

Determination of efficacy of physical examination in the diagnosis diaphragmatic injuries due to stab wound to lower thoracic area confirmed with thoracoscopy

Alireza Khazaei¹, Mostafa Dahmardehei^{*1}, Behzad Narouie² and Arash Beiraghi Toosi³

1. Department of Surgery, Zahedan University of Medical Sciences, Zahedan, Iran
2. General Practitioner, Researcher of Clinical Research Development Center, Ali -Ebne -Abitaleb Hospital, Zahedan University of Medical Sciences, Zahedan, Iran
3. General Surgeon, Zahedan University of Medical Sciences, Zahedan, Iran

*Corresponding Author:

Mostafa Dahmardehei (MD), Department of Surgery, Ali -Ebne -Abitaleb Hospital, Zahedan University of Medical Sciences, Zahedan, Iran
 Email: Dahmardehei@zaums.ac.ir,
Alireza_khazaei@yahoo.com, Tel: +98-915-540-5570

Abstract: Diaphragmatic injury is probable in penetrating trauma to the thorax below nipple line and patients should be evaluated to rule it out Chest XRay, Ultrasonography, CT scan, Pneumoperitoneum and abdominal paracentesis are usually limited in diagnosing diaphragmatic injury and many cases may be missed with these diagnostic modalities. Thoracoscopy is known as an accurate method for diagnosis of diaphragmatic injury. The purpose of this study is to introduce thoracoscopy as a procedure for diagnosis of diaphragmatic injury in stab wounds to the lower thoracic area and to evaluate the efficacy of physical examination with finger through the wound in comparison with thoracoscopy in the diagnosis of these injuries. Hemodynamically stable patients with stab wound to the lower thoracic area studied. First patients examined with finger through the wound and then the accuracy of digital exploration in the diagnosis of diaphragmatic injury evaluated with thoracoscopy. 42 patients (15 to 30 years) studied. 30 patients (71.4%) had stab wound to left side. 28 patients (66.7%) had stab wound to anterior chest. Results of physical examination were positive in 7 (16.7%) negative in 32 (79.2%) and inconclusive in 3 (7.1%) patients. All patients with diaphragmatic injury confirmed with thoracoscopy were diagnosed with digital exploration too; and all negative cases in physical examination had intact diaphragm in thoracoscopy. Putting inconclusive cases aside sensitivity specificity positive and negative predictive value of digital exploration in the diagnosis of diaphragmatic injuries due to stab wound to lower thoracic area were 100%. Digital exploration through the wound is an accurate simple and inexpensive procedure for the diagnosis of diaphragmatic injury in stab wounds to the lower thoracic area that without need to general anesthesia or additional incisions allows early diagnosis of diaphragmatic lesions in cases that the exam is inconclusive the procedure can be performed using general anesthesia or thoracoscopy may be considered as an alternative diagnostic method.

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Introduction:

The majority of diaphragm damages are caused by penetrating injuries (1-5, 30). During exhalation, the right and left diaphragms lift up to fifth rib and fifth intercostal space on the chest, respectively (6-10, 15). In penetrating injuries of the chest below the nipple, the possibility for diaphragm damage is close to 30-42% (11-17, 37). Patients with penetrating injuries below the nipple and upper costal edge of the chest should be examined to reject diaphragm injury (18-22, 30). This is

important, as damage to the diaphragm may be along with the injuries of abdominal viscera. Moreover, herniation of abdominal viscera may cause life-threatening heart and pulmonary instabilities (23-27, 37). Stomach injury along with diaphragmatic injury may cause empyema (24, 28). There is also a risk of damage to the spleen and liver along with diaphragm injury. Delay in the diagnosis of diaphragmatic injury can cause gradual herniation of intra-abdominal

and incarcerated viscera and finally their strangulation (23-24,29).

