Clinical Spectrum of Internal Hernia: A Surgical Emergency

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Abstract

Purpose. To define the indicators of bowel ischemia caused by congenital or acquired internal hernia, based on our 10-year experience in one center.

Methods. We reviewed the medical records, imaging studies, and operative findings of 20 patients who underwent surgery for an internal hernia at our medical center between 1995 and 2005. The clinical characteristics and related indicators of the patients with, and those without bowel ischemia were compared and analyzed statistically.

Results. The subtypes of congenital internal hernia (CIH) included transmesenteric ($n = 6$, 60%), paraduodenal ($n = 2$, 20%), and pericecal ($n = 2$, 20%) hernia. The abdominal surgical procedures preceding acquired internal hernia (AIH) were Roux-en-Y anastomosis ($n = 6$, 60%) and appendectomy ($n = 3$, 30%). Transmesenteric hernia was the most prevalent type of CIH in children. Abdominal rebound tenderness, advanced leukocytosis ($>18\,000/mm^3$), or a high level of manual band form ($>6\%$) were the positive predictive factors for bowel ischemia, whereas a history of chronic intermittent abdominal pain was a negative indicator. No recurrence was noted during the 10-year study period. The overall mortality rate was 20%, attributable to enteral bacteria sepsis in all cases.

Conclusion. Internal hernia is a rare but lethal condition. Early diagnosis and prompt surgical intervention provide the only chance of a successful outcome.

Key words Internal hernia · Small-bowel obstruction · Indicator · Bowel ischemia

Introduction

Internal hernia is defined as a protrusion of abdominal viscera, most commonly small bowel, into a normal or abnormal aperture within the abdominal and pelvic cavity.[1–9] According to autopsy reports, the incidence of internal hernia ranges from 0.2% to 0.9%,[4,10,11] and various investigators have found that it causes 0.6%–5.8% of all small bowel obstructions.[8,12–18] The orifice of a congenital internal hernia (CIH) is usually created by abnormal rotation of the bowel during the embryonic period, but it can also be caused by a pre-existing anatomic structure. Many types of CIH have been reported, including paraduodenal, transmesenteric, pericecal, transmesosigmoid, supra- or perivesical, Winslow's foramen, omental hernia, and rarely, hernia through the broad ligament, the mesoappendix, or the mesentery of a Meckel's diverticulum.[1,3,9,17,19–22] In contrast, acquired internal hernia (AIH) arises from a prior surgically created entrapment such as a Roux-en-Y anastomosis, inflammation or infectious process, and trauma.[1,18] We conducted this retrospective study to establish the related indicators of bowel ischemia in patients who underwent surgery for an internal hernia in our institution during a 10-year period.

Patients and Methods

We reviewed the medical records of 1 827 patients who underwent surgery for small- or large-bowel obstruction between February 1995 and January 2005 at the Changhua Christian Hospital, a 1 500-bed medical center in central Taiwan. A preoperative diagnosis of internal hernia was suspected in 51 of these patients, based on their clinical signs and symptoms. Fifteen of the 51 patients were excluded from this retrospective study, either because they had negative operative findings ($n = 1$) or because they were treated nonsurgically

(*n* = 14). Another 16 patients were excluded because their final postoperative diagnosis was herniation outside the abdominal cavity; as lumbar hernia in 4 patients, obturator hernia in 3, and incisional hernia in 9. Thus, we analyzed 20 patients with a definitive postoperative diagnosis of internal hernia.

An AIH was diagnosed if the patient had undergone previous abdominal surgery or if their condition could have been related to a secondary underlying cause, such as infection. The type of AIH was classified based on the previous surgical method used or on the specific type of secondary cause. A CIH was diagnosed if the patient did not have a history of related abdominal surgery or a secondary cause. The type of CIH was classified based on the location of the herniation orifice. All laboratory data analyzed in this series were the initial findings when the patients presented to our hospital. Complete blood counts with a differential count were done in all patients, but the serum level of C-reactive protein (CRP) was checked in only seven patients. Advanced leukocytosis (white blood cell count >18000/mm^3) and a high level of manual band form (band >6%) were taken as signs of severe inflammation or infection. The cutoff value was twice the upper limit of the normal range. All imaging studies, including anteroposterior view of abdominal plain films and abdominal computed tomography (CT) enhanced by intravenous contrast material, were reinterpreted by an experienced senior radiologist unaware of the postoperative diagnosis or findings.

