

Repair of Acute Diaphragmatic Injury Diagnosed within Few Days of Trauma via Thoracic Approach

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Case report

Keywords: Diaphragmatic injury, Hernia repair, Thoracic approach

Posted Date: November 5th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-94474/v1>

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Abstract

Background

Diagnosis of diaphragmatic injury (DI) in acute trauma settings is challenging and missed or delayed detection is not uncommon. The surgical approach for repair of acute diaphragmatic injury is mainly determined by the presence of associated injuries. In the majority of cases repair is accomplished through exploratory laparotomy together with dealing with associated intra-abdominal injuries.

Cases presentation

We reported 5 cases (4 males and 1 female), age ranging from 21 to 52 years, with acute blunt diaphragmatic injury. There was a latent period of few days (ranging from 3 to 8 days) before definite diagnosis and surgical intervention. All patients were managed through small lower posterolateral thoracotomy approach without complication.

Conclusion

Repair of diaphragmatic injury via thoracic approach is easy, safe, and efficient. We recommend thoracic approach especially on the right side even in acute situation in absence of other indications for laparotomy.

Background

Traumatic diaphragmatic rupture is uncommon with incidence ranging from 1–7% in blunt trauma patients [1]. Right side diaphragmatic injuries (DI) is less frequently reported, this can be attributed to the cushioning effect of the liver; while others attribute this to the possible association with significant tears in the inferior vena cava or hepatic veins with frequent prehospital death [2]. Isolated injury of the diaphragm is rare, associated injuries usually involve the adjacent chest and abdominal organs as well as remote neurological and orthopedic injuries [1, 3]. Review of literature revealed that the majority of DI cases (74%) were repaired via laparotomy, while 18% were via thoracotomy and 8% had thoracoabdominal approaches [3].

The choice of thoracic approach for repair of DI with concentration on the better exposure and easiness of repair has not been addressed before. Authors recommending thoracic approach for repair of chronic diaphragmatic hernias justify this mainly to the safety of release of adhesions between herniated viscera and the lung [4]. In this report we propose that thoracic approach is better option in absence of indication for abdominal exploration and may support the concept of individualizing the surgical approach according to the patient clinical and radiological conditions.

Cases Presentation

During the period from January 2014 to March 2020, we had five patients of DI presented few days after time of trauma. (Table 1)

Table 1
Demographic and clinical data of the patients.

	Age/ year	Gender	Trauma	Laterality	Radiologic studies**	Associated injuries	Delay period/day
1	33	male	RTA*	Right	Plain CT abdomen	Fracture humerus	3
2	35	male	RTA	Right	Plain CT abdomen	Lung contusion	3
3	21	male	RTA	Right	X ray chest	Lung contusion	4
4	42	male	RTA	Right	Plain CT abdomen	Mild hemothorax	3
5	52	female	RTA	left	None	Skin wounds	8
RTA* = Road Traffic Accident.							
Radiologic studies **= radiological studies done at the referring hospitals.							

Four patients were referred to our center from regional peripheral hospitals. these hospitals are run by junior specialists.

The fifth patient refused admission in a remote hospital, she went home under her responsibility; few days later she presented to us with shortness of breath and chest discomfort after heavy meal.

All patients were hemodynamically stable and their laboratory results were within normal. Three patients had plain CT abdomen and one patient had only chest x-ray in the referral hospital. Chest and abdomen CT with IV contrast were done in all patients. Radiological diagnosis was possible in all patients together with exclusion of other abdominal injuries.

The choice of thoracic approach was discussed with general surgeon. All patients received general anaesthesia with double lumen endotracheal tube and were positioned in lateral decubitus position according to the side involved.

Small lateral thoracotomy with preservation of serratus anterior muscle was done. The chest was entered through the 7th space; contents were evaluated and reduced; edges of the tear were identified and repaired in two layers with proline suture using interrupted transverse mattress sutures in the first layer and continuous over and over suture in the second.

All patients were extubated on table and postoperative course was uneventful in all cases.

