrete IH sites are the transverse mesocolon defect (retrocolic technique), the jejunojejunostomy mesenteric defect, and the Petersen's space (the area between the mesentery of the Roux limb and the transverse mesocolon) (Fig. 4). The frequency and location of the IH depends on

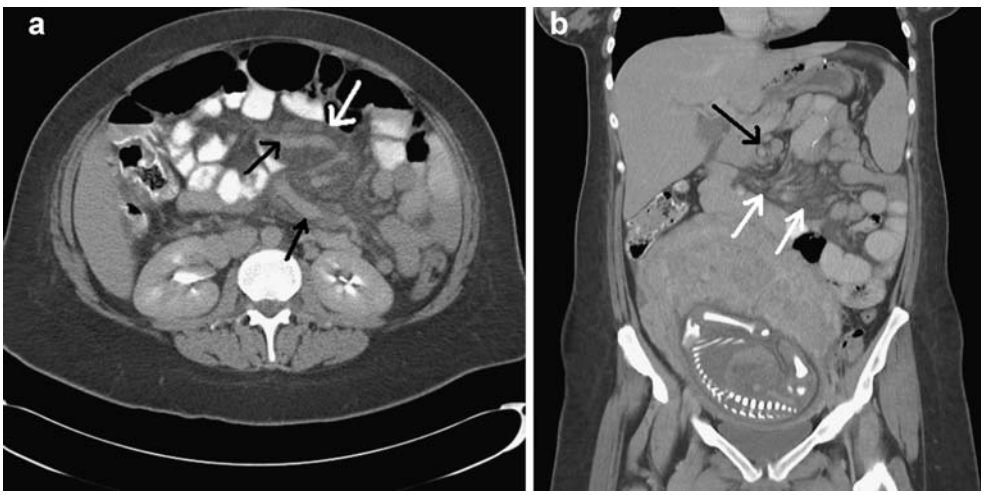

Fig. 3 **a** Transverse CT scan shows edema of the small-bowel mesentery (*white arrow*); the mesenteric vessels (*black arrows*) of the herniated bowel segments are crowded, twisted, and engorged. **b** Coronal CT scan show small-bowel herniation through Petersen's space (*white arrows*). A mesenteric swirl formed around the superior mesenteric artery (*black arrow*)

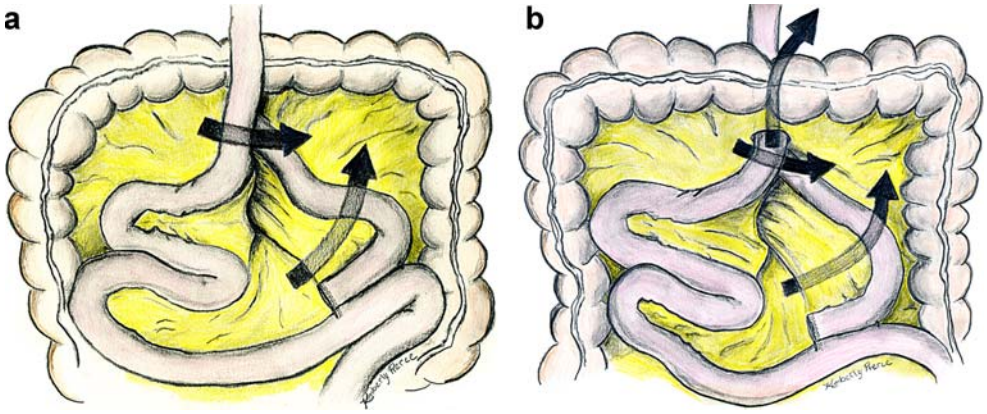

Fig. 4 **a** IH location in the antecolic RYGB, including the jejunojejunostomy mesenteric defect (*long lower arrow*) and Petersen's space (*short upper arrow*). **b** IH location in the retrocolic RYGB, including the transverse mesocolon defect (*upper arrow*), the Petersen's space (*middle arrow*), and the jejunojejunostomy mesenteric defect (*lower arrow*)

the surgical technique, with an incidence of 0.6% in antecolic Roux versus 2.4% in retrocolic Roux limb ($P< 0.05$) [19]. Complications of IH may include SBO, incarceration, strangulation, and anastomotic disruption [16]. SBO during pregnancy is infrequent and it is associated with significant fetomaternal morbidity and mortality [20]. The risk of SBO during pregnancy after bariatric surgery is not increased [21].

