

Evidence-based assignment of diagnostic peritoneal lavage (DPL) sensitivity in penetrating abdominal trauma

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Abstract

Background: There are a large number of patients with penetrating abdominal trauma who have normal vital signs and negative abdominal examination when referred to trauma centers. A great deal of controversy exists between authorities about screening these patients for emergency explorative laparotomy. Many references have reported more than 90% sensitivity for DPL as a diagnostic method to determine whether intraabdominal injuries were present and emergent laparotomy is indicated or not. This study is for reassignment of this sensitivity according to our own evidence.

Methods: All of the patients with abdominal stab wounds and normal vital signs plus negative abdominal examination who were referred to Shohada-e-Tajrish hospital between March 2004 to December 2005, underwent local wound exploration and those confirmed to have peritoneal penetration, underwent emergency laparotomy. In the operating room and prior to surgery, under general anesthesia, DPL was performed. Then DPL results were compared with laparotomy findings and DPL sensitivity was assigned.

Results: Of the total number of 34 patients, 8 had a positive DPL and positive laparotomy; 2 had a positive DPL and negative laparotomy; 8 had negative DPL and positive laparotomy, and 16 patients had negative DPL and negative laparotomy.

Conclusion: According to our study, DPL sensitivity is much less than mentioned in trauma texts (approximately 50%). So, it is not a valuable tool to discriminate between operative and conservative approaches in penetrating abdominal trauma. We suggest more sensitive modalities. Laparotomy is the most sensitive approach but at the price of a high negative laparotomy rate.

Keywords: penetrating abdominal trauma, diagnostic peritoneal lavage, laparotomy, stab wound.

Introduction

Nowadays the incidence of penetrating abdominal trauma is increasing [1]. In spite of great achievements in the treatment of such pa-

tients, some basic problems are still obscure: Which patients must undergo emergent laparotomy and which ones can be managed conservatively? Is there a method to help us avoid unnecessary laparotomies?

It is noteworthy that early diagnosis and

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emergent laparotomy is life saving in penetrating abdominal trauma. Exsanguination, sepsis and multiorgan failure (MOF) are the principal preventable causes of death in cases of delayed laparotomy. Intraabdominal injuries often-but not always-manifest as vital sign instability or signs of peritoneal irritation [6].

In hemodynamically stable patients who have normal abdominal examination, the surgeon has an opportunity for further evaluations to minimize negative laparotomies[8].

Stab wounds almost always are caused by knives. In 1/3 of cases, the stab does not penetrate the peritoneal cavity and just in half of peritoneal penetrations, surgical intervention is inevitable [1].

Initial evaluation in penetrating abdominal trauma after primary resuscitation includes an exact history taking and precise physical examination.

Important points in history comprise: injury time, trauma mechanism and site, amount of bleeding at the scene, time of the last food intake, past medical and drug history, history of simultaneous blunt or penetrating trauma, etc [12].

Critical points in physical examination include: vital sign evaluation, presence or absence of evisceration or peritoneal irritation signs, thoracic examination, digital rectal examination and NG tube and Foley catheter insertion [17].

Localized abdominal tenderness at the trauma site can be due to abdominal wall injury, while distant rebound tenderness is an evidence of intraabdominal visceral injury [9].

Patients with abdominal shotgun or gunshot injury; and stab wound cases with initial vital sign instability, evisceration, signs of generalized peritoneal irritation and presence of blood or bloody fluid on rectal exam, NG tube or Foley catheter (all equal peritonitis), should undergo emergency laparotomy without any further diagnostic procedures [1].

Patients with abdominal stab wound who

have normal vital signs and physical examination at the beginning, undergo wound exploration at the emergency department [1-4,7,10]. Under local anesthesia, the stab wound is explored. If the anterior rectus sheath is not penetrated, the patient is discharged after wound closure [1-4,7]. But if it has been penetrated, there are two available options: Exploratory laparotomy [4], and diagnostic peritoneal lavage [2-4,11].

In abdominal stab wounds, at least 50% of peritoneal penetrations are not accompanied by intraabdominal injury [1]. Therefore, to minimize negative laparotomy, some authors prefer DPL to distinguish intraabdominal injury [2,3].