All patients in this series were divided into a bowel ischemia group and a bowel nonischemia group according to the intraoperative findings. We compared the clinical characteristics between these two groups to analyze the indicators of bowel ischemia caused by an internal hernia. The continuous variables, including age, serum CRP, interval between operations, and length of hospital stay, are all expressed as means and the standard deviation (Mean ± SD). Statistical analyses were carried out by the Fisher Exact Test and the Mann–Whitney *U*-test. Possibility levels of less than 0.05 were considered significant.

Results

Internal hernias were confirmed intraoperatively in 20 patients (5 children and 15 adults): as CIH in 10 and as AIH in 10. The types and demographics of the internal hernias are listed in Table 1. Of the ten CIHs, six were transmesenteric hernias, including four defects in the small bowel mesentery and two defects in the transverse mesocolon. An associated anomaly was found in three of the children with a transmesenteric hernia, and included a duodenal web in one girl and malrotation in two boys. Roux-en-Y anastomosis was the most common cause of AIH, followed by appendectomy. Roux-en-Y anastomosis had been performed in six adults: for gastric cancer in two and for a perforated peptic ulcer in four. AIH associated with prior appendectomy was caused by part of the small bowel protruding through a band near the appendiceal stump in three patients. An 80-year-old man without a history of abdominal surgery presented with abdominal rebound tenderness and evidence of tuberculosis infection. He underwent a laparotomy for symptoms and signs of acute bowel obstruction, which revealed 50 cm of intestine herniating through a band between the ascending colon and nearby omentum.

The clinical indicators of bowel ischemia caused by an internal hernia are summarized in Table 2. Patients have significant risk of small-bowel ischemia if they present with one of the two following characteristics: abdominal rebound tenderness, and advanced leukocytosis or a high level of manual band form (both *P* < 0.05). In contrast, a history of chronic intermittent abdominal pain was more common in the nonischemia group (*P* = 0.017). All patients had at least one abdominal plain X-ray done, which showed a small-

Table 1. Type and demographics of internal hernias

	Child			Adult			Total		
Cause	No. (%)	Age (years) (Mean ± SD)	Sex (M:F)	No. (%)	Age (years) (Mean ± SD)	Sex (M:F)	No. (%)	Age (years) (Mean ± SD)	Sex (M:F)
Congenital									
Left PDH	0	0	0	2 (13.3)	48.0 ± 33.9	1:1	2 (10)	48.0 ± 33.9	1:1
TMH	4 (80)	8.5 ± 5.4	2:2	2 (13.3)	81.0 ± 5.7	1:1	6 (30)	32.7 ± 37.8	3:3
PCH	0	0	0	2 (13.3)	43.5 ± 3.5	0:2	2 (10)	43.5 ± 3.5	0:2
Acquired									
OH-TB	0	0	0	1 (6.7)	80	1:0	1 (5)	80	1:0
R-en-Y	0	0	0	6 (40)	63.8 ± 19.7	5:1	6 (30)	63.8 ± 19.7	5:1
App	1 (20)	16	1:0	2 (13.3)	57.0 ± 24.0	0:2	3 (15)	43.3 ± 29.1	1:2
Total	5 (100)	10.0 ± 5.8	3:2	15 (100)	61.5 ± 20.5	8:7	20 (100)	48.6 ± 29.0	11:9

PDH, paraduodenal hernia; TMH, transmesenteric hernia; PCH, pericecal hernia; R-en-Y, Roux-en-Y anastomosis reconstruction; App, appendectomy; OH-TB, omental hernia related to tuberculosis infection

