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HOW I DO IT

Management Strategies for Internal Hernia after Gastric Bypass

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Abstract
Background Internal hernia after gastric bypass is common, occurring with an incidence approaching 10% in some series. Operative management of internal hernia after gastric bypass presents significant conceptual and technical challenges.
Methods This manuscript reviews management of internal hernia after gastric bypass with a focus on operative strategy.

Keywords Gastric bypass · Internal hernia · Petersen's hernia · Retrocolic hernia · Mesenteric hernia

Introduction

The incidence of internal hernia after gastric bypass ranges from 0.5% to 9%.[1–8] Given the increasingly popularity of gastric bypass, surgeons will be faced more frequently with patients requiring exploration for suspected internal hernia. The differential diagnosis for abdominal pain after gastric bypass is large. This manuscript focuses on symptoms and signs specific to internal hernia and provides an overview of general management strategy with a focus on operative approach.

Diagnosis

Patients with internal hernia most often present within 2 years of gastric bypass and report severe chronic episodic diffuse abdominal pain lasting one or more hours. Risk factors may include extreme weight loss, which may lead to enlargement of mesenteric defects due to loss of mesenteric fat. Pregnancy has also been identified as a risk factor as a result of changes in intra-abdominal anatomy due to the enlarging uterus.[9] Pain may be post-prandial or spontaneous, and may persist for months, presumably due to episodic transient incarceration that spontaneously resolves. Nonetheless, the risk of strangulation remains present. The diagnostic workup should be guided by clinical presentation, and may include EGD, ultrasound, CT scan, and other tests as indicated. CT scan is the test of choice for internal hernia, but in the absence of pain, is often non-diagnostic. While experience and clinical judgment are of course necessary, and patients with chronic pain unrelated to internal hernia will be encountered, patients with acute onset severe pain in the absence of a clear alterative diagnosis should undergo surgical exploration, preferably through a laparoscopic approach to rule out internal hernia. Such patients should *not* undergo an initial trial of conservative management with nasogastric decompression, which incurs the risk of allowing incarcerated hernias to progress to strangulation. Rather, expedient surgical exploration is necessary. Closure of internal hernia defects, even if incarceration is not found at the time of operation, relieves symptoms in the majority of patients.[10–12] Less commonly, patients present with unrelenting pain. While the yield of CT is higher in such cases, and may demonstrate a mesenteric swirl sign [13–15] or other signs of bowel obstruction, strangulation may nonetheless be imminent even if CT is non-diagnostic. For this reason,

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surgical exploration is warranted in patients with ongoing acute onset severe pain even in the face of non-diagnostic imaging.

Gastric Bypass and Internal Hernia Anatomy

An understanding of the anatomy of gastric bypass is required for effective clinical diagnosis and surgical management of internal hernia. From an anatomic standpoint, gastric bypass consists of a gastroplasty with a Roux-en-Y reconstruction. Standard terminology for intestinal limbs are made in reference to the distal intestinal anastomosis (jejunojejunostomy), and include Roux, afferent, and efferent limbs, also termed alimentary, biliopancreatic, and common channel limbs, respectively, in bariatric parlance. The majority of Roux limbs in gastric bypass are positioned antecolic, while a minority are retrocolic, retrogastric, and even fewer are retrocolic, antegastric.[16] While variations exist, a common configuration positions the biliopancreatic limb in the left upper quadrant, with the Roux limb positioned along the right side of the abdomen. The side-to-side jejunojejunostomy anastomosis is thus configured with the distal stapled end of the biliary limb directed cephalad along the Roux limb, pointing towards the gastrojejunal anastomosis (Fig. 1).

