

# Imaging of Small Bowel Obstruction following Gastric Bypass Surgery for Morbid Obesity

## A retrospective review

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## التصوير الشعاعي لانسداد الأمعاء الدقيقة بعد إجراء عملية مجازة معدية لعلاج بدانة مفرطة مرضية مراجعة استعادية

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**الملخص:** الهدف: هذه دراسة استعادية لتقييم نتائج التصوير الشعاعي لانسداد الأمعاء الدقيقة بعد إجراء عملية المجازة المعدية نوع ر-ان-واي خلف القولون وأمام المعدة لعلاج البدانة المفرطة. الطريقة: تم دراسة الصور الشعاعية لـ 490 مريضاً خضعوا لعملية المجازة المعدية من قاعدة البيانات الشعاعية من يناير 2001 – 2005 في المركز الصحي الجامعي التابع لمستشفى رويال فيكتوريا لجامعة ماكجيل لمعرفة حالات انسداد الأمعاء الدقيقة الناجمة عن تلك العملية، وقد تمكنا من حصر 22 حالة من ذلك النوع. أجري لـ 10 منهم التصوير المقطعي المحوسب للبطن والحوض، كما أجري لـ 12 مريضاً فحص متابعة شعاعي للمعدة والأمعاء الدقيقة. النتائج: من بين 22 حالة من المرضى المصابين بانسداد الأمعاء الدقيقة، كان هناك 14 حالة بسبب تضيق تفاعلي أو التصاق، و 7 حالات بسبب فتق داخلي وحالة واحدة للانغلاف الصائمي. من بين المرضى المصابين بانسداد الأمعاء الدقيقة بسبب التضيق التفاعلي والالتصاق (وعددهم 14) تم علاج 11 مريضاً منهم علاجا دوائياً بينما تم إجراء عمليات جراحية لثلاث حالات. استطاعت الأشعة المقطعية المحوسبة أن تشخص 4 من أصل 5 حالات بما في ذلك المرضى الثلاثة الذي عولجوا جراحياً بينما استطاع فحص المتابعة الشعاعية للمعدة والأمعاء الدقيقة تشخيص ما تبقى من الحالات التسعة التي تم علاجها طبياً. ومن بين المرضى المصابين بفتق داخلي (وعددهم 7)، استطاعت الأشعة المقطعية المحوسبة تشخيص حالتين من أصل أربع حالات، في حين تم تشخيص حالة واحدة من مجموع ثلاث حالات بواسطة فحص المتابعة الشعاعية للمعدة والأمعاء الدقيقة. وأخيراً تم تشخيص الانغلاف الصائمي بواسطة الأشعة المقطعية المحوسبة. الخلاصة: ظهر أن السبب الأكثر شيوعاً لانسداد الأمعاء الدقيقة هو التضيق التفاعلي أو الالتصاق. وتبين أن الأشعة المقطعية المحوسبة هي الأسلوب الأنجع لتشخيص الأعراض الحادة لانسداد الأمعاء الدقيقة بسبب الفتق الداخلي أو الالتصاق / التضيق التفاعلي، بينما يبدو فحص المتابعة الشعاعية للمعدة والأمعاء الدقيقة أكثر ملائمة لتشخيص حالات التطور البطيء تحت الحاد لحالات الالتصاق التي تسبب انسداداً جزئياً في الأمعاء الدقيقة.

**مفتاح الكلمات:** جراحة مجازة المعدة ، انسداد الأمعاء الدقيقة، السمنة المرضية، تضيق تفاعلي.

**ABSTRACT: Objectives:** This study is a single institution retrospective evaluation of imaging findings of small bowel obstruction (SBO) after retrocolic antegastric Roux-en-Y gastric bypass surgery for morbid obesity. **Methods:** The radiological database of 490 patients who underwent gastric bypass surgery for morbid obesity from January 2001-2005 at the Royal Victoria Hospital McGill University Health Center was searched for SBO complications related to the procedure. There were 22 cases of small bowel obstruction related to the procedure. Ten patients had abdominal and pelvic computed tomography (CT) scans, 12 patients had upper gastrointestinal (UGI) and small bowel follow through (SBFT). **Results:** Among 22 cases of SBO, 14 cases were due to anastomotic stenosis or adhesion, 7 due to internal hernia and one to jejunum-jejunal intussusception. Among the 14 patients with SBO related to adhesion and anastomotic narrowing, 11 patients were managed medically and 3 cases managed surgically. CT scans correctly diagnosed 4 out of 5 cases including the 3 patients managed surgically and UGI and SBFT examinations diagnosed the remaining 9 cases that were managed medically. Among the 7 patients with internal hernias, CT scans correctly diagnosed 2 out of 4 cases, while UGI and SBFT examinations correctly diagnosed 1 out of 3. The jejunum-jejunal intussusception was correctly diagnosed by CT scan. **Conclusion:** The most frequent cause of SBO is anastomotic narrowing or adhesion. CT scan remains the most appropriate imaging modality in diagnosing acute presentation of SBO caused by internal hernia or adhesion/anastomotic narrowing. UGI and SBFT appear more appropriate for diagnosing the subacute insidious presentation of adhesive partial SBO.

