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Diagnostic Accuracy of FAST Scan in Hemodynamically Stable Blunt Abdominal Injury Patients; Is it "Fast" enough?

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ABSTRACT

Objective: To determine the diagnostic accuracy of a Focused Assessment with Sonography for Injury (FAST) scan in blunt abdominal injury with suspected hollow viscus organ perforation, keeping a computed tomography (CT) scan of the abdomen as a reference.

Study Design: Cross-sectional study.

Place and Duration of Study: Radiology Department, Combined Military Hospital, Peshawar Pakistan, from Aug 2017 to Feb 2018.

Methodology: One hundred forty-seven hemodynamically stable patients aged 20-60 years of either gender presenting in the Emergency Department (ED) with clinical suspicion of blunt abdominal injury were included. FAST scan and CT abdomen reporting were done by two separate consultants blinded to each other.

Results: The mean age was 35.84±8.44 years, ranging from 21-60 years. Among 72 FAST-positive patients, 68(46.3%) were true positive, and 4(2.7%) were false positive. Among 75 FAST negative patients, 6(4.1%) were false negative, and 69(46.9%) were true negative. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of FAST compared to CT was 91.89%, 94.52%, 94.44% and 92.00%, respectively; FAST scan was correct in 93.20%.

Conclusions: FAST Ultrasound is a sensitive and specific tool in the screening and diagnosing of abdominal injury resulting from blunt abdominal injury.

Keywords: Blunt abdominal injury, Computerized Tomography, FAST scan, Ultrasound.

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INTRODUCTION

The reported incidence of all abdominal injury patients is 82.7%, of which 69.4% comprise blunt abdominal injury (BAT) and 30.6% include penetrating abdominal injury.[1,2] Rupture of hollow viscus has been reported in up to 51.6% in blunt abdominal injury.[3]

Over the years, better evaluation and management have still not resulted in a significant reduction in mortality and morbidity of blunt abdominal injury.[4] During the last decade, FAST has become the go-to initial investigation in the emergency room and has largely replaced DPL.[5,6] Clinical examination alone is inadequate and initial management guided by FAST and CT abdomen can be helpful for the evaluation of hollow viscus blunt abdominal injury, especially those with few clinical signs of abdominal injury.[7,8]

As there is a significant variation in the accuracy of FAST, as reported in the literature by various authors, this study explores the diagnostic accuracy of FAST in the local population to evaluate hollow viscus perforation in BAT. There are no published local studies conducted on the diagnostic accuracy of FAST. Although CT scan has significant sensitivity and specificity for diagnosing hollow viscus injury in blunt abdominal injury, it is associated with high cost, is time intensive, is not freely available in peripheral hospitals and carries an inherent risk of ionizing radiation exposure. In contrast, FAST is readily available, portable, relatively economical and less time-intensive.[9] The objective was to determine the diag-nostic accuracy of FAST in blunt abdominal injury with suspected hollow viscus organ perforation, keeping a CT scan of the abdomen as a reference standard.

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METHODOLOGY

The cross-sectional study was conducted at the Department of Radiology, Combined Military Hospital, Peshawar, from August 2017 to February 2018 after approval of the Institutional Review Board (IRB Approval Letter No- 0056/22). The sample size was calculated by taking a prevalence of 52%, sensitivity and specificity of 76% and 70%, respectively.[10]

Inclusion Criteria: Patients aged 20-60 years of either gender presenting in the Emergency Department (ED) with clinical suspicion of blunt abdominal injury and hemodynamically stable (BP ≥100/70 mmHg & pulse 70-100/min) were included.

Exclusion Criteria: Patients requiring exploratory laparotomy on arrival, hemodynamically unstable patients and those with penetrating abdominal injury/intra-abdominal haemorrhage were excluded.

The four domains of QUADAS 2 (Quality Assessment of Diagnostic Accuracy Studies–2) were kept in mind and applied during the planning stage of the study. Informed written consent was taken from the patient or next of kin (if the patient could not consent). Demographic information like name, age, sex and address were recorded in a pre-designed questionnaire. A thorough history and detailed physical examination were done. After initial resuscitation and stabilization of patients, FAST examination was performed by a consultant radiologist. The patient was supine with a display screen on the patient's right side. A lower-frequency transducer of 3.5-5 MHz curved array was selected. FAST examination incorporated six views: sub-xiphoid for pericardial, longitudinal right and left upper quadrant for peri-hepatic and peri-splenic, right and left lateral for para-colic gutters and longitudinal, transverse view for pelvis. Ideally, a full bladder provides an acoustic window to detect free fluid in the deep pelvis. In the case of a urinary bladder catheter in situ, it was either clamped or distended by instillation of sterile fluid for better visualization. The presence of free fluid was considered as a positive FAST scan.

