

The Sensitivity of Abdominal CT Scan In Comparison to Laparoscopy in Detecting Occult Diaphragmatic Injuries in Hemodynamically Stable Patients with Thoracoabdominal Trauma

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ABSTRACT

Laparoscopy can be a valuable diagnostic tool in identifying diaphragmatic injury. It is best suited for those hemodynamically stable, asymptomatic patients who are at risk for diaphragmatic injury and who have no other indication for abdominal exploration. The benefit of laparoscopic surgery in comparison with CT in the diagnosis of diaphragmatic injury have been suggested with respect to increased sensitivity of laparoscopy over CT diagnosis. In our study, we compared between CT and Diagnostic laparoscopy in detection of diaphragmatic injury in stable patients with thoracoabdominal trauma. The CT couldn't detect any injury but laparoscopy detected 5 injuries and used to treat one of them. There was no relation between mode of trauma, age of the patients, site of trauma and diaphragmatic injury. The laparoscopy is superior to abdominal CT scan in detecting diaphragmatic injuries. Moreover, it can be used to repair the injury.

Key words: diaphragmatic injury, laparoscopy, trauma, CT scan.

INTRODUCTION

Traumatic rupture of diaphragm occurs in up to 5% of patients requiring laparotomy for blunt or penetrating trauma to the chest or abdomen⁽¹⁾. Major causes are penetrating injuries such as gunshot and stab wounds, but blunt injuries such as falls and motor vehicle accidents also can cause such rupture. Acute diaphragmatic rupture is recognized with increasing frequency, with a reported incidence of 0.8% to 7% associated with blunt trauma and 10% to 15% resulting from penetrating trauma⁽²⁾. Complications such as visceral herniation or strangulation may arise early in the patient's clinical course or remote from the traumatic event⁽³⁾.

Early diagnosis and repair of diaphragmatic rupture are desirable because surgical repair is easier before fibrosis develops, and because the morbidity and mortality associated with the latent and obstructive phases of diaphragmatic rupture can be avoided⁽⁴⁾.

There is no "gold standard" for early diagnosis of traumatic diaphragmatic rupture, and it still seems to be a diagnostic dilemma. Several diagnostic tools such as initial chest x-ray, radiographs after nasogastric tube placement, thoracoabdominal computed tomography (CT) scanning, sonography,

diagnostic peritoneal lavage, upper and lower gastrointestinal contrast study, liver scintigraphy, contrast or air peritoneography, and magnetic resonance imaging (MRI) are described for the management of traumatic rupture of the diaphragm⁽⁵⁾.

The need to exclude diaphragmatic injury in asymptomatic patients with penetrating injuries to the thoracoabdominal region continues to be a topic of debate. Principles of nonoperative management for blunt abdominal trauma have been extended to include many patients with penetrating injuries⁽⁶⁾. Several reports have described the use of laparoscopy to exclude these injuries⁽⁷⁾. However, most of them did not include a confirmatory celiotomy or thoracoscopy to definitively exclude missed diaphragmatic injury. The one study that included mandatory celiotomy after laparoscopic evaluation of the diaphragm included symptomatic patients as well as asymptomatic patients. Therefore, true sensitivity remains unknown⁽⁸⁾.

The purpose of this study is to determine the sensitivity of laparoscopy for detection of occult diaphragmatic injury in asymptomatic, stable patients with thoracoabdominal trauma after normal CT scan imaging. We hypothesized that occult diaphragmatic injuries after

thoracoabdominal trauma is common and hence

CT scan is not sufficient to exclude diaphragmatic injury.

PATIENTS & METHODS

The study was conducted at Faculty of medicine, Fayoum University, Emergency department, from July 2010 to January 2011.

The study included 20 patients with thoracoabdominal injuries. All patients with blunt thoracoabdominal injuries and hemodynamically stable were included in the current study. Also we included patients with penetrating injury between the nipple line and the subcostal plane with or without intercostal tube.

Excluded patients were those who had thoracoabdominal trauma and were hemodynamically unstable or trauma to other organ i.e. head trauma. All patients were subjected to history taking, clinical examination (General and local) and laboratory investigation in the form of (CBC, PT, PC, INR, Liver functions, and kidney functions). Radiological examinations done for all patients were (Chest X-ray, Abdominal U/S and CT abdomen with contrast).

