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Case Report

Posttraumatic Transdiaphragmatic Intercostal Hernia: Report of a Case and Review of the Literature

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Intercostal hernias are rare, and usually occur following injuries of the thoracic wall. The scope of this report is to present a case of a 53-year-old obese patient that developed a transdiaphragmatic intercostal hernia. The patient presented with a palpable, sizeable, reducible mass in the right lateral thoracic wall, with evident bowel sounds in the area, 6 months after a motor-vehicle accident. On computed tomography (CT), the hernia sac contained part of the liver and part of the ascending colon. A surgical repair of the defect was performed, using a prosthetic patch. The patient's postoperative course was uneventful and she remains recurrence free at 12 months after surgery. Intercostal hernias should be suspected following high-impact injuries of the thoracic wall, and CT scans will facilitate the diagnosis of intercostal hernia. We consider the surgical repair of the defect, with placement of a prosthetic mesh, as the treatment of choice to ensure a favorable outcome.

Key words: Hernia – Transdiaphragmatic – Intercostal – Abdominal – Mesh

The herniation of abdominal contents through the thoracic wall, as a result of the disruption of diaphragmatic and/or intercostal muscles, is an uncommon clinical entity.[1–3] This condition is usually reported to occur following penetrating or blunt injuries of the thoracic wall.[4] However, there are several cases that have been described to be a consequence of a coughing–spell rib fracture, usu-

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Fig. 1 Evident protrusion of the right lateral thoracic wall.

ally in patients with other predisposing factors such as chronic obstructive pulmonary disease, asthma, advanced age, or osteoporosis.[1,3,4]

The present report describes a case of a middle-aged obese patient that developed a transdiaphragmatic intercostal hernia involving the liver and the ascending colon 6 months after a traumatic incident. The underlying mechanism, the anatomical and diagnostic considerations, as well as the treatment options are also discussed.

Case Report

A 53-year-old obese woman, with significant history for chronic obstructive pulmonary disease, presented to our respiratory medicine clinic complaining of dyspnea. Six months before presentation, she had a motor vehicle accident where she suffered multiple upper and lower extremity fractures that were surgically treated. The clinical and laboratory examination revealed a paradox movement in the right thorax and type I respiratory disease. A computed tomography (CT) scan was executed,

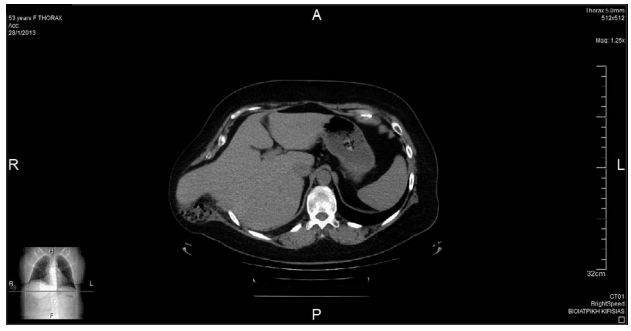

Fig. 2 Preoperative CT of the patient showing protrusion of the 6th segment of the liver and part of the colon through the 8th intercostal space defect.

which revealed fractures of the 8th and 9th ribs. The patient was treated conservatively with medications and rescheduled for a visit 1 month later.

On her second appointment, the patient presented with an improved respiratory function, but also with an evident protrusion in the right lower thorax (Fig. 1). The protruding mass was reducible, and there were evident bowel sounds in the auscultation of the area. On CT, the defect measured 10×7.6 cm and the sac contained part of the segment VI of the liver, as well as part of the ascending colon (hepatic flexure) along with its mesocolon (Fig. 2).

A surgical repair of the defect was performed under general anesthesia, with the patient in left lateral decubitus position. Upon dissection, a large defect between the 8th and 9th rib was identified. Due to the patient's position, the contents of the hernia were already reduced, and the sac was opened through an oblique incision in the enlarged 8th intercostal space (Fig. 3). The further exploration of the area revealed degeneration of the diaphragmatic attachment to the lateral thoracic wall, through which the hernia contents were also protruding within the right hemithorax. The defect was repaired using a prosthetic patch (GoreTex; WL Gore & Associates, Inc., Flagstaff, AZ, USA; Fig. 4). The patient's postoperative course was uneventful and she was discharged on the 5th postoperative day. The patient had a follow-up CT 3 weeks after surgery that showed full closure of the defect, and remains recurrence free at her 12-month follow-up.