The three primary types of internal hernia are *mesenteric, Petersen's*, and *mesocolic* (Figs. 1 and 2). A *mesenteric hernia* traverses the space created by division of the mesentery of the jejunum adjacent to the jejunojenostomy and is present in all types of reconstruction. *Petersen's hernia*, in modern parlance,[17] may occur in an antecolic or retrocolic reconstruction, although it is thought to be more common in the former, and its borders are the Roux limb and its mesentery anteriorly/ventrally and the tranverse colon and its mesentery posteriorly/dorsally. Finally, a *mesocolic hernia* traverses the defect in the transverse colon mesentery and is specific to the retrocolic configuration.

Specific Technical Considerations at Primary Gastric Bypass

Technical considerations at primary gastric bypass may impact on the frequency of post-operative internal hernia. Roux limb anatomy is one of the most important of these considerations. A retrocolic limb reduces tension on the gastrojejunostomy and is thus an important tool in the repertoire of the bariatric surgeon, especially when faced with the patient with foreshortened mesentery or otherwise unfavorable anatomy. Proponents of retrocolic reconstruction argue that pouch emptying is improved as well, and contend

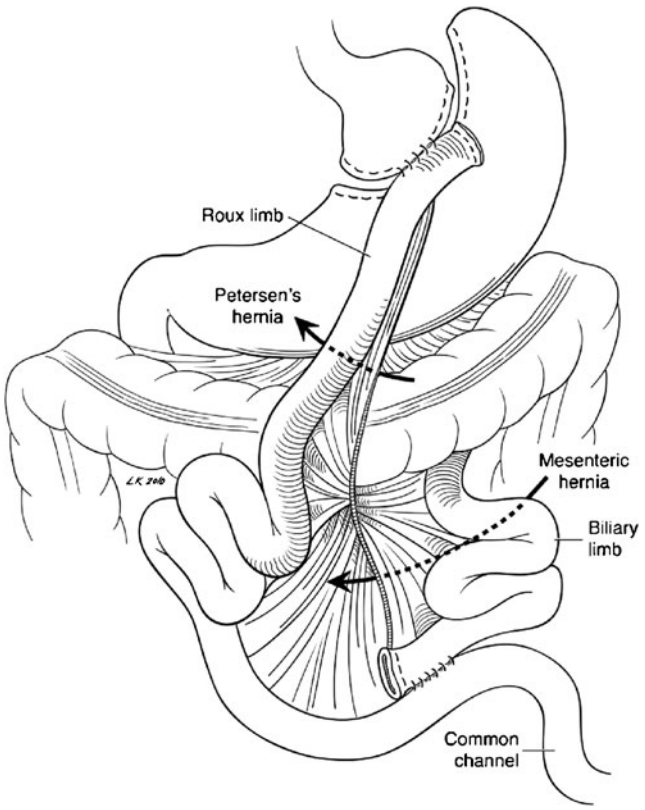

Fig. 1 Gastric bypass and internal hernia anatomy

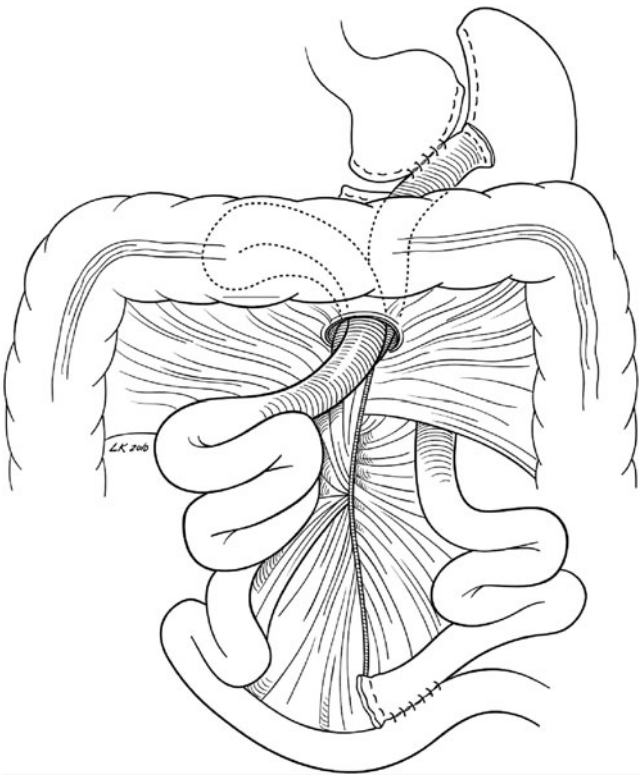

Fig. 2 Mesocolic hernia

that high rates of mesocolic hernias are due to learning curve issues related to closure of this defect, which is difficult in a laparoscopic environment in obese patients with large amounts of mesocolic fat. Proponents add that mesocolic hernia rates can be lowered with experience with defect closure.[1,18] Despite these arguments, the antecolic Roux limb configuration is more commonly utilized.[16] Proponents argue that no data demonstrate lower clinical anastomotic leak or ulcer rates with retrocolic anatomy despite reduced tension on the gastrojejunostomy. Furthermore, the antecolic approach eliminates mesocolic hernias, which in series of retrocolic bypasses, are the most common type of internal hernia.[1,6,19] Antecolic reconstruction may therefore be associated with a lower overall internal hernia rate.[20]

