CASE REPORT

Dual incarcerated internal hernias after laparoscopic total gastrectomy with Roux-en-Y reconstruction for gastric cancer

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SUMMARY

Internal hernia postgastrectomy is an exceedingly rare complication especially in the laparoscopic cohort of patients. Different types of internal hernias have been described, of which, Petersen's and jejunojejunostomy mesenteric defect hernias are the most commonly encountered followed by oesophageal defect and transverse colon mesocolic defect hernias. As the early presentation is always non-specific, late diagnosis of internal hernia has significant implication on morbidity and mortality. Here, we present a rare case of a patient with previous laparoscopy-assisted total gastrectomy presented with features of impending bowel obstruction and bowel ischaemia secondary to dual incarcerated internal hernias. We also reviewed the literature focusing on clinical features of internal hernia, essential CT findings and preventive measures.

BACKGROUND

Laparoscopic gastrectomy with Roux-en-Y reconstruction is increasingly preferred in most centres for the management of gastric cancer.^{1–4} Nevertheless, robust data on complication arising from internal hernias are limited despite much interest. In contrast, internal hernia following laparoscopic gastric bypass with Roux-en-Y reconstruction is a recognised complication, ranging from 3.1% to 9.7%.⁵ Several series have reported their incidence in various internal hernia postlaparoscopic gastrectomy, ranging from <1% to 7%.^{1–6} However, the incidence of internal hernia might be clouded as these series included a mixture of cases of distal gastrectomy and total gastrectomy. Its incidence in laparoscopy-assisted total gastrectomy is believed to be even rarer <0.1%.⁶ Furthermore, most evidence available is reported from the Asian literature.^{1–3 6–8}

Internal hernia can be classified as the following: (1) transverse colon mesocolic defect, (2) Petersen's defect—the potential space between the mesentery of the ascending Roux limb and the transverse mesocolon, (3) jejunojejunostomy mesenteric defect, and (4) oesophageal defect. Internal hernia can potentially lead to incarceration, bowel obstruction and subsequently bowel ischaemia which carry a high morbidity and mortality rate.

We here describe a rare case of dual incarcerated internal hernias (Petersen's and hiatus) 24 months postlaparoscopy-assisted total gastrectomy, requiring emergency laparotomy. The published literature is also reviewed with a focus on the incidence of

various internal hernias, identifying early red flags for early management to prevent morbidity and mortality and possible strategies in the prevention of internal hernia postlaparoscopic gastrectomy with Roux-en-Y reconstruction.

CASE PRESENTATION

A 62-year-old man presented to the emergency department following a rapid onset of epigastric pain 15 min after meal. The abdominal pain was described as constant, non-radiating and sharp in nature with associated nausea but no vomiting. He opened his bowels 1 day ago and has not passed any flatus since. He denies any change in bowel habits. He denied any dyspnoea, chest pain, fevers or rigors. Important medical history includes laparoscopy-assisted total gastrectomy with Roux-en-Y reconstruction (antecolic) 2 years ago for a moderately differentiated gastric adenocarcinoma (grade 3, pT3 pN0 Mx). In his previous surgery, it was noted that a moderate size hiatus hernia was also repaired. His previous adjuvant chemotherapy was 6 months ago. Gastroscopy postoperatively showed satisfactory lumen space. He also reported losing 40 kg postlaparoscopy-assisted total gastrectomy.

On examination, vital signs were stable and he was afebrile. His abdomen was not distended, soft with mild epigastric tenderness. There were no signs of peritonism. Biochemistry test was unremarkable with normal white cell count and C reactive protein level. Chest X-ray (figure 1A) showed evidence of a large hiatus hernia with small bowel loops intrathorax but no evidence of bowel obstruction. Abdominal X-ray (figure 1B) did not

Figure 1 (A) Erect chest x-ray showing a large hiatus hernia containing loops of small bowels (arrow). (B) Erect abdominal x-ray showing faecal loading and no features of bowel obstruction or perforation.

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Figure 2 (A) Coronal view of CT abdomen/pelvis demonstrating the proximal superior mesenteric artery with a short length of narrowing to the left of the midline (arrow). (B) Coronal view of CT abdomen/pelvis showing an abrupt change of calibre of superior mesenteric vein with a collapsed segment between two distended portions (arrow).