Discussion

Intercostal hernias occur most frequently following a traumatic incident that has resulted in the disruption of intercostal and/or diaphragmatic

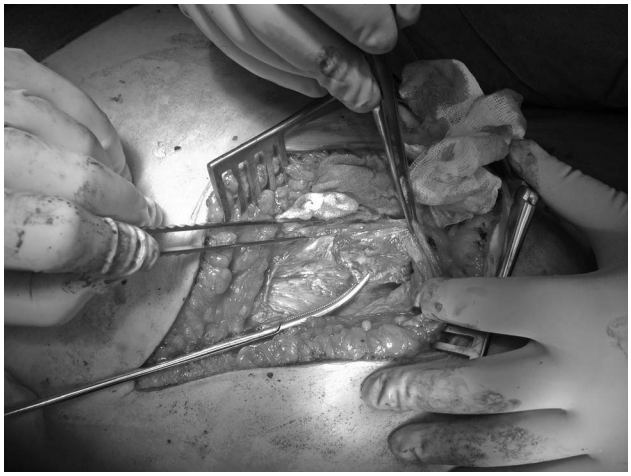

Fig. 3 Intraoperative view of the lateral thoracic wall defect. The hemostat clamp holds a fractured rib tip.

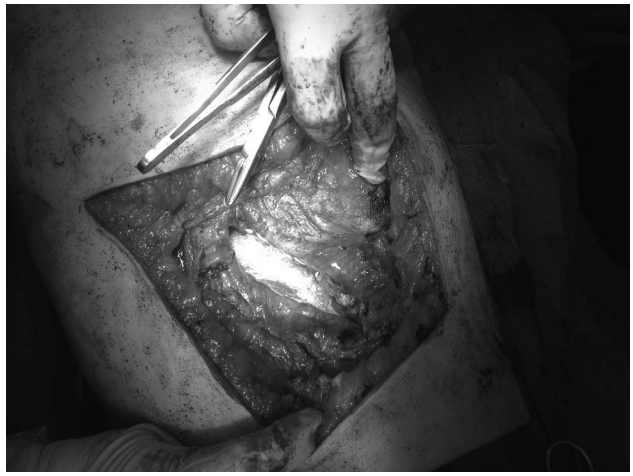

Fig. 4 Intraoperative view of the reconstruction of the defect with GoreTex patch.

muscles, either penetrating or blunt. When the abdominal viscera enter the intercostal space through an associated diaphragmatic defect, the term "transdiaphragmatic intercostal hernia" is usually used.[2] If no diaphragmatic abnormality is involved, the term "abdominal intercostal hernia" is more appropriate.[2]

Intercostal hernias have been described to occur with two distinct mechanisms: First, they can occur acutely secondary to a penetrating trauma or a direct blunt trauma,[5] or even after repeated violent coughing episodes.[1,3,4] The second mechanism is the delayed presentation, as described in the present case, where the physical activity and respiratory movements lead to enlargement of an initially small defect in the thoracic wall and/or the diaphragm that might initially be occult.[5,6]

From an anatomical point of view, the chest wall is weaker from the costochondral junction to the sternum, due to the lack of external intercostal muscle support, and from the costal angle posteriorly to the vertebrae due to the lack of internal intercostal muscle support.[7] Lung or abdominal contents may be herniated upon development of defects in these areas,[8] although usually the weakened space is a result of a traumatic incident.