In the open technique of DPL, under local anesthesia, a 3-5cm midline incision is made just below the umbilical ring and the peritoneum is opened under direct vision.

Then, a catheter (eg. Nelaton urinary catheter) is inserted in the pelvic cavity and aspiration is performed. If at least 10cc of blood is withdrawn, DPL is considered grossly positive and discontinued. Otherwise, 1 liter of N/S or Ringers solution is instilled intraperitoneally and at least 600cc is drawn back and sent for laboratory analysis. In any of the following conditions, the DPL result is considered positive [2-5,13-15]:

RBC count >10000/dl in lower thoracic trauma (from nipples to costal margins).

RBC count >100000/dl in anterior abdominal trauma (between costal margins, posterior axillary lines and groin).

Amylase >20 IU/dl and alkaline phosphatase >3 IU/dl [16].

Grossly visible food, bile, stool and urine.

In the presence of positive DPL results, the patient is prepared for emergency laparotomy [2-4,18]. Otherwise, the patient is discharged after IV antibiotic therapy.

Methods

In this study, any patient with lower thoracic or anterior abdominal stab wound who was re-

ferred to Shohada-e-Tajrish Hospital from March 2004 to December 2005, whose initial vital signs and physical examination was normal, underwent local wound exploration. All cases of peritoneal penetration were selected for emergency laparotomy; but in the operating room under general anesthesia, a DPL was performed before laparotomy.

DPL results were compared with laparotomy findings.

In most references, more than 95% sensitivity is mentioned for DPL in distinguishing intraabdominal injury [2-4].

34 patients were studied with initial normal vital signs and negative abdominal examination plus absence of bloody contents in rectal exam, NG tube and Foley catheter.

The patient average age was 28.1 years.

2 cases (5.8%) were stabbed in the lower thoracic area, and the rest were injured in the anterior abdominal region.

On the average, every patient had received 1.5 knife stabs but just 2 patients had more than one abdominal stab wound (meaning that the second one clashed the extremities).

The average time from trauma occurring to hospital arrival was 120 minutes.

Results

Of the total 34 patients, in 10 cases (29.4%), DPL was positive and in 16 cases (47.07%), intraabdominal injury was found during laparotomy.

- DPL positive + laparotomy positive=8 cases
- DPL positive + laparotomy negative=2 cases
- DPL negative + laparotomy positive= 8 cases
- DPL negative + laparotomy negative=16 cases
- DPL sensitivity = a/(a+c) = 50%.
- DPL specificity= d/(b+d) = 88.8%.

DPL positive predictive value= a/(a+b)= 80%.
 DPL negative predictive value= d/(c+d)= 66.6%.

Among 34 patients with peritoneal penetration by stab, intraabdominal injury was found in just 16 (47.7%). Of these 16 patients, in 8 cases (50%), the DPL result was negative. This means that a negative DPL can not rule out intraabdominal injuries.

12 out of these 16 cases, had single organ injury. In all 4 cases with dual organ injury, the diaphragm was one of the damaged organs and in 3 of these 4, DPL was negative.

No kidney and urinary tract, pancreas and gall bladder injury were found.

5 cases of splenic injury were found but splenectomy was not indicated in any of them.

3 cases of small intestinal injury were found and DPL was negative in all of them.

In 1 case, a severe colon perforation was found in whom DPL was also negative (!).

Overall, 20% of patients with positive DPL result could be managed conservatively (as compared with 53% of negative laparotomy rate when DPL was not done); If laparotomy was performed only when DPL was positive, at the price of decreasing negative laparotomy rates, 8 cases with intraabdominal injury (50% of the injuries) would have been missed, which is not acceptable at all.

Conclusion

DPL negative result (with aforementioned criteria) can not rule out intraabdominal injury.

DPL sensitivity (with aforementioned criteria) is much less than the reported figures in surgical textbooks (50% versus 95%).

The most important portion of DPL fluid analysis is RBC count (in none of 16 cases with

| | <i>Laparotomy positive</i> | <i>Laparotomy negative</i> | <i>Total DPL</i> |
|------------------|----------------------------|----------------------------|------------------|
| DPL positive | 8(a) | 2(b) | 10 |
| DPL negative | 8(c) | 16(d) | 24 |
| Total laparotomy | 16 | 18 | |

Table 1. Results of DPL & laparotomy in the total 34 patients.

intraabdominal injury was an RBC count < 1000/dl found).

