

## The role of laparoscopy in the diagnosis and treatment of missed diaphragmatic rupture

A. Matz, M. Alis, I. Charuzi, S. Kyzer

Department of Surgery "B," Wolfson Medical Center, Holon, P.O.B. 5, Holon 58100, Israel and Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

Received: 12 July 1999/Accepted: 21 October 1999/Online publication: 8 May 2000

### Abstract

**Background:** Diaphragmatic rupture is one of the most commonly missed injuries in trauma cases. Traditionally, laparotomy or thoracotomy has been the treatment of choice for this condition.

**Methods:** During the last 2 years, we treated three patients laparoscopically to address neglected diaphragmatic ruptures that caused herniation of the intraabdominal contents.

**Results:** In all three cases, laparoscopy succeeded in identifying the diaphragmatic defect, so that the herniated viscera could be released and the defect repaired primarily or with a prosthesis. The intraoperative and the postoperative courses were uneventful; there were no significant complications.

**Conclusion:** Laparoscopy has an important role in the surgical treatment of missed diaphragmatic ruptures.

**Key words:** Diaphragmatic rupture — Laparoscopic repair — Traumatic diaphragmatic hernia

Diaphragmatic rupture as a result of abdominal trauma is one of the most commonly missed injuries [3]. As early as 1984, Adamthwaite [1] had recommended the use of laparoscopy for the diagnosis of traumatic diaphragmatic hernia. With the development of laparoscopic surgery during the last decade, laparoscopy can now be used in the treatment as well as the diagnosis of the injury. However, this approach has been described in only a few papers that focused on single cases [6, 8]. The aim of this paper is to summarize our experience with the laparoscopic diagnosis and treatment of missed diaphragmatic injuries.

### Patients and methods

In 1997 and 1998, we used the laparoscopic approach to operate on three patients suffering from missed diaphragmatic rupture. There were two

women aged of 58 and 67 years, respectively, and one 50-year-old man. Two of the patients had a history of severe thoracoabdominal trauma that occurred 2–6 months prior to admission. The presence of a diaphragmatic tear was suspected in two cases on the basis of chronic epigastric pains, nausea, and vomiting. The third patient presented with acute onset of abdominal pains due to incarceration of the diaphragmatic hernia (Fig. 1). The presence of diaphragmatic rupture was confirmed in the patients with chronic complaints via either CT and/or upper GI series.