Much debate surrounds the issue of routine closure of internal hernia defects at the time of primary gastric bypass. While some authors advocate for routine closure,[20] the literature as a whole does not clearly demonstrate a lower incidence of internal hernia associated with this practice. Series with and without routine closure demonstrate similar incidences of internal hernia ranging from 0.2% to 9%.[5–8] Despite this debate, routine closure of defects at the time of gastric bypass is straightforward, and we therefore advocate this practice.

Debate exists regarding mesenteric defect length during primary gastric bypass. The mesentery of the small intestine is a primary source of downward (caudad) tension on the Roux limb, and extended division of its mesentery reduces tension on the Roux limb at the gastrojejunal anastomosis. Long mesenteric divisions may, however, create larger defects that are more likely to result in internal hernia. For this reason, some surgeons minimize the length of mesenteric division and, simply divide the jejunum but not the mesentery, accepting a higher degree of tension on the anastomosis.[8] With routine closure of the mesenteric defect, however, we feel that the benefit of reduced anastomotic tension associated with a long mesenteric split exceeds the risk of hernia.

Limb length may also affect internal hernia rates. Virtually any segment of small intestine can incarcerate in any type of internal hernia, but the biliary limb is often involved, and longer biliary limb lengths may be associated with an increased risk of internal hernia.[2] Similarly, a long redundant Roux limb may be at increased risk of herniation through a Petersen's defect by rotating on itself (Fig. 3).

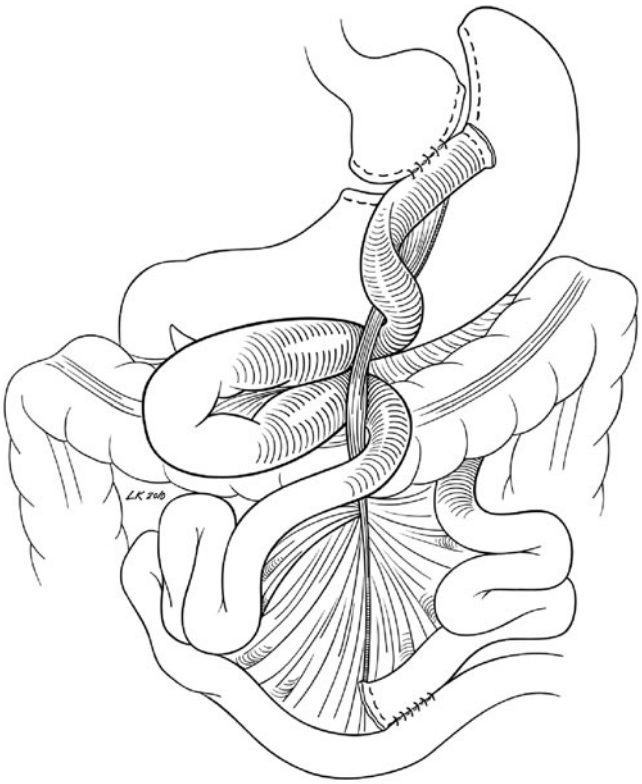

Fig. 3 Roux limb rotating on itself and herniating from left to right through Petersen's defect