Both transdiaphragmatic and abdominal intercostal hernias are scarce in the medical literature.[9] The first description of chest wall intercostal hernia is attributed to Roland *et al*. as early as 1499.[10] On the other hand, Croce and Mehta[11] were the first to report a case of abdominal intercostal hernia, or "intercostopleuroperitoneal" hernia, as they termed it. Although rare in the existing literature, these types of hernias have been suggested to actually be more frequent than the literature indicates, as their course is often asymptomatic.[9,12]

More common on the left thoracic side,[9] these types of hernias are almost always located inferiorly to the seventh rib, and may contain omentum, colon, spleen, stomach, and/or small bowel.[12] There are only a few reports, including the present, of liver segments being contained in an intercostal hernia, with or without other coexisting abdominal viscera (Table 1).[4,5,10,12–17]

The diagnosis of intercostal hernia has been historically challenging, with the interval between the initial traumatic incident and the repair of the hernia varying from immediately after the trauma to more than three decades later.[9] Clinically, a patient with transdiaphragmatic intercostal hernia would typically present with a reducible, palpable soft tissue lump in the lower chest wall with a positive cough impulse. The swelling should increase on inspiration and decrease on expiration. A paradox change of the size of the hernia would suggest a pulmonary intercostal hernia.[8] However, intercostal hernias may be mistaken for lipomas or hematomas,[9] and high clinical suspicion, thorough patient history, and clinical exam are needed for the correct evaluation of the patient in clinically challenging cases.

The final diagnosis will be made following a CT scan that will confirm the intercostal herniation. Although ultrasound has also been useful in the diagnosis of such cases[18] and offers a more affordable option than CT, it is almost deterministic that a contrast-enhanced CT will be needed preop-

Table 1 Overview of published cases of intercostal hernias containing liver segments

Authors	Year	Age/Sex	Time of diagnosis	Side	Mechanism of injury	Defect position	Hernia contents
Maurer and Blades[10]	1946	19/M	4 months	R	Penetrating injury	Intercostal and diaphragmatic	Liver
Maurer and Blades[10]	1946	26/M	9 months	R	Penetrating injury	Intercostal and diaphragmatic	Liver
Maurer and Blades[10]	1946	27/M	10 months	R	Penetrating injury	Intercostal and diaphragmatic	Liver
Testelin *et al.*[17]	1970	N/A	Immediate	R	Coughing	Intercostal	Omentum, liver
Guivarc'h and Fournier[16]	1978	68/M	2 years	R	Heavy weight lifting	Intercostal	Liver, gallbladder, colon
Fiane and Nordstrand[13]	1993	75/F	6 months	R	Coughing	Intercostal	Liver, lung
Losanoff *et al.*[4]	2004	51/M	Immediate	R	Coughing	Intercostal	Liver
Smith *et al.*[15]	2008	74/M	2 weeks	R	Fall	Intercostal	Liver
Ohlow and Hocke[14]	2011	61/F	4 years	R	Incisional	Intercostal	Liver
Benizri *et al.*[5]	2012	66/F	2 years	R	Blunt injury	Intercostal and diaphragmatic	Liver, ascending colon
Benizri *et al.*[5]	2012	83/F	6 months	R	Blunt injury	Intercostal and diaphragmatic	Liver, ascending colon
Bendinelli *et al.*[12]	2012	61/M	Immediate	R	Blunt injury	Intercostal and diaphragmatic	Liver, ascending colon
Present case	2013	53/F	12 months	R	Blunt injury	Intercostal and diaphragmatic	Liver, ascending colon

eratively, in order to evaluate the contents of the hernia sac and rule out other pathologies, as well as to plan the appropriate surgical treatment.

If left untreated, an intercostal hernia could grow in size, or cause bowel or respiratory symptoms. Abdominal viscera strangulation, however, has been reported only in the presence of a concurrent transdiaphragmatic passage of hernia content.[19] Apart of the complications of the hernia itself, a surgical repair could also be indicated because of cosmetic discomfort.

Most reported cases of intercostal hernias have been surgically managed by open surgical repair. Abdominal, thoracoabdominal, and thoracic approaches have all been used in order to access the hernia sac and repair the defect.[5,20] The abdominal approach is often used in trauma patients, as the mechanism of injury might be associated with concurrent intra-abdominal injuries. Conservative management might also be considered in asymptomatic patients or elderly patients with significant comorbidities.[15,21]

