G Chir Vol. 33 - n. 6/7 - pp. 209-217
June-July 2012

original article

Complications after laparoscopic Roux-en-Y gastric bypass: a diagnostic challenge. Report of three cases and review of the literature

D. HENNEMAN, S. LAGARDE, N. GEUBBELS, J. TUYNMAN, S. JENSCH, B. VAN WAGENSVELD

SUMMARY: **Complications after laparoscopic Roux-en-Y gastric bypass: a diagnostic challenge. Report of three cases and review of the literature**

D. HENNEMAN, S. LAGARDE, N. GEUBBELS, J. TUYNMAN, S. JENSCH, B. VAN WAGENSVELD

The number of Laparoscopic Roux-en-Y Gastric Bypass (LRYGB) procedures for morbid obesity and type 2 diabetes mellitus will increase worldwide, and therefore, an increase in perioperative morbidity can be anticipated.

The authors present three cases based on different complications after LRYGB to demonstrate the diagnostic challenge that clinicians face in this particular group of patients. Also, a review of the literature covering the value of different imaging in these particular cases is provided by the authors. The role of imaging in the diagnostic process is discussed.

RIASSUNTO: **Complicanze post-bypass gastrico laparoscopico con ricostruzione ad Y secondo Roux: una sfida diagnostica. Descrizione di tre casi e revisione della letteratura.**

D. HENNEMAN, S. LAGARDE, N. GEUBBELS, J. TUYNMAN, S. JENSCH, B. VAN WAGENSVELD

In tutto il mondo sono aumentate le procedure laparoscopiche di bypass gastrico con ricostruzione ad Y secondo Roux per obesità patologica o diabete mellito di tipo 2. Di conseguenza è prevedibile un incremento della morbidità perioperatoria correlata.

Gli Autori illustrano tre casi di differenti complicanze post-bypass gastrico laparoscopico per evidenziare le difficoltà diagnostiche che si possono incontrare in questi pazienti. Inoltre presentano una revisione della letteratura anche sull'imaging di questi casi particolari, discutendone il ruolo.

KEY WORDS: Complications - Laparoscopy - Obesity - Roux-en-Y gastric bypass - Imaging.
Complicanze - Laparoscopia - Obesità - Bypass con ricostruzione ad Y secondo Roux - *Imaging*.

Introduction

Obesity, defined as a Body Mass Index (BMI) of more than 30 kg/m² is an increasing problem in the Western World. In the United States, the prevalence is around 30% in the adult population (1). The World Health Organisation (WHO) predicts that worldwide in 2025 there will be 300 million obese people (2).

Obesity is associated with the development of a metabolic syndrome, early osteoarthrosis and a high risk of cardiovascular disease (3). Bariatric surgery aims at inducing weight loss by reducing gastric volume and/or absorption capacities of the intestines. Over the past decades, a wide variety of bariatric procedures have been developed, such as the adjustable gastric banding, gastric sleeve resection and Roux-en-Y Gastric Bypass (RYGB). At present, the Laparoscopic RYGB (LRYGB) is the gold standard because of its superior results, when compared to gastric banding, in sustained weight loss and resolution of co-morbidity. A large meta-analysis reported 49,0 versus 63,3 percent excess body weight loss, and 70,9 versus 58,3 percent resolution of type 2 diabetes (T2D) after two years, both in favour of the RYGB (4). With the increasing need for bariatric surgery, widening of indications and a shift towards more complex (laparoscopic) procedures, centralization in centers of excellence takes place. Although many authors describe a higher success rate for RYGB over the gastric banding procedure, there seems to be a higher percentage of early complications associated with the RYGB. This

St. Lucas Andreas Hospital, Amsterdam, The Netherlands

TABLE 1 - COMMON COMPLICATIONS AFTER LAPAROSCOPIC ROUX-EN-Y GASTRIC BYPASS (LRYGB).

Early	*Late*
Anastomotic leak	Anastomotic stenosis
Intra-abdominal fluid collection	Ulcer formation
Anastomotic edema, obstruction	Internal hernia
Ileus	Gastric dumping
Distention of excluded stomach	Gastro-gastric fistula
Bleeding	Blind loop pouching
Staple line disruption	

also includes more severe ones such as anastomotic leakage (5). Early leak rates are up to 5% and usually involve the gastrojejunostomy (6). The most common complications are listed in Table 1. With the expected increase in volume of performed RYGBs worldwide, it can be expected that there will be an increase in perioperative morbidity. A recent review outlines the growing problem that complications after bariatric operations form (7). Due to the excessive body weight, differentiation between the various complications can be challenging in this patient group; symptoms are often subtle and the value of physical examination and imaging is limited compared to non-obese patients (8).

We present three patients with a similar presentation but with different early complications after LRYGB, illustrating the diagnostic challenges in this patient group. The second patient has a rare early presentation of a usually late complication and the third patient has a complication after LRYGB that, to our knowledge, has not been described in the literature so far.