Operative Management

This review focuses on laparoscopic exploration for internal hernia in patients who have formerly undergone laparoscopic gastric bypass, although less commonly, patients may present with internal hernia after open gastric bypass. While a laparoscopic approach may be considered in such patients, an open approach is often necessary. For laparoscopic exploration, the patient is positioned supine with the surgeon on the patient's right. Trocars are placed in right upper (surgeon's left hand), middle (camera), and lower (surgeon's right hand) quadrants. An assistant port is placed in the left upper quadrant. We use a hydraulic camera holder to the right of the surgeon, but a second assistant may be used in this position instead.

The bowel is run starting at the gastrojejunostomy, down the Roux limb to the jejunojejunostomy. From the jejunojejunostomy, the biliopancreatic limb is then run proximally to the ligament of Trietz, which is exposed by elevating the transverse colon with cephalad retraction of an appendix epiploicae. Next, the common channel is run from the jejunojejunostomy to the cecum. In the absence of an internal hernia, it should be possible to run the entire bowel in this manner without difficulty. If difficulty is encountered at any point in running the bowel, then an internal hernia is likely present. In some cases, a loop of bowel that is clearly incarcerated in an identifiable internal hernia defect is encountered. With larger hernias, however, the surgeon may encounter a loop of bowel that dives under other bowel or into the retroperitoneum and cannot be traced further. In such cases, deciphering the anatomy and type of internal hernia in a laparoscopic environment may be challenging.

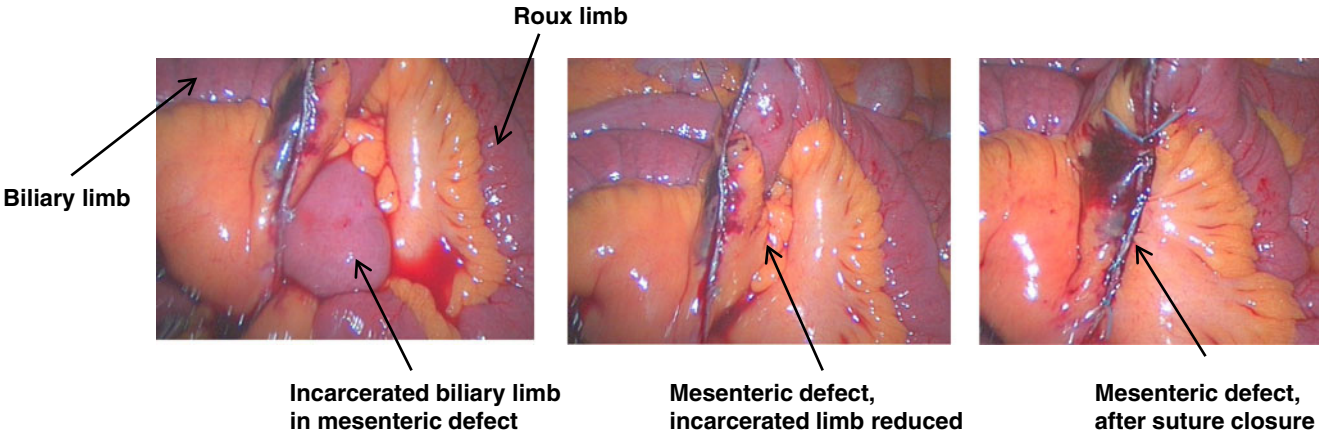

Fig. 4 Repair of mesenteric defect: view from the patient's right, with jejunojejunostomy elevated to expose mesenteric defect

A mesenteric hernia is identified by elevating the jejunojejunostomy, thus exposing the mesenteric defect. Mesenteric hernias often involve the biliopancreatic limb, which most often herniates through the mesenteric defect from its normal position in the left upper quadrant to the right. Less commonly, the Roux limb or the common channel may herniate through a mesenteric defect in either direction. Closure of the mesenteric defect is accomplished by elevating the jejunojejunostomy ventrally, reducing the hernia, and closing the defect with non-absorbable suture (Fig. 4).