The surgical management of intercostal hernias demands close attention to the damaged anatomy. The repair typically consists of reduction of the hernia contents, and obliteration or excision of the hernia sac. Currently, there is no consensus recommendation regarding the use of prosthetic mesh.[20] However, it has been reported that the nonuse of prosthetic reinforcement is associated with recurrence.[21] Concurrent rib fractures are usually not stabilized, but cable banding around the ribs to counteract the dehiscence tension forces has also been suggested as a reliable method of repairing those hernias for which massive loss of chest wall integrity precludes endogenous repair.[4,22]

The choice of the prosthetic mesh has not been unvarying between different authors reporting similar cases (Table 2). In general, polypropylene mesh, the most commonly used prosthetic material,

Table 2 Summary of mesh choices for the repair of intercostal hernias containing liver segments

Authors	**Defect size**	**Mesh**	**Placement**
Fiane and Nordstrand[13]	N/A	GoreTex ePTFE + rib approximation	Intra-abdominal, extrathoracic side of the defect
Losanoff *et al.*[4]	6 cm	Marlex mesh + periosteal cables	Sutured to the posterior periosteum of the ribs
Ohlow and Hocke[14]	5 × 7 cm	Partially absorbable (Ultrapro)	N/A
Benizri *et al.*[5]	N/A	Polypropylene + rib periosteal sutures	External thoracoabdominal muscle slip
Benizri *et al.*[5]	N/A	Partially absorbable + polypropylene	Intra-abdominal + in front of the fascia
Bendinelli *et al.*[12]	12 × 9 cm	ePTFE double mesh	Intra-abdominal (laparoscopic)
Present case	10 × 7.6 cm	GoreTex ePTFE patch	Intra-abdominal

carries a significant risk of cutaneous fistulas if placed directly over the viscera.[23] Thus, based on our concern for adhesions and the potential risk for fistula formation, we consider the insertion of a nonabsorbable mesh or a prosthetic patch (WL Gore & Associates, Inc.) a justified decision for our patient, since it would be in contact with the abdominal viscera. However, there is currently no evidence to support that the placement of ePTFE mesh is superior to polypropylene mesh as far as recurrence is concerned. Our patient remains recurrence-free 12 months after surgery and, although this is a relatively short period of follow-up, it is important to note that most recurrences in these types of hernias usually occur in the first few months.[24–26]

Laparoscopic techniques, which are nowadays available in almost every field of modern surgery, have also been introduced in intercostal hernia repair. So far, there are 3 reports of laparoscopic repair of abdominal intercostal hernia: The first 2 were performed by Kurer *et al*.[24] in 2006 and Bobbio *et al*.[2] in 2008. In both these cases, the hernia contents consisted of omentum alone, suggesting the feasibility of an endoscopic approach in similar cases. Subsequently, Bendinelli *et al*.[12] reported an additional case of delayed laparoscopic repair of an intercostal hernia containing part of the liver. However, this patient presented with recurrence at 12 months postoperatively due to failure of the permanent tack (ENDOTACK; Karl Storz GmbH & Co., Tuttlingen, Germany) fixation.

In conclusion, intercostal hernia is a rare clinical entity that can develop either immediately following a trauma incident, or as a late complication. It should be suspected following high-impact blunt or penetrating injuries, and patients suffering such injuries should be followed up appropriately. A high clinical suspicion, along with a timely CT scan, will successfully set up the diagnosis of an abdominal or transdiaphragmatic intercostal hernia, which may contain different abdominal viscera. Surgical repair of the defect, with placement of a prosthetic mesh and with or without stabilization of concurrent rib fractures will warrant a favorable outcome.