Figure 3 (A) Sagittal view of the CT abdomen/pelvis showing the whirl sign where there is swirling of the vessels (arrow). (B) Axial view of the CT abdomen/pelvis demonstrating the crowding of the mesentery, signifying marked oedema of the mesentery (arrow).

reveal any features of perforation or obstruction with some features of faecal loading.

INVESTIGATIONS

His abdomen progressively became more tender at epigastric region with associated diaphoresis and tachycardia. A CT scan of abdomen/pelvis (figures 2 and 3) was organised, demonstrated concerning features suggestive of a mesenteric volvulus and/or internal hernia with resultant venous ischaemia causing a gross mesenteric oedema, but no features of bowel mural thickening.

TREATMENT

An emergency midline exploratory laparotomy was performed. Intraoperatively, the entire length of small bowel was found to have herniated and incarcerated through a Petersen's defect and into the hiatus hernia. Small amount of free fluid was also seen. The herniated small bowel was reduced. The small bowel was inspected and was viable. The Petersen's defect was repaired with 3/0 interrupted polydioxanone sutures.

OUTCOME AND FOLLOW-UP

Postoperatively, the patient recovered progressively and was discharged on day 7.

DISCUSSION

In this era of minimally invasive surgery, laparoscopic gastrectomy with Roux-en-Y reconstruction for gastric cancers is favoured over open surgery due to its multiple benefits of quicker recovery, lesser pain, better cosmetic outcomes and equivalent long-term oncological outcomes.⁶ For the past decade, internal hernia is well recognised as a complication postlaparoscopic gastric bypass with Roux-en-Y reconstruction but it is uncommonly encountered in laparoscopic gastrectomy with Roux-en-Y reconstruction. The incidence is thought to be <0.1%. Several studies have also reported higher incidence of internal hernia in the laparoscopic group than in the open group.^{1 3 9} As the incidence of gastric cancer is significantly lower in the western demographics, laparoscopic gastrectomies are infrequently performed and therefore there is less experience dealing with potential complications such as internal

Table 1 A summary of the available evidence of occurrence of various internal hernias postgastrectomy and its outcomes

No	Author/Year/Country/Reference	Procedure (n)	Type of hernia (n)	Overall percentage	Interval to development	Outcome
1	Piciuchi <i>et al</i> /2010/Italy ¹¹	Partial gastrectomy (n=1)	ED (hiatus hernia)	—	3 months	NA
2	Larkin <i>et al</i> /2011/Ireland ¹²	Radical total gastrectomy with RY (n=1)	JJMD	—	10 months	Small bowel preserved
3	Hosoya <i>et al</i> /2011/Japan ¹	LADG (antecolic) (n=129) LATG (antecolic) (n=44)	LADG: 2 JJMD LATG: 2 JJMD	2.31% (4/173)	LADG: 402 days (mean) LATG: 250 days (mean)	LATG: one case required reoperation secondary to leakage No morbidity or mortality
4	Miyagaki <i>et al</i> /2012/Japan ⁶	ODG (n=4756) OTG (n=2748) OPG (n=217) LADG (n=1028) LATG (n=218) LAPG (n=16)	ODG: 5 OTG: 7 OPG: 0 LADG: 3 LATG: 3 LAPG: 0 PD: 8 JJMD: 8 TCMD: 1 ED: 1	0.2% (18/8983)	Overall: 411 days (3–3437 days) (median)	Bowel resection in three cases Short bowel syndrome in one case No mortality
5	Kelly <i>et al</i> /2013/US ⁹	ODG (n=99) OTG (n=165) LADG (n=16) LATG (n=18)	ODG: 1 OTG: 10 LADG: 1 LATG: 4 PD: 7 JJMD: 7 Unknown: 2	5% (16/298) ► Open: 4% ► Lap: 15%	15.1 months (median)	Two deaths and two short gut syndrome
6	Yoshikawa <i>et al</i> /2014/Japan ³	ODG (n=NA) OTG (n=NA) LADG (n=NA) LATG (n=NA)	ODG: 3 OTG: 3 LADG: 2 LATG: 4 PD: 5 JJMD: 5 TCMD: 1	2.8% (12/428) ► Open: 2.4% ► Lap: 3.3%	Overall 20.6 months (1–63 months)	
7	Kojima <i>et al</i> /2014/Japan ⁴	LADG (n=238) LATG (n=120)	Total of 6 (not specified)	1.67% (6/358)	Overall: 351 days (mean)	LATG: one case of reoperation due to leakage No mortality
8	Murata <i>et al</i> /2014/Japan ⁷	OTG (retrocolic) (n=1)	ED (hiatus hernia)	—	2 days	Two metres of small bowel and transverse colon preserved
9	Kimura <i>et al</i> /2015/Japan ²	LADG n=257 LATG n=98	PD: 7 JJMD: 5 TCMD: 3	4.2% (15/355)	Antecolic group: 36.1 months (median) Retrocolic group: 8.4 months (median)	Two cases of small bowel resection in TCMD (one died from DIC); Another two deaths—one from cancer and one from DIC after recurrence of internal hernia at JJMD
10	Baba <i>et al</i> /2015/Japan ⁸	OTG (antecolic) (n=2)	Case 1: PD Case 2: PD	—	Case 1: 12 months Case 2: 18 months	Case 1: small bowel preserved Case 2: small bowel preserved
11	Santos <i>et al</i> /2016/Brazil ¹³	LATG (n=1)	ED (hiatus hernia)	—	60 days	Thirty centimetres of ischaemic small bowel resected with primary anastomosis
12	Tashiro <i>et al</i> /2016/Japan ¹⁴	OTG (antecolic)	ED (hiatus hernia)	—	2 days	Roux limb and transverse colon preserved
13	Gonzalo <i>et al</i> /2016/Spain ¹⁵	Total gastrectomy, lower esophagectomy with RY (antecolic)	ED (hiatus hernia)	1	30 days	Small and large bowels preserved
14	Matthews <i>et al</i> /2016/UK ¹⁰	OTG n=120 LATG n=5	ED	Total 3.2% (4/125)	NA	NA