Discussion

A-The challenge of diagnosis and missed injuries

Diagnosis of DI can be challenging and several imaging modalities may participate in diagnosis. Chest x-ray may give a clue to diagnosis by showing air-fluid level consistent with hollow viscera (with or without coiled nasogastric tube) in the chest cavity. However, x-ray may not be conclusive either due to delayed herniation of viscera or improper technique. Also, on the right side it is difficult to differentiate between elevated diaphragm and herniation of the liver [4].

Although Focused Assessment with Sonography for Trauma (FAST) is widely used for initial evaluation in trauma settings, its usefulness in diagnosis of DI is scarcely reported [5].

Importantly, the advent of multiple detector computed tomography (MDCT) with coronal and sagittal multiplanar reformation represent a great advances. This technique allows better demonstration of DI with high sensitivity, specificity, and accuracy [6]. However, missed diagnosis of DI is still frequently reported; the reasons could be due to clinically occult DI or the presentation is dominated by other associated major injuries [7]. This leads some authors to utilize laparoscopy or video-assisted thoracoscopic surgery (VATS) or both for diagnosis. Both modalities allow assessment and possible repair of the diaphragm especially when open surgery is not required [8, 9]. Laparoscopy could have identified occult diaphragmatic injuries in up to 24% of the patients with penetrating injuries of the left lower chest [9].

Early diagnosis of DI and surgical intervention are important, as the repair will be easy before development of fibrosis and atrophy of the diaphragm. Moreover, missed DI may result in herniation of intra-abdominal viscera into the thoracic cavity and subsequent strangulation [7, 10].

The delay in diagnosis in our series can be attributed to one or more of the following reasons. Delay in transfer process as less priority is given to stable patients without clear indications for surgical intervention. Secondly, subtle radiological findings can be missed by junior staff and subsequently detected by a more experienced radiologist at higher centers. Another possibility is that, stable patients referred to subspecialty usually are not subjected to routine multidisciplinary assessment of acute trauma cases in emergency department and diagnosis is discovered later when the patient starts to complain or during evaluation for general anaesthesia.

B- Choice of surgical approach

The choice of surgical approach in acute situations is mainly determined by the presence of associated injuries requiring immediate intervention. Other factors are the surgeon choice, and availability of specialized trauma surgery unit [1].

Only few authors reported the use of thoracic approach (usually in selected patients among their series) in absence of abdominal injuries [4, 11]. But there are no studies with matched patient populations comparing abdominal and thoracic approaches for repair of DI whether in the acute or chronic phase; this leads to difficulty to formulate a clear recommendation regarding the preferred approach especially in elective chronic visceral herniation. In these situations, whatever the approach used, it is wise to anticipate and prepare for a second cavity approach (thoracotomy or laparotomy) due to potential difficulties in dealing with hernia contents from the initial approach [12].

Abdominal exposure of the diaphragm requires one or two assistants for retraction of abdominal wall and the mobilized abdominal organs. With maximal assistance, viewing and access to some areas of diaphragm is still difficult. Moreover, the presence of the liver on the right side adds more obstacles. All these factors may explain missing some of diaphragmatic injuries during exploratory laparotomy for trauma [13]. On the contrary, thoracotomy and entering the chest through lower intercostal space gives direct access to the target operative site and the whole diaphragm can be accessed easily without much assistance especially with the use of single lung anaesthesia. The herniated viscera can be returned to the abdomen more easily and safely particularly in situations of small diaphragmatic rent and hour-glass herniation of the stomach or gut. Moreover, the operative field is in alignment with direction of surgeon's vision; accordingly repair can be done more safely and efficiently. (Figs. 1, 2)

Computed tomography has lower sensitivity in diagnosis of pancreatic, mesenteric and colon injuries [14]. Accordingly, some authors advised to keep patient with suspected abdominal injury under observation for at least 24 hours even if primary abdominal CT is free [15]. Others follow a similar policy before minimal invasive laparoscopic repair in stable cases with penetrating diaphragmatic injury [16]. This period of observation allows for occult injuries to manifest. If this principle is applied to our cases, the short time delay in diagnosis can be considered as unplanned observation period during which any occult abdominal injuries would have manifest. The latent period between time of injury and surgical intervention whether planned or unplanned gives more confidence to surgeon's choice.

