Focussed Assessment Sonograph Trauma (FAST) and CT scan in blunt abdominal trauma: surgeon's perspective

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Abstract

Background: Diagnosis of blunt abdominal trauma is a real challenge even for experienced trauma surgeons. Diagnostic tools that help the treating doctor in optimum management of blunt abdominal trauma include; Focussed Assessment Sonography for Trauma (FAST), Diagnostic peritoneal lavage (DPL) and CT scan.

Objectives: the aim of this communication is to define the recent role of FAST and CT scan of the abdomen in the diagnosis of blunt abdominal trauma.

Findings and conclusions: FAST is useful as the initial diagnostic tool for abdominal trauma to detect intraabdominal fluid. With proper training and understanding the limitations of ultrasound, the results of FAST can be optimized. DPL is indicated to diagnose suspected internal abdominal injury when ultrasound machine is not available, there is no trained person to perform FAST, or the results of FAST are equivocal or difficult to interpret in a haemodynamically unstable patient. In contrast, in haemodynamically stable patients the diagnostic modality of choice is CT with intravenous contrast. It is useful to detect free air and intraperitoneal fluid, delineate the extent of solid organ injury, detect retroperitoneal injuries, and help in the decision for conservative treatment. Helical CT is done rapidly which reduces the time the patient stays in the CT scan room. Furthermore, this improves sagittal and coronal reconstruction images which are useful for detecting ruptured diaphragm.

Running title: FAST and CT scan in trauma

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Introduction

Diagnosis of blunt abdominal trauma is a real challenge even for experienced trauma surgeons. The clinical findings are usually not reliable. Abdominal examination is compounded by different factors like fractures of lower chest ribs, contusion and abrasions of the abdominal wall, presence of fractured lumbar vertebrae with retroperitoneal haematoma, and reduced level of consciousness. Diagnostic tools that help the treating doctor to take critical decisions like the need for laparotomy or conservative treatment are mandatory if we aim for a favorable outcome. Diagnostic peritoneal lavage (DPL) had been the gold standard to detect intraperitoneal fluid since the sixties. Use of Focussed Assessment Sonography for Trauma (FAST) and helical CT scan have dramatically changed our methods for diagnosing blunt abdominal trauma, refined our decisions, and enabled us to select patients for conservative treatment. The choice of a particular modality depends on the haemodynamic stability of the patient, the reliability of physical examination, the severity of associated injuries, and the availability of a particular diagnostic modality. The aim of this communication is to define the recent role of FAST and CT scan of the abdomen in the diagnosis of blunt abdominal trauma.

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Focussed Assessment Sonography for Trauma (FAST)

FAST was initially started in Europe and Japan in the eighties to be adopted by North America in the early nineties. From there it has spread worldwide[1,2]. It is worthy to note that Kuwait was one of the earliest countries in the Middle East to start FAST in the Emergency Department[3].

FAST is a goal directed study answering a simple question as to whether there is intraperitoneal fluid or not. (Fig 1). It is a safe quick diagnostic tool that can be learnt easily[2,3]. It is of great value for those patients who are haemodynamically unstable and who can not be shifted to CT scan room. One of the great advantages is that it can be done bedside during resuscitation without

the need to move the patient from the resuscitation room. The great value of FAST lies in its high sensitivity for detecting intraperitoneal fluid which accumulates in dependent areas around the liver, spleen and pouch of Douglas[2]. This sensitivity may reach up to 100%. The finding of free intraperitoneal fluid in a hypotensive patient alerts the treating doctor that the patient may need an urgent laparotomy. Limitations of ultrasound have to be well understood when using FAST. Ultrasound is not accurate in obese patients due to lack of penetration of sonographic waves. Furthermore, it will be difficult to visualize intra-abdominal structures in case there is ileus or surgical emphysema under the skin. Ultrasonography is highly accurate in detecting intraperitoneal fluid but it can not differentiate between blood, urine, bile or ascites. That is why the sonographic findings have to be correlated with the clinical findings to make critical decisions. FAST has to be used within a diagnostic algorithm to have a proper role[4]. Ultrasound should be used as the clinician's stethoscope in the clinical setting. In case the patient is haemodynamically stable then the CT scan of the abdomen is the diagnostic modality of choice[5]. Ultrasound will miss 25% of intra-abdominal injuries in case it is the only diagnostic tool[6,7]. Furthermore, ultrasound is not accurate in detecting retroperitoneal or gastrointestinal lesions[6,7].

The use of FAST has replaced the use of DPL for detecting intraperitoneal bleeding in the majority of patients[3]. We think that FAST should always be performed before DPL in the Emergency Room because it is non invasive and takes shorter time. DPL is indicated to diagnose suspected internal abdominal injury when ultrasound machine is not available, there is no trained person to perform FAST, or the results of FAST are equivocal or difficult to interpret in a haemodynamically unstable patient so the patient can not be shifted to a CT scan room[2]

Recently different trials on FAST using portable hand held ultrasound machines have shown that they have comparable accuracy to hospital based ultrasound machines in detecting fluid (8). This proved useful to define patients who need to be swiftly evacuated to the hospital in prehospital settings and mass causality situations[2].

In general the results of FAST will depend on three factors: the ultrasound machine, the patient and the operator. The ability of the ultrasound machine will vary depending on its specifications. Black and white B mode is all what is needed to perform FAST but the machine should have proper resolution and gain. The patient's body build, obesity, presence of ileus from trauma or presence of surgical emphysema can make the FAST study difficult. The technical details of using FAST are beyond the scope of this manuscript. This has been detailed elsewhere (2). Finally the experience of the operator is a major factor that affects the results (9). It was proven that the results of FAST are not different in the hands of surgeons, radiologists or emergency physicians if they were trained properly[10]. Training should include a theoretical part and a practical part after which a hospital based credentialing process should be started[1, 11, 12]. This is essential to assure the quality of health care given to patients.