Petersen's hernia usually involves the Roux limb or the biliary limb, and the incarcerated intestine often traverses the space between the mesentery of the Roux limb and the transverse colon from left to right, positioning incarcerated bowel in the right upper quadrant. Thus, the finding of small intestine in the right upper quadrant that cannot be clearly identified as unincarcerated Roux limb (i.e., if the Roux limb cannot be run from gastrojejunostomy to jejunojejunostomy without encountering incarceration) is suggestive of a Petersen's hernia (Fig. 3). Closure consists of suturing the Roux limb mesentery to the underlying transverse colon and its mesentery. This may be difficult in the obese patient, as the Roux limb is often tightly apposed to the underlying transverse colon, and completing the closure to the root of the small bowel mesentery can be challenging. Such closures are typically performed from the right side of the abdomen, with the Roux limb reflected to the patient's left, exposing the root of the small bowel and transverse colon mesenteries (Fig. 5a). The mesentery of the Roux limb is then sutured to the underlying transverse colon and its mesentery. Closure

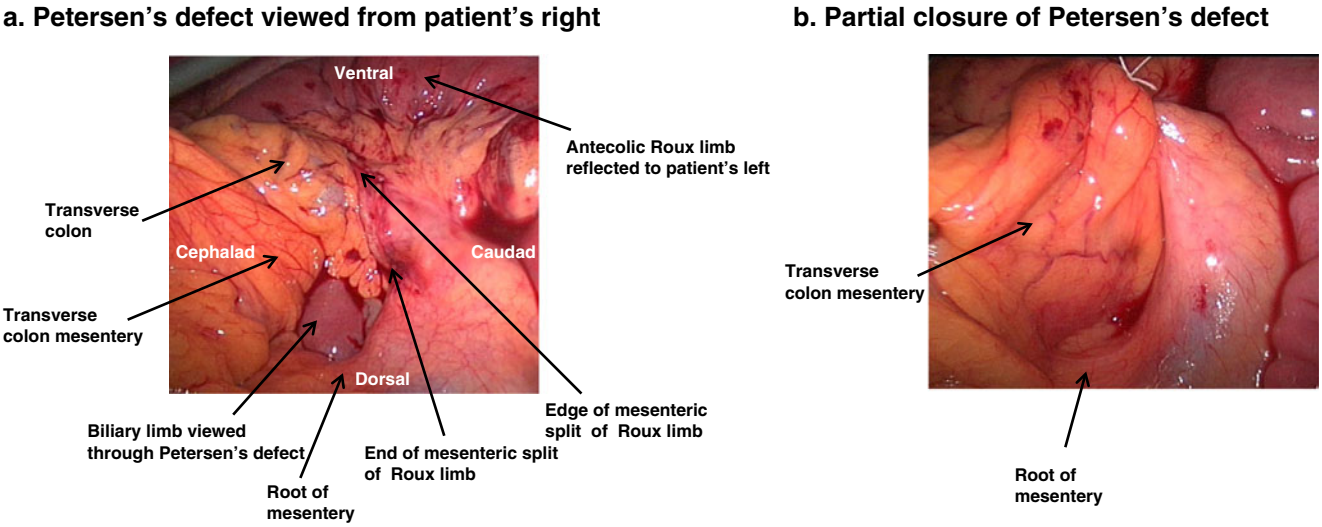

Fig. 5 Repair of Petersen's defect: **a**. View of Petersen's defect from the patient's right, with Roux limb reflected to patient's left. **b**. Partial closure of Petersen's defect—the edge of the Roux limb mesenteric split has been sutured to the transverse colon and its mesentery, and only the distal suture of this closure is seen in the upper photograph, which marks the end of the Roux limb mesenteric split. The remaining defect (which should be closed) is shown extending beyond the Roux limb mesenteric split to the root of the mesentery

should be carried dorsally down to the root of the mesentery, which extends beyond the end of the split in the mesentery of the Roux limb (Fig. 5b).