**Keywords:** Gastric bypass surgery; Small bowel obstruction; Morbid obesity; Anastomotic narrowing

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**ADVANCES IN KNOWLEDGE**

1. This study showed the importance of being familiar with the approach of gastric bypass surgery performed in order to assist in interpreting imaging findings of small bowel obstruction following retrocolic antegastric Roux-en-Y gastric bypass surgery for morbid obesity.

**APPLICATION TO PATIENT CARE**

1. This study showed the importance of prompt diagnosis of causes of small bowel obstruction in morbid obese patients who have undergone retrocolic antegastric Roux-en-Y gastric bypass surgery. Physicians should take this into account in order to achieve better patient management.

**O**BESITY HAS RECENTLY INCREASED IN prevalence and severity throughout the world, particularly in North America, and it has become a leading worldwide health concern.<sup>1-3</sup> Patients who have a body mass index (BMI) of 18.5–24.9 kg per m<sup>2</sup> are considered normal, while those with a BMI equal to or more than 30 kg per m<sup>2</sup> are obese. Currently for those patients with intractable morbid obesity, defined as having a BMI of more than 40 kg per m<sup>2</sup>, gastric bypass surgery offers the only option for achieving meaningful and sustainable weight loss.<sup>3-5</sup> Even dietary therapy together with exercise, pharmacological and behavioural therapy is rarely successful in these patients.<sup>1,3,4</sup> The gastric bypass technique was introduced by Mason and Ito in 1967.<sup>6</sup> In 1994, Wittgrove *et al.* described the laparoscopic approach widely employed today.<sup>7</sup> The Roux Y-limb gastric bypass surgery is currently considered the main treatment option in patients with intractable morbid obesity as it combines both restrictive and malabsorption approaches.<sup>1,4,5,8,9</sup> The Roux Y-limb gastric bypass surgery can be performed either by the open or laparoscopic method, with the laparoscopic approach being preferred as it lowers the risk of wound related complications, and has the advantages of shorter hospitalisation and faster recovery. The Roux Y-limb procedure involves the creation of a gastric pouch. The small bowel is transected at about 45 cm distal to the ligament of Treitz, and 75 cm below this transection a side to side anastomosis is created between the Roux-en-Y and the pancreaticobiliary limb. The Roux-en-Y limb is either antegastric or retrogastric and is anastomosed to the gastric pouch via a retrocolic or antecolic approach.<sup>10</sup> The main procedure at our institution is the retrocolic, antegastric approach [Figures 1 and Figures 2 a & b].

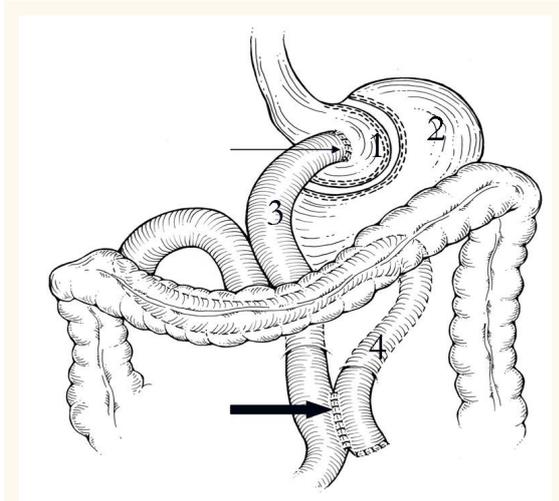
Imaging is crucial in the work-up of complications related to this procedure including anastomotic leaks, bowel obstruction, abscesses, fistulas and

haematomas.<sup>11</sup> It also plays an important role in the diagnosis of small bowel obstruction which could be due to adhesions or an internal hernia.<sup>11</sup> Blacher *et al.*<sup>11</sup> reported on 23 patients with small bowel obstruction following laparoscopic Roux-en-Y limb gastric bypass surgery using the antegastric retrocolic approach. Fourteen patients had internal hernias, while the remaining nine patients had small bowel obstruction due to adhesions. The prevalence of small bowel obstruction due to internal hernia was higher in Blacher *et al.*'s study as compared to our series,<sup>11</sup> a complication that appears to be more common with the laparoscopic approach.