Patient with thoracoabdominal trauma (blunt or penetrating) and their computed scan (CT) shows no diaphragmatic injuries were subjected to laparoscopic exploration.

Operative procedure: After induction of general anesthesia, Ryle's tube and Foley's catheter were inserted. The skin is prepared from the neck to the mid-thighs so the chest is included in the surgical field in case urgent insertion of intercostal tube is required. The laparoscopic set including the light source, camera, and insufflator, is positioned on whichever side allows for least interference of the cords with the progression of the case. A single 10-mm trocar is introduced through the umbilicus using the open technique. A 30-degree, 10-mm laparoscope was used throughout the procedure.

At first exploration of different areas of the abdominal cavity for other injuries was done then the diaphragm is evaluated using the scope while placing the patient in a reverse Trendelenburg position. An additional trocar was placed, when needed, for retraction. Laparoscopy was carried out until the surgeon

feels that the evaluation of the diaphragm is sufficient to identify or exclude injury.

When diaphragmatic injury was not associated with other abdominal organ injury, it has been repaired laparoscopically. When diaphragmatic injury was associated with other abdominal organ injury that can be dealt with laparoscopically, the diaphragmatic injury has been repaired laparoscopically. When there was diaphragmatic injury associated with other abdominal organ injury that could not be dealt with laparoscopically, the diaphragmatic injury had been repaired surgically (open method).

Postoperatively all patients received analgesics in the form of NSAIDs. Patients were monitored for passing flatus, intestinal sounds, oral intake and discharge from the hospital.

Statistical Analysis:

Analysis of data was performed using SPSS 17 (Statistical Package for Scientific Studies) for Windows. quantitative variables was in the form of mean, standard deviation (SD), minimum and maximum whereas qualitative variables was in the form of numbers (No.) and percents (%). Comparison between variables was carried out by Chi-Square test (χ^2). Fisher exact test was used instead of Chi-square test. The significance of the results was assessed in the form of P-value.

RESULTS

Twenty patients were included in this study; all were males (n=20; 100%), their age ranged from 13 to 51 years old with a mean age of 29.9 years. Most of them were in the younger age group (n=13; 65%) ranged from 10 to 29 years old.

The mode of trauma was a penetrating trauma in (n=17; 85%) cases and blunt trauma in (n=3; 15%). The site of the penetrating trauma was the left side in (n=11; 55%) patients, epigastrium in (n=2; 10 %) patients and right side in (n=4; 20 %) patients.

Plain chest X-ray and abdominal ultrasound could not detect any abnormality in all cases.

CT scan examination showed radiological findings in three patients (n=3;

15%) in the form of perisplenic collection in two patients with penetrating trauma and retroperitoneal haematoma in one patient with blunt trauma.

The CT scan failed to detect any abnormality in rest of patients (n=17; 85%). These were 15 patients with penetrating traumas and 2 patients with blunt trauma (table 1).

Table 1: CT finding in relation to type of trauma among studies cases

CT findings	Blunt trauma		Penetrating trauma		P value
	Number of patients	Percent	Number of patients	Percent	
Free	2	66.7	15	88.2	0.046
Perisplenic collection	0	0	2	11.8	
Retroperitoneal haematoma	1	33.3	0	0	

The CT didnt show any diaphragmatic abnormality among all studied cases (n=20; 100%).

Diagnostic laparoscopy didn't show any diaphragmatic injury in 15 patients (11 patients were totally free and 4 patients had a liver tear), it showed also a diaphragmatic tear in 5 patients (3 of them had isolated diaphragmatic injury. One was repaired laparoscopically and two were repaired by open surgery. Due to technical difficulties, the other 2 patients had splenic injury and hemo-pneumothorax and both of them was repaired by open technique (table 2). Figure 1 shows Laparoscopic repair of isolated diaphragmatic injury case.

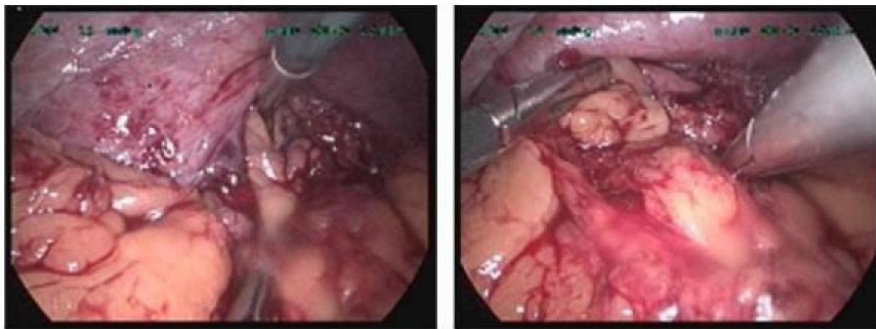


Figure 1: Laparoscopic repair of diaphragmatic injury

There were no significant relation (p was >0.05) between diaphragmatic injury and the type of trauma, the age of the patients and the site of trauma among penetrating injuries.

