# Focused Abdominal Sonography for Trauma (Fast) At the Emergency Department of Kirkuk General Hospital

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## ABSTRACT:

**BACKGROUND :**

Blunt abdominal trauma (BAT) is a diagnostic challenge. The introduction of bedside ultrasound provides another diagnostic tool for the emergency physician (EP) to detect intra-abdominal injuries.

**OBJECTIVE**:

To assess the benefits of FAST in the evaluation of patients with blunt abdominal trauma in the emergency department of Kirkuk General Hospital in Kirkuk.

**PATIENTS AND METHODS:**

This was a prospective study including100 consecutive cases of blunt abdominal trauma in the emergency department of Kirkuk General Hospital in Kirkuk. The results of FAST scans were analyzed and compared with operative findings, diagnostic laparoscopy and CT scanning when the FAST was positive or followed by a period of clinical observation when the FAST was negative. Descriptive statistics, sensitivity, specificity, and predictive values were calculated.

**RESULTS** :

There was a 100 consecutive blunt abdominal trauma cases during 9 months period, and FAST scans were performed in these cases. The sensitivity and specificity were 92% and 93.3%, respectively. The negative predictive value was 0.97, while the overall accuracy was 93%.

**CONCLUSION:**

The high specificity of FAST (93.3%) makes it a good 'rule in' tool for BAT patients. The high negative predictive value also makes the FAST scan a useful screening tool. However, ultrasound examination is operator dependent, and FAST scan has its own limitations.


**KEYWORDS** :Blunt abdominal trauma, Emergency medicine, Ultrasound, FAST.

## INTRODUCTION:

Abdominal trauma can be either blunt or penetrating. The most common cause of blunt abdominal trauma in metropolitan trauma centers is the motor vehicle accident (MVA), responsible for 45% to 50% of BATs. Assaults, falls, automobile–pedestrian accidents and work-related injuries are also common. Abdominal injuries in blunt trauma result from compression, crushing, shearing, or deceleration mechanisms. The most frequently injured organs are the spleen (40% to 55%), the liver (35% to 45%), and the retroperitoneum (15%). Abdominal injuries rank third as a cause of traumatic death just after head and chest injuries. Unrecognized abdominal injuries are frequently the cause of preventable death, which constitutes a significant diagnostic challenge to emergency physicians (EP) ([1]).

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Diagnostic modalities for BAT include physical examination, radiography, focused assessment with sonography for trauma (FAST), computed tomography (CT), Diagnostic peritoneal lavage (DPL) and diagnostic laparoscopy. In the past, we relied on clinical signs that have relatively low diagnostic accuracy (47% to 87%), especially when the patient had a decreased consciousness level, neurological deficit, other associated injuries, or was under the influence of drugs or medications [(2)].

The introduction of bedside ultrasonography provides another non-invasive, readily available, and time-saving option for patients with blunt abdominal trauma. The focused assessment with sonography for trauma (FAST) examination is an important tool in the evaluation of abdominal trauma. Its portability, speed, noninvasiveness, and reproducibility make it an ideal diagnostic study. It has some limitations, in its dependency on free intra peritoneal fluid for a positive study. Thus, hollow visceral and retroperitoneal injuries are not detected reliably by the FAST exam [(3)].

In fact, there was an over 30-year history of using ultrasound in the evaluation of abdominal trauma. As early as 1971, Kristensen described the use of ultrasound scanning in the diagnosis of abdominal trauma [4]. After that, the use of ultrasound in abdominal trauma grew gradually, and the term 'focused abdominal sonography for trauma' (FAST) scan has been used since the early 1990s

The objective of this study was to evaluate the performance of FAST scan in BAT patients by the emergency physicians in Kirkuk General Hospital in Kirkuk.

## PATIENTS AND METHODS:

This was a prospective study including 100 consecutive cases of blunt abdominal trauma between November 2016 and August 2017 (9 months) at the Emergency Department at Kirkuk General Hospital in Kirkuk. Inclusion criteria included patients with isolated blunt abdominal trauma and no obvious multiple injuries. Exclusion criteria were penetrating abdominal trauma and patients with multiple injuries like head and thoracic injuries.

