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Prospective Comparison of Diagnostic Peritoneal Lavage (DPL) and Focused Abdominal Sonography for Trauma (FAST) for the Diagnosis of Hemoperitoneum in Blunt and Penetrating Abdominal Trauma

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Abstract

Background: **Clinical assessment of intra-abdominal injury following blunt or penetrating trauma may be unreliable, due to the alteration of consciousness, neurological deficit, medications or other associated injuries. Diagnostic peritoneal lavage (DPL) is more accurate than physical examination in assessing abdominal injury. However, it is an invasive procedure and carries risk of organ injuries. Focused Abdominal Sonography for Trauma (FAST) is a focused assessment of the abdomen which is safe, non-invasive, inexpensive and painless and can be completed within 3 minutes.**

Materials and Methods: **Over a 12 months period from January 2006 to January 2007, FAST was performed in all abdominal trauma patients with indications for DPL. The results were compared with traditional DPL by open technique.**

Results: **Fifty four patients with abdominal injury were evaluated by FAST and the results were compared with the results of DPL. Forty-eight patients had positive FAST and positive DPL. Five patients had negative FAST but positive DPL. Only one patient had negative FAST and negative DPL. No patient had FAST positive but negative DPL. The sensitivity and specificity of FAST compared to DPL for detection of hemoperitoneum in this study were 91% and 100%, respectively.**

Conclusion: **FAST is an efficient and accurate method in the evaluation of hemoperitoneum in blunt and penetrating abdominal trauma compared with DPL.**

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Introduction

Clinical assessment of the abdomen for possible intra-abdominal injury following blunt or penetrating trauma is often unreliable. This may be due to decreased patients' conciousness, neurological deficits, medications, or other associated injuries. Diagnostic peritoneal lavage (DPL) is superior to clinical examination in assessing abdominal injury.[1,2] However, it is an invasive procedure and carries the risk of intra-abdominal organ injuries. Numerous studies have reported the role of ultrasonography in the assessment of trauma patients. It is safe, inexpensive, movable, non-invasive, and painless and can be completed within 3-4 minutes. It should be performed during the initial trauma assessment.[3-7]

This study prospectively evaluated the use of focused abdominal sonography in trauma (FAST) and compared with diagnostic peritoneal lavage (DPL) in the diagnosis of hemoperitoneum in blunt and penetrating abdominal trauma.

Materials and Methods

From January 2006 to January 2007, adult patients with blunt abdominal trauma or penetrating injury of lower chest and/or abdomen admitted in the Division of Surgery, Somdej Prapinklao Hospital, were enrolled into this study. Penetrating injury of the abdomen is defined as injury to the area bounded superiorly by costal margins, laterally by anterior axillary lines, and inferiorly by groin creases. Thoraco-abdominal injury is defined as penetrating trauma between the nipple line and costal margins.

Patients with abnormal physical findings showed by peritonitis, shock, pneumoperitoneum, evisceration or other conditions suggesting intraperitoneal injury were taken directly to the operating room and were excluded from this study.

Indications for DPL in patients with blunt abdominal trauma included equivocal abdominal signs, unexplained blood loss, altered mental status or unreliable abdominal examination and prolonged anesthesia for others associated injuries. Patients with penetrating wounds but without indications for immediate surgery were treated according to the following guidelines. If the wound located below the costal margin, a formal local wound exploration was performed in the emergency room. If the end of stab wound tract was clearly visualized and not penetrating to superficial muscle fascia, the patient could be managed as superficial stab wound. DPL was performed in all patients with anterior stab wound if the end of stab wound penetrated through superficial muscle fascia. Patients with wound located above the costal margin and penetrating into muscle underwent DPL. Indications for DPL were determined by senior residents or attending staff.

All patients with indications for DPL underwent FAST assessment for hemoperitoneum before performing DPL. Accreditation in the use of FAST at Somdej Prapinkao Hospital requires completion of recognized course in the application of ultrasonography in emergency setting. Courses include technical information of ultrasound mechanics, theory, and real time examination of live patients. FAST usually involves imaging 4 areas; 1) the right frank, to demonstrate the hepato-renal pouch (Morison's pouch), 2) the left frank, to demonstrate the peri-splenic view, 3) the suprapubic window, to demonstrate the pelvis, and 4) the subcostal pericardial view.

All lavage procedures were performed by well-trained surgical resident or surgical staff. A positive lavage was defined as red blood cell count greater than 100,000 cell/mm^3 in blunt injury or greater than 10,000 cell/mm^3 in penetrating thoraco-abdominal and abdominal injuries.

Statistical Analysis

Results of FAST and DPL were compared by Fisher's Exact Test. Statistical analysis was performed by using the SPSS soft ware for Windows version 11.01. A value of $p<0.05$ was considered statistically significant.