Table 2. Clinical indicators of bowel ischemia caused by an internal hernia

Characteristics	Ischemia No. (%)	Nonischemia No. (%)	P value
Cause	n = 11	n = 9	
Congenital internal hernia	5 (45.5)	5 (55.6)	1.000
Acquired internal hernia	6 (54.5)	4 (44.4)	1.000
History			
Chronic constipation	8 (72.7)	9 (100)	0.218
Chronic intermittent abdominal pain	1 (9.7)	6 (66.7)	0.017*
Symptoms and signs			
Acute abdominal pain	11 (100)	9 (100)	—
Nausea or vomiting	10 (90.9)	7 (77.8)	0.566
Bloody or tarry stool	2 (18.2)	0 (0)	0.479
Fever	6 (54.5)	2 (22.2)	0.197
Rebound tenderness	7 (63.6)	1 (11.1)	0.028*
Shock in the emergency department	3 (27.3)	3 (33.3)	1.000
Laboratory tests			
Advanced leukocytosis or high level of manual band form[a]	7 (63.6)	1 (11.1)	0.028*
C-reactive protein[b], mg/l (Mean ± SD)	156 ± 207	5 ± 5	0.245
Image studies			
Abdominal plain film			
Small-bowel obstruction	11 (100)	8 (88.8)	0.449
Pneumoperitoneum	2 (18.2)	0 (0)	0.485
Abdominal CT scan[c]	n = 8	n = 6	
Small-bowel cluster	4 (50.0)	3 (50.0)	1.000
Transitional zone	4 (50.0)	1 (16.7)	0.301
Whirl sign	2 (25.0)	1 (16.7)	1.000
Pneumatosis intestinalis[d]	3 (37.5)	0 (0)	0.209
Ascites	7 (87.5)	2 (33.3)	0.091

CT, computed tomography
[a] Advanced leukocytosis was defined as white blood cell count >18 000/mm^3; a high level of manual band form was defined as Band >6%. Patients with any one of the above two criteria were included
[b] Only five patients in the ischemia group and two in the non-ischemia group were checked
[c] Only 14 patients underwent abdominal CT scan
[d] No patient had history of chronic obstructive pulmonary disease, an idiopathic cause of pneumatosis intestinalis
* Significant, $P < 0.05$

Table 3. Intraoperative findings of the different types of internal hernia

Intraoperative findings	PDH n = 2	TMH n = 6	PCH n = 2	R-en-Y n = 6	App n = 3	OH-TB n = 1
Bowel ischemia, No. (%)	0 (0)	4 (66.7)	1 (50)	3 (50)	3 (100)	0 (0)
Perforation, No. (%)	0 (0)	1 (16.7)	0 (0)	3 (50)	0 (0)	0 (0)
Volvulus, No. (%)	0 (0)	1 (16.7)	0 (0)	0 (0)	2 (66.7)	0 (0)
Malrotation, No. (%)	0 (0)	2 (33.3)	0 (0)	0 (0)	0 (0)	0 (0)
Intestinal resection, No. (%)	0 (0)	3 (50.0)	1 (50)	3 (50)	3 (100)	0 (0)

PDH, Paraduodenal hernia; TMH, Transmesenteric hernia; PCH, pericecal hernia; R-en-Y, Roux-en-Y anastomosis reconstruction; App, appendectomy; OH-TB, omental hernia related to tuberculosis infection

bowel obstruction in 95%. Fourteen patients underwent abdominal CT scan with intravenous contrast material. A senior radiologist identified the diagnostic indicators of internal hernia on these abdominal CT scans (Fig. 1). The CT findings of the patients with, and those without bowel ischemia were not significantly different (Table 2).

Precipitating factors of internal hernia were suspected in three patients. A 15-year-old boy was brought to our emergency department with severe acute abdominal pain 12h after completing a track event at school. The other two patients presented with acute abdominal pain after eating a large meal. One had a congenital left paraduodenal hernia; the other had a history of gastrectomy and Roux-en-Y anastomosis for a perforated peptic ulcer.

