# Critical Review Form

## Diagnostic Test

The Utility of Sonography for the Triage of Blunt Abdominal Trauma patients to Exploratory Laparotomy, *AJR* 2007;188: 415-421

**Objective: "To investigate the possible role of sonography (FAST) in patients with blunt abdominal trauma." (p 416)**

**Methods: Retrospective, University of California Davis trauma-registry study of blunt abdominal trauma patients treated from January 1995 to January 2001. Exclusion criteria included incomplete clinical, radiological, or surgical information. Focused abdominal sonography for trauma (FAST) exams performed by medical sonographers (not EM physicians) with at least two years' experience using one of three ultrasound-machine types: an XP10-128 (Acuson), 5200S (Acoustic Imaging), or Sequoia 512 (Acuson-Siemens). Sonographers used phased-array or convex linear 2.5-5.0 MHz transducers with patients in the supine position to evaluate the abdomen (hepatorenal and splenorenal regions, paracolic gutters), pelvis, and subxiphoid views of the heart. These sonographers were available in the ED around-the-clock. The determination of which patients underwent FAST exam was at the discretion of the ED attending or trauma surgeon. FAST was usually performed within 30-minutes of ED arrival. CT scans used a LightSpeed Scanner with IV contrast. No oral contrast was used.**

**The on-call radiology attending or resident reviewed all images immediately. The authors retrospectively reviewed the sonography reports and assigned the following qualitative severity assessments for free fluid:**

- **Small amount = Not moderate or large;**
- **Moderate amount = ≥ 3 locations with small amounts of free fluid;**
- **Large amount = ≥ 3 locations with moderate amounts of free fluid.**

**Sonography findings were graded as positive if any free fluid was present. The authors categorized injuries retrospectively as therapeutic (required surgical repair) or non-therapeutic (no surgical repair performed) laparotomy. Surgical interventions that met criteria for therapeutic laparotomy included bleeding liver laceration requiring hemostasis, splenic laceration requiring splenorrhaphy or splenectomy, bowel laceration/perforation, bleeding renal laceration requiring nephrectomy or embolization, bleeding mesenteric injury requiring repair, or expanding retroperitoneal hematoma requiring repair.**

**The authors compared therapeutic laparotomy rates between normotensive and hypotensive patients. Although they do not describe their methods, they also**

**report estimates of sensitivity and specificity stratified by normotensive and hypotensive subsets.**

| Guide | | Comments |
|---|---|---|
| **I.** | **Are the results valid?** | |
| **A.** | **Did clinicians face diagnostic uncertainty?** | Uncertain since the authors do not clearly describe that the ultrasounds were obtained before the CT scans so there is the potential for *incorporation bias*. |
| **B.** | **Was there a blind comparison with an independent gold standard applied similarly to the treatment group and to the control group?** **(Incorporation Bias)** | No blinding is reported in this retrospective study. It is possible that sonographers were aware of the CT findings when they interpreted their ultrasounds or that the Radiologists interpreting the CT were also aware of the ultrasound results. In addition, not all blunt trauma patients had an ultrasound or CT performed. This was at the discretion of the attending EM or trauma physician. |
| **C.** | **Did the results of the test being evaluated influence the decision to perform the gold standard?** **(Verification Bias)** | The decision of going to CT or OR were based on the results of the FAST exam. *Verification bias* biases the point estimates of sensitivity upwards and specificity downwards. |
| **II.** | **What are the results?** | |

**A.**

**What likelihood ratios were associated with the range of possible test results?**

**All Patients**

| | Therapeutic lap | Non-Therapeutic lap |
|---|---|---|
| FAST Free Fluid | 261 | 149 |
| FAST No Free Fluid | 46 | 3573 |

**Normotensive Patients**

| | Therapeutic lap | Non-Therapeutic lap |
|---|---|---|
| FAST Free Fluid | 189 | 134 |
| FAST No Free Fluid | 33 | 3551 |

**Hypotensive Patients**

| | Therapeutic lap | Non-Therapeutic lap |
|---|---|---|
| FAST Free Fluid | 72 | 15 |
| FAST No Free Fluid | 13 | 22 |

**Accuracy of FAST for predicting therapeutic laparotomy stratified by amounts of fluid**

**All Patients**
Small 47%
Moderate 89%
Large 89%

**Normotensive patients**
Small 42%
Moderate 86%
Large 89%

**Hypotensive patients**
Small 85%
Moderate 97%
Large 89%

**Accuracy of FAST for predicting therapeutic laparotomy per number of pockets viewed**

**All Patients**
Accuracy with 1 pocket 49%
Accuracy with 2 pockets 56%
Accuracy with 3 pockets 87%
Accuracy with 4 pockets 100%
Accuracy with 5 pockets 100%