FAST scans were performed by the attending emergency physician using Philips inviser 2006 ultrasound machine with a 3.75-MHz curvilinear probe. Scans were done after the primary survey with the patient in supine position. Four standard views were performed in each case, namely, (1) right upper quadrant view to include Morrison's pouch; (2) left upper quadrant view to include the splenorenal recess; (3) subxiphoid pericardial view ; (4) pelvic view to visualize the cul-de-sac

Positive scan was defined as the presence of free intra-peritoneal fluid, regardless of the fluid volume and location. The absence of any free intra-abdominal fluid was considered as negative scan. No further investigations (e.g., DPL or CT scan) would be warranted for negative scan, unless the patient clinical condition deteriorated or experienced persistent abdominal pain. Methods used to confirm the ultrasound results included CT scans, diagnostic laparoscopy, laparotomy, and clinical progress. All the patients were admitted to hospital for monitoring of at least 24hours.

## RESULTS:

Chi square test was used to analyze the results with significance determined at $P<0.05$.

FAST scans were performed in these 100 consecutive cases during 9 months period . The age range of patients was from 12 to 61 years old (Mean 27.6).

In these 100 cases, 28 (28%) of them showed intra-abdominal free fluid; 10 patients with unstable hemodynamics were immediately transferred to the operation room for emergency laparotomy without undergoing other investigations such as DL , CT scan or DPL, All of them showed positive results in laparotomy (Figure 1,2).

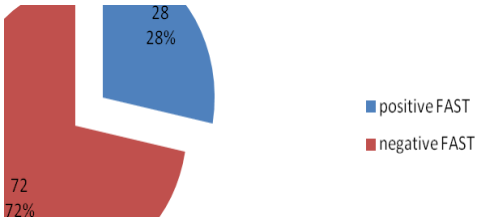


**Figure 1: FAST findings.**

The remaining 18 cases with stable hemodynamics were further evaluated by diagnostic laparoscopy later on in the operating theatre of the emergency department, of them, 5 cases were found to have a false positive scan: 9 patients had a significant intra peritoneal injury that needed an explorative laparotomy immediately to deal with. The other 2 cases had a simple bleeding that was dealt with laparoscopically, and the last 2 cases had a minor injury that needed no intervention. (Figure 3)

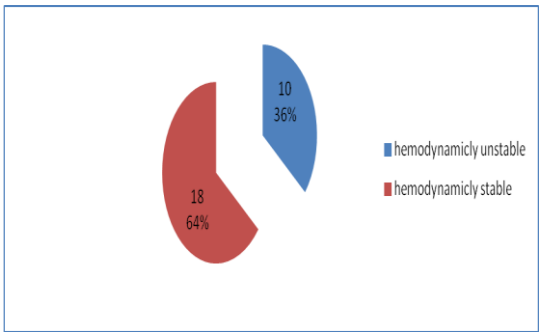


**Figure 2 : FAST positive patients.**

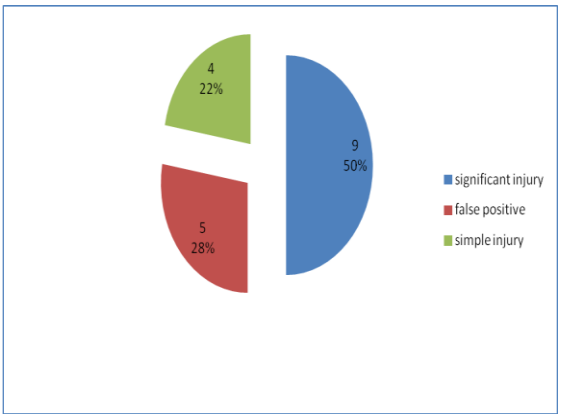


**Figure 3: Findings in DL.**

For those 72 cases with negative FAST scans, two were ultimately found to have hemoperitoneum by subsequent CT scans after admission. CT scans were done in these cases because the patients were experiencing persistent abdominal pain. One of them showed liver lacerations; the other showed mesenteric hematomas with bowel thickening. Both of them showed small amounts of free intra-peritoneal fluid. Both of them were treated conservatively with excellent results. The other 70 patients were also treated conservatively without any recorded complications.

In this study, the sensitivity and specificity of the FAST scan were 92% and 93.3%, respectively, with the accuracy of 93% (Table 1). The negative predictive value was 0.97, while the positive predictive value was 0.82. The overall accuracy was 93%.

## DISCUSSION:

In BAT, rapid determination of which patients should require emergency laparotomy is crucial for life saving, especially for those with unstable haemodynamics. On the other hand, avoidance of unnecessary laparotomy, which is an invasive procedure with inherent complications, is also important. The FAST scan provides a useful initial diagnostic tool for this kind of patient.

