FAST Exam Versus CT Scan in the Diagnosis of Interperitoneal Injury in a Hemodynamically Stable Patient With Blunt Abdominal Trauma: A Systematic Review.

Heather L. Morley

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FAST Exam Versus CT Scan in the Diagnosis of Interperitoneal Injury in a Hemodynamically Stable Patient With Blunt Abdominal Trauma: A Systematic Review.

Abstract
Background: The FAST exam is a tool that trauma physicians can use to evaluate patients with blunt trauma and possible abdominal injury. Currently, FAST has become the method of choice in evaluating hemodynamically unstable patients due to the rapid determination of any life-threatening abdominal injuries. The question that remains is the value of the FAST exam in hemodynamically stable blunt abdominal trauma patients. The evidence was evaluated using GRADE, which was developed to help health care professionals determine the quality of evidence and strength of recommendations presented in studies.

Method: An extensive literature search was performed using Medline, CINAHL, Cochrane Systematic Reviews, PubMed, and Web of Science. The search was limited to human subjects, the English language, and articles published since the last systematic review in 2009.

Results: Three studies were included in this systematic review. For this review, the sensitivity for the FAST exam in detecting free fluid was variable across all three studies; however, the specificity, positive predictive value, and negative predictive value were consistent and greater than 88% throughout the studies.

Conclusion: Given the above results, the overall GRADE of evidence was upgraded from low to moderate. Since the sensitivity of the FAST exam was variable throughout the studies, the final conclusion of this systematic review is to continue using CT scan after blunt abdominal trauma to avoid missing any potential life-threatening injuries. A large multicenter trial would be useful in evaluating the effectiveness of FAST in hemodynamically stable blunt trauma patients.

Keywords: Abdominal injury, FAST exam, ultrasonography, CT scan.

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FAST Exam Versus CT Scan in the Diagnosis of Interperitoneal Injury in a
Hemodynamically Stable Patient With Blunt Abdominal Trauma: A Systematic Review.

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ABSTRACT

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INTRODUCTION

Background

The focused assessment by sonography for trauma (FAST) exam is a tool that trauma physicians can use to evaluate patients with possible blunt abdominal injury. Currently, FAST with its rapid determination of any life-threatening injuries has become the method of choice in evaluating hemodynamically unstable patients. (Natarajan, B., Gupta, P. K., Cemaj, S., Sorensen, M., Hatzoudis, G. I., & Forse, R. A., 2010; Becker, A., Lin, G., McKenney, M. G., Marttos, A., & Schulman, C. I., 2009). Now, the question that remains is the value of the FAST exam in hemodynamically stable blunt abdominal trauma patients (Natarjan et al., 2010; Becker et al., 2009). When a patient presents to the Emergency Department after sustaining blunt abdominal trauma, the Clinician needs to have a high level of suspicion for intra-abdominal injury. Peitzman, A. B., Rhodes, M., Schwab, C. W., Yealy, D. M., & Fabian, T. C. (2008), explain how the abdominal examination can be unreliable due to distracting injuries or the patients altered mental status (2008). There are multiple ways to diagnose an intra-abdominal injury and currently abdominal computerized tomography (CT) is the radiological gold standard (Kornezos, I., Chatziioannou, A., Kokkonouzis, I., Nebotakis, P., Moschouris, H., Yiarmenitis, S.,…Matsaidonis, D., 2009). According to authors Bowra, J., Forrest-Horder, S., Caldwell, E., Cox, M., & D’Amours, S. K., there is evidence that patient care is improved when the FAST exam is included in the initial workup of the patient (2009).

It can be difficult for the Emergency Room Clinician to decide whether or not to proceed with a FAST exam or a CT scan. Currently the CT scan is the gold standard for diagnosing intra-abdominal injury after blunt abdominal trauma (Kornezos et al., 2009). There are advantages and disadvantages to a CT scan. According to Natarajan et al., CT scans have a
sensitivity of 92-98% for diagnosing intra-abdominal injury after blunt trauma. The authors mention how CT also helps physicians localize and grade the injury, which helps with the initial management of the patient. A CT scan is not as operator dependent as the FAST exam, and it is not limited by bowel gas, obesity, or subcutaneous emphysema (2010, Kornezos et al., 2009). Limitations include that CT cannot be use in pregnant or unstable patients and it exposes patients to radiation (2010). Kornezos et al., states the risk of possible renal toxicity, cost, artifacts due to patient movement, and the need to transfer the patients are also limitations when considering using a CT scan for evaluating a patient’s injury (2009).