There are various comments on how to deal with penetrating chest injuries below the nipple. Shelds believes that if only stab wounds with symptoms are investigated, some diaphragm ruptures will remain undiagnosed. Pneumoperitoneum and abdominal paracentesis generally do not help in early diagnosis of these injuries. Sonography and CT scan are of limited value. In cases where the Chest X-Ray (CXR) is suspected, and these tests are not able to diagnose the trauma, thoracoscopy or laparoscopy will definitively confirm or deny the diaphragm injuries (31-34, 28). The results of Murray et al. showed that among 45 patients with diaphragmatic injury, 31% did not suffer from abdominal tenderness and 40% had normal Chest X-Ray (17). Jackson believes that all patients with penetrating damage below the left intercostal space should be examined by thoracoscopy (12). Sabiston declared that in the case of upper costal edge penetrating trauma below the nipple, patients with epigastrium stab wound should be examined by Peritoneal lavage. The Patients with Hemothorax or Pneumothorax should be examined by thoracoscopy. Patients with normal CXR and external wounds in thoracoabdominal regions should be examined by laparoscopy (30). Schwartz believes that in the lower chest stab wounds, following the local anesthetic, the finger must be entered into the thoracic space and the diaphragm must be touched. If the hole is not touched by the finger, but there is a risk of damage to the diaphragm, diagnostic peritoneal lavage (DPL) should be performed. If the red cell count is between 1,000 and 10,000 per cubic millimeter, then thoracoscopy should be performed (26). Fehenmo believes that in the case of penetrating wounds of the lower chest, the diaphragm should be touched by the finger, especially if the chest tube is inserted (34). Morales stated that the finger diagnosis is a simple method with high accuracy which allows early diagnosis of diaphragm rupture. This method has high sensitivity and negative predictive value (16).

The objective of the present study is to introduce the thoracoscopy as the golden standard method for the diagnosis of diaphragmatic injuries for penetrating injuries below the nipple in Khatam-Al-Anbia Hospital of Zadehan. Attempts were done to compare the clinical values of finger and thoracoscopy examinations. All patients with a stab wound in the lower chest were examined by thoracoscopy following finger examination. By comparing the results of these two diagnosis methods, the sensitivity and specificity of clinical examination with the finger for diagnosis of diaphragm injury were determined.

Morales examined the patient with left side abdominal stab wound by finger through the wound and then compared the obtained results with thoracoscopy and

laparotomy. 6 patients (7.3%) could not be examined with the finger. These include four patients due to the ribs or cartilage overlap and 2 patients due to unwillingness for cooperation. The diaphragm damage was diagnosed by thoracoscopy in 2 patients. According to Morales, the sensitivity of finger examination, specificity, positive and negative predictive values were equal to 96%, 83.3%, 91% and 93.7%, respectively (16).

estrepo and Conostudied 33 patients. They found the sensitivity and specificity of 100% and 93.9%, respectively for finger examination (16).

Nelhas studied 55 patients with penetrating stab wounds in left side lower chest. He reported the sensitivity, specificity and accuracy of thoracoscopy of 100%, 90% and 94%, respectively for diagnosis of diaphragmatic injury (18).

Uribe has examined 28 patients with penetrating trauma of thoracoabdominal region. His results showed that the sensitivity and specificity of thoracoscopy for diagnosis of diaphragmatic injury is equal to 100% (35). Spann and Lazdunski Lang studied 26 and 14 patients, respectively. Their results also showed that sensitivity and specificity of thoracoscopy for diagnosis of diaphragmatic injury is equal to 100% (35).

Methods :

The sampling method is the simple available successive sampling method. The statistical population is patients with stab wounds in lower chest who have referred to Khatam-Al-Anbia Hospital of Zahedan during the period of study. Patients should be hemodynamically stable or become stable after chest tube insertion. Patients who have simultaneously traumatic limbs are included in the population. Also, patients with penetrating trauma in both sides of the chest who were stabilized with the insertion of bilateral chest tubes were also included.

Patients with penetrating bullet trauma, unstable patients and patients with abdominal trauma were excluded from the study population. The decision was taken for inserting chest tube in emergency ward or the surgery room considering the patient stability and the respiratory distress.

After preparation of the wound and following the anesthetic injection, the wound was examined by the researcher with the index finger. The examination results along with patient demographic information including age, gender, side, injured intercostal space, and its anteriority and posteriority were recorded in the checklist.

