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The current role of focused assessment with sonography for trauma (FAST) in the ever-evolving approach to abdominal trauma

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Faculty Reviewer: Dr. Roy W. Roebottom MD FCFP(EM) (Division of Emergency Medicine)

BACKGROUND

Trauma is the leading cause of mortality worldwide, and is a leading cause of death in both men and women under the age of 35. Apart from the high incidence of mortality, trauma is responsible for leaving 45 million people per year worldwide with moderate to severe disabilities. It is no surprise that victims of traumatic events have significantly better morbidity and mortality outcomes when treated at centres with designated trauma units, where there are health care professionals that have been trained in specific triage, diagnostic and treatment techniques to manage trauma patients.

One of the main complications leading to high mortality after trauma is exsanguination from injuries to organs of the abdomen. The liver and spleen are the most common culprits, with the kidneys injured often as well. Blunt abdominal trauma is most frequently caused by motor vehicle accidents involving both vehicles and pedestrians. A minority of other causes include blows or falls involving the abdomen. The evaluation of abdominal trauma is one of the most challenging areas of acute trauma management because injuries may not manifest in the initial assessment, physical findings are often unreliable, the presence of other injuries causes difficulties, and the patients can present with altered mental status from head injuries or intoxication. Historically, blunt abdominal trauma was even more difficult to manage because practitioners lacked the non-invasive and expedient imaging techniques that are available today. Non-therapeutic laparotomy was the primary method by which trauma personnel uncovered significant abdominal injury. However, laparotomy carries a risk of complication (0.8-2.3%) and exposes the patient to the short- and long-term sequelae of the procedure. There has been a continuous search for accurate and expedient tests that can detect occult bleeding and obviate the need for invasive procedures, such as the non-therapeutic laparotomy.

DIAGNOSTIC PERITONEAL LAVAGE

The first report of the diagnostic peritoneal lavage (DPL) was in 1965, and represented a major advance in the assessment of abdominal injury. The study was small, but it was able to diagnose hemoperitoneum in 100% of patients that presented with blunt abdominal trauma. Since this initial investigation, many studies have supported the results, and there has been a gradual increase in the use of DPL at trauma centres as a replacement for the non-therapeutic laparotomy. One such study by Danne et al. in 1988 found that only 0.25% of patients were not correctly diagnosed within 4 hours of arrival to the trauma centre, and false negative and positive rates were similarly very low. Few complications of the procedure were reported.

The primary function of DPL is to detect occult injuries in hemodynamically unstable patients that have sustained either blunt or penetrating abdominal trauma, even with a low threshold of suspicion. A secondary function also developed, namely, to save unnecessary laparotomies. The principle of DLP is to infuse fluid into the peritoneum to mix with possible intraperitoneal blood, and to recover the fluid through drainage. A small, midline incision is made in the sub-inguinal region, and the linea alba is separated. A peritoneal dialysis catheter is inserted into the peritoneum and held in place by a purse string suture. Warm saline solution (0.9%) is then infused, drained, and sent for analysis. Depending on the experience of the physician, the entire procedure can take between 5 to 30 minutes. However, there are some significant limitations to the DPL. The procedure is invasive, it provides no information regarding the organ that is injured, it has a high rate of negative laparotomies, and it can be time consuming if the operator is unskilled. Therefore, newer ultrasound-guided techniques have largely eclipsed the DPL.

FOCUSED ASSESSMENT WITH SONOGRAPHY FOR TRAUMA

An ultrasound-based assessment for trauma patients became popular in the early 1990s, addressing the shortcomings of DPL. The technique called Focused Assessment with Sonography for Trauma (FAST) was found very early to be accurate, non-invasive, and could provide expedient aid in the decision-making process for further treatment in the critical care setting. FAST is a bedside ultrasound assessment protocol that can be performed rapidly as a screening tool for the detection of intraperitoneal injury and, less commonly, pericardial tamponade. The assessment is not overly complex, and can be performed by surgeons and radiologists with equal reliability. Currently, FAST is most often used by surgeons and physicians in the emergency department. Canadian ER practitioners call the technique Emergency Department Targeted Ultrasound (EDTU).

FAST is performed with the patient supine (if possible) and uses a mobile ultrasound machine. The depth of ultrasound wave penetration must be at least 20cm, so the transducer frequency that is usually required is 3.5-5MHz with a convex transducer. Several views are obtained of high risk areas of the abdomen prone to fluid accumulation after abdominal trauma. A longitudinal view of the right upper quadrant will allow visualization of the hepatorenal recess (Morison’s pouch) that can show free fluid after a liver laceration. A longitudinal view of the left upper quadrant to visualize the perisplenic space will assess for splenic and renal injuries. Both transverse and longitudinal views of the suprapubic region (pouch of Douglas) are used to rule out urinary bladder rupture. Finally, a transverse view of the subxiphoid region is sometimes obtained to assess for free fluid of the pericardium. When performed by experienced sonographers, the entire exam will take no longer than 5 minutes to complete. However, complications in obtaining the standard views can prolong the assessment.