Case reports

Patient 1

The first patient is a 29 year old lady with a BMI of 50.5. Her relevant medical history consists of slight Obstructive Sleep Apnea Syndrome (OSAS). She underwent an uncomplicated LRYGB and was discharged on postoperative day three after an uneventful admission. On postoperative day 21, she returned with acute pain in the epigastric region, radiating to the left shoulder. There was no history of trauma and she did not have any gastrointestinal or respiratory complaints. On examination, she had a pulse of 80/minute, a blood pressure of 117/63 mmHg, a respiratory rate of 30/minute and an O_2 saturation of 92%, which was similar to an earlier measurement. Relevant laboratory results were a leukocyte count of $12.0x10^9$/L and a CRP of 15 mg/L. A chest X-ray showed free air under the diaphragm. Subsequently, an abdominal CT with oral contrast was performed which was indicative for an anastomotic leak of the gastro-jejunostomy (Fig. 1). Soon hereafter, a re-laparoscopy was performed in which a small defect on the gastro-jejunostomy was seen; the defect could not be closed primarily but an omentoplasty was done. The abdominal cavity was irrigated and three drains were placed, as well as a nasogastric tube. Postoperatively, the patient recovered on the ICU for one day but could be discharged to the ward quickly. All three drains could be removed after a few days without any problems. The patient was treated with intravenous antibiotics for five days and recovered very well. On postoperative day seven, an Upper GastroIntestinal (UGI) series was performed, which showed no contrast leakage and good passage of the contrast solution. The patient was discharged in a good condition.

Patient 2

The second patient is a 62-year old lady with a BMI of 49.5. Her medical history includes severe OSAS, chronic obstructive pulmonary disease (COPD), and T2D. She is on oral antidiabetics as well as insulin and uses inhalation steroids and bronchodilators. She underwent an uncomplicated laparoscopic RYGB which took 78 minutes. The postoperative course was uneventful; post-operatively she spent three days on the ICU for respiratory support for her known OSAS. On postoperative day four she was discharged in good condition. Two days later, she presented with general unwell-being and abdominal pain. She had been vomiting a few times. On examination she had slight dyspnoea and she had tachycardia of 117 beats per minute. There was tenderness on palpation in the epigastric region, without any guarding. Leukocyte count was $5.5x10^9$/L and CRP was 32 mg/L (which had been 233 mg/L three days earlier). Chest and abdominal X-rays revealed no abnormalities. The patient was admitted to the ward with a nil per os regimen, a nasogastric tube and intravenous fluids. A thoracoabdominal CT scan was made the next

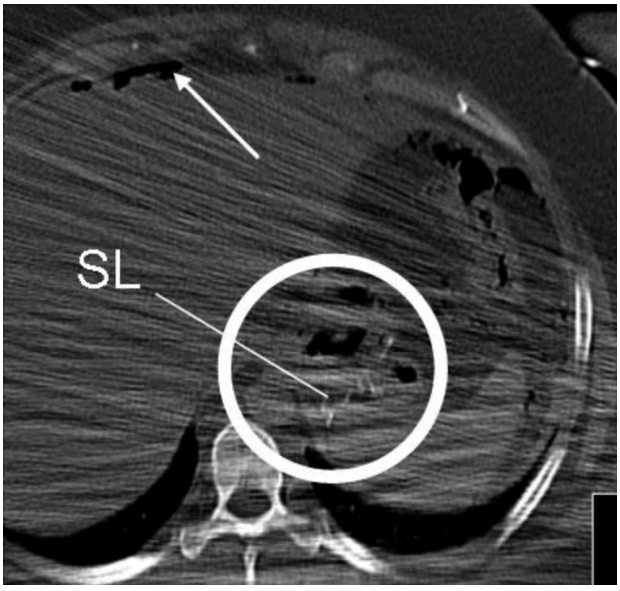

Fig. 1 - Abdominal Computed Tomography (CT) scan of patient 1. Anastomotic leakage suspected from the proximal anastomosis (circle). Image blurred by artefacts from the patient's left arm. Note the free air next to the staple line and around the liver (arrow). SL = staple line.