The aim of this study was therefore to evaluate imaging findings of small bowel obstruction (SBO) after retrocolic antegastric Roux-en-Y gastric bypass surgery for morbid obesity.

## Methods

Following approval by the institutional Review Board, the radiological and surgical databases of 490 patients, who underwent gastric bypass surgery for morbid obesity at our institution from 2001-2005, were searched for SBO complications related to the procedure. Given the retrospective nature of the study, the requirement for informed consent was waived. There had been increase in the numbers of gastric bypass cases performed laparoscopically at our institution since October 2003. Therefore there were a total of 273 patients who underwent gastric bypass by the laparoscopic approach while the remaining 217 had the open approach. Among the 490 patients, there were 22 cases of small bowel obstruction (SBO). Among the 22 cases of SBO, 10 patients had computed tomography (CT) scans, 12 patients had upper gastrointestinal (UGI) examinations and one patient had both UGI and CT. The imaging findings were reviewed by two abdominal radiologists in consensus, and the clinical characteristics were reported according to



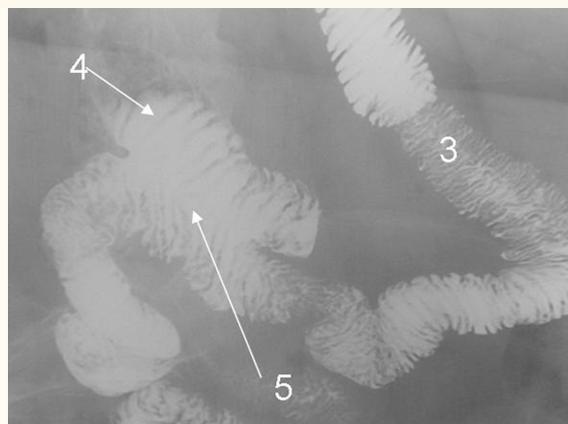
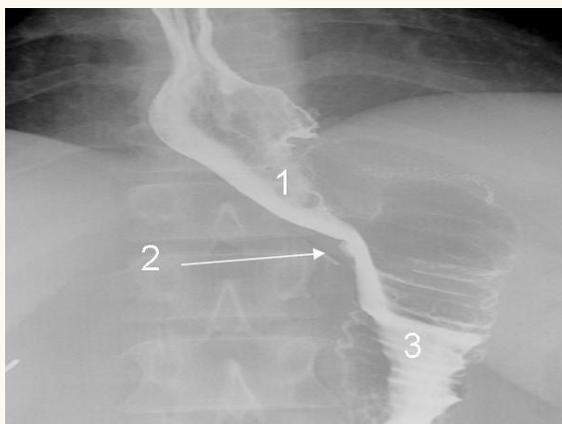
**Figure 1:** Gastric bypass surgery using antegastric, retrocolic approach. 1) Gastric pouch; 2) excluded stomach; 3) Roux limb; 4) pancreaticobiliary limb; Gastrojejunal anastomosis (thin arrow); (thick arrow) jejunojunctional anastomosis.

the time after surgical management of SBO. The imaging findings were recorded and compared to the surgical findings, when applicable, and to the literature. All CT scans were performed with either a 4 or 16 slice General Electric scanner (GE Healthcare) with preference being given to a 16 slice CT scan whenever available. Patients received 125 ml of Optiray 350 which was administered at a rate of 2–3 ml per second with a power injector. In patients who were suspected to have an anastomotic leak immediately postoperatively, UGI and small bowel follow through (SBFT) examinations were performed using water soluble contrast. Rapid