FAST is currently indicated to be used in the primary circulatory

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survey of an unstable patient that has sustained blunt abdominal trauma for detection of intraperitoneal and pericardial fluid. A secondary indication of FAST is the assessment of the thoracic cavity to detect a possible pneumothorax. This protocol, termed extended FAST (E-FAST; or EDTU-2 in the Canadian ER), is performed on unstable trauma patients if there is time after the primary survey. This exam is based on the principle that air in the pleural cavity can be distinguished from air in the lungs with ultrasound during normal ventilation. E-FAST has reported sensitivities and specificities of 0.59-1.00 and 0.94-1.00, respectively.\(^{11}\) It is currently unclear whether an E-FAST should be routinely conducted in the critical care setting, but it is reasonable to conclude that if there is sufficient time, an E-FAST can be performed to rule out pneumothoraces before patients go to the CT suite or surgery.

**ADVANTAGES AND LIMITATIONS OF FAST**

The FAST protocol has many key advantages that make it superior to DPL in the assessment of abdominal trauma. FAST boasts relative ease of use, rapidity, availability, and low cost imaging. It offers greater flexibility for patient positioning, which is very important for patients who have undergone significant trauma. It can be employed within minutes of a patient’s arrival at a critical care centre, while other health care personnel perform diagnostic and therapeutic maneuvers simultaneously.\(^{14}\) A 2007 study found that patients with positive FAST results had significantly higher mortality than FAST-negative patients. FAST-positive patients also had a higher likelihood of operation than FAST-negative patients. Patients with equivocal FAST results, or areas that could not be well visualized, were found to have more statistically significant negative results and had a higher likelihood of operation than FAST-negative patients.\(^{14}\) However, equivocal results only made up 6.7% of the assessments when FAST was undertaken by trained clinical sonographers.\(^{15}\) These results highlight the importance of FAST as an effective method for identifying patients at risk of serious intraabdominal injury. FAST results can be used to guide mobilization of hospital resources, and identify patients who can be managed expectantly.\(^{14}\)

However, limitations to the FAST technique do exist. Firstly, FAST does not accurately detect the extent of, in some cases, the precise site of organ injury. Therefore, FAST-positive patients often need to be followed up with a CT scan to locate the origin of the bleeding and evaluate the extent of the injury.\(^{16}\) The sensitivity of FAST is also low (34-55%) relative to other imaging modalities available.\(^{17}\) Other limitations of FAST are aspects that are inherent to ultrasound itself as an imaging modality, such as operator dependence, inability to completely standardize the procedure, limited retroperitoneal accuracy, and poor scanning results in obese patients or patients with tissue abnormalities like superficial wounds.\(^{11}\)

**DEBATE ABOUT THE CURRENT ROLE OF FAST**

There is considerable debate about what should be done in the case of negative FAST results for hemoperitoneum. Some studies show as many as 29% of negative scans still have some degree of intraabdominal injury.\(^{18}\) Since CT scanning has become more widely available, faster, and a more economical test than it was in the past, it has come to dominate much of the survey of abdominal trauma patients. CT is a more accurate test than FAST, especially when comparing the false negative rates of both tests. The discordance in the results of CT and FAST have led to some centres adopting the CT scan as the primary imaging modality for blunt abdominal trauma.\(^{18}\) However, the utility of FAST is only questionable when it is used as a purely diagnostic tool. Recent evidence suggests that clinical suspicion should still play an important role in determining the therapeutic steps for trauma patients. For example, if a patient sustained a seatbelt injury, a negative FAST result could probably still be followed with a CT scan to ensure that no intraabdominal injury exists.\(^{19,20}\) A stand-alone FAST result should not preclude patients from further investigation, or guide treatment by itself. It is in this setting that the value of FAST is realized. As a screening tool implemented in the primary circulatory survey, along with available clinical evidence, FAST is instrumental in the first decision point for trauma patients: to the OR or further investigation?\(^{21}\) Figure 1 depicts a typical decision tree, where FAST is integral to the early steps. In this role, FAST-positive patients can be dealt with in the most expedited manner possible, and patients with negative or equivocal results can undergo further testing. This approach still results in effectively identifying the maximum number of at-risk patients, while using CT scanning sparingly. This saves the hospita money, frees up valuable CT suite time, and avoids unnecessary radiation exposure to patients. Overall, FAST can be viewed not as a

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**Figure 1.** The typical decision-making process involved in the assessment of blunt abdominal injury. Adapted from van der Viles et. al.\(^{21}\)
solitary solution to a diagnostic problem, but as an adjunct to the triage and decision-making process. In this capacity, there will still be a very integral role for FAST in the work-up of blunt abdominal trauma patients for the foreseeable future.

REFERENCES