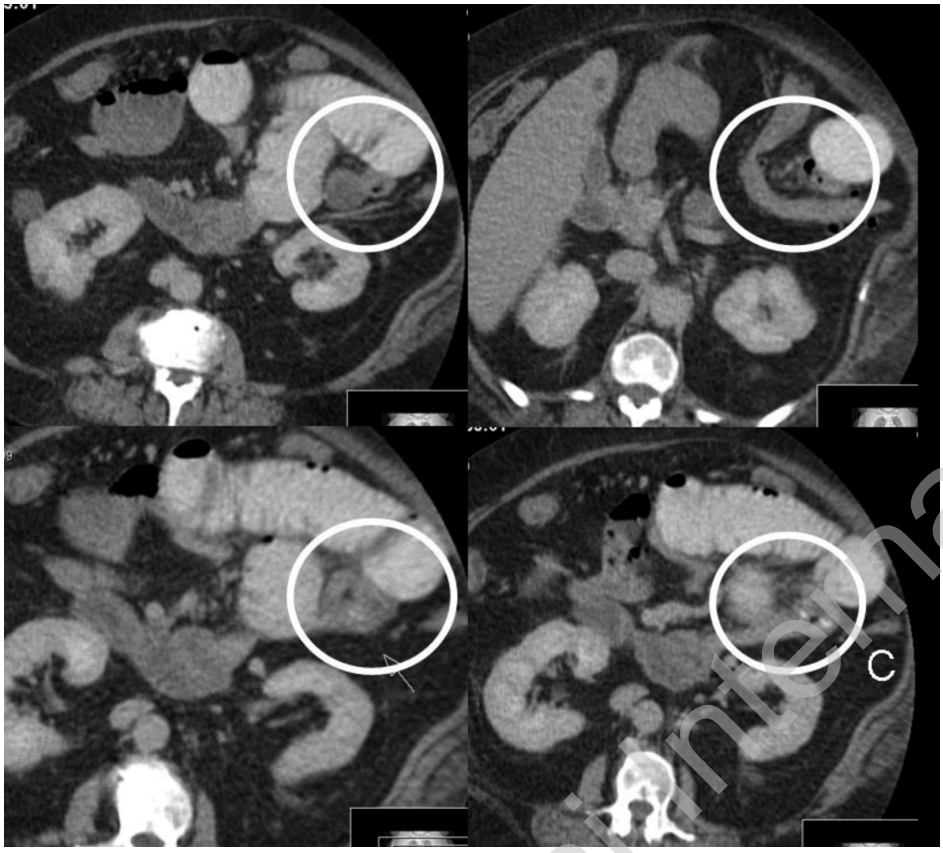

Fig. 2 - Abdominal CT scan of patient 2. Internal hernia next to jejuno-jejunostomy. The staple line is seen as the white line in the circle in the right lower image. Note the collapsed colon marked with "C".

day to rule out pulmonary embolism and anastomotic leaks. These complications were not seen but a high obstruction of the small intestines was diagnosed (Fig. 2). An emergency laparoscopy was performed and a small herniation of the digestive loop, just proximal of the jejuno-jejunostomy, through Petersen's space was repositioned. Consequently, Petersen's space was closed primarily. Postoperatively she was monitored on the ICU overnight and was transferred to the ward the next day. She remained stable, tolerating liquids without any problems. On day five after the reoperation, she was discharged in good condition.

Patient 3

The third patient is a 44-year old lady who was referred to us because of her BMI of 41. Her relevant surgical and medical history revealed two diagnostic laparoscopies in 1998 and 2004 for evaluation of fertility, and asthmatic bronchitis since children's age. Current home medication was pantoprazole 40 mg once daily. The laparoscopic RYGB was uneventful. Postoperative and preoperative haemoglobin levels were 7,5 and 7,4 mmol/L respectively. She was discharged in good condition on postoperative day one. On postoperative day five, she presented to our emergency department with acute pain in the left flank on inspiration. She did not have any symptoms of dyspnoea or coughing and she had no complaints of vomiting and a normal defecation pattern. There was no history of trauma. On initial examination, the patient was stable with a pulse of 80/minute, a blood pressure of 123/79 mmHg, a breathing frequency of 12/minute and an O_2 saturation of 97%. Abdominal examination revealed some left upper quadrant tenderness on palpation, as well as some rebound tenderness but no evident abdominal guarding. Laboratory results showed a hemoglobin level of 7.4 mmol/L, a leukocyte count of $8.0x10^9$/L and a C-reactive protein (CRP) of 32 mg/L. Electrolytes and renal function were normal. Electrocardiography showed no abnormalities. An upper GI series was performed. This showed a normal passage of contrast through the stomach pouch without evidence for leakage. The subsequently made thoracoab-

Fig. 3 - Abdominal CT scan of patient 3 with large subcapsular hemorrhage. Also note contrast outside the splenic capsule (circle) and fluid around the liver (arrow).