In this study, the high specificity (93.3%), positive predictive value (0.82) made the FAST scan a good 'rule in' tool for BAT patients. Other international studies also showed similar specificity with a range of 83%–100% [4-15].

The sensitivity was 92%, corresponding with many similar studies (Table 1). Literature review showed that the sensitivity of FAST scan performed by EP for BAT patients ranged from 42% to 95% [4-15]. The FAST scan is also valuable as a screening tool considering its high negative predictive value of 0.97.

There are many factors that could influence the result of FAST scans. It is well known that ultrasound scanning is operator dependent. Although the technique of FAST scan could easily be acquired, physicians did need some training and practice to become familiarized with the skill, the true required number for proficiency remains ill-defined. [16,17].

The timing of the scan is also an important factor. The aim of FAST scan is to detect free intra-

peritoneal fluid secondary to bleeding from abdominal organ injury; however, there is a time lag for the accumulation of a significant amount of blood in the peritoneal cavity to be detectable by the scan. Studies suggest that the average volume of fluid detectable by the FAST scan ranges from 250 ml to 620 ml [18,19], although some authors demonstrated that ultrasound could detect as little as 100 ml of free intra-peritoneal fluid . In order to eliminate this drawback, patients with negative scans should be observed for at least 4–6 h, and if indicated, serial FAST scan or CT scan should be considered.

There were two false-negative cases in this study. The patients complained of persistent abdominal pain during observation. CT of the abdomen was performed in these cases, both showing small amounts of free intra-peritoneal fluid. One case showed liver lacerations; the other showed mesenteric haematomas with bowel thickening. Both of them were treated conservatively.

In fact, many studies showed that FAST scan was limited or unable to detect certain types of injuries, such as bowel/mesenteric injury, diaphragmatic injury, solid organ/retroperitoneal organ injury (e.g., pancreatic, renal, and adrenal), vascular injury, and spinal/pelvic fracture . Therefore, a high level of suspicion should be maintained. In case of doubt, physicians should proceed to further investigations, such as CT scan.

Other causes of false-negative scan include emptying the urinary bladder too early or without an adequately filled urinary bladder for ultrasonic window, failure to recognize intra-peritoneal blood clot, patient obesity, and surgical emphysema in the chest and/or abdominal wall.

In this study, there were five false-positive cases after DL. Perinephric fat was one of the common causes. Fluid in the stomach or bowel might be mistaken as free intra-peritoneal fluid also. Other causes of false-positive result include pre-existing ascites, intra-peritoneal fluid collection due to ruptured ovarian cyst, or pelvic inflammatory disease [20].

With advanced skill and technology, the use of emergency ultrasonography is extended from blunt abdominal trauma to include chest trauma also. The term ‘Focused Assessment with Sonography for Trauma’ (FAST) was coined by Rozycki et al. in 1996. In such FAST scans, in addition to detecting free intra-peritoneal fluid, they also attempted to detect any fluid collection in the pericardium and lung bases through the subxiphoid, right upper quadrant, and left upper quadrant views. FAST scan, therefore, also played a significant role in early detection of cardiac temponade and hemothorax in trauma patients (21). In 2002, Dulchavsky further extended the use of FAST scan to involve extremity and respiratory evaluation and named it the FASTER examination. Such FASTER examination may play an important role in remote locations, such as military and aerospace applications [22].

**Table 1 : Sensitivity ,specificity and NPV in various studies.**

| Study | No. of subjects | Sensitivity (%) | Specificity (%) | NPV (%) |
|---|---|---|---|---|
| Our study | 100 | 92 | 93.3 | 97.2 |
| Nural (2005) | 454 | 86.5 | 95.4 | 98.7 |
| Holmes (2004) | 447 | 79 | 95 | 93 |
| Miller (2003) | 359 | 42 | 98 | 93 |
| Mattew (2001) | 2,576 | 86 | 98 | 98 |
| Mckenney (2001) | 996 | 88 | 99 | 98 |
| Coley (2000) | 107 | 55 | 83 | 50 |
| Boulanger (1999) | 400 | 81 | 97 | 96 |
| Shackford (1999) | 234 | 69 | 98 | 98 |
| Chiu (1997) | 772 | 71 | 100 | 78 |

## CONCLUSION:

FAST scan is a useful diagnostic tool in the initial assessment of BAT patients. It is easy to learn, readily available, repeatable, and non-invasive. The performance of EPs in using FAST scans in BAT patients was very encouraging. The high specificity (93.3%), positive predictive value (0.82), make it a good ‘rule in’ tool for BAT patients. The high negative predictive value

also causes FAST scan to be a useful screening tool. However, ultrasound examination is operator dependent, and FAST scan has its own limitations. Therefore, for negative FAST scan cases, we recommend a period of monitoring, serial FAST scans, or further investigations, such as DL, CT scan or peritoneal lavage.