Diagnostic laparoscopy was able to detect diaphragmatic injury in 100% of cases that were injured and these injuries can be defined as occult injures as it can't be diagnosed clinically and the CT showed no injuries. The laparoscopy showed a significant difference in relation to CT diagnosis of diaphragmatic injury ($P = 0.033$) (table. 2).

Table 2: the sensitivity of CT to detect diaphragmatic injury among studied group

	Diaphragmatic injury		No Diaphragmatic injury	
	N.	%	N.	%
CT results	0	0%	15	100%
Laparoscopy results	5	100%	15	100%

DISCUSSION

Only seven studies were detected in English language between 1995 to 2008 comparing between laparoscopy and CT in detection of occult diaphragmatic injuries.

In this study, all patients were males this was in accordance to the study conducted by Sharmila et al., 2005 on 23 male cases with penetrating abdominal trauma for the evaluation of diaphragmatic injury⁽⁹⁾. Other studies showed predominance of male gender in penetrating injuries^(10,11,12).

In our study, the patient's age ranged from 13 to 51 years with mean age of 29.9 years. Other studies showed similar mean age (30 years, 31.5 years)^(10,11). This can be explained as more accidents happened to young males with violent activities.

In our study the patient's mode of trauma was penetrating trauma in 17 cases (85 %) and blunt abdominal trauma in 3 cases (15%).

Benjamin et al., 2007 conducted a study on 108 hemodynamically stable patients with thoracoabdominal trauma who didn't have indications for abdominal exploration, they were evaluated with diagnostic laparoscopy to determine the presence of a diaphragmatic injury and stated that 80 patients had penetrating injuries (74%), which showed results comparative to our study.

In our study the injured side of the diaphragm was the left side in the 5 cases which is 100% of the positive cases in the study. Bhatia et al 2008 in his study stated that the common site of diaphragmatic injury was the left side. This is mostly because the injuries are caused by right handed assailants.

In our study the diagnostic laparoscopy didn't show any diaphragmatic injury in 15 patients (11 patients were totally free and 4 patients had a liver tear), it showed also a diaphragmatic tear in 5 patients (3 of them had isolated diaphragmatic injury that was repaired laparoscopically in one of them repaired by open surgery in 2 of them due to technical difficulties, the other 2 patients had splenic injury and hemo – pneumothorax and both of them were repaired by open technique).

The laparoscopic exploration showed associated injuries in six cases (30%), four of them showed liver tear (20%) and two of them showed splenic injury (10%).

Athanassiadi et al., 1999 in his study conducted on 41 patients, liver injury was detected in 14 cases (34%) and splenic injury in 18 cases (43%).

Spann et al., 1995 stated in his study that was conducted on 26 patients, that showed the associated injuries was detected in 6 patients (23%)⁽¹³⁾.

Benjamin et al., 2007 stated in his study that was conducted on 108 patients that liver injury was detected in 2 cases (1.8%) and splenic injury in 5 cases (4.6%)⁽¹⁴⁾.

In our study, one case was treated by laparoscopic repair and four cases were converted to open repair, two of them were converted to open repair because of associated injury and the other two were converted to open because of technical difficulties.

Sharmila et al., 2005 in his study, all the patients with diaphragmatic injuries were repaired laparoscopically.

The difference between the results may be due to lack of equipments or experience. There was no procedure-related morbidity or mortality in our cases.

This is the same to the results of a study conducted by Spann et al., 1995 and that is because he admitted only hemodynamically stable patients. But other study conducted by Bhatia et al 2008 on 14 patients and there were two cases of mortality.

Our study showed that 100% of injured cases were diagnosed as injured by laparoscopy whereas CT diagnosis showed 0% as all the injured cases were not diagnosed by CT. So there is significant difference between the CT findings and diaphragmatic injury as detected by laparoscopy. CT couldn't detect any diaphragmatic injury among studied group P value was (0.033).

