Focused Abdominal Sonography in Trauma

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ABSTRACT

Clinical assessment of the abdomen for possible intra-abdominal injury following blunt abdominal trauma is often unreliable, due to decreased patient consciousness, neurological deficits, medications, or other associated injuries. Diagnostic peritoneal lavage is superior to clinical examination in assessing abdominal injuries, however, it is an invasive procedure and carries the risk of producing organ injury. It also decreases the specificity of subsequent ultrasound and/or computed tomography. Computed tomography is the standard radiological investigation for blunt intra-abdominal trauma, but entails inevitable time delay, requires patient transfer, and is unsuitable for haemodynamically unstable patients.

Focused abdominal sonography in blunt abdominal trauma is an accessible, portable, non-invasive, and reliable diagnostic tool for the assessment of the presence or absence of abdominal fluid. This article discusses the technique of focused abdominal sonography in blunt abdominal trauma, clinical utilisation, and relevant literature.

Key Words: Abdominal injury, Trauma, Ultrasound

INTRODUCTION

The clinical diagnostic accuracy of blunt abdominal injury is low (47 to 87%). The clinical examination is often unreliable due to decreased patient consciousness, neurological deficits, medications, or other associated injury.1

Diagnostic peritoneal lavage (DPL) has been the main surgical tool to diagnose haemoperitoneum since 1965. Despite continuous refinements in DPL technique and equipment, however, it remains an invasive procedure, with a complication rate of up to 10%. Some of these complications are significant including bowel perforation, bladder penetration, and vascular laceration. False-positive DPL can also occur from iatrogenic injuries during the placement of the DPL catheter, as well as through peritoneal contamination with blood from the DPL incision site.2-4

The capabilities and limitations of ultrasound in the evaluation of blunt abdominal injury have been discussed in many publications.5-10 Despite the widespread use of ultrasound for assessing blunt abdominal injury in Europe and Japan, application in North America has been limited.4,10-14 The standard radiological method of investigation for such clinical scenarios has been enhanced computed tomography (CT) of the abdomen and pelvis. A rapid, portable, and reliable method of screening blunt abdominal trauma patients is desirable.

TECHNIQUES

Focused abdominal sonography in blunt abdominal trauma (FAST) is a sonographic examination for blunt trauma to the abdomen. Using a portable ultrasound machine, the scans are performed and interpreted in the emergency department by radiologists, within 30 minutes of the patient arriving at the hospital. The FAST scans are performed in conjunction with patients’ triage and resuscitation. Each scan is completed within 10 minutes.

The scans are designed to look for free fluid in the pericardium, perihepatic area (including Morrison’s pouch), perisplenic region (including the splenorenal recess),
paracolic gutters, and cul-de-sac. The urinary bladder is filled with saline before or during the scan to allow visualisation of the cul-de-sac (Figure 1). Solid organs (liver and spleen) are not evaluated for evidence of injury.

**CLINICAL PROTOCOL**

Absence of any abdominal fluid is considered a negative scan and no further radiological investigations are warranted, unless the clinical presentation changes and/or the patient’s haemoglobin decreases significantly. In this situation, an abdomino-pelvic CT scan is performed. Patients with FAST-negative scans, without other injuries that mandate hospital admission, are observed in the emergency department for 12 hours prior to discharge. The patient and his/her family are instructed to return to the emergency department if symptoms deteriorate.

Figure 1. The six point focused abdominal sonography in blunt abdominal trauma scan (normal example). (a) The splenorenal recess; (b) the hepatorenal recess; (c) the pericardiac space; (d) the right paracolic gutter; (e) the left paracolic gutter; (f) the cul-de-sac.
The presence of abdominal fluid is considered a positive scan, regardless of the fluid volume and location (Figures 2 and 3). A contrast-enhanced helical CT scan of the abdomen and pelvis is performed to further evaluate the extent of solid organ and/or bowel injury. Patients with FAST-positive scans confirmed by CT are admitted for further management.

All patients with inconclusive (indeterminate) FAST scans due to patient size, subcutaneous emphysema, or limited sonographic windows, are treated as positive studies and assessed by emergency CT.

**LITERATURE REVIEW**

Relevant literature supports the view that FAST is a sensitive (95%), specific (98%), and accurate (95%) method for detecting haemoperitoneum. McKenney et al, and Bode et al, both advocate the inclusion of sonographic solid organ screening as part of FAST, however. Chiu et al reported significant blunt abdominal injuries without haemoperitoneum in 5% of all blunt abdominal injuries, which represents a potential limitation of FAST. Careful analysis of this data, however, reveals that only four of a total 15 patients with false-negative FAST scans needed surgery. Of these, one patient had unnecessary surgery and two others clinically deteriorated after an initial negative FAST and could have been diagnosed by a repeat FAST or a CT scan. This indicates that 6.5% of false-negative FAST scans or 0.5% of all blunt abdominal traumas may have significant injuries, which tend to be revealed during the observation period.

This author is of the view that in the absence of haemoperitoneum, it is unlikely that the patient would require surgical intervention. Although this consideration does not eliminate the exceptional case of high-grade abdominal injury without haemoperitoneum, it is unlikely that such patients remain haemodynamically stable during the 12-hour observation period in the emergency department.

The use of ultrasound scoring systems which grade according to fluid amount and location is unnecessary, as there is no correlation between the extent of the haemoperitoneum and the grade of the solid organ injury. Any demonstrable free fluid in the abdomen is an indication for further evaluation by CT, which can be elective if the patient is haemodynamically stable. The decision whether or not to operate should be based on the clinical and haemodynamic status of the patient.

**LIMITATIONS OF FOCUSED ABDOMINAL SONOGRAPHY IN BLUNT ABDOMINAL TRAUMA**

Ultrasound is a dynamic exam that should be performed by competent and experienced sonologists only. Despite many publications in the literature about surgical and emergency physicians performing and interpreting FAST scans, potentially, subtle fluid collections, renal injury, and retroperitoneal collections, can be missed or wrongly interpreted by inexperienced sonographers. This is evident in the studies by Chiu et al and Thomas et al, where limited experience led to large periton- eums being missed, as well as unnecessary surgery. Although the limitations of ultrasound in detecting bowel injury are well documented, such injuries requiring more than conservative therapy usually produce detectable amounts of free fluid.

FAST scans are frequently performed under sub- optimal conditions including excessive room lighting,
limited patient manoeuvrability, and limited sonographic windows due to dressings, chest tubes, and subcutaneous emphysema. Sonographic artifacts, particularly in the pelvis creating pseudocollection, add to the examination difficulty. The need to fill the urinary bladder prior to or during the examination in order to displace bowel gas and decrease the likelihood of missing a pelvic haemoperitoneum, must be emphasised. In comparing ultrasonography to CT, McGahan et al.\textsuperscript{23} reported that 14 false-negative sonographic results out of a total of 500.\textsuperscript{23} Almost half of these false-negatives, however, were due to identification of free fluid in the pelvis on CT — but not on ultrasound — owing to lack of a full bladder.

**CONCLUSION**

FAST is an efficient and accurate method to evaluate blunt abdominal trauma. A negative FAST scan reduces (and probably eliminates altogether) the need for DPL, and allows a significant reduction in the number of emergency abdomino-pelvic CT scans performed. The high negative predictive value of FAST makes it a good screening tool for blunt abdominal injury.

**REFERENCES**