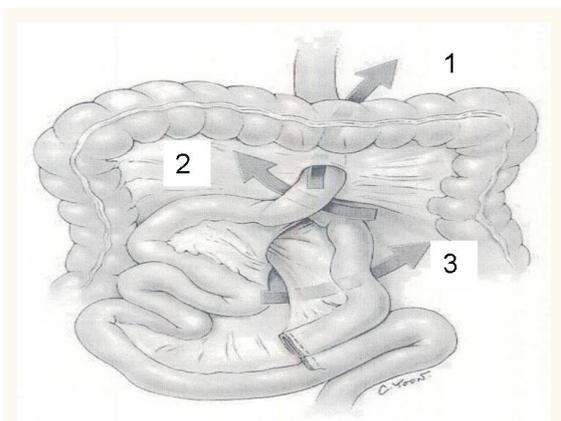
sequence images of gastrojejunal anastomosis were obtained in different projections. Overhead radiographs were obtained at 15–20 minute intervals until contrast opacified the jejunojunctional anastomosis. In patients who presented beyond the immediate postoperative period, and in whom anastomotic leaks were not suspected, UGI and SBFT examinations were performed using thin barium; overhead radiographs were obtained following fluoroscopic examination at 15–20 minutes.

## Results

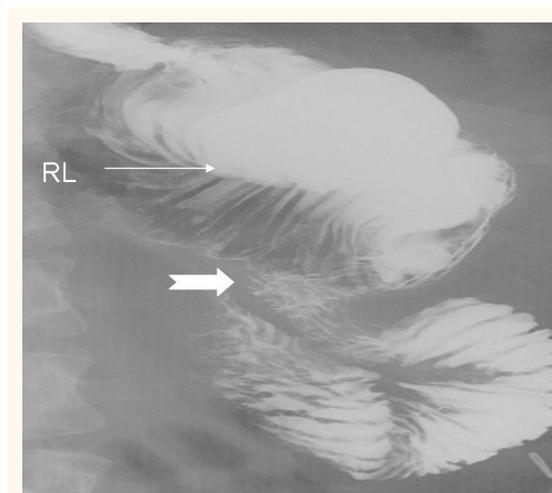
Imaging findings were reviewed retrospectively by two abdominal radiologists who were blinded to the level and cause of the SBO. There were 22 cases of SBO: 14 cases were due to anastomotic narrowing/adhesions; there were 7 cases of internal hernia (3 of them were at transverse mesocolon defect and 4 were at small bowel mesentery defect) and one case of jejunojunctional intussusception. No Peterson hernia was encountered [Table 1]. The mean time from Roux-en-Y gastric bypass surgery to the diagnosis of adhesive small bowel obstruction was 100 days, while that due to internal hernia was 255 days mean. In 10 out of 22 patients the presentation was acute with the most common presenting symptoms being abdominal pain, vomiting, and distention. These patients underwent a CT scan. In the remaining 12 cases, the presentation was subacute with insidious onset of intermittent postprandial abdominal pain and nausea. These patients underwent UGI and



**Figures 2a & b:** Fluoroscopic spot image obtained at upper gastrointestinal examination showing a normal postoperative anatomy following a gastric bypass procedure. 1) gastric pouch; 2) side to side gastrojejunal anastomosis; 3) Roux limb; 4) pancreaticobiliary limb; 5) side to side anastomosis between pancreaticobiliary limb, and Roux limb.



**Figure 3:** Potential sites of small bowel internal hernia following gastric bypass surgery are: 1) transverse mesocolon defect; 2) Roux-en-Y Limb mesentery, and 3) distal jejunum-jejunal mesentery.



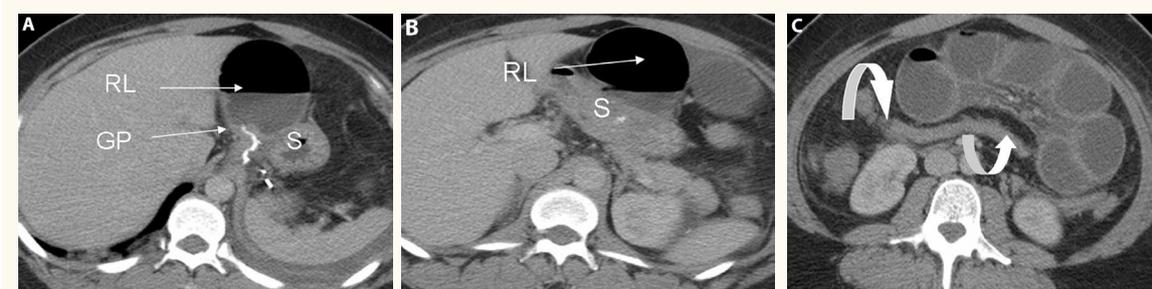
**Figure 4:** Contrast enhanced image of the upper gastrointestinal tract demonstrates significant dilatation of the Roux limb (thin white arrow) with delay in passage of contrast at the level of the transverse mesocolon defect (thick white arrow). Surgery revealed SBO at the transverse mesocolon defect due to adhesion.