We performed an open (no year limits set) search of Medline and PubMed using combinations of the following terms: gastric bypass, bariatric surgery, laparoscopic, morbid obesity, obesity, small bowel obstruction, internal hernia, pregnancy, and maternal mortality. Reference sections of articles found were also searched. We found ten cases of SBO during pregnancy after gastric bypass (Table 1 [13, 14, 22, 26–29, 34, 35]).

As previously reported most of the cases of SBO in our review occurred during the first post-operative pregnancy [20]. In our two cases and in the majority of cases reported in the literature, the IH occurred during the third trimester. Some authors suggested that the increased abdominal pressure and the cephalad intestinal displacement caused by uterine enlargement increase the likelihood of the bowel becoming trapped in an IH [22].

SBO presents with signs and symptoms that are commonly found during pregnancy. Vomiting is uncommon after RYGB because there is no large reservoir to accumulate secretions. The lack of specific signs and symptoms can lead to delayed diagnosis and intervention with an increase in overall morbidity [6, 16]. The evaluation of the post-RYGB pregnant patients with abdominal pain should include a detailed history, physical

Table 1 SBO after RYGB during pregnancy

Author	Age (years)	Weeks gestation	Pregnancy number after RYGB	Interval between RYGB and SBO (mo)	Type of RYGB	Surgery performed	Bowel resected	Cause of SBO	Maternal or fetal death
Moore et al. [14]	41	31	1	18	NR	Open	Yes	IH	Both
Baker and Kothari [22]	33	25	1	10	L (Retrocolic)	Open	No	IH (Petersen's)	No
Charles et al. [13]	23	25	1	12	NR	Open	Yes	IH (J-J)	No
Kakarla et al. [30]	33	12	1	30	O	Open	No	IH (Petersen's)	No
	35	34	1	9	L	Laparoscopic	No	IH	No
Loar et al. 2005 [37]	31	25	NR	NR	L	Open	No	Midgut volvulus	Maternal
Ahmed and O'Malley [31]	26	30	1	8	L (Retrocolic)	Laparoscopic	No	IH (transverse mesocolon)	No
Bellanger et al. [29]	25	33	NR	NR	L (Retrocolic)	Open	No	IH (J-J)	No
Wang et al. [32]	32	36	1	11	O (Retrocolic)[a]	Open	Yes	IH (J-J)[a]	No
Wax et al. 2007	35	21	1	18	L (Antecolic)	Laparoscopic	No	Intussusception	No
Our 2 patients	25	32	1	17	L (Antecolic)	Open	No	IH (Petersen's)	No
	27	30	1	28	L (Antecolic)	Open	No	IH (Petersen's and J-J)	No

SBO Small bowel obstruction, *L* laparoscopic, *O* open, *IH* internal hernia, *J-J* jejunojejunostomy, *NR* not reported, *RYGB* Roux-en-Y gastric bypass, *mo* months

[a] Personal communication with the author

examination, laboratory work, and imaging modalities. The laboratory work should include complete blood count and comprehensive metabolic panel. Early involvement by the bariatric surgeon is critical. The differential diagnosis for abdominal pain after bariatric surgery is different than for abdominal pain of patients who have not had bariatric surgery. In addition, imaging studies such as abdominal radiographs, abdominal ultrasound, and CT scans may be inaccurate or misinterpreted in this patient population [7, 16]. Plain abdominal radiographs are frequently misleading as normal. Common conditions like cholelithiasis can be incidental findings that may confound the diagnosis. A CT scan is the study of choice in this patient population.

The imaging of pregnant women presents a unique challenge because of the concern about radiation exposure to the embryo or fetus. Ultrasonography confers no risk for the conceptus but has limited diagnostic capabilities in pregnant patient with abdominal pain. There have been some reports that describe the use of magnetic resonance imaging (MRI) as an alternative for the evaluation of pregnant patients with acute abdominal and pelvic pain [23, 24]. MRI may be considered as option that eliminates the risk of radiation exposure of the embryo or fetus. One of the limitations of MR imaging is the use of gadolinium. The current American College of Radiology guidance document for safe MR practices suggests that MR contrast agents should not be routinely provided to pregnant patients and this decision should be made on a case by case basis accompanied by a risk-benefit analysis. The high cost and restricted availability of MRI imaging limit its utility in the emergency setting. Also the weight and size of the patient may be a limitation to perform an MRI. The radiation exposure related to a CT scan is a major concern and the risks and benefits should be evaluated. The absolute risks of fetal effects, are small at conceptus doses of 100 mGy and negligible at doses of less than 50 mGy [25]. CT examinations of the abdomen and pelvis rarely exceed 25 mGy. Because the dose from a single-acquisition CT examination of the abdomen and pelvis poses a small risk to fetal health, CT may be appropriate depending on the clinical situation [25, 26]. However, an attempt should be made to perform this test with the lowest dose possible. The risks associated with radiation exposure of the conceptus during the second and third trimesters of pregnancy are reduced and also should be considered [25].