References

1. Unlu E, Temizoz O, Cagli B. Acquired spontaneous intercostal abdominal hernia: case report and a comprehensive review of the world literature. *Australas Radiol* 2007;**51**(2):163–167
2. Bobbio A, Ampollini L, Prinzi G, Sarli L. Endoscopic repair of an abdominal intercostal hernia. *Surg Laparosc Endosc Percutan Tech* 2008;**18**(5):523–525
3. Losanoff JE, Richman BW, Jones JW. Transdiaphragmatic intercostal hernia: review of the world literature. *J Trauma* 2001;**51**(6):1218–1219
4. Losanoff JE, Richman BW, Jones JW. Recurrent intercostal herniation of the liver. *Ann Thorac Surg* 2004;**77**(2):699–701
5. Benizri EI, Delotte J, Severac M, Rahili A, Bereder JM, Benchimol D. Post-traumatic transdiaphragmatic intercostal hernia: report of two cases. *Surg Today* 2012;**43**(1):96–99
6. Serpell JW, Johnson WR. Traumatic diaphragmatic hernia presenting as an intercostal hernia: case report. *J Trauma* 1994; **36**(3):421–423
7. Saw EC, Yokoyama T, Lee BC, Sargent EN. Intercostal pulmonary hernia. *Arch Surg* 1976;**111**(5):548–551
8. Hruska LA, Corry D, Kealey GP. Transdiaphragmatic intercostal hernia resulting from blunt trauma: case report. *J Trauma* 1998;**45**(4):822–824
9. Biswas S, Keddington J. Soft right chest wall swelling simulating lipoma following motor vehicle accident: transdiaphragmatic intercostal hernia. A case report and review of literature. *Hernia* 2008;**12**(5):539–543
10. Maurer E, Blades B. Hernia of the lung. *J Thorac Surg* 1946;15: 77–98
11. Croce EJ, Mehta VA. Intercostal pleuroperitoneal hernia. *J Thorac Cardiovasc Surg* 1979;**77**(6):856–857
12. Bendinelli C, Martin A, Nebauer SD, Balogh ZJ. Strangulated intercostal liver herniation subsequent to blunt trauma. First report with review of the world literature. *World J Emerg Surg* 2012;**7**(1):23
13. Fiane AE, Nordstrand K. Intercostal pulmonary hernia after blunt thoracic injury. *Eur J Surg* 1993;**159**(6–7):379–381
14. Ohlow MA, Hocke M. Incisional intercostal hernia with prolapse of the liver. *Ann Hepatol* 2011;**10**(1):80
15. Smith E, Spain L, Ek E, Farrell S. Post-traumatic intercostal liver herniation. *ANZ J Surg* 2008;**78**(7):615–616
16. Guivarc'h M, Fournier F. Abdominal intercostal hernia. A case of a right-sided hernia [in French]. *Chirurgie* 1978;**104**(2):149–158
17. Testelin GM, Ledon F, Giordano A. [A case of abdominal intercostal hernia]. *Chirurgie* 1970;**96**(8):569–570
18. Rettenbacher T, Hollerweger A, Macheiner P, Gritzmann N, Gotwald T, Frass R *et al*. Abdominal wall hernias: cross-sectional imaging signs of incarceration determined with sonography.*AJR Am J Roentgenol* 2001S;**177**(5):1061–1066
19. Rompen JC, Zeebregts CJ, Prevo RL, Klaase JM. Incarcerated transdiaphragmatic intercostal hernia preceded by Chilaiditi's syndrome. *Hernia* 2005S;**9**(2):198–200
20. Sarkar D, Warta M, Solomon J. Transdiaphragmatic intercostal herniation following blunt trauma. *Case Rep Radiol* 2012;**2012**: 502765

21. Connery A, Mutvalli E. Cough-induced abdominal intercostal hernia. *JRSM Short Rep* 2010;**1**(3):23
22. Cole FH, Jr., Miller MP, Jones CV. Transdiaphragmatic intercostal hernia. *Ann Thorac Surg* 1986;**41**(5):565–566
23. Losanoff JE, Richman BW, Jones JW. Entero-colocutaneous fistula: a late consequence of polypropylene mesh abdominal wall repair: case report and review of the literature. *Hernia* 2002;**6**:144–147
24. Kurer MA, Bradford IM. Laparoscopic repair of abdominal intercostal hernia: a case report and review of the literature. *Surg Laparosc Endosc Percutan Tech* 2006S;**16**(4):270–271
25. Le Neel JC, Mousseau PA, Leborgne J, Horeau JM, Labour PE, Mousseau M. La hernia intercostale abdominale. Rapport de quatre observations. *Ann Chir* 1978;**32**(2):138–141
26. Sharma OP, Duffy B. Transdiaphragmatic intercostal hernia: review of the world literature and presentation of a case. *J Trauma* 2001;**50**(6):1140–1143