SBFT exams. Seven of these cases were due to internal hernia, three due to adhesion, while one case was due to jejunum-jejunal intussusception. The remaining 11 cases of presumed partial small bowel obstruction were managed conservatively [Table 2]. Among the adhesive small bowel obstructions, 13 cases were obstruction at jejunum-jejunal anastomosis and most cases were managed conservatively except for two cases that required surgical management. There was one case of adhesive SBO at transverse mesocolon that was managed surgically. Among surgically managed SBO, UGI correctly diagnosed one of three internal hernias, one case was labelled incorrectly as adhesion, and one case was equivocal. While one case of adhesive SBO was correctly diagnosed using UGI, CT correctly diagnosed 2 of the 4 internal hernias, 2 of the 3 adhesions, and one case of jejunum-jejunal intussusception. Among the medically managed partial SBO, 9 cases out of 11 were diagnosed using UGI and two cases using CT.

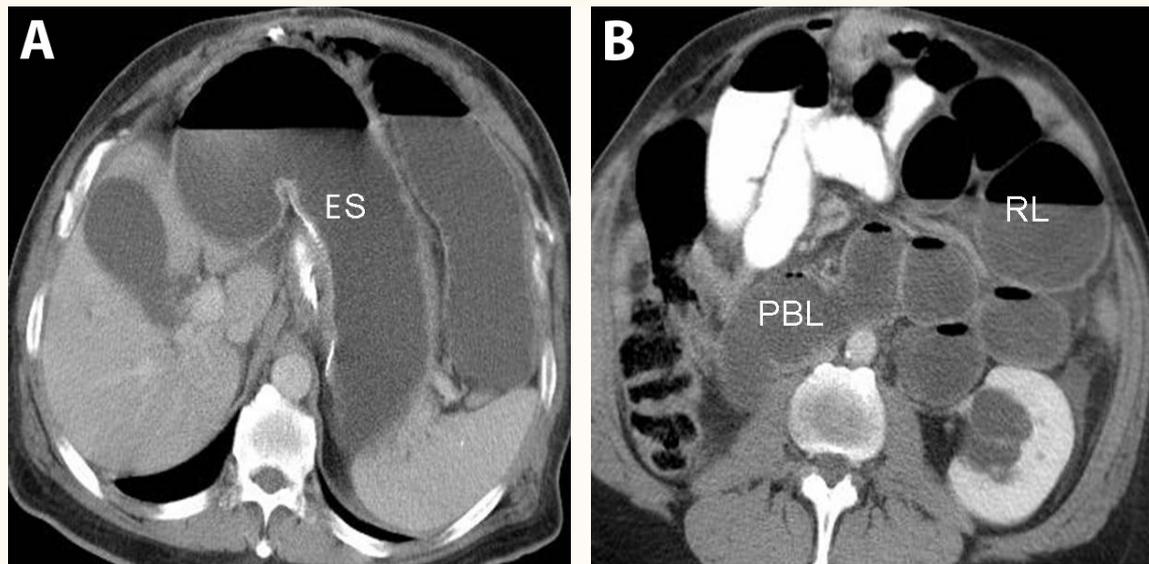
In two of the four cases of small bowel mesentery internal hernia, there was herniation of both the Roux-en-Y and pancreaticobiliary limb, while the remaining two cases had herniation of the Roux-en-Y limb only. Among the 7 patients with internal hernia, 5 had a laparoscopic approach and 2 had the open approach. Among the 14 patients with adhesive/anastomotic narrowing SBO, 7 had the laparoscopic approach and the remaining 7 had the open approach.

## Discussion

The interpretation of SBO imaging findings following gastric bypass surgery can be challenging



**Figures 5a, b & c:** Small obstruction caused by internal hernia at transverse mesocolon defect. 5a & b: transverse computed tomography (CT) images show dilated Roux-en-Y Limb (arrow) anteromedial to excluded stomach(s). 5c: transverse CT images show cluster of small bowel loops against the mid-abdominal wall with no overlying omentum and displacement of the transverse colon (curved arrow) posterocentrally.