Evaluation of the CT scan by a radiologist experienced in bariatric patients, or a bariatric surgeon is mandatory to identify the signs of an IH. Radiographic evaluation to diagnose IH after LRYGB has been used with varying rates of success [16, 27]. Some series have reported that up to 20% of patients experiencing SBO from an IH had normal radiographic findings [16]. When a radiologist experienced in bariatric patients and a bariatric surgeon read the studies the diagnosis of IH can be close to 100% [27]. Signs on CT that suggest an IH depend on the location. Clustering and crowding of dilated small-bowel loops and congestion may be seen in the majority of the cases. When the herniated bowel passes through the transverse mesocolon defect, it is located behind the stomach remnant and may produce a mass effect on its posterior wall. If the herniated bowel passes through the jejunojejunostomy defect, it is pressed against the abdominal wall, causing central displacement of the colon, with no overlying omental fat. In cases of a Petersen-type hernia, the radiologic diagnosis can be difficult and the only clue may be engorgement and crowding of the mesenteric vessels and evidence of small bowel obstruction [28]. In our first case, the radiological signs of IH were more apparent, but the radiologist from a small hospital not accustomed to bariatric surgery did not identify this complication. In our second case, the findings were not as clear as the first case, but were noted after re-evaluation. This is in concordance with previous reports, indicating that Petersen's hernias are difficult to recognize and are often not diagnosed until surgical exploration [28]. Our findings support the idea that the evaluation of a CT scan in a patient who has undergone bariatric surgery should be done by a radiologist with experience in bariatric patients or by a bariatric surgeon [27]. Many bariatric surgeons believe that diagnostic laparoscopy may be the only reliable method to rule out an IH [7].

It is of paramount importance not to delay surgical exploration in these patient population, even in the absence of a positive finding on imaging. Delaying surgery may lead to potentially devastating consequences for the mother and/or the fetus [14]. In cases where surgery was performed promptly, outcome for the mother and infant were good [22, 29–31]. In some cases a small bowel resection was necessary [13, 14, 32]. For the majority of the cases reported a laparotomy was performed, but laparoscopy was done in two cases [30, 31].

Management of IH begins with prevention by closing the potential defects [29]. Modifications of the technique, by using an antecolic pathway for Roux limb instead of the retrocolic, eliminates the mesocolon defect, which is a common site of IH [6, 17]. In a nonacute setting, a proactive approach to electively repair an hernia laparoscopically should be advocated, preferentially in the second trimester [16, 29]. Once the decision to operate on a SBO from IH has been made, the surgical approach (laparotomy vs. laparoscopy) should be based on the skills of the surgeon and the availability of staff and equipment. Recent studies have shown that open or laparoscopy surgery can be done safely during any trimester of pregnancy [26, 33]. In the third trimester of pregnancy and in cases where there is significant amount of distended small bowel, laparoscopy may be difficult and open surgery may be more appropriate.

Care must be taken to ensure infection and thromboembolic prophylaxis. The combination of pregnancy and obesity may represent an increased risk for thrombosis [30]. If it is possible, during surgery the patient should be placed in a left lateral recumbent position to improve venous return and cardiac output [34].

Fetal heart monitoring should be performed pre- and postoperatively [26, 35]. Intraoperative fetal monitoring is highly recommended but not mandatory [35]. A multidisciplinary approach involving the bariatric surgeon, obstetrician, and anesthesiologist is recommended [36]. Delaying surgery for obstetric consultation should be avoided because it may increase the risk for the mother and fetus [26]. Tocolytic agents should not be used prophylactically. When signs of preterm labor are present they should be considered [26].

The current cases and the literature review indicate that: (1) most cases of SBO due to IH after RYGB occur during the first pregnancy after RYGB, (2) most of the cases occurred during the third trimester, (3) SBO due to IH in these patients occurred 8 months or more after RYGB, (4) even if no clear radiological findings are present, the possibility of an IH must be entertained, and (5) there should be a low threshold to consult a bariatric surgeon in pregnant patients with abdominal complaints and a history of RYGB.

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