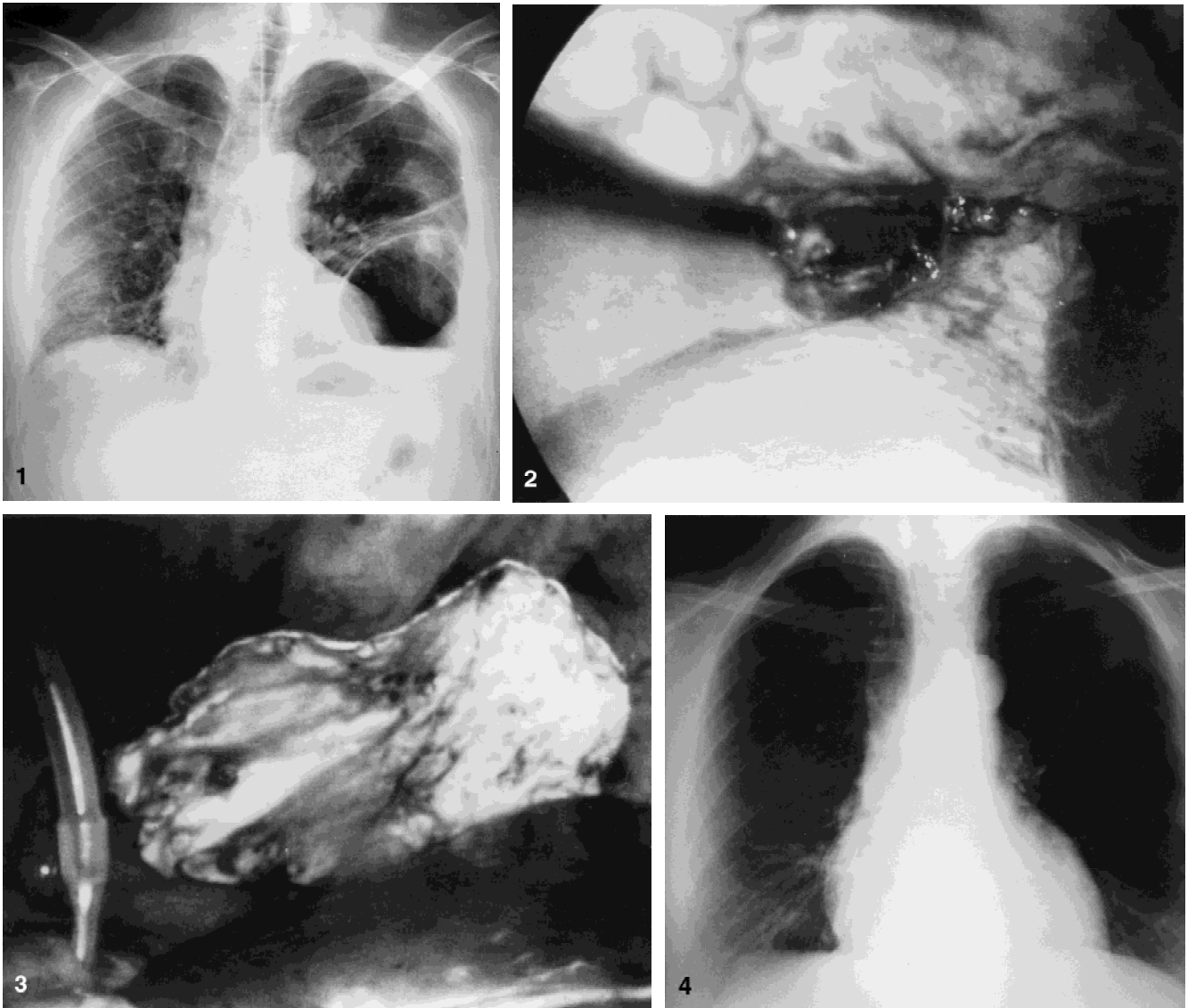
Using a 30° laparoscope, laparoscopy was carried out in the reverse Trendelenburg position after gastric intubation with CO<sub>2</sub> pneumoperitoneum. The sites of the entry ports were the same as for all foregut laparoscopic procedures.

### Results

In all three cases, the diaphragmatic defect was identified easily. Although months had elapsed since the abdominal trauma, only a few adhesions to the diaphragm were found. The diaphragmatic tear was found in two cases on the left side; in the other case, it was on the right side. The sizes of the diaphragmatic defects were 5 × 2 cm, 10 × 3 cm, and 3 × 4 cm, respectively (Fig. 2). Herniation of the stomach had occurred through the tears to the left diaphragm. Through the defect of the right diaphragm, herniation of the right liver lobe, colonic hepatic flexure, and the omentum was found.

Reposition of the herniated content was achieved easily in all cases. In the patient who presented with acute symptoms due to incarceration of the stomach through a left-sided tear, the diaphragmatic defect had to be slightly enlarged before reposition of the stomach was possible. The defects on the left side of the diaphragm were sutured primarily. The large defect (10 × 3 cm) of the right diaphragm was repaired with an expanded polytetrafluoroethylene prosthesis (Fig. 3) (EPTFE, Gore-Tex; W. Gore, Flagstaff, AZ, USA).

The durations of the procedures were 40, 60, and 90 min, respectively. There were no intraoperative complications. Postoperatively, one of the patients developed an intestinal obstruction due to incarceration of the small bowel at the umbilical trocar site. Under local anesthesia, the



**Fig. 1.** Chest radiograph of a patient presenting with acute incarceration of gastric fundus through an occult diaphragmatic tear. A supradiaphragmatic air bubble can be seen.

**Fig. 2.** Diaphragmatic defect in the left hemidiaphragm found after release of the incarcerated fundus.

**Fig. 3.** Large right hemidiaphragmatic defect repaired with EPTFE mesh.

**Fig. 4.** Chest radiograph of the patient presented in Fig. 3 18 months postoperatively. No diaphragmatic defect is seen, and the lung is now fully expanded.

bowel was released, with no signs of strangulation. Otherwise, the postoperative courses were uneventful. The durations of the postoperative hospitalizations were 3, 5, and 7 days, respectively. During follow-up periods of 3, 12, and 18 months, the patients had no recurrences of the diaphragmatic tear (Fig. 4).