Table 3 lists the intraoperative findings in the patients with CIH and in those with AIH. The mean interval between prior abdominal surgery and reduction of the AIH was 10.3 ± 11.4 years (range, 1–30 years) and the
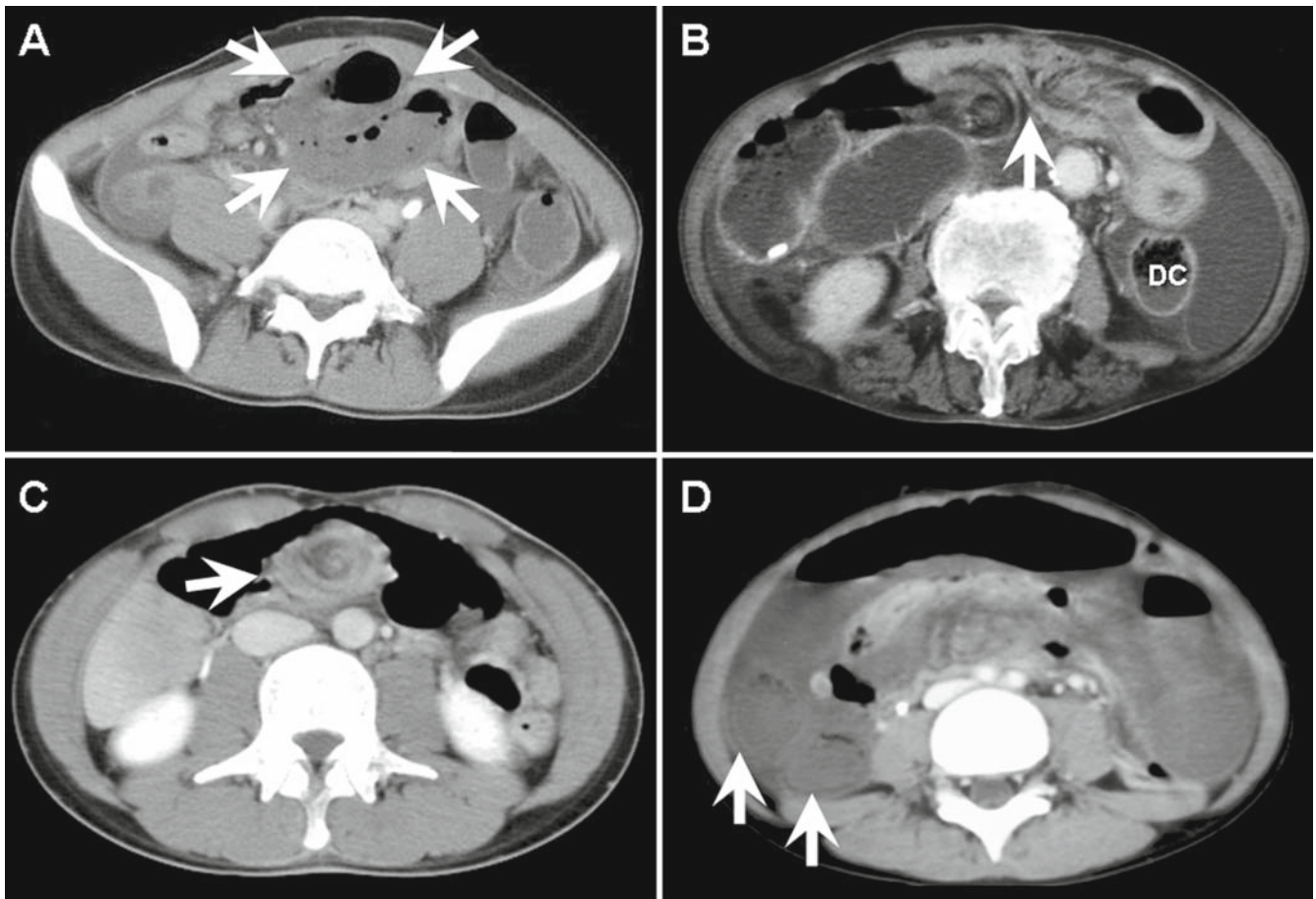
Fig. 1A–D. Diagnostic indicators of internal hernia seen on abdominal computed tomography (CT) scans. **A** A cluster of small bowel (*arrows*). **B** Medial displacement of the descending colon (*DC*). The *arrow* indicates the transitional zone. **C** Whirl sign (*arrow*). **D** Pneumomatosis intestinalis (*arrows*)