Results:

42 patients with a stab wound in lower part of the chest with stable vital signs were studied. The age of patients was ranging from 15 to 30 years old with the average

age of 22.4 years old. All patients were male (100%). 30 patients (71.4%) suffered a left side stab wound and 12 patients (28.6%) suffered from a rightside stab wound. The fifth to ninth intercostal spaces suffered from trauma where the seventh space had the highest frequency (Table 1).

Table 1 - Distribution of involved intercostal space in patients with stab wound in lower chest

Intercostal Space	Number	Percent (%)
5	8	19.1
6	9	21.4
7	13	30.9
8	7	16.7
9	5	11.9
Total	42	100

38 patients (66.7%) suffered a stab wound anterior to the posterior Axillaryline and 14 patients (233%) suffered a posterior stab wound. All patients were examined by thoracoscopy in the first 24 hours after trauma. In 6 patients (14.3%), general anesthesia was used for thoracoscopy. Local anesthesia was performed for 1 patient due to numerous stab wounds and for 4 patients due to patients' noncompliance and lack of good vision of diaphragm. One patient firstly was put under general anesthesia due to possibility of diaphragm rupture. In none of the cases, the saturation of arterial blood with single lung ventilation by patients or under general anesthesia exceeds less than 90%, and there was no need to terminate the operation did prematurely.

None of the patients had any previous history of heart-pulmonary disease or thoracoscopy surgery. The results of clinical examination were positive, negative and inconclusive in 7 (16.7%), 32 (76.2%) and 3 (7.1%) patients, respectively. The inconclusive cases were due to the ribs overlap and the lack of precise touch of the diaphragm.

The results of thoracoscopy were positive and negative in 7 (16.7%) 35 (83.3%) patients, respectively. There was no inconclusive case. In total, 16.7% of patients with stab wound in lower chest suffered from diaphragm rupture.

All patients in whom diaphragmatic rupture was confirmed by thoracoscopy, were also have been diagnosed by clinical examination with finger. All of the negative cases in terms of health examination had also normal diaphragm in thoracoscopy. The 3 inconclusive cases showed no evidence symptoms of diaphragm rupture in thoracoscopy clinical examination.

The incidence of diaphragm rupture in left-side and right-side stab wounds was equal to 6 of 30 (20%) and 1 of 12 (8.3%), respectively. The observed difference was not statistically significant (P = 0.84).

The incidence of diaphragm rupture in the anterior and posterior stab wounds was equal to 5 of 28 (17.9%) and 2 of 14 (14.3%), respectively. The observed difference was not statistically significant (P = 0.174). With excluding 3 inconclusive cases, the sensitivity, specificity and positive and negative predictive values of 100% are calculated for the examination with finger for diagnosis of diaphragm rupture caused by the lower chest stab wound:

Diaphragm Rupture Diagnosed by Thoracoscopy

	Positive	Negative	Total
Positive	7	0	7
Negative	0	32	32
Total	7	32	

Diaphragm Rupture Diagnosed by
Clinical Examination with Finger

$$= \frac{32}{32 + 0} = \% 100 \text{ Specificity} = \frac{7}{7 + 0} = \% 100 \text{ Sensitivity}$$

$$= \frac{32}{32 + 0} = \% 100 \text{ Negative Predictive Value} = \frac{7}{7 + 0} = \% 100 \text{ Positive Predictive Value}$$

Discussion:

In this study, the mean age of patients was 22.4 years old which is comparable to the literature review conducted by the Shah. The third decade was known as the most common ages in various studies. In this study, all patients were male, while the ratio of men to women was 4 to 1 in Shah's study. Diaphragm trauma in men is much more than women. This difference is due to inclusion of blunt trauma cases in Shah's review, while only stab wounds were investigated in the present study. The social and cultural issues are also involved in the observed difference (27).

71.4% of patients suffered a left side stab wound which is consistent with the results of Dudley. Basically, the most attackers are right-handed, and there is a close relationship between this region and the target, i.e. the heart, therefore most thoracoabdominal injuries occur on the left side (9).

Also, the incidence of diaphragm rupture in left side and right side stab wounds was equal to 20% and 80%, respectively. Although there is no statistically significant difference due to patient noncompliance in emergency ward (16).