Computed tomography

The contrast enhanced CT scan is a non invasive procedure. It has become the gold standard radiographic modality in evaluating blunt abdominal trauma patients[6]. CT scanners are available now in most trauma centers. With the advent of helical CT scan, scan time has become significantly shorter.

CT scan is indicated in blunt abdominal trauma in haemodynamically stable patients with equivocal findings on physical examination, neurological injury or impaired sensorium due to drugs or alcohol, multiple extra-abdominal injuries[13], and when the mechanism of injury is suggestive of duodenal or pancreatic injury [14]. CT scan is contraindicated in a blunt abdominal trauma patient with clear indication of laparotomy and in haemodynamically unstable patient.

Fig 1: Sonographic sagittal section of the right upper quadrant showing the liver, kidney and free fluid in hepatorenal pouch (arrows).

Fig 2: CT scan of the abdomen with intravenous contrast in a 4-years old pedestrian who was hit by a car showing multiple lacerations of the spleen (arrows).The patient was hemodynamically stable and was treated conservatively.

Fig 3: CT with intravenous contrast in a 30 years old male driver who was involved in a road traffic collision. CT has shown active contrast blush inside the liver (arrow).The patient ended with a laparotomy.There is also free fluid near the spleen (arrow heads).

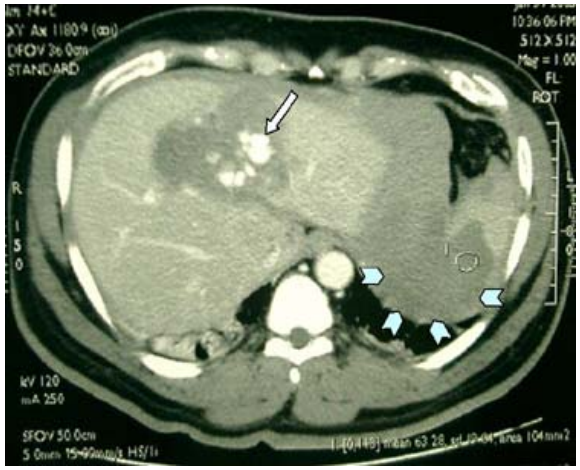
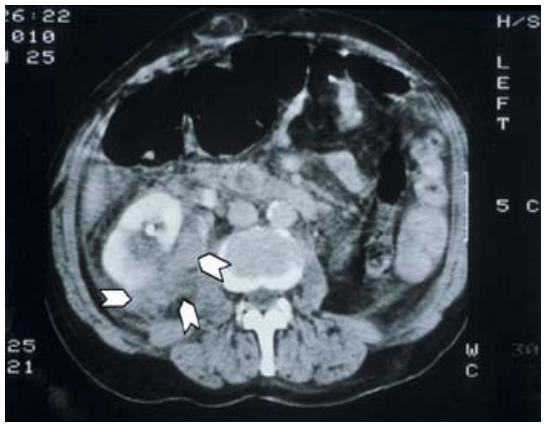


Fig 4: CT scan of the abdomen with intravenous contrast showing good perfusion of the right kidney.There is an injury to the right kidney reaching up to the right pelvis with extravasation of fluid around the kidney (arrow heads).



CT scan has a high accuracy reaching about 95%. It has a very high negative predictive value reaching almost 100%[13]. Despite that, patients with suspected abdominal injury should be admitted for at least 24 hours in the hospital for observation even with a negative CT scan result[15]. CT provides a detailed image of injuries. Finding free intraperitoneal air or rupture diaphragm are definite indications for laparotomy. It is very useful in defining the severity of solid organ injury (Fig 2) and guiding the non operative management and decisions for surgery. Helical CT with contrast enhancement can detect arterial extravasations (contrast blush) in blunt abdominal trauma patients (Fig 3).This can be used to localize the anatomical sites of injury and to guide angiographic or surgical intervention[16]. Follow up CT scan is useful to help making clinical decisions when adopting a conservative approach. It allows adequate assessment of retroperitoneal structures.This is a major advantage over the other modalities. Furthermore, it allows the assessment of blood perfusion of different organs (Fig 4). Helical CT scan sagittal and coronal reconstruction images are useful for detecting ruptured diaphragm. Moreover, it seems to improve the diagnosis of gastrointestinal injuries[17].

Nevertheless, CT scanning has certain limitations. It needs a specialized technician to perform it and a radiologist to read it. CT scan, although very sensitive in detecting solid organ injuries, may miss mesenteric tears, bowel injury especially small tears, diaphragmatic rupture if coronal and sagittal reconstruction was not made, and pancreatic injury if done early after trauma[18,19] A large multi-institutional study has shown that 13% of patients with perforated small bowel injury had a normal CT scan preoperatively[20]. Intravenous and oral contrast has the hazards of aspiration, delay in diagnosis when oral contrast is used, and allergic reaction with the use of intravenous contrast [21].

The presence of free intraperitoneal fluid in blunt abdominal trauma in absence of a detectable solid organ injury creates a clinical dilemma. There is a probability of 25% of missing bowel lesions. DPL is advised in that situation if a conservative approach is advocated[22].

Conclusions

FAST is useful as the initial diagnostic tool for abdominal trauma to detect intraabdominal fluid. Indications for diagnostic peritoneal lavage are becoming more restricted. In haemodynamically stable patients, the diagnostic modality of choice is CT scanning. These three modalities are complementary and not competitive.Their usefulness is maximized when they are applied properly within defined clinical algorithms.

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