Table 4. Hospital course and prognosis

Characteristics	Ischemia $n = 11$	Nonischemia $n = 9$	P value
Hospital course			
No. of patients admitted to ICU (%)	10 (90.9)	2 (22.2)	0.005*
Days in ICU (Mean ± SD)	5.7 ± 6.2	1.7 ± 4.6	0.007*
Length of hospital stay, days (Mean ± SD)	17.5 ± 10.1	19.3 ± 13.8	0.909
Prognosis			
Short bowel syndrome; no. of patients (%)	0 (0)	0 (0)	—
Mortality; no. of patients (%)	3 (27.3)	1 (11.1)	0.591
Recurrence; no. of patients (%)	0 (0)	0 (0)	—

ICU, intensive care unit
*Significant, $P < 0.05$

herniated viscera was small intestine in all patients. The complications of internal hernia included bowel ischemia, bowel perforation, and volvulus. These complications were predominant in patients with transmesenteric hernia and those with a history of abdominal surgery.

The hospital course and prognosis of the patients with, and those without bowel ischemia are compared in Table 4. Patients with bowel ischemia had a higher ICU admission rate and a longer ICU stay. When we analyzed the length of hospital stay according to age, we found that it was significantly shorter for the children than for the adults (9.6 ± 4.0 vs 20.9 ± 12.2 days, $P = 0.026$). The overall mortality rate was 20% ($n = 4$). All four patients who died were elderly (mean age,

77.3 ± 8.3 years), and the cause of death was sepsis, 3–42 days postoperatively. Blood cultures grew Gram-negative bacilli; as *Pseudomonas aeruginosa* (n = 3) and *Enterococcus* with *Proteus mirabilis* (n = 1). Three of these four patients had underlying diseases; namely, diabetes mellitus, chronic renal insufficiency, and colon cancer with bone metastasis in one each, respectively. None of the surviving patients had short-bowel syndrome and no sign of recurrence was noted within this 10-year study period.

Discussion

Since the first description of a paraduodenal hernia in an autopsy in 1786,[2] internal hernia has become increasingly recognized and many other types have been reported.[1,3,9,17,19–22] However, most of these reports document individual cases, studies of a limited group, and reviews of a special type of internal hernia. These hernias are often difficult to diagnose preoperatively, but their rapid progression to bowel ischemia presents a life-threatening emergency.[3,5,6,8,18,20,21,23,24] Therefore, we reported our 10-year clinical experience and attempted to define the indicators of bowel ischemia in this rare but lethal disease.

During the study period, internal hernia accounted for only about 1.1% (n = 20/1827) of the causes of intestinal obstruction in our institution. There were an equal number of patients with CIH (n = 10) and AIH (n = 10) in this series; similar to a previous case series of 14 patients reported in 1986, comprised of 8 with CIH and 6 with AIH.[18] Interestingly, the proportion of AIHs is increasing, which may be due to the increase in the many kinds of operations that carry a risk of internal hernia, such as liver transplantation, gastric bypass surgery, and laparoscopic surgery.[1,25–28]

In our series, transmesenteric hernia was the most prevalent type of internal hernia in children. Although there are few reports discussing internal hernia in children, Murphy reported 11 cases to support this point.[29] The interval between prior abdominal surgery and reduction of an internal hernia ranged widely in our series, indicating that an internal hernia may occur at any time after prior surgery. It was reported that the tip of a noninflammatory appendix or a gangrenous appendix may adhere to the herniated loop of the small intestine.[5] During our 10-year study period, internal hernia associated with prior appendectomy occurred in 1 (0.05%) of 1976 patients at our institution.