We can increase DPL sensitivity by decreasing RBC count threshold to consider DPL result as positive; but at the price of a high negative laparotomy rate.

To determine a more precise RBC count threshold that can minimize the negative laparotomy rate, further studies with higher patient numbers are recommended.

References

1. Timothy CF, Martin AC. Abdominal trauma, including indications for celiotomy. In: Feliciano, Moore, Mattox, editors. *Trauma*. 3rd ed. Appleton & Lange. 1996. pp. 441-460.
2. Burch JM, Reginald J, Francoise, Moore EE. Trauma. in: *Schwartz's Principles of Surgery*. 8th ed. McGraw Hill. 2005. pp. 129-160.
3. Hoyt DB, Coimbra R, Potenza B. Management of acute trauma. in: *Sabiston Textbook of Surgery*. 17th ed. Saunders. 2004. pp. 483-532.
4. Moore FA, Moore EE. Trauma resuscitation. In: *ACS principles and practice of surgery*. WebMD. 2002. pp. 31-48.
5. Read RA, Moore EE, Moore FA, Burch JM. Blunt and penetrating trauma. In: *Maingot's abdominal operations*. 10th ed. Prentice Hall International. 1997. pp. 763-786.
6. Nicholas JM, Rix EP, Easley KA, Feliciano DV, Cava RA, Ingram W, et al. Changing patterns in the management of penetrating abdominal trauma: the more things change, the more they say the same. *J Trauma* 2003 Dec; 55(6):1095-108.
7. Walters JM. Abdominal paracentesis and diagnostic peritoneal lavage. *Clin Tech Small Anim Pract* 2003 Feb; 18(1):32-8.
8. Johnson JW, Gracias VH, Schwab CW, Reilly PM, Kauder DR, Dabrowski GP, et al. Evolution in damage control for exsanguinating penetrating abdominal injury. *J Trauma* 2001 Aug; 51(2):261-9.
9. Leppaniemi AK, Voutilainen PE, Haapiainen RK. Indications for early mandatory laparotomy in abdominal stab wounds. *Br J Surg* 1999 Jan; 86(1):76-80.
10. Ameh EA, Nmadu PT. Penetrating abdominal injuries in children in Nigeria. *Ann Trop Paediatr* 1999 Sep; 19(3):293-6.
11. Tsai MJ, Chen JP, Liu TJ, Wu CC, Wu TC, Yang MD. Management of penetrating abdominal injury.

Gaoxiong Yi Xue Za Zhi 1991 Jan; 7(1):32-7.

12. Sturm JT, Cicero JJ, Perry JF Jr. Peritoneal lavage for the diagnosis of abdominal visceral injury. *Am J Emerg Med* 1984 May; 2(3):246-50.

13. Maxwell-Armstrong C, Brooks A, Field M, Hammond J, Abercrombie J. Diagnostic peritoneal lavage analysis: should trauma guidelines be revised? *Emerg Med J* 2002 Nov; 19(6):524-5.

14. Gonzalez RP, Phelan H 3rd, Hassan M, Ellis CN, Rodning CB. Is fecal diversion necessary for nondestructive penetrating extraperitoneal rectal injuries? *J Trauma* 2006 Oct; 61(4):815-9.

15. Shoham N, Sweed Y. Abdominal trauma in childhood: the conservative approach in 95 cases. *Harefuah* 1999 May; 136(9):627-7,755.

16. McAnena OJ, Marx JA, Moore EE. Diagnostic peritoneal lavage enzyme determinations following blunt and penetrating abdominal trauma. *J Trauma* 1991 Aug; 31(8):1161-4.

17. Henneman PL, Marx JA, Moore EE, Cantrill SV, Ammons LA. Diagnostic peritoneal lavage: accuracy in predicting necessary laparotomy following blunt and penetrating trauma. *J Trauma* 1990 Nov; 30(11): 1345-55.

18. Henneman PL. Penetrating abdominal trauma. *Emerg Med Clin North Am* 1989 Aug; 7(3):647-66.