In the present study, 16.7% of patients suffered from diaphragm rupture which is comparable with other studies that have reported the incidence of diaphragm rupture in the range of 7% to 32% (13, 17, 34 and 36). The sensitivity and specificity of 100% was obtained for examination with finger for diagnosis of diaphragm rupture caused by the lower chest stab wound. Morales has reported the sensitivity and specificity of 96% and 83.3%, respectively. The sensitivity of 100% and the specificity of 93.9 have been reported by Restrepo and Vano. There were only 2 false negative cases in Morales's study which were inconclusive by clinical examination with finger.

Conclusion:

It seems that the number of such cases can be reduced by intercostal anesthesia and most careful clinical examination with finger and thereby specificity can be increased. According to Morales, it can be said that the examination with finger is a simple and low cost method with high sensitivity and negative predictive value. It allows the early diagnosis of diaphragm rupture without the need for general anesthesia or an additional incision. In cases where the examination is inconclusive, the examination under general anesthesia or thoracoscopy can be considered as an alternative diagnostic method (16).

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significant difference between the values, but they are in good agreement with studies which reported the most incidence of penetrating trauma on left side (34). The incidence of diaphragm rupture in the anterior and posterior stab wounds was equal to 17.9% and 14.3%, respectively. Although there is also no statistically significant difference between values, but they are in good agreement with studies which have reported the most incidence of the diaphragm rupture in anterior stab wound (34).

The clinical examination with finger was inconclusive for 7.1% of patients due to ribs overlap and lack of precise touch of the diaphragm. The results of Morales also showed that 7.3% of patients examined by clinical examination with finger were inconclusive due to ribs overlap (4.9%) and patient noncompliance (2.4%). There were no such cases in the present study because the examination with finger was performed in the operating room following the intercostal anesthesia or general anesthesia in the cases where there was no possibility for clinical examination. Sciences for their leading suggestions on this manuscript.

References

- 1 - Azargasht, E., Research Methods in Medical Sciences, Tehran, Ladan Publications, 1997.
- 2 - TakZare, N., Guidelines for Writing and Presenting Thesis, Research Reports and Scientific Papers, 2nd Edition, Tehran, Teimorzadeh, 1996.
- 3 - Dawson, B., Therap, Z. J. Medical Statistics: Clinical Basis: Translated to Persian by A. A. Sarafraz, Ghaffarzadegan K., edited by M. Rohani, Mashhad: Mashhad University of Medical Sciences Publications, 1997.
- 4 - Rasti Ardakani, M., Adibi, P. Scientific Literature Writing Methods, Isfahan, Isfahan University of Medical Sciences and Health Services, 1995.
- 5- Armitage P, Berry G. Statistical methods in medical research, 2nd ed. Blackwell, London; 1971.
- 6- Becker EL, Stechford LB, Harvey Am. Churchill's Medical dictionary. Churchill Livingstone, New York; 1989:513.
- 7- Britt LD, Cole FG. Alternative surgery in trauma management. Arch Surg 1998; 133 (11):1177-81.
- 8- Brown GL, Richardson JD. Traumatic diaphragmatic hernia: a continuing challenge. Ann Thorax Surg 1985;39:170-3.
- 9- Dudley H, Carter D, Russell RCG. Rob & Smith's operative surgery: Trauma surgery, Part 1, 4th ed. Butterworth's, London: 1998:281.
- 10- Freeman RK, Al-Dossari G, Hutcheson KA, et al. Indications for using video-assisted thoracoscopic