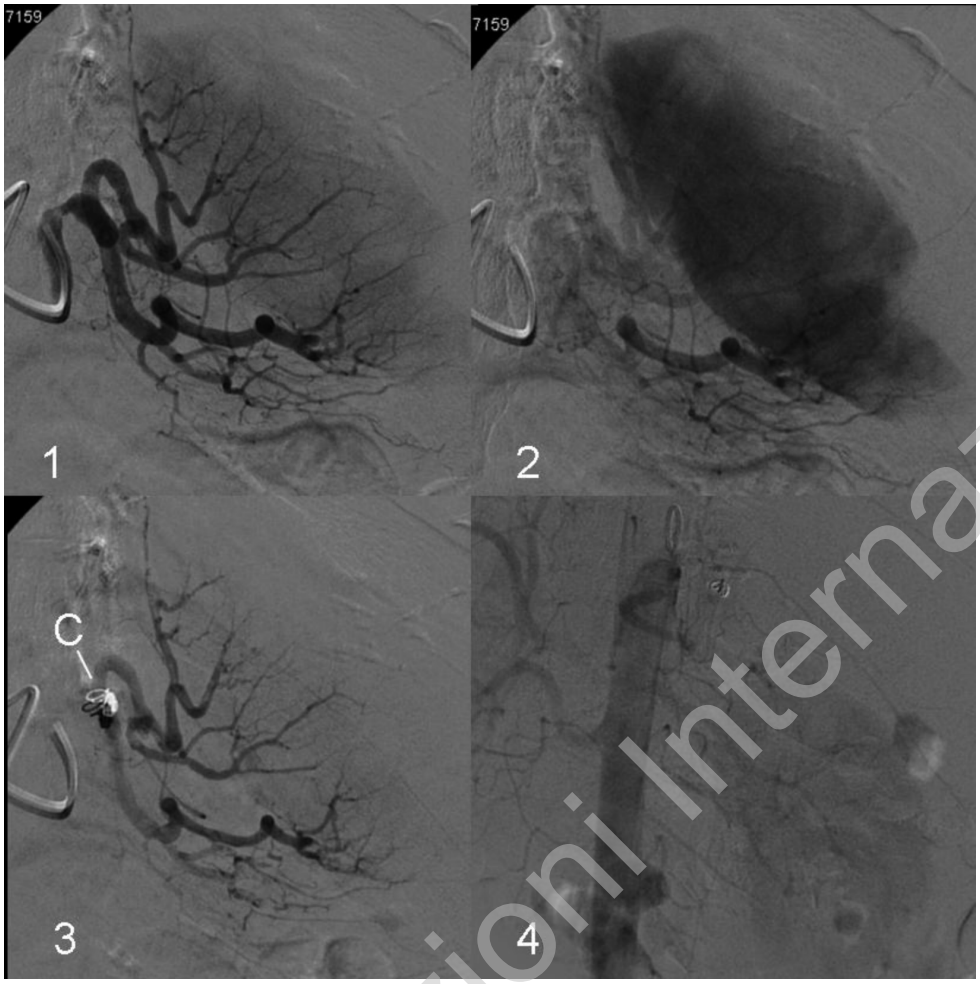

Fig. 4 - Angiography with coiling of the spleen in patient 3. Chronologically from 1 to 4: 1 and 2, visualisation of the spleen, no active bleeding point; 3, coiling of the distal splenic artery; 4, vascular exclusion of the spleen. C = coil.

dominal CT showed a large subcapsular splenic hemorrhage with active bleeding (Fig. 3). By this time, haemoglobin level was decreased to 5.6 mmol/L. Embolization was then attempted and the distal splenic artery was coiled with good result (Fig. 4). Post-procedure ICU monitoring was initiated. The patient received two units of packed cells. On a repeat CT angiography, adequate vascular exclusion of the spleen was seen (Fig. 5). The patient was transferred to the ward on day two and on day four she was discharged in a good condition.

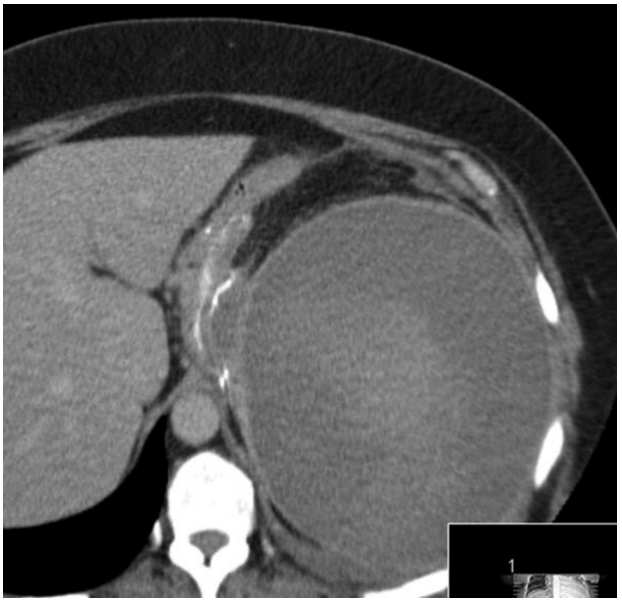

Fig. 5 - Vascular exclusion of the spleen on abdominal CT in patient 3, three days after the procedure.

Discussion and review of the literature

Since the first gastric bypass was described in 1967 by Mason and Ito (9), more experience with this procedure has been gained and more knowledge about complications has been collected. Nowadays gastric bypass is the gold standard, as 88% of bariatric operations in the United States, in 2002, were Roux-en Y Gastric Bypass (10). The RYGB is believed to have more severe postoperative complications than, for example, gastric banding (11). Complications can present in many ways, from

only tachycardia, to vague or specific abdominal pain to septic shock. The most feared complication in the postoperative setting is the anastomotic leak. Other complications can present in the same way, however. It is unclear which imaging study can be best performed in this specific group of patients, especially since diagnostic accuracy may be lower than normal due to obesity.

Case one: the anastomotic leak

Despite her relatively late presentation on postoperative day 21, patient 1 had an anastomotic leak. The imaging study initially chosen to demonstrate anastomotic leakage is usually the Upper Gastrointestinal (UGI) series: leaks will demonstrate contrast leakage out of the reconstructed gastro-intestinal tract into a contained area or diffusely into the abdominal cavity. In many centers, common practice is or, at least, was to perform a routine UGI in the first 24 or 48 hours postoperatively. Other centers use this imaging study selectively when a leak is suspected. An alternative is a CT scan. In contrast to UGI series, CT scan may also visualize leaks from the jejunojejunostomy and the excluded stomach (12).

The upper gastrointestinal series and anastomotic leak

Table 2 shows the available evidence on the sensitivity (the percentage of patients with anastomotic leaks who are correctly identified as having a leak) and specificity (the percentage of patients with patent anastomoses who are correctly identified as not having a leak) of UGI and CT scan for anastomotic leaks after RYGB (8, 13-27). In a number of papers, sensitivity and specificity was not deductable from the papers. These publications are indicated by § in the right box in Table 2. *Schiesser et al* compared selective versus routine UGI series, finding a sensitivity of 80% when using selective UGI versus 50% when performed routinely, with comparable specificity (22). According to this study, a negative UGI series does not rule out an anastomotic leak. *Lee et al* describe the detection rates of leaks of two patient groups: the first in the early time period when UGI series were performed routinely and the second when they initiated a selective UGI series regimen. They conclude a higher detection rate of leaks and cost savings with a similar clinical outcome after abandoning routine postoperative UGI series (24).