A mesocolic hernia is identified by elevating the transverse colon cephalad using an appendix epiploicae. While other intestine may be involved, the majority of mesocolic hernias involve a herniation of the Roux limb itself, with the jejunojejunostomy involved in some cases. Closure is accomplished with circumferential sutures around the Roux limb as it passes through the defect.

Large defects may lead to large hernias. Often, the jejunojejunostomy acts as a lead point, and carries large segments of biliopancreatic, Roux, and common channel limbs through a Petersen's or mesenteric defect. In such cases, a majority of the small intestine may be incarcerated, and most of the small bowel mesentery may be twisted on itself. Identification of anatomy and reduction of the hernia in a laparoscopic environment in such cases may be difficult. When faced with large hernias, returning to known anatomy is useful. The terminal ileum is often clearly identifiable in the presence of a large incarcerated hernia, and retrograde tracing of the terminal ileum is often the best place to start. This sometimes requires the surgeon to operate from the patient's left initially and transition to the patient's right as the bowel is run proximally. That said, we are usually able to run the entire small bowel in most cases from the patient's right side. Similarly, the proximal Roux limb is rarely involved in internal hernia, as it is tethered by the gastrojejunostomy proximally. Running the Roux limb distally from the gastrojejunostomy is therefore also a useful starting point. Finally, identification of the jejunojejunostomy, especially in cases where it is the lead point for herniation, is also useful. When an incarceration is encountered, gentle traction on the intestine may reduce the hernia. If not, it is often helpful to explore the “other side” of the internal hernia defect and “push” rather than pull the incarcerated intestine through the defect. What constitutes the “other side” of the hernia of course depends on the specific anatomy. In the case of a mesenteric hernia with biliopancreatic limb incarceration from left to right, the incarcerated hernia is found on the right “medial” side of the mesenteric defect, and pushing from right to left (rather than pulling from left to right) may reduce the hernia. In the case of a Petersen's hernia traversing from left to right, the incarcerated bowel may be found in the right upper quadrant, and pushing from right to left under the Roux limb mesentery may reduce the hernia. Once reduced, closure of internal hernia defects is usually straightforward. We close all defects with non-absorbable suture. Tacking the closure to non-fat fixed structures such as adjacent bowel or the ligament of Treitz in the case of a mesocolic hernia has been suggested and may enhance the strength of such repairs.

The surgeon may rarely encounter atypical internal hernias. One such hernia occurs between the limbs of jejunum distal to the end of the staple line and proximal to the distal stay suture of the side-to-side jejunojejunostomy.[21] Prevention consists of ensuring that the staple line fully traverses these stay sutures. The surgeon must of course be alert for alternative diagnoses as well as other types of hernia, including ventral hernias, and acquired or congenital diaphragmatic (e.g., hiatal, Bochdalek, Morgagni) and abdominal wall (e.g., trocar site, Spigelian) hernias.

Conclusion

The management of internal hernia after gastric bypass presents numerous challenges, and surgeons will be faced with such patients with increasing frequency. An understanding of the anatomy and technical aspects of primary gastric bypass will inform diagnostic and operative management of subsequent internal hernia. While this review is directed towards the general surgeon, management is expedited and optimized at centers with experience in bariatric surgery. All patients with symptoms suggestive of internal hernia or bowel obstruction should be treated by surgeons and centers with significant experience in bariatric surgery when possible.

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