- surgery to diagnose diaphragmatic injuries after penetrating chest trauma. *Ann Thorax Surg* 2001;72(2):342-7.
- 11- Ivatury RR, Simon RJ, Wechsler B, et al. Laparoscopy in the evaluation of the intra thoracic abdomen after penetrating injury. *J Trauma* 1992;33:101.
- 12- Jackson AM, Ferreira AA. Thoracoscopy as an aid to the diagnosis of diaphragmatic injury in penetrating wounds of the left lower chest: a preliminary report. *Injury* 1976;7(3):213-7.
- 13- Leppaniemi A, Haapiainen R. Occult diaphragmatic injuries caused by stab wounds. *J Trauma* 2003; 55(4):646-50.
- 14- Moore JB, Moore EE, Thompson JS. Abdominal injuries associated with penetrating trauma in the lower chest. *Am J Surg* 1980; 140: 724.
- 15- Moore KL, Dalley AF. Clinically oriented anatomy, 4thed Lippincott Williams & Wilkins, Philadelphia: 1999:289.
- 16- Morales CH, Villegas MI, Angel W, et al. Value of digital exploration for diagnosing injuries to the left side of the diaphragm caused by stab wounds. *Arch Surg* 2001; 136(10):1131-5.
- 17- Murray JA, Demetrius's D, Cornwell EE, et al. Penetrating left thoracoabdominal trauma. The incidence and clinical presentation of diaphragmatic injuries. *J Trauma*.1997; 43:624-26.
- 18- NelJH, Warren BL. Thoracoscopic evaluation of the diaphragm in patients with knife wounds of the left lower chest, *Br J Surg* 1994; 81:713-14.
- 19- Ochsner MG, Rozycki GS, Lucent F, et al. Prospective evaluation of thoracoscopy for diagnosing diaphragmatic injury in thoracoabdominal trauma: a preliminary report. *J Trauma* 1993; 34:704.
- 20- Oreskovich MR, Carrick CJ. Stab wound of the abdomen – analysis of a management plan using local wound exploration and quantitative peritoneal lavage. *Ann Surg* 1983; 198:411.
- 21- Patselas TN, Gallagher EG. The diagnostic dilemma of diaphragm injury. *The American Surgeon* 2002; 68(7):633-9.
- 22- Pearson FG, Deslauriers J, Ginsberg RJ, et al. Thoracic Surgery. Churchill Livingstone, New York; 1995:1566-9.
- 23- Rebar PU, Schmidt B, Baer HU, et al. Missed Diaphragmatic injuries and their long – term sequelae. *J Trauma* 1998; 44:183-7.
- 24- Sabiston DC, Spencer FC. Surgery of the chest, 6thed W.B.Saunders, Philadelphia; 1996:486.
- 25- Salvinio CK, Esposito TJ, Marshall WS, et al. The role of diagnostic laparoscopy in the management of trauma patients: a preliminary assessment *J Trauma* 1993; 34:507.
- 26- Schwartz SI, Shires GT, Spencer FC, et al. Principles of surgery, 7th ed. McGraw-Hill, New York ; 1999:168.
- 27- Shah R, et al. Traumatic rupture of diaphragm. *Ann Thorax Surg* 1995; 60:1444-49.
- 28- Shields TW, Locicero III J, Ponn RB. General thoracic surgery, 5thed. Lippincott Williams & Wilkins, Philadelphia ; 2000 :863-70.
- 29- Stoica SC, Walker WS. Video assisted thoracoscopic surgery. *postgrad Med J* 2000 ; 76(899):547-50.
- 30- Townsend CM, Beauchamp RD, Evers BM, et al. Sabiston Textbook of surgery, 6th ed. W.B.Saunders, Philadelphia;2001:330.
- 31- Van Loenhout RM, Schiphurst TJ, Wittens CH, et al. Traumatic intraperitoneal diaphragmatic hernia. *J Trauma* 1986 ;26:271.
- 32- Westaby S, Odell JA. Cardiothoracic trauma, Arnold, New York ; 1999:113-4.
- 33- Wiencek RG, Wilson RF, Steiger Z. Acute injuries of the Diaphragm. An analysis of 165 cases. *J Thorac Cardiovasc Surg* 1986; 92:989.
- 34- Wilson RF, Walt AJ. Management of trauma : pitfalls and practice, 2nd ed. Williams & Wilkins, Baltimore; 1996:432-48.
- 35- Yim APC, Hazelrigg SR, Izzat MB, et al. Minimal access cardiothoracic surgery. W.B. Saunders, Philadelphia, 2000:308-12.
- 36- Zierld D, Perstein J, Weidman ER, et al. Penetrating trauma to the diaphragm: Natural history and ultrasonographic characteristics of untreated injury in a pig model. *Arch surg* 2001;136(1):32-7.
- 37- Zinner MJ, Schwartz SL, Ellis H, et al. Maginot's abdominal operations, 10thed. Appleton & Lange, Stamford ; 1997:771.

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