Computed tomography and anastomotic leak

Limited data is published on the power of CT scan for detecting anastomotic leaks after RYGB, but the available literature suggests superiority over UGI series in terms of sensitivity and specificity (Table 2). Again, from a vast number of papers, sensitivity and specificity was not deductable. *Lyass et al* describe the advantage of CT scan over UGI because it detects complications other than anastomotic leaks (18). *Yu et al* retrospectively reviewed 100 CT scans of 72 patients with an expert panel. They report an excellent visualization of post-RYGB anatomy in the non-clinical setting (23).

Case two: the internal hernia.

Patient two also presented on postoperative day five with pain in the abdomen and left flank. The diagnosis, Internal Hernia (IH), was made on an abdominal CT. This complication is caused by the altered anatomy and is not uncommon after RYGB. Some authors advocate to routinely close the mesenteric defects in order to prevent IH, but opponents of this strategy point out that there is no higher incidence without closure of defects and that the defects will reappear with weight loss and loss of visceral fatty tissue (28). A laparoscopic procedure is believed to be more prone to developing postoperative IH due to lack of formation of adhesions (29). Four types of IH after RYGB are commonly known (Table 3, Fig. 6) (30). It is usually a "late" complication, e.g., later than a month after the initial operation. To our knowledge, our second patient is the earliest described IH after RYGB in the literature so far.

Computed tomography and internal hernia

CT is believed to be the imaging of choice in diagnosing IH (31). Different signs on CT may be used to diagnose the various IHs, with sensitivity and specificity differing per sign, per author and per subtype of IH. Up to 14 signs have been described. The most commonly found ones are listed in Table 4. The different publications on the value of CT for diagnosing IH are displayed in Table 5 (23, 29, 32-40). From many papers, not much can be said about sensitivity and specificity of CT since many authors looked retrospectively at their subpopulation of patients with known IH only. Different authors used different sets of CT signs to diagnose IH. *Marchini et al.* took a closer look at their 71 patients with IH. In 34 patients that had undergone a CT scan, they evaluated the value of 14 different signs in distinguishing between the four types of IH. They identified a few signs that were discriminative: the place where clustered small bowel loops were seen proved to be a significant predictor for type; widening of the jejunal anastomosis was a significant sign for jejuno-jejunal hernia (32).

Lockhart et al compared results of three radiologists using 7 signs on CT scan. Individual sensitivity ranged from 0 to 83% differing per sign and per radiologist. Individual specificity ranged from 67 to 100%, with an overall score of 56-78% sensitivity and 78-89% specificity (34). *Paroz et al.* found a 100% detection of IH on CT scan for acute presentation but only 40% in the non-acute setting (37).

TABLE 2 - SENSITIVITY AND SPECIFICITY OF COMPUTED TOMOGRAPHY (CT) AND UPPER GASTROINTESTINAL (UGI) SERIES FOR ANASTO-MOTIC LEAK AFTER RYGB.

Author	Year	CT/UGI	Routine/ Selective	No. of patients (total)	Overall no. of leaks (%)	Sensitivity	Specificity
Ganci et al.	1999	UGI	Routine	58	1 (1,7%)	0%	98%
Serafini et al.	2002	UGI	Routine	100	3(3%)	66,6%	99%
Blachar et al.	2002	UGI CT	Routine Selective	12 (463) 11	12 (2,6%)	75% 63%	100% 100% ±
Hamilton et al.	2003	UGI	Routine	210	9 (4,3%)	22%	100%
Singh et al.	2003	UGI	Routine	242	2 (1,2%)	100%	97%*
Sims et al.	2003	UGI	Routine	201	9 (4,5%)	33,3%	100%
Lyass et al.	2004	CT	Selective	41 (368)	4 (1,1%)	100%	100%
Carter et al.	2007	UGI	Routine	634 (654)	7 (1,0%)	42,8%	99,7%
Madan et al.	2007	UGI	Routine	245	8 (3%)	75%	99%
Doraiswamy et al.	2007	UGI CT	Routine Selective	516 1	3 (0,58%)	33% 100%	98% 100% ±
Schiesser et al.	2010	UGI UGI CT	Routine Selective Selective	382 (804) 422 4	9 (1,1%)	50% 80% 100%	97% 91% 100% ±
Yu et al.	2004	CT	Selective	72 (890)	12 (1,3%)		§
Lee et al.	2007	UGI	Routine Selective	267 (418) 151	18 (5,7%)		§
Gonzalez et al.	2007	UGI CT	Routine Selective	56 (3018) 50	63 (2,1%)		§
Carucci et al.	2007	UGI	Routine	48 (906)	50 (5.3%)		§
Ballesta et al.	2008	UGI CT	Routine Selective	48 18	59 (4,9%)		§

**: positive predictive value of only 27%. ±: performed after negative UGI. §; sensitivity and/or specificity not deductable from paper.*

TABLE 3 - THE FOUR COMMONLY KNOWN INTERNAL HERNIAS (IH) AFTER RYGB.