**REFERENCES:**


1. American College of Surgeons Committee on Trauma (1997) Abdominal trauma. In: Advanced Trauma Life Support Program for Doctors, (Instructor course manual), 6th edn. Chicago; American College of Surgeons Committee on Trauma.
2. Perry JF. A Five-year survey of 152 acute abdominal injuries. J Trauma. 1996;5:53–57.
3. Chiu WC, et al. Potential limitation of FAST. J Trauma. 1997;42:617–22.
4. Smith J. Focused assessment with sonography in trauma (FAST): should its rule be reconsidered?. Postgrad Me J. 2010;86:285-91.
5. Griffin XL, Pullinger R. Are diagnostic peritoneal lavages or focused abdominal sonography for trauma safe screening investigations for hemodynamically stable patients after blunt abdominal trauma? A review of the literature. J Trauma. 2007;62:779–84.
6. Lingawi SS. Focused abdominal sonography in trauma. J HK Coll Radiol. 2001;4:222–25.
7. Yoshii H, Sato M, Yamamoto S, et al. Usefulness and limitation of ultrasonography in the initial evaluation of blunt abdominal trauma. J Trauma. 1998;45:45–51.
8. Smith ZA, et al. FAST scanning in the developing world emergency department. S Afr Med J.2010;100:105-8
9. Dolich MO, McKenney MG, et al. Ultrasounds for blunt abdominal trauma. J Trauma. 2001;50:108–12.
10. McKenney KL, McKenney MG, Mark G, Cohn SM, Compton R. Hemoperitoneum score helps determine need for therapeutic laparotomy. J Trauma. 2001;50:650–56.
11. Sue K. The occasional ED ultrasound :focused assessment with sonography for trauma(FAST). Can J Rural Med. 2015;20:33-39.
12. Nural MS, Yardan T, Guven H, Baydin A, Bayrak IK, Kati C. Diagnostic value of ultrasonography in the evaluation of blunt abdominal trauma. Diagn Interv Radiol. 2005;11:41–44.
13. Holmes JF, Harris D, Battistella FD. Performance of abdominal ultrasonography in blunt trauma patient with out-of-hospital or emergency department hypotension. Ann Emerg Med. 2004;43:354–61. doi: 10.1016/j.annemergmed.2003.09.011.
14. Miller MT, Pasquale MD, Bromberg WJ, Wasser TE, Cox J. Not so FAST. J Trauma. 2003;54:52–59.
15. Coley BD, Mutabagani KH, Martin LC, et al. Foscued abdominal sonography for trauma (FAST) in children with blunt abdominal trauma. J Trauma. 2000;48:902–6.
16. American College of Emergency Physicians Use of ultrasound imaging by emergency physicians. Ann Emerg Med. 2001;38:469–70. doi: 10.1067/mem.2001.115880.
17. Shackford SR, Rogers FB, Osler TM, et al. Focused Abdominal Sonogram for Trauma: the learning curve of non-radiologist clinicians in detecting hemoperitoneum. J Trauma. 1999;46:492–98.
18. Branney SW, Wolfe RE, Moore EE, Albert NP, Heinig M, Mestek M, et al. Quantitative sensitivity of ultrasound in detecting free intraperitoneal fluid. J Trauma. 1995;39:375–80.
19. Gracias VH, Frankel HL, Gupta R, Malcynski J, Gandhi R, Collazzo L, et al. Defining the learning curve for the Focused Abdominal Sonogram for Trauma (FAST) examination: implications for credentialing. Am Surg. 2001;67:364–68.
20. American College of Emergency Physicians. Policy statement 2015. Emergency ultrasound imaging criteria compendium. p 26.
21. Rozycki GS, Ochsner MG, Schmidt JA, Frankel HL, Davis TP, Wang D, et al. A prospective study of surgeon-performed ultrasound as the primary adjuvant modality for injured patient assessment. J Trauma. 1995;39:492–98.
22. Dulchavsky SA, Henry SE, Moed BR, et al. Advanced ultrasonic diagnosis of extremity trauma: the FASTER examination. J Trauma. 2002;53:28–32.