As with the CT scan, there are benefits and limitations to the FAST exam. The FAST exam is a low cost and portable method for evaluating blunt abdominal trauma. It provides reasonable accuracy and has a high negative and positive predictive value. However, if patients have sustained other injuries, including spinal fractures, pulmonary contusions, diaphragm ruptures, vascular injuries, pancreatic injuries, or bowel and mesenteric injuries, its accuracy has been disputed (Kornezos et al., 2009, Becker et al., 2009).

**Purpose of the Study**

The purpose of this paper is to evaluate the studies that have compared the FAST exam to an abdominal CT scan when trying to diagnose an intra-abdominal injury in a patient who has sustained blunt abdominal trauma. A systematic review will be done using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) tool developed by the GRADE Working Group (Guyatt, G. H., Oxman, A. D., Vist, G., Kunz, R., Falck-Ytter, Y., Alonso-Coello, P., & Schünemann, H. J., 2008).
METHODS

An extensive literature search was performed using Medline, CINAHL, Cochrane Systematic Reviews, PubMed, and Web of Science. These databases were accessed through the Pacific University Library. The following keywords were searched individually and in combination: abdominal injuries, FAST exam, FAST, and CT scan. The search was limited to human subjects, the English language, and articles published since the systematic review in 2009. Three studies were found which had relevance for this systematic review. All of the studies included in the systematic review were retrospective observational case studies.

RESULTS

For this systematic review three articles were reviewed in their entirety.

FAST scan: Is it worth doing in hemodynamically stable blunt trauma patients?

The first study reviewed, was performed by Natarajan et al., 2010, and was designed as a retrospective study. The authors reviewed all the patients who were entered into their trauma database, at their Level I trauma center in Nebraska, from January 2002 to December 2008. Per their trauma protocol, a FAST exam is included in the secondary survey of a trauma patient and is performed by a surgery resident under the supervision of the trauma attending physician. Altogether, there were 2,980 patients evaluated by the trauma team during the relevant 7 year period, 850 of which did not have FAST results in the database. Eighteen patients had an inconclusive FAST and 7 patients were found to be dead on arrival. The remaining 2,105 patients were analyzed to see whether or not a FAST exam was valuable in detecting intra-abdominal injury in a hemodynamically stable blunt trauma patient. The FAST exam results were confirmed by either abdominal CT, diagnostic peritoneal lavage (DPL), or exploratory laparotomy. This study did include penetrating and blunt abdominal trauma, as well as
hemodynamically stable and unstable patients. Natarjan et al, (2010) analyzed the data separately and together. For the purpose of this systematic review only the hemodynamically stable blunt abdominal trauma patients will be examined as an outcome.

Of the 2,105 patients analyzed, 1,832 were hemodynamically stable and had blunt trauma. There were 60 patients who had a true positive FAST, 4 patients with false positive FAST, 1,681 patients with true negative FAST, and 87 patients with false negative FAST exam. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy rate were 40.8%, 99%, 94%, 95%, and 95%, respectively (Natarjan et al, 2010).

The authors concluded, given the poor sensitivity of the FAST exam, that a more reliable test is needed to detect an intra-abdominal injury. For a hemodynamically stable blunt trauma patient, they advocate for the use of a CT scan over the FAST exam. They also question whether or not there is a difference in result when a radiologist rather than a surgical resident performs the FAST exam (Natarjan et al, 2010). This question could not be answered because the inquiry was out of the scope of the retrospective data.

Findings and limitations of focused ultrasound as a possible screening test in stable adult patients with blunt abdominal trauma: a Greek study.

The next study also was a retrospective study that reviewed the ultrasound results of 1,999 hemodynamically stable adult patients over a 3 year period (Kornezos et al., 2009). The FAST exam was performed in the Emergency Department by a junior radiologist, with the results confirmed by a senior radiologist. They considered a positive finding to be either the presence of abdominal fluid and/or intra-abdominal injury. All the patients were observed in the hospital for 24 hours post admission. A CT scan or surgical intervention was only performed according to ultrasound findings or due to the clinical progression of the patient. If the patient
had a true negative result then they were discharged after the observation period (Kornezos et al, 2009).