Type	Description
Mesocolic hernia	SB through colic mesenteric defect
Petersen's hernia	Roux limb through Petersen's space
Mesenteric hernia	Hernia through jejunal mesenteric defect
Jejuno-jejunal hernia	Through surgical defect between J-J- staple line and lateral suture next to J-J

SB= small bowel. J-J: Jejuno-jejunal anastomo-sis.

TABLE 4 - THE MOST COMMONLY USED CT SIGNS TO DIAGNOSE IH.

Sign	Description
Swirl sign	Swirled aspect of mesentery and bowel
Engorged vessels	Mesenteric vessels crowded, stretched or engorged
Clusters	Clustered loops of small bowel
Mushroom sign	Mushroom shape of herniating mesenteric root
Hurricane eye sign	Round shape of mesenteric fat closely surrounded by bowel loops
SB behind SMA	Small bowel other than duodenum visible behind the superior mesenteric vessels

TABLE 5 - SENSITIVITY AND SPECIFICITY OF COMPUTED TOMOGRAPHY (CT) AND UPPER GASTROINTESTINAL (UGI) SERIES FOR ANASTO-MOTIC LEAK AFTER RYGB.

Author	Year	No. of signs used	No. of patients (total)	Overall no. of internal hernia (%)	Sensitivity	Specificity
Yu et al.	2004	?	72 (890)	3 (0.3%)	66,6%	100%
Ianucilli et al.	2009	8	19 (768)	9 (1.2%)	11-100%	70-90%
Lockhart et al.	2007	7	36 (501)	18 (3.5%)	56-78%	78-89%
Gunabushanam et al.	2009	8	17 (835)	13 (1,6%)	33,3%	100%
Higa et al.	2003	?	63 (2000)	63(3.1%)	§	§
Garza et al.	2004	?	43(1000)	43(4.3%)	§	§
Paroz et al.	2006	?	24 (607)	24 (3.9%)	§	§
Reddy et al.	2007	5	27 (1000)	49 (4.9%)	§	§
Ahmed et al.	2009	4	37 (2572)	58 (2.2%)	§	§
Al-Sukaiti et al.	2010	?	10 (490)	7 (1.4%)	§	§
Marchini et al.	2011	14	34 (349)	71(4.9%)	§	§

**: positive predictive value of only 27%. ±: performed after negative UGI. §; sensitivity and/or specificity not deductable from paper.*

The third case: splenic injury

Patient 3 presented on postoperative day 5 with pain in the abdomen and the left flank. Not an anastomotic leak but a splenic hemorrhage was causing her sympoms. Splenic injury is a known complication of abdominal surgery and has frequently been reported after gastrectomy, hiatus hernia repair, fundoplication, colonic surgery and upper abdominal vascular operations. The reported incidence varies between 0,9 and 19,6% after upper gastrointestinal surgery (41). However, to our knowledge, it has not been described so far after gastric bypass surgery. Pe-

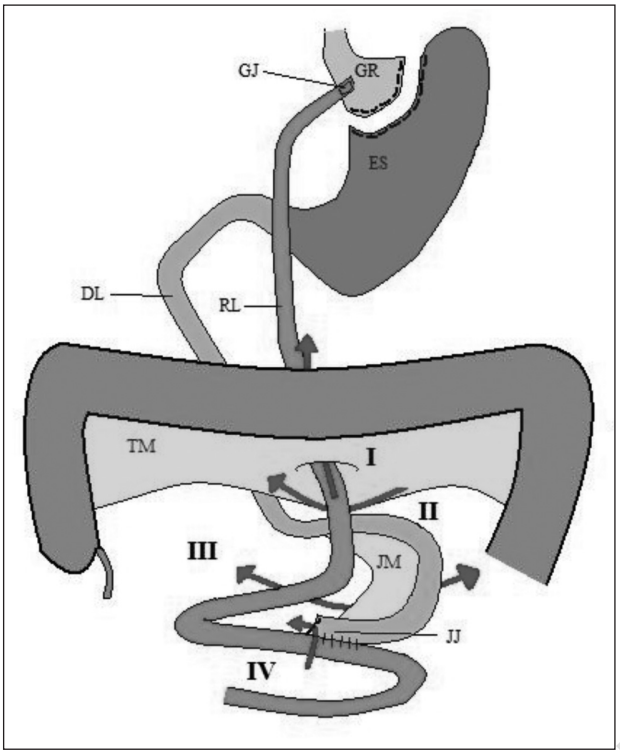

Fig. 6 - Anatomy after RYGB (retrocolic configuration) and locations of internal hernias. GR = Gastric reservoir; GJ = Gastro-jejunostomy; ES = Excluded Stomach; DL = Digestive (biliopancreatic) Limb; RL = Roux Limb; TM = Transverse Mesocolon; JM = Jejunal Mesentery; JJ = Jejuno-jejunostomy. I= Mesocolic Hernia, II = Petersen's Hernia, III = Mesenteric Hernia, IV = Jejuno-jejunal Hernia. Note that in our hospital, we perform an antecolic Roux-en-Y reconstruction.

ters et al describe five cases of splenic injury following vertical banded gastroplasty, but unlike in our patient, these injuries emerged and were managed during the operation (42). In our patient, the operation was uncomplicated and no splenic mobilization, manipulation or injury was noted at that time. However, we consider the splenic hemorrhage in this case as a true complication of the LRYGB. Abdominal CT with intravenous contrast is the imaging of choice to diagnose or exclude splenic injury, as is common practice in trauma patients (43).