**Figures 6a & b:** Small bowel obstruction caused by internal hernia at the jejunal mesenteric defect. 6a: Transverse computed tomography (CT) images show significant dilatation of the excluded stomach(s). 6b: Transverse CT images show significant dilatation of the pancreaticobiliary and Roux limbs with a cluster of these bowel loops lying against the left abdominal wall with no overlying omentum.

Legend: ES = Excluded stomach; PBL = pancreaticobiliary limb; RL = Roux-en-Y limb

for the radiologist. Usually, these patients present with symptoms of abdominal pain, nausea and vomiting which are nonspecific in such patients. Imaging can play an important role in classifying SBO according to level of obstruction and cause (i.e. adhesion or internal hernia) [Figure 3]. In order to interpret the imaging findings, the radiologist has to be familiar with the gastric bypass surgery approach performed at his institution. We have reported our experience of SBO imaging findings following retrocolic antegastric Roux-en-Y gastric bypass surgery. The incidence of SBO in our series was 4% which is similar to the rates reported in the literature.<sup>10-14</sup>

Small bowel obstruction following gastric bypass surgery is mainly due to adhesions or anastomotic stenosis. Internal hernias occur to a lesser extent and intussusception is rarely a cause.<sup>11,15</sup> Small bowel obstruction due to anastomotic narrowing or adhesion occurs in the gastrojejunal or

**Table 1:** Level and cause of small bowel obstruction in 22 patients following Roux-en-Y gastric bypass surgery

	Gastrojejunal anastomosis	Jejunojejunal anastomosis
Adhesion	1	13
Internal hernia	3	4
Intussusception	0	1

jejunojejunal anastomotic region. In our series, 13 cases out of 14 had obstruction at jejunojejunal anastomosis, and one case had obstruction at gastrojejunal anastomosis. The imaging findings on UGI and CT varied between abrupt angulation from a dilated proximal bowel loop to a collapsed distal loop and delay in passage of contrast beyond the transition point on UGI [Figure 4]. Potential sites for internal hernia following gastric bypass surgery are transverse mesocolon defect, small bowel mesentery defect and the space behind the Roux limb.<sup>16</sup> In our series, 7 out of 22 (32%) cases presented with internal hernias, 3 of them were

**Table 2:** Management of 22 cases of small bowel obstruction following Roux-en-Y gastric bypass surgery

	Surgical Management	Conservative Management
Adhesion GJ anastomosis	1	0
Internal hernia GJ anastomosis	3	0
Adhesion at J-J anastomosis	2	11
Internal hernia at J-J anastomosis	4	0
Intussusception at J-J anastomosis	1	0

GJ = gastrojejunal; J-J = jejuno-jejunal



**Figure 7:** Small bowel obstruction caused by intussusception at the jejunum-jejunal anastomosis. Transverse computed tomography images show multilayered appearance of small bowel intussusception. The intussusceptum (white thick arrow), with accompanying mesenteric fat (white thin arrow) is surrounded by the thick walled intussusciens (black arrow).

internal hernias at transverse mesocolon defect and 4 were at small bowel mesentery defect. A possible predisposing factor for developing internal hernia in these patients is rapid massive weight reduction which results in decrease intraperitoneal fat that may enlarge the mesenteric defect.<sup>11</sup> Since the Roux-en-Y limb is anastomosed to the gastric pouch in a retrocolic, antegastric approach at our institution, the CT imaging findings of internal hernia through the transverse mesocolon defect were a cluster of small bowel loops lying anterior to the body of excluded stomach and against the mid-abdominal wall with no overlying omentum. In addition, there was displacement of transverse colon dorsally and centrally [Figures 5 a, b & c].<sup>17</sup>

In the case of small bowel mesenteric hernias, the CT imaging findings were a cluster of small bowel loops against left abdominal wall with no overlying omentum and posteromedial displacement of the descending colon.<sup>11,17</sup> In two of the four cases of internal hernia through the small bowel mesentery defect, there was herniation of both the Roux-en-Y and pancreaticobiliary limb which resulted in dilatation of both limbs and the gastric remnant [Figures 6 a & b].