Of the 1,999 patients examined, there were 109 abnormal results. Of the 109, 102 patients had free intra-abdominal fluid and 58 patients had an abdominal organ injury. Of the 109 abnormal results, only 106 were true positives. Three patients had a false positive result after a subsequent normal CT scan. There were 1,876 patients with a true negative result, while there were 14 false-negatives. The majority of the false negative results were organ injuries. Their estimated specificity was 88.3% and the sensitivity was 99.8%. The positive and negative predictive values were 97.2% and 99.2%, respectively (Kornezos et al., 2009).

It was the conclusion of this study, that the FAST exam produced a high negative predictive value with reasonable accuracy, low cost, and portability. The authors felt an experienced examiner was needed to help with uncooperative patients, obese patients, excessive bowel gas, or an empty bladder to provide more reliable results. The authors felt that the reason for their superior results was that the FAST exam was performed by a radiologist. Their final recommendation was that stable patients with negative ultrasound results should remain under close observation for at least 12 hours. If they continue to remain stable after a new clinical assessment, then the patient could be discharged without any further examination (Kornezos et al., 2009).

Is the FAST exam reliable in severely injured patients?

The final study reviewed was by Becker et al., (2009), and was a retrospective study which reviewed data collected from the trauma registry at the Ryder Level I Trauma Center between 2000 to 2005. Patients were included in the study in they had a FAST exam during their initial assessment and then an abdominal CT scan. This study further divided groups of
patients based on their Injury Severity Score (ISS). Group 1 had an ISS of 1-14, group 2 had an ISS of 16-24, and group 3 had an ISS of > 25. The FAST exam was performed by a trauma resident, a fellow, or an attending physician and the result was considered positive if free fluid was present. The results were considered a true positive if the CT scan or laparotomy revealed free fluid and a false positive if the CT scan or laparotomy did not confirm free fluid. A true negative was recorded if the subsequent CT scan or laparotomy did not show free fluid and if there was free fluid on CT or the patient had a therapeutic laparotomy then the FAST findings were considered to be a false negative (Becker et al., 2009).

The inclusion criteria for this study incorporated patients who were hemodynamically stable with blunt abdominal trauma who underwent a FAST exam and CT scan to evaluate their injury. The trauma service admitted 9,280 patients during the 5 year period, however after the exclusion of patients who had a penetrating injury, who were hemodynamically unstable, and the patients who did not undergo a CT scan after a FAST exam, the study reviewed the cases of the remaining 3,181 patients. Overall the study had 352 true positive, 44 false positive, 2,664 true negative, and 121 false negative results. The sensitivity was 75% and specificity was 98%. The positive predictive value was 88% with a negative predictive value of 95%. The rate of accuracy was 95% (Becker et al., 2009). This study included additional outcomes that were not relevant to this systematic review.

The authors recommended the use of FAST as an initial screening tool, but expressed concern that an abdominal CT should be used as the definitive imaging method as the FAST cannot always rule out intra-abdominal injuries safely.
DISCUSSION

The three studies acknowledged in this systematic review have come to similar conclusions regarding the use of FAST in the Emergency Department. It was felt that until the specificity and sensitivity of the FAST exam can approach that of CT, then CT should continue to be the gold standard when evaluating blunt abdominal trauma (Natarajan et al., 2010).

The GRADE tool was developed to help health care professionals determine the quality of evidence and the strength of recommendations presented by different studies (Guyatt, G. H et al., 2008). This systematic review looked at the FAST exam as a potential alternative to CT scan for patients who are hemodynamically stable with blunt abdominal trauma. The outcomes assessed were the sensitivity, specificity, positive predictive value, and negative predictive value of the FAST exam in detecting intra-abdominal injury. Overall, the GRADE of the evidence was moderate. The GRADE working group explains how there are four different levels of evidence: high, moderate, low, and very low. All levels look at how further research might change the confidence in the estimate of effect. The GRADE working group states that a high level of evidence means further research is very unlikely to change the confidence in the estimate of effect and moderate evidence means further research is likely to have an important impact on the confidence in the estimate of effect. Low evidence means that further research is very likely to have an important impact on the confidence in the estimate and that very low means any estimate of effect is very uncertain (Guyatt, G. H et al., 2008). “While observational studies will generally yield only low quality evidence, there may be unusual circumstances in which this evidence will be classified as moderate or even high quality. For example, on the rare occasions when they yield extremely large and consistent estimates of the magnitude of a treatment effect, we may be confident about the results of observational studies” (Guyatt, G. H et al., 2008).
this review, the sensitivity was variable across all three studies; however, the specificity, positive predictive value, and negative predictive value were consistent and greater than 88% across the studies. This demonstrated a significant magnitude of treatment effect for specificity, positive and negative predictive values; therefore, the GRADE for these outcomes was upgraded from low to moderate. The GRADE for sensitivity remained at a low quality of evidence. Since three of the four outcomes were upgraded to moderate quality of evidence, the overall GRADE of evidence was upgraded from low to moderate as well. Since the evidence is moderate further research is likely to have an important impact on the confidence in the estimate of effect.