The laparoscopy is a good positive test whereas the CT is a failed positive test. On the other hand the laparoscopy showed no injury in 100% of not injured case also the CT showed no injury in 100% of not injured cases. Both laparoscopy and CT are good negative tests. Laparoscopy is both sensitive and specific in detecting occult diaphragmatic injuries. Laparoscopy rarely misses a diaphragmatic injury and normal CT doesn't mean no diaphragmatic injury. A negative CT result should not be reassuring and suggesting laparoscopy for every

case with thoracoabdominal trauma is a matter of debate.

The incidence of diaphragmatic injury associated with thoracoabdominal trauma is high. Clinical and radiographic findings can be unreliable at detecting occult diaphragmatic injury. Diagnostic laparoscopy provides a vital tool for detecting occult diaphragmatic injury among patients who have no other indications for formal exploration⁽¹⁰⁾.

In conclusion: Diagnostic laparoscopy is a reliable procedure in diagnosis of diaphragmatic tears. Laparoscopy should be considered the procedure of choice for the evaluation of injuries of the lower chest and upper abdomen to rule out diaphragmatic injuries even when CT gives negative results. Laparoscopy can be used to repair minimal diaphragmatic injuries as well.

REFERENCES

1. **Sapiro MJ, Heiberg E, Durham M, Luchtefeld W, Mazuski JE.** The unreliability of CT scans and initial chest radiographs in evaluating blunt trauma-induced diaphragmatic rupture. *Clin Radiol* 1996;51: 27-30.
2. **Rosati C.** Acute traumatic injury of the diaphragm. *Chest Surg Clin N Am* 1998; 8:371-378.
3. **Huggon AM, Houghton A, Watson DP.** Ruptured diaphragm: the latent phase. *Br J Clin Pract* 1996; 50:408-409.
4. **Arak T, Solheim K, Pillgram-Larsen J.** Diaphragmatic injuries. *Injury* 1997; 28:113-117.
5. **Nau T., Seitz H., Mousavi M., Vecsei V.** The diagnostic dilemma of traumatic rupture of the diaphragm. *Surg Endosc* (2001) 15:992-996.
6. **Shatney CH, Koji S, Morgan L.** The natural history of stab wounds of the diaphragm: implications for a new management scheme for patients with penetrating thoracoabdominal trauma. *Am Surg.* 2003; 69:508 –513.
7. **Murray JA, Demetriades D, Asensio JA, et al.** Occult injuries to the diaphragm: prospective evaluation of laparoscopy in penetrating injuries to the left lower chest. *J Am Coll Surg.* 1998; 187:626 – 630.
8. **Randall S. Friese, C. Eric Coln, and Larry M. Gentilello.** Laparoscopy Is Sufficient to Exclude Occult Diaphragm Injury after Penetrating Abdominal Trauma. *J Trauma.* 2005; 58:789 –792.
9. **Sharmila, Dissanaik; Griswold, John A; Frezza, Eldo E:** *The American Surgeon,* 2005; 71:493-496.
10. **Mahajna, A.1; Mitkal, S.1; Bahuth, H.2; Krausz, M.3:** *Surgical Endoscopy,* 2004; 18:1485- 1487.
11. **Bhatia, Sanjiv1; Kaushik, Robin2; Singh, Rajdeep1; Sharma, Rajeev1; Attri, Ashok1; Dalal, Usha1; Dalal, Ashwani1; Bansawal, Rajesh1:** *Indian Journal of Surgery,* 2008; 70: pp. 56-61.
12. **Athanassiadi K.1; Kalavrouziotis G.; Athanassiou M.; Vernikos P.; Skrekas G.; Poultzidi A.; Bellenis I.:** *European Journal of CardioThoracic Surgery,* 1999; 15: 469-474.
13. **Spann J.C.; Nwariaku F.E.; Wait M.:** *The American Journal of Surgery,* 1995; 170: 628-631.
14. **Benjamin S Powell, Louis J Magnotti, Christopher W Finnell, Thomas J Schroepfel, Stephanie A Savage, Martin A Croce, Timothy C Fabian.** University of Tennessee Health Science Center, Memphis, TN, USA: Diagnostic laparoscopy for the evaluation of occult diaphragmatic injury following penetrating thoracoabdominal trauma, 2007.