**Normotensive patients**
Accuracy with 1 pocket 44%
Accuracy with 2 pockets 49%
Accuracy with 3 pockets 85%
Accuracy with 4 pockets 100%
Accuracy with 5 pockets 100%

**Hypotensive patients**
Accuracy with 1 pocket 68%
Accuracy with 4 pockets 100%
Accuracy with 5 pockets 100%

- 4029 blunt abdominal trauma patients had a FAST exam over 6-years, including 122 (3%) with hypotension upon ED arrival.
- The primary mechanisms of injury were MVC whether hypotensive (61%) or normotensive (65%), while the next most common mechanism was auto-versus-pedestrian.
- In total, **7.6% (307/4029) underwent a therapeutic laparotomy**.
- The proportion of patients with a therapeutic laparotomy increased as the amount of fluid on FAST exam increased whether hypotensive (37% with negative FAST exam to 90% with large amount of free fluid) or normotensive (1% with negative FAST exam to 89% with large amount of free fluid).
- The following diagnostic accuracies were reported (2x2 tables not reported in the manuscript but reconstructed at left):

**All Patients**
LR+ 21.2 (95% CI, 18.6-23.7)
LR- 0.16 (95% CI, 0.12-0.20)

**Normotensive patients**
**LR+ 23** (95% CI, 20-26)
**LR- 0.15** (95% CI, 0.11-0.21)

**Hypotensive patients**
LR+ 2.1 (95% CI, 1.4-3.1)
LR- 0.26 (95% CI, 0.14-0.47)

- The authors also stratified the accuracy of FAST exam accuracy by the quantity of fluid and the number of pockets of fluid (see left).
- The most commonly missed injuries were bowel, spleen, or liver in both the normotensive and the hypotensive subsets.

| III. | How can I apply the results to patient care? | |
|---|---|---|
| **A.** | **Will the reproducibility of the test result and its interpretation be satisfactory in my clinical setting?** | No, this study lacks external validity in today's ED. In this study, FAST was preformed by a radiology tech and read by a radiologist, which is not the current standard of care in most settings where the ED or surgery residents/attendings perform the FAST and independently interpret the images in, real-time. Most centers do not have round-the-clock access to professional sonographers in the ED. |
| **B.** | **Are the results applicable to the patients in my practice?** | Probably, since this is a Level 1 trauma center. However, there was no distinction between pediatric and adult patients with blunt abdominal trauma which may skew practice patterns as pediatric surgeons tend not to go directly to laparotomy even with a positive FAST. |
| **C.** | **Will the results change my management strategy?** | Yes, using skilled sonographers, US can accurately triage normotensive blunt abdominal injury patients to a more definitive test (usually CT). Unfortunately, FAST is insufficient to rule-in or rule-out therapeutic laparotomy in hypotensive subsets who would most benefit from bypassing CT.<br><br>Increasing amounts of free fluid and increasing number of locations of fluid pockets of free fluid has is associated with increasing diagnostic accuracy for therapeutic laparotomy. |
| **D.** | **Will patients be better off as a result of the test?** | This study does not support using FAST to risk-stratify hypotensive patients who are appropriate to bypass CT to proceed directly to the OR. With a LR+ 23, one could justify moving FAST-positive normotensive blunt abdominal trauma patients to the front of the CT queue since free fluid on the FAST exam will increase the post-test probability from 7.6% to 65%. |

## Limitations

1) **No chart review methods.**

2) **Limited external validity for ED settings where EM physicians or trauma surgeons perform the FAST exam.**

3) **No acknowledgement of potential for *incorporation bias* that can bias the point estimates of sensitivity and specificity upwards.**

4) **No acknowledgement of potential for *verification bias* that can bias the point estimates of sensitivity upwards and specificity downwards.**

5) **Failure to reference or use the STARD criteria, including no likelihood ratio reporting or 2x2 tables.**

## Bottom Line

**The pre-test probability of blunt abdominal trauma patients requiring a therapeutic laparotomy is 7.6%. FAST is useful to identify normotensive blunt abdominal trauma patients who are significantly more (LR+ 23) and less (LR- 0.15) likely to require a therapeutic laparotomy. This study does not support using FAST to risk-stratify hypotensive patients who are appropriate to bypass CT to proceed directly to the operating room.**