There were limitations in the above studies. Becker et al. (2009), explains how their study had several limitations. First, the authors explain how the study was retrospective with nonconsecutive patient enrollment and that the exact reason for the CT scan was not determined in these patients. Thus, this could have impacted the results. Also, the authors mention how the FAST exam is often performed in a trauma resuscitation bay where possible chest tube and line placement procedures, bandages and dressings, and bright lighting can lead to inaccurate results. Natarajan et al. (2010), points out how 695 patients were observed in the trauma center without undergoing a FAST exam; therefore, it is unclear whether or not these patients belonged in the true negative group. No follow-up data was available, so these patients might have had missed injuries (2010). This same limitation was present in the Kornezos et al. (2009) study. Given the fact the study was done retrospectively, it was impossible to follow up with patients who had been discharged after a negative ultrasound. Patients were advised to return to the hospital if needed, but it is unknown whether or not the patients received care at other hospitals after their discharge (2009).
Although, Becker et al. (2009), defines the primary goal of FAST, which was determined by the international consensus conference, as the detection of free fluid as a injury marker (2009), recent literature reports that even though the FAST exam is sensitive to free intra-peritoneal fluid, it cannot be relied upon to give an accurate diagnosis of abdominal organ injuries (Natarajan et al., 2010). Furthermore, Kornezos et al. (2009), adds that some studies have shown lower sensitivity in detecting organ injuries and the amount of intra-peritoneal fluid does not correlate to the severity of the injury (2009).

There are many factors taken into consideration when deciding the best possible care for a hemodynamically stable blunt abdominal trauma patient. After reviewing the literature, given the variable sensitivity of the FAST exam, it cannot be recommended to use the FAST exam in replacement of a CT scan. The above studies recorded a sensitivity between 40-99%, whereas the CT scan has a documented sensitivity of 92-98% (Natarajan et al., 2010). It is understandable to want to save time and expenses. However, when the results of one study have 121 false negative results with 18% of those patients requiring surgery (Becker et al., 2009), and another study has 87 false negative results and 21% of those patients needing an operation (Natarajan et al., 2010), those numbers are not convincing and it is not worth putting those patients at risk of missing a significant intra-abdominal injury. Therefore, it is the final conclusion of this systematic review to continue using CT scan after blunt abdominal trauma to avoid missing any potentially life-threatening injuries. It is felt, along with Natarajan et al., that a large mutli-center trial would be useful in evaluating the effectiveness of FAST in hemodynamically stable blunt trauma patients (2010).
REFERENCES


## APPENDIX

### GRADE Table

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Outcome</th>
<th>Quantity and type of Evidence</th>
<th>Findings</th>
<th>Starting Grade</th>
<th>Magnitude of effect</th>
<th>Dose-Response</th>
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<th>Grade of Evidence for Outcome</th>
<th>Overall Grade of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAST exam vs. standard evaluation techniques</td>
<td>Sensitivity</td>
<td>1 Cohort study, 2 case studies</td>
<td>Variable</td>
<td>Low</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Specificity</td>
<td>1 Cohort study, 2 case studies</td>
<td>&gt;88%</td>
<td>Low</td>
<td>+1</td>
<td>0</td>
<td>0</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Positive Predictive Value</td>
<td>1 Cohort study, 2 case studies</td>
<td>&gt;88%</td>
<td>Low</td>
<td>+1</td>
<td>0</td>
<td>0</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Negative Predictive Value</td>
<td>1 Cohort study, 2 case studies</td>
<td>&gt;92%</td>
<td>Low</td>
<td>+1</td>
<td>0</td>
<td>0</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>