Recently, there are several reports of either 3-port or single port VATS repair of traumatic diaphragmatic hernia. This technique shares many of the advantages of open thoracic approach in addition to the advantage of being less invasive. In comparison to laparoscopic repair, VATS is safer as it avoids the risk of tension pneumothorax due to escape of the CO₂ gas through the diaphragmatic rent to the pleural space. In experienced hands VATS may be the proper management approach [8, 17].

Conclusion

Open thoracic approach is a good option in acute diaphragmatic injury especially on the right side in stable patients without evidence of associated intra abdominal injuries; this approach provides better exposure, easier and more efficient repair. In experienced hands thoracoscopy could be the appropriate treatment option in such cases.

Abbreviations

DI: Diaphragmatic Injury

CT: Computed Tomography

VATS: Video Assisted Thoracoscopic Surgery

FAST: Focused Assessment with Sonography for Trauma

Declarations

Informed consent for publication:

individual patient consent was collected.

Ethics approval and consent to participate:

the study was approved by ethical committee of our center, individual patient consent was collected.

Guarantor:

N/A

Competing interests:

The authors declare no competing interests.

Funding:

none

Contributorship:

both authors share equally in this work.

Availability of supporting data;

data available on request.

Acknowledgement:

I would like to thank Dr. Anas R. Alkhalifa, thoracic surgery registrar, for assisting in collection of data and preparation of the figures.

Conflict of interest:

no conflict of interest.