Table 1 Summary of patient demography

	Minimum	Maximum	Mean	S.D.
Age	15	51	31.63	10.79
Hct	26	47	35.83	4.65

Table 2 Mechanism of injury

Mechanism of Injury	Number	%
Stab wound of the abdomen	24	46.3
Blunt abdominal trauma	18	33.3
Stab wound, thoracoabdominal	12	20.4

Table 3 Intra-abdominal organ injuries

Mechanism	No.	Intraabdominal organ injury
Blunt abdominal injury	10	Liver injury grade 1-2
Blunt abdominal injury	1	Splenic injury grade 4
Blunt abdominal injury	2	Liver injury grade 1-2, tear omentum, retroperitoneal hematoma zone 2
Blunt abdominal injury	3	Liver injury grade 1-2, retroperitoneal hematoma zone 2
Blunt abdominal injury	1	Perforation of jejunum, hematoma of mesentery
Blunt abdominal injury	1	Perforation of sigmoid colon, retroperitoneal hematoma zone 3
Penetrating abdominal injury	3	Tear of omentum
Penetrating abdominal injury	2	Tear of omentum, mesentery
Penetrating abdominal injury	1	Tear of omentum, partial tear of stomach
Penetrating abdominal injury	3	Tear of omentum, partial tear of transverse colon
Penetrating abdominal injury	6	Liver injury grade 1-3
Penetrating abdominal injury	4	Tear of omentum, partial tear of jejunum
Penetrating abdominal injury	4	Liver injury grade1-2, Rt. Kidney injury grade 1-2
Penetrating abdominal injury	1	Liver injury, gallbladder injury, tear of IVC.
Penetrating thoraco-abdominal injury	5	Rt. Diaphragmatic injury, liver injury grade 1-2
Penetrating thoraco-abdominal injury	2	Rt. Diaphragmatic injury, liver injury grade 1-2, partial tear of transverse colon
Penetrating thoraco-abdominal injury	1	Lt. Diaphragmatic injury, partial tear of stomach
Penetrating thoraco-abdominal injury	1	Liver injury grade 2 segment 6, 7
Penetrating thoraco-abdominal injury	2	Lt. Diaphragmatic injury, tear of omentum

Results

Fifty-four abdominal trauma patients with indications for DPL underwent FAST examination before DPL. Forty-seven patients were male and 7 were female with mean age of 31.63 ± 10.79 years (Table 1). Mechanisms of injury included blunt abdominal injury in 18 patients (33.30%), penetrating abdominal injury in 24 patients (46.30%), penetrating thoraco-abdominal injury in 12 patients (20.40%) (Table 2).

Forty-eight patients had positive FAST and positive DPL. Five patients had negative FAST but positive DPL. Only one patient had negative FAST and negative DPL. No patient had positive FAST but negative DPL.

Fifty-three patients with positive DPL underwent laparotomy. One patient with negative DPL was admitted for close observation for 24 hours. No immediate morbidity or mortality was found. Four patients had postoperative morbidity from superficial surgical site infection.

A summary of the intra-abdominal organ injuries is shown in Table 3.

Fisher's Exact Test was used to compare the results of FAST and DPL. We found no differences between the 2 in detecting hemoperitoneum ($p = 0.11$, p-value >0.1).

Table 4 Statistical analysis

	DPL Positive	DPL Negative	Total
FAST Positive	48	-	48
FAST Negative	5	1	6
	53	**1**	**54**

Positive Predictive value (48/48) = 100%, Negative Predictive value (1/6) = 17%, Prevalence (53/54) = 98%, Fisher's Exact Test = 0.11, Sensitivity (48/53) = 91%, Specificity (1/1) = 100%, Accuracy (49/54) = 91%

The sensitivity and specificity of FAST in the diagnosis of hemoperitoneum in blunt and penetrating abdominal trauma were 91% and 100%, respectively, with a positive predictive value of 100%. A summary of the statistical analysis is shown in Table 4.

Discussion

Abdominal trauma is one of main reasons for emergency operation which is associated with high morbidity and mortality. DPL is one of principle methods used for the detection of intraperitoneal injury. Root et al. in 1965 reported this technique and showed a dramatic decline in the number of death from unrecognized intraperitoneal injury when DPL

was used, with complication rates ranged from 0-1.6%.[1,2]

In contrast, FAST can be very rapid and non-invasive investigation.[8,9] North America trauma centers reported a sensitivity of 80%-86% and specificity of 90%-99% for non-radiologist using this technique.[10,11] Other studies have shown that the ability to detect hemoperitoneum using FAST technique is equally accurate in the hands of radiologist and non-radiologist alike.[11] Identification of hemoperitoneum by FAST had been found to correlate well with the need for a therapeutic laparotomy.[7] Small amount of fluid detectable by FAST is disputed in the literature; but it will be clearly dependent on the experience of the operator. FAST is easily repeated and studies have shown that sequential focused scanning can improve the sensitivity of the test.

The results of FAST in abdominal trauma in this study are accurate compared with DPL, with the sensitivity of 91%; specificity of 100%; and positive predictive value of 100%. However, FAST cannot replace the precise anatomical information provided by CT scan. It is extremely valuable in the initial assessment of the unstable injured patient and a useful adjunct to CT scan in stable patients for non-operative management.

We recommend the use of FAST for the detection of hemoperitoneum as the initial investigation to augment the clinical assessment of abdominal trauma.

Conclusion

FAST is an efficient and accurate method in the evaluation of hemoperitoneum in blunt and penetrating abdominal trauma compared with DPL. The sensitivity of FAST has been shown in several studies on trauma patients to support its application as a screening test for hemoperitoneum. We recommend that FAST should be adopted as an initial investigation to augment the clinical assessment in patients with abdominal trauma.

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