The clinical manifestations of internal hernia range from mild digestive symptoms to acute abdomen, depending on the severity of the obstruction and the presence of incarceration.[1,4,5,18,22,30] The location of abdominal pain may depend on the type of internal

hernia involved, but it was non-diagnostic in our series. Many investigators have tried to establish predictors of strangulation and obstruction, and although some positive correlations have been found, such as old age (>70 years), a high white blood cell count (>18 000/mm^3), shock, hypothermia, rectal bleeding, and abdominal rigidity.[12–14,18,31,32] However, no definite predictors have been reported. Furthermore, the incidences of these findings were often low, and their presence indicated an advanced stage of strangulation, which made them unsuitable for early diagnosis.[18] In the present study, a history of chronic abdominal pain had a negative correlation with bowel ischemia, which may suggest that patients with episodic spontaneous reducible internal hernia are at lower risk of incarceration of the small bowel.

No pathognomonic radiological findings of internal hernia on abdominal plain films have been reported. In fact, Janin et al. reported that roentgenography provides few clues as to the cause of intestinal obstruction.[5] Conversely, small-bowel obstruction was seen on abdominal plain films in 95% of our patients. Therefore, we suggest that symptomatic patients with signs of small-bowel obstructions on an abdominal plain film should undergo further imaging studies to rule out an internal hernia.

The interval between intestinal obstruction and bowel ischemia may be short. It is generally accepted that a time-consuming diagnostic workup before surgery may endanger the life of an acutely ill patient.[6,23,30,33] Some investigators advocate abdominal CT scanning as an appropriate diagnostic technique for such patients.[1,7,17,22,26,27,34] This is because abdominal CT shows the hernia sac and its anatomic relationship to the surrounding organs and vasculature. It is also much faster to perform than other diagnostic imaging modalities. There are, however, no well-established CT criteria for diagnosing internal hernia. Blachar et al. reported CT scan sensitivity of 63%, and specificity of 76% in diagnosing transmesenteric hernias.[7] We suggest that surgeons consider internal hernia in the differential diagnosis and plan for emergent laparotomy if abdominal CT scan reveals a cluster of small bowel, transitional zone, whirl sign, and pneumatosis intestinalis.

Internal hernia may be complicated by gangrenous bowel, perforation, or volvulus.[1,2,5,6,18,23,26,35] In our experience, patients with a transmesenteric hernia and those with prior abdominal surgery were more susceptible to complications. We presumed that the lack of a herniation sac or pouch, which allows protrusion of a considerable length of small bowel, was responsible for the high complication rate. The reported mortality rate of internal hernia ranges from 38% to 73%.[5,18,23,29,33,36,37] The overall mortality rate in our series was 20%, and all deaths were caused by enteral bacteria sepsis, predomi-

nantly *Pseudomonas aeruginosa*. Thus, we recommend that board-spectrum anti-enteral bacteria antibiotics, ideally an anti-pseudomonas regimen, should be given to geriatric patients with underlying disease. Recurrence of internal hernia is extremely rare. In a collective review of 467 cases, there was only one case of recurrent herniation through the Winslow foramen.[35]

In conclusion, transmesenteric hernia is the most common type of CIH, and the most prevalent type of internal hernia in children. On the other hand, the most common prior surgical procedure underlying AIH is Roux-en-Y anastomosis. Patients presenting with abdominal rebound tenderness are at higher risk of bowel ischemia, in contrast to patients with a history of chronic intermittent abdominal pain. Advanced leukocytosis or a high level of manual band form could be an indicator of bowel ischemia associated with this disease. Although radiological imaging does not yet provide satisfactory sensitivity and specificity for a definite diagnosis of internal hernia, some abdominal CT findings may raise the index of suspicion. Geriatric patients with underlying disease should be commenced on an appropriate antibiotic regimen early to prevent the development of fatal sepsis postoperatively.

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