In our series, we did not encounter a case of Peterson hernia. Intussusception is very rare following gastric bypass surgery, with few reported cases.<sup>11,15,18</sup> In our series, we had one case that presented with jejunum-jejunal intussusception that required emergency exploratory laparotomy. The

diagnosis was made via a CT scan, the imaging findings were a target like appearance with invagination of mesenteric fat and vessels in the intussusciens [Figure 7].

## Conclusion

The most frequent cause of SBO following gastric bypass surgery is anastomotic narrowing or adhesions. CT scan remains the most appropriate imaging modality in diagnosing acute presentations of SBO caused by internal hernias or adhesions. UGI and SBFT appear more appropriate in diagnosing the subacute insidious presentation of adhesive or anastomotic narrowing of a partial SBO. While small bowel obstruction following gastric bypass surgery may represent a diagnostic challenge to the radiologist, the knowledge of surgical approach and clinical presentation will help in identifying the level and cause of SBO, thus helping in operative planning.

## CONFLICT OF INTEREST

The authors reported no conflict of interest.

## References

1. Fisher BL, Schauer P. Medical and surgical options in the treatment of severe obesity. *Am J Surg* 2002; 184:9–16S.
2. Allison DB, Fontaine KR, Manson JE, Stevens J, Vanitallie TB. Annual deaths attributable to obesity in the United States. *JAMA* 1999; 282:1530–8.
3. Carucci LR, Turner MA, Conklin RC, DeMaria EJ, Kellum JM, Sugeran HJ. Roux-en-Y gastric bypass surgery for morbid obesity: evaluation of postoperative extraluminal leaks with upper gastrointestinal series. *Radiology* 2006; 238:119–27.
4. Gastrointestinal Surgery for Severe Obesity: National Institutes of Health Consensus Development Conference Statement. *Am J Clin Nutr* 1992; 55:615–195.
5. Nguyen NT, Ho HS, Palmer LS, Wolfe BM. A comparison study of laparoscopic versus open gastric bypass for morbid obesity. *J Am Coll Surg* 2000; 191:149–55.
6. Mason EE, Ito C. Gastric bypass in obesity. *Surg Clin North Am* 1967; 47:1345–51.
7. Wittgrove AC, Clark GW, Tremblay LJ. Laparoscopic gastric bypass, Roux-en-Y: preliminary report of five cases. *Obes Surg* 1994; 4:353–7.
8. Brolin RE. Update: NIH consensus conference-

- gastrointestinal surgery for severe obesity. *Nutrition* 1996; 12:403–4.
9. Marema RJ. Laparoscopic Roux-en-Y gastric bypass: a step by step approach. *J Am Coll Surg* 2005; 200:979–82.
  10. Fobi MA, Lee H, Holness R, Cabinda D. Gastric bypass operation for obesity. *World J Surg* 1998; 22:925–35.
  11. Blacher A, Federle MP, Ikramuddin S, Schauer PR. Gastrointestinal complications of laparoscopic Roux-en-Y gastric bypass surgery: Clinical and imaging findings. *Radiology* 2002; 223:625–32.
  12. Schauer PR, Ikramuddin S. Laparoscopic surgery for morbid obesity. *Surg Clin N Am* 2001; 81:1145–78.
  13. Higa KD, Boone KB, Ho T, Davis OG. Laparoscopic Roux-en-Y gastric bypass for morbid obesity: technique and preliminary results of our first 400 patients. *Arch Surg* 2000; 135:1029–33.
  14. Schauer PR, Ikramuddin S, Gourash W, Ramanathan R, Luketich J. Outcomes after Laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Ann Surg* 2000; 232:515–29.
  15. Duane TM, Wholgemuth S, Ruffin K. Intussusception after Roux-en-Y gastric bypass. *Am Surg* 2000; 66:82–4.
  16. Blacher A, Federle MP. Gastrointestinal complications of laparoscopic Roux-en-Y gastric bypass surgery in patients who are morbidly obese: findings on radiography and CT. *AJR* 2002; 179:1437–42.
  17. Blacher A, Federle MP, Dodson SF. Internal hernia: Clinical and imaging findings in 17 patients with emphasis on CT criteria. *Radiology* 2001; 218:68–74.
  18. Bocker J, Vasile J, Zager J, Goodman E. Intussusception: an uncommon cause of postoperative small bowel obstruction after gastric bypass. *Obes Surg* 2004; 14:116–9.