DIC, disseminated intravascular coagulation; ED, esophageal defect; JJMD, jejunojejunostomy mesenteric defect; LADG, laparoscopic-assisted distal gastrectomy; LAPG, laparoscopic-assisted proximal gastrectomy; LATG, laparoscopic-assisted total gastrectomy; NA, not available; ODG, open distal gastrectomy; OPG, open proximal gastrectomy; OTG, open total gastrectomy; PD, Petersen's defect; RY, Roux-en-Y reconstruction; TCMD, transverse colon mesocolic defect.

hernia. In fact, only two western series are reported in the literature.^{9 10}

To the best of our knowledge, this is the first report of a dual incarcerated internal hernias postlaparoscopy-assisted total gastrectomy for gastric cancer in the literature. From our review of the various internal hernias, jejunojunostomy mesenteric defect and Petersen's defect are the most common followed by oesophageal defect and finally transverse colon mesocolic defect. The reported case and other case series are presented in table 1.^{1-4 6-15}

A few potential risk factors are found to be associated with the occurrence of internal hernia: (1) laparoscopic surgery reduces the formation of adhesions due to less handling of bowels, (2) weight loss as a result of the surgery reduces the mesenteric fat and accelerates the increase of the size of the mesenteric defect,⁶ (3) men are more likely to have internal hernia and (4) retrocolic limb Roux-en-Y reconstruction is associated with higher incidence of internal hernia than antecolic limb in a few series.³ Internal hernia secondary to retrocolic technique is associated with higher rates of bowel resections.³

The duration of development of internal hernia from the index surgery ranges from 2 days to 9 years. Nonetheless, majority of the series report the occurrence of internal hernia from 12 to 36 months (table 1).

Internal hernias are known to be a challenge to diagnose and majority present in an emergency setting.⁹ The initial presentation is usually non-specific and requires a high clinical suspicion. Patients may have symptom of postprandial upper abdominal pain, nausea and vomiting. Occasionally, patients may provide a history of intermittent abdominal pain that maybe due to interval herniation that spontaneously reduces. On clinical examination, findings of tachycardia and fever should raise suspicious of bowel compromise.³ Biochemistry examination maybe unremarkable until late progression in which leucocytosis, raised C reactive protein and lactate levels would be observed. Elevation of pancreatic enzymes could indicate biliopancreatic limb obstruction.³ In terms of imaging, CT scan has become the mainstay in excluding other intra-abdominal causes, identifying the internal hernia and provides valuable information for pre-operative planning. Key CT findings of internal hernias are engorged and/or crowded mesenteric vessels, displacement of the main mesenteric trunk outside the lateral margin of the aorta by more than the diameter of the aorta, twisted