## Discussion

Patients with injuries to the diaphragm are often asymptomatic on admission. These injuries may remain clinically silent for years yet cause life-threatening complications associated with diaphragmatic herniation. Occult diaphragmatic injuries can be diagnosed immediately after thoracoabdomi-

nal injuries by laparoscopy or thoracoscopy [5, 9, 10]. Murray et al. [5] found that laparoscopy can demonstrate occult injuries to the diaphragm in 24% of the patients operated immediately after penetrating injuries to the left lower chest. However, 88% of their patients were not repaired laparoscopically and were converted to celiotomies. In most cases, conversion was due to bleeding from associated solid organ injuries, which raised concern about missed and associated hollow viscus injury. In a few cases, the insufflation could not be maintained because of escape of gas into the thorax and out the chest tube. Interestingly, none of the patients that underwent celiotomy were found to have hollow viscus injury.

Our experience demonstrates the importance of laparoscopy in the presence of missed diaphragmatic tears. With

laparoscopy, the diaphragmatic tear can be identified, and the herniated intrathoracic viscera can be easily put back into the abdomen. In addition, the diaphragmatic defect can be repaired.

Although the surgeon must be prepared to insert a chest tube before induction of anesthesia and positive pressure ventilation to obviate the risk of inducing pneumothorax, we did not encounter any such problem in our patients. In this type of case, the intrathoracic adhesions eliminate the potential for a communicating pneumoperitoneum and pneumothorax.

There is still no unanimity on the question of whether laparoscopy or thoracoscopy should be the preferred approach to diagnose occult diaphragmatic tear in the immediate posttraumatic period [4, 10]. However, we prefer the use of laparoscopy for the delayed diagnosis and treatment of missed diaphragmatic rupture. Our preference is based on the ease and safety with which adhesions can be released with laparoscopy, the merits of avoiding double-lumen intubation, and the ability to repair large diaphragmatic defects [2, 5, 8].

In addition, we recommend the use of an EPTFE prosthesis and not a polypropylene mesh, as advocated by Slim et al. [8], for repair large diaphragmatic defects. With this option, there is less risk for digestive fistula formation [7] and fewer adhesion formations to the mesh. Fibrous adhesions to the polypropylene mesh can cause enormous difficulties, whether the laparoscopic or thoracoscopic approach to the diaphragm is chosen, in cases where recurrent herniation develops.

In conclusion, our experience demonstrates that laparos-

copy plays an important role in the diagnosis and treatment of missed diaphragmatic injuries.

*Acknowledgments.* We are grateful to Judy Brandt for her skillful English editing, her word processing expertise, and her other contributions to the manuscript.

## References

1. Adamthwaite DN (1984) Traumatic diaphragmatic hernia: a new indication for laparoscopy. *Br J Surg* 71: 315
2. Badhwar V, Mulder DS (1996) Thoracoscopy in the trauma patient: what is its role? [Editorial]. *J Trauma* 40: 1047
3. Guth AA, Pachler HL, Kim V (1995) Pitfalls in the diagnosis of blunt diaphragmatic injury. *Am J Surg* 170: 5–9
4. Johnson CD (1988) Blunt injuries of the diaphragm. *Br J Surg* 75: 226–230
5. Murray JA, Demetriodes D, Asensio JA, Cornwell EE, Velmalios GC, Belzberg H, Berne TV (1998) Occult injuries to the diaphragm: prospective evaluation of laparoscopy in penetrating injuries to the left lower chest. *J Am Coll Surg* 187: 626–630
6. Power M, McCoy D, Cunningham AJ (1994) Laparoscopic-assisted repair of a traumatic ruptured diaphragm. *Anesth Anal* 78: 1187–1189
7. Schneider R, Herrington JL, Granda AM (1979) Marlex mesh in repair of a diaphragmatic defect later eroding into the distal esophagus and stomach. *Am Surg* 45: 337–339
8. Slim K, Bousquet J, Chipponi J (1998) Laparoscopic repair of missed blunt diaphragmatic rupture using a prosthesis. *Surg Endosc* 12: 1358–1360
9. Smith RS, Fry WR, Morabito DJ, Koehler RH, Organ CH (1995) Therapeutic laparoscopy in trauma. *Am J Surg* 170: 632–637
10. Spann JC, Nwariaku FE, Wait M (1995) Evaluation of video-assisted thoracoscopic surgery in the diagnosis of diaphragmatic injury. *Am J Surg* 170: 628–631