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Figures

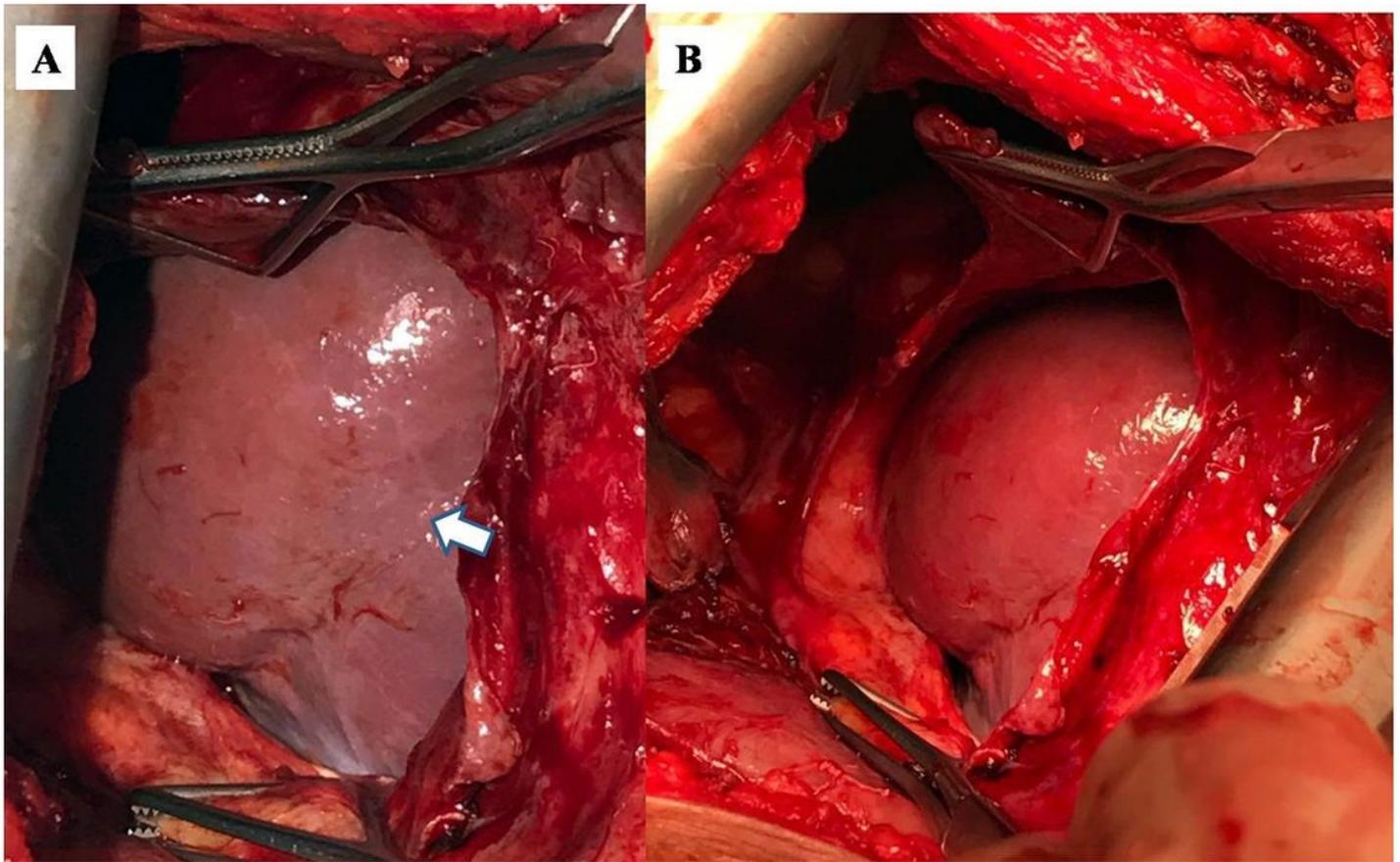


Figure 1

Operative view from surgeon position with only rib spreader in place, showing direct access to the injured diaphragm 1A: the herniated liver with mark of the site of compression of the diaphragmatic tear producing liver hump (arrow). 1B: Edges of the tear are mobilized with abdominal reduction of the liver.

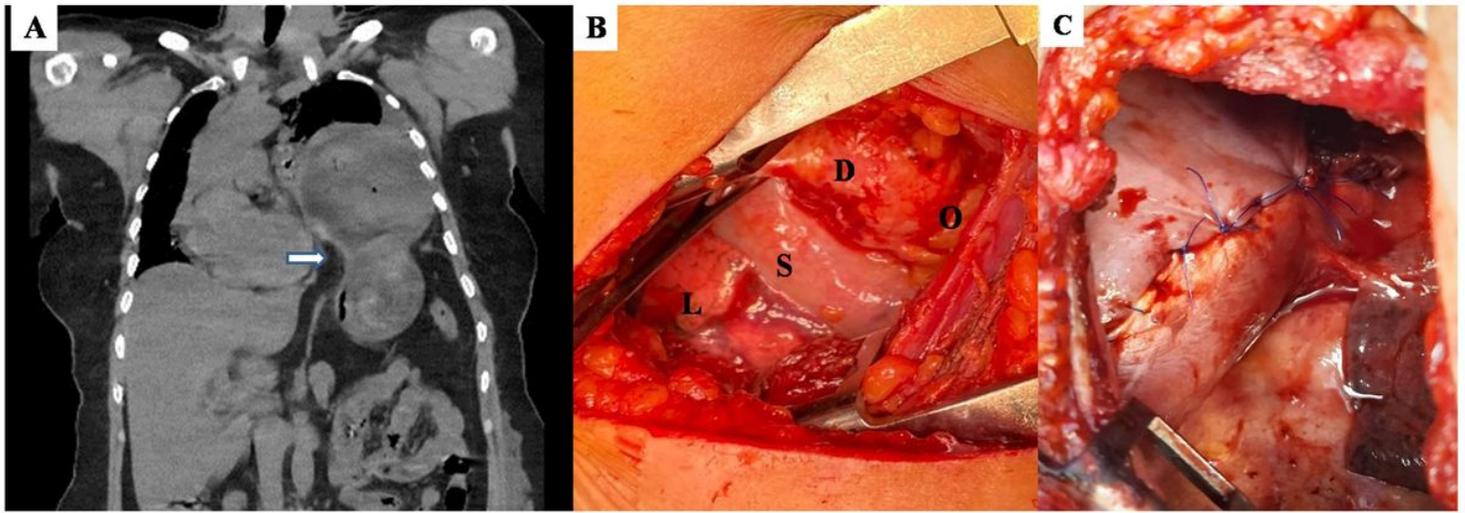


Figure 2

1A: CT chest and abdomen, multiplaner coronal reformation view showing herniation of the stomach with hourglass sign (arrow) and compression of the lung and mediastinal shift. 1B: Operative view without any assistance showing L= lung, S= stomach, D= diaphragm and O= omentum. 1C: Operative view showing repaired complex y-shaped diaphragmatic tear.