Conclusion

As the three cases show, evaluation a sick patient after LRYGB is difficult and the various complications can present quite similarly. Clinical signs of anastomotic leak may be subtle, and performing a physical exam may be, apart from measuring vital signs, difficult. The time from initial surgery to development of symptoms usually gives a good clue about the differential diagnosis, but as our cases show, it is not always helpful in determining which complication one is dealing with. The clinician will, in most cases, rely on imaging studies to make an adequate diagnosis. As our review shows, UGI series cannot accurately rule out anastomotic leaks. CT scan seems to have a better performance, and the most important advantage of CT scanning is that besides the anastomotic leak, it can reveal another diagnosis. In our opinion, CT should play a pivotal role in evaluating complications after LRYGB.

Conflict of interest statement: D. Henneman and other co-authors have no conflict of interest.

References

1. Ogden CL, Caroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. JAMA 2006;295(13):1549-55.
2. World Health Organization. Life in the 21st Century-a vision for all. The World Health Report. Geneva, Switzerland: World Health Organization; 1998.
3. Li Z, Bowerman S, Heber D. Health ramifications of the obesity epidemic. Surg Clin North Am. 2005;85(4):681-701.
4. Buchwald H, Estok R, Fahrbach K, Banel D, Jensen MD, Pories WJ, et al. Weight and type 2 diabetes after bariatric surgery: systematic review and meta- analysis. Am J Med 2009;122(3):248-56.
5. Flum DR, Belle SH, King WC, Wahed AS, Berk P, Chapman P et al. Perioperative Safety in the longitudinal assessment of bariatric surgery. N Engl J Med 2009; 361(5):445-51.
6. Durak E, Inabnet WB, Schrope B, Davis D, Daud A, Milone L et al. Incidence and management of enteric leaks after gastric bypass for morbid obesity during a 10-year period. Surg Obes Relat Dis 2008(4);389-93.
7. Hamdan K, Somers S, Chand M. Management of late postoperative complications of bariatric surgery. Br J Surg 2011 Oct;98(10):1345-55.
8. Hamilton EC, Sims TL, Hamilton TT, Mullican MA, Jones DB, Provost DA. Clinical predictors of leak after laparoscopic Roux-en-Y gastric bypass for morbid obesity. Surg Endosc 2003; 17:679-84.
9. Mason EE, Ito C. Gastric Bypass in obesity. Surg Clin North Am. 1967 Dec;47(6), 1345-51.
10. Santry HP, Gillen DL, Lauderdale DS. Trends in bariatric surgical procedures. JAMA 2005; 294:1960-64.
11. Tice JA, Karliner L, Walsh J. Gastric Banding or bypass? A systematic review comparing the two most popular bariatric procedures. Am J Med 2008 Oct; 121(10):885-93 .
12. Kothari SN. Bariatric Surgery and Postoperative Imaging. Surg Clin N Am 2011;155-72.
13. Ganci-Cerrud G, Herrera MF. Role of Radiologic Contrast Studies in the Early Postoperative Period After Bariatric Surgery. Obes Surg 1999;9:532-34.