appearance of small bowel and whirl sign. Whirl sign is defined as the strangulation of the superior mesenteric artery and superior mesenteric vein and has about 70–80% sensitivity and specificity in predicting internal hernia (positive in 15% and 78% of cases, respectively, in Yoshikawa *et al*'s³ and Miyagaki *et al*'s⁶ series). Other important indicators of bowel ischaemia include bowel wall thickening and ascites. Mild ascites was present in our case but there was no bowel wall thickening.

Surgical management by exploratory laparotomy is the preferred approach. Only two cases have been managed via laparoscopic approach.⁶ Intraoperatively, the incarcerated bowel is reduced and assessed for its viability. Bowel resection with primary anastomosis maybe required in certain cases. Nevertheless, majority of patients that require bowel resection recover well according to various reports in the literature. Three cases of short gut syndrome and four cases of mortality have been reported.^{2 6 9} Depending of the location of internal hernia, a primary repair is usually performed for Petersen's defect, jejunojunostomy mesenteric defect and transverse colon mesocolic defect with nonabsorbable sutures. The oesophageal defect (ie, hiatus hernia) is in a unique situation. Primary repair with non-absorbable sutures can be considered if the defect is relatively small. In our case, we decided not to perform a primary repair (with mesh) due to the significant size of defect (figure 4), previous history of hiatus hernia repair, and presence of free fluid (which may contaminate mesh if placed). If primary suture repair is not feasible, we recommend elective mesh repair by a specialist unit. Of the cases reported in the literature, most performed primary suture repair except for Gonzalo *et al*¹⁵ who performed a mesh repair in the second surgery during the same admission for hiatus hernia.^{7 11 13 14} It was not specified in Matthews *et al*'s¹⁰ series how the four cases of oesophageal defect were repaired.

As part of the Roux-en-Y reconstruction, iatrogenic mesenteric defects are created as aforementioned. It is still an area of contention if these defects should be closed during the index surgery as prevention. Some studies have demonstrated lower occurrence of internal hernia after a switch in practice by closing the defects (table 2).^{1 2 4} A large Japanese study revealed a significant reduction in incidence of internal hernia (jejunojunostomy mesenteric defect; 0% vs 3.4%, $p=0.01$) and a similar trend in Petersen's defect.² In Miyagaki *et al*'s series,⁶ they do not close Petersen's space and opinioned that if the

Figure 4 (A and B) Coronal and axial views of CT chest showing hiatus hernia with herniated small bowel loops.

Table 2 A comparison between the internal hernia occurrence rate between the no closure group and closure group

N	Author/reference	No closure (n)/ internal hernia (n)	Closure (n)/ internal hernia (n)
1	Hosoya <i>et al</i> ¹	58/4 (7%)	115/0 (0%)
2	Kojima <i>et al</i> ⁴	268/6 (2.2%)	90/0 (0%)
3	Kimura <i>et al</i> ²	▶ 250/7 (2.8%)	▶ 105/0 (0%)
	▶ Petersen's defect	▶ 149/5 (3.4%)	▶ 206/0 (0%)
	▶ Jejunojejunostomy mesenteric defect	▶ 122/0 (0%)	▶ 233/3 (1.3%)
	▶ Transverse mesocolic defect		

orifice is not closed, it should be left large to allow transposition of small bowel and avoid incarceration.

Finally, there is limited data on the long-term follow-up of these patients in recurrence of internal hernia. Only Hosoya *et al*¹ reported no recurrence of internal hernia (mean follow-up of 719 days).

Learning points

- ▶ Internal hernia postgastrectomy remains a rare complication. The possible diagnosis of internal hernia should always be considered in any patient with background of gastrectomy that presents with abdominal pain.
- ▶ CT scan is considered the most helpful in diagnosis and preoperative planning of internal hernia in patients with background of laparoscopic total gastrectomy with Roux-en-Y reconstruction.
- ▶ The definitive management for internal hernia is surgical intervention. Further studies are required to assess the efficacy of closure of the defects during the index surgery and long-term follow-up is desired to evaluate the recurrence rate of internal hernia.

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