14. Serafini F, Anderson W, Ghassemi P, Poklepovic J, Murr MM. The Utility of Contrast Studies and Drains in the Management of Patients After Roux-en-Y Gastric Bypass, Obes Surg 2002; 12: 34-38.
15. Blachar A, Federle MP, Pealer KM et al, Ikramuddin S, Schauer PR. Gastrointestinal Complications of Roux-en-Y Gastric Bypass Surgery: Clinical and Imaging Findings. Radiology 2002; June: 625-32.
16. Singh R, Fisher BL. Sensitivity and Specificity of Postoperative Upper GI Series Following Gastric Bypass. Obes Surg 2003; 13: 73-75.
17. Sims TL, Mullican MA, Hamilton EC, Provost DA, Jones DB. Routine Upper Gastrointestinal Gastrografin Swallow after laparoscopic Roux-en-Y Gastric Bypass. Obes Surg 2003; 13: 66-72.
18. Lyass S, Khalili T, Cunneen S, Fujita F, Otsuka K, Chopra R et al. Radiological Studies after Roux-en-Y Gastric Bypass: Routine or Selective? Am Surg 2004;70(Oct):918-21.
19. Carter JT, Tafreshian, Campos GM, Tiwari U, Herbella F, Cello JP et al. Routine upper GI series after gastric bypass does not reliably identify anastomotic leaks or predict stricture formation. Surg Endosc 2007;21:2172-77.
20. Madan AK, Stoecklein HH, Ternovits CA, Tichansky DS, Phillips JC. Predictive value of upper gastrointestinal series versus clinical signs for gastrointestinal leaks after laproscopic gastric bypass. Surg Endosc 2007;21:194-96.
21. Doraiswamy A, Rasmussen JJ, Pierce J, Fuller W, Ali MR. The utility of routine postoperative upper GI series following laparoscopic gastric bypass. Surg Endosc 2007;21:2159-62.
22. Schiesser M, Guber J, Wildi S, Guber I, Weber A, Muller MK. Utility of Routine Versus Selective Upper Gastrointestinal Series to Detect Anastomotic Leaks After Laparoscopic Gastric Bypass. Obes Surg 2010;Sep 26 (Epub ahead of print).
23. Yu J, Turner MA, Cho S, Fulcher AS, DeMaria EJ, Kellum JM et al. Normal anatomy and complications after Gastric Bypass Surgery: Helical CT findings. Radiology 2400; 231:753-60.
24. Lee SD, Khouzam MN, Kellum JM, DeMaria EJ, Meador JG, Wolfe LG et al. Selective, versus routine, upper gastrointestinal series leads to equal morbidity and reduced hospital stay in laparoscopic gastric bypass patients. Surg Obes Rel Dis 2007;3:413-16.
25. Gonzalez R, Sarr MG, Smith CD, Baghai M, Kendrick M, Szomstein S et al. Diagnosis and Contemporary Management of Anastomotic Leaks after Gastric Bypass for Obesity. J Am Coll Surg 2007 Jan;204(1):47-55.
26. Carucci LR, Turner MA, Concklin RC, DeMaria EJ,Kellum JM, Sugerman HJ. Roux-en-Y Gasstric Bypass for Morbid Obesity: Evaluation of Postoperative Extraluminal Leaks with Upper Gastrointestinal Series. Radiology 2006; 238(1):119-27.
27. Ballesta C, Berindoague R, Cabrera M, Palau M, Gonzalez M. Management of Anastomotic Leaks After Laparoscopic Roux-en-Y Gastric Bypass. Obes Surg 2008;18:623-30.
28. Cho M, Pinto D, Carrodeguas L, Lascano C, Soto F, Whipple O et al. Frequency and management of internal hernias after laparoscopic antecolic antegastric Roux-enY gastric bypass without division of the small bowel mesentery or closure of mesenteric defects: review of 1400 consecutive cases. Surg Obes Rel Dis 2006;2(2):87-91.
29. Higa KD, Ho T, Boone KB. Internal Hernias After Laparoscopic Roux-en-Y gastric Bypass: Incidence, Treatment and Prevention. Obes Surg 2003;13:350-54.
30. Steele KE, Prokopowicz GP, Magnuson T, Lidor A, Schweitzer M. Laparoscopic antecolic Roux-en-Y gastric bypass with closure of internal defects leads to fewer internal hernias than the retrocolic approach. Surg Endosc 2008;22:2056-61
31. O'Rourke RW. Management Strategies for Internal Hernia after Gastric Bypass. J Gastrointest Surg 2011;15:1049-54.
32. Marchini AK, Denys A, Paroz A, Romy S, Suter M, Desmartines N et al. The Four Different Types of Internal Hernia Occuring After Laparoscopic Roux-en-Y Gastric Bypass Performed for Morbid Obesity: Are There Any Multidetector Computed Tomography (MDCT) Features permitting Their Distinction? Obes Surg 2011;21:506-16.
33. Iannuccilli JD, Grand D, Murphy BL, Evangelista P, Roye GD, Mayo-Smith W. Sensitivity and specificity of eight CT signs in the preoperative diagnosis of internal mesenteric hernia following Roux-en-Y gastric bypass surgery. Clin Radiol 2009;64(4):373-80.
34. Lockhart ME, Tessler FN, Canon CL, Smith JK, Larrison MC, Finberg NS et al. Internal Hernia After Gastric Bypass: Sensitivity and Specificity of Seven CT Sign with Surgical Correlation and Controls. AJR 2007; 188:745-50.
35. Gunabushanam G, Shankar S, Czerniach DR, Kelly JJ, Perugini RA. Small-Bowel Obstruction After Laparoscopic Roux-en-Y Gastric Bypass Surgery. J Comput Assist Tomogr 2009;33:369-75.
36. Garza E jr, Kuhn J, Arnold D, Nicholson W, Reddy S, McCarty T. Internal hernias after laparoscopic Roux-en-Y gastric bypass. Am J Surg 2004;188(6):796-800.
37. Paroz A, Calmes JM, Giusti V, Suter M. Internal Hernia After Laparoscopic Roux-en-Y Gastric Bypass for Morbid Obesity: A Continuous Challenge in Bariatric Surgery.Obes Surg 2006;16:1482-87.
38. Reddy SA, Yang C, McGinnis LA, Seggerman RE, Garza E, Ford KL 3rd. Diagnosis of transmesocolic Internal Hernia as a Complication of Retrocolic Gastric Bypass: CT Imaging Criteria. AJR 2007;189:52-55.
39. Ahmed AR, Rickards G, Johnson J, Boss T, O'Malley W. Radiological Findings in Symptomatic Internal Hernias After Laparoscopic Gastric Bypass. Obes Surg 2009;19:1530-35.
40. Al-Sukaiti R, Stein L, Christou N, Mesurolle B, Artho GP. Imaging of Small Bowel Obstruction following Gastric Bypass Surgery for Morbid Obesity. SQU Med J 2010 Dec;10(3):354-60.
41. Cassar K, Munro A. Iatrogenic Splenic Injury. J R Coll Surg Edin 2002, Dec:731-41.
42. Peters TG, Steinmetz SR, Cowan Jr GS. Splenic Injury and Repair During Bariatric Surgical Procedures. South Med J 1990; 83(2):166-69.
43. Jansen JO, Yule SR, Loudon MA. Investigation of blunt abdominal trauma. BMJ 2008; 336:938-42.