After the FAST scan, a CT of the abdomen was done to confirm the findings using a 128-slice multi-detector CT scanner Aquilion Prime (Canon Medical systems) following a standard departmental protocol for Injury CT comprising 4 phases: Non-contrast, arterial phase, delayed venous phase and pyelogrphic phase. Free fluid or air was taken as a positive CT scan. The team performing and reporting the CT scan was blinded from the FAST scan result. However, both results were communicated to the clinician in real-time for ongoing patient management. The exclusion criteria were strictly followed to control confounders and exclude bias in study results. Both results and clinical information were entered by a separate team into data collection proformas pre-designed for the purpose. The study variables were age, sex and FAST findings. Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 23.00 and MS Excel 2016 software. Mean±SD was calculated for continuous variables. Frequency and percentage were calculated for categorical variables. For comparison, the Chi-square test was used. The *p*-value of ≤0.05 was considered significant. The 2x2 table was made for the calculation of diagnostic parameters.

RESULTS

A total of 147 FAST patients were included with the mean age of 35.84±8.44 years (21-60 years). Among 72 FAST-positive patients, 68(46.3%) had confirmed blunt abdominal injury on a CT scan (i.e. true positive), and 4(2.7%) had a negative CT scan (i.e. false positive). Among 75 negative FAST patients, 6(4.1%) had free fluid or air and, therefore, a positive CT scan (false negative), and 69(46.9%) had a negative CT scan (true negative) as shown in Table-I. Therefore, patients with a positive FAST scan had a statistically significant probability of a confirmed blunt abdominal injury on CT (*p*=0.001). The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of FAST as compared to CT are shown in Table-II.

Table-I: Comparison of Focused Assessment with Sonography for Injury (FAST) with CT Scan (n=147)

FAST	CT Scan n(%)		Total
	Positive	Negative	
Positive	68(46.3)	4(2.7)	72
Negative	6(4.1)	69(46.9)	75
Total	74	73	147

Table-II: Diagnostic parameters (n=147)

Diagnostic Parameters	Values
Sensitivity=True Positive/(True Positive +False Negative)	91.89%
Specificity=True Negative/(True Negative+False Positive)	94.52%
Positive Predictive Value=True Positive/(True Positive+ False Positive)	94.44%
Negative Predictive Value=True Negative/(True Negative +False Negative)	92.00%
Diagnostic Accuracy=(True Positive+True Negative)/All Patients	93.20%

DISCUSSION

The results of the study reveal a high diagnostic accuracy (91.89%) with good sensitivity (89.4%) and very good specificity (94.4%), showing FAST to be a significant tool even in the setting of LMICs for the diagnosis of hollow viscus injury in blunt abdominal injury. However, it is not yet lucidly clear whether FAST alone can be used as a diagnostic test leading to surgical intervention when the literature is reviewed in this regard. The increasing use of FAST has been

demonstrated to be significantly correlated with the reduction in the use of CT scan abdomen for blunt abdominal injury.[11]

FAST can detect from 100-620 ml of free intraperitoneal fluid.[12] The sensitivity of FAST in hollow viscus perforation in blunt abdominal has been reported as high as 73% with 100% specificity, a negative predictive value (NPV) of 93%, positive predictive value (PPV) of 100%, and accuracy of 94%.[13] Studies have reported sensitivity and specificity of FAST in the range of 38.5%,[14] to 76.0%,[15] and 70.8-100.0% respectively.[16] CT abdomen is the current gold standard with a sensitivity of 97%17 a and specificity of 100%,[18,19] for diagnosis of hollow viscous injuries in blunt injury.

In marked contrast to our findings, a retrospective study by Carter *et al*. on 1671 patients revealed a sensitivity of only 22% in hemodynamically stable patients and 28% in the hemodynamically unstable, revealing a very high chance of missing an intraabdominal injury.[20] In a study by Kumar *et al*., findings of FAST were compared with CT and per-operative surgical findings. Compared to the contrast-enhanced CT scan (CECT) abdomen, the sensitivity, specificity, and accuracy were 77.27%, 100%, and 79.16 %, respectively. Compared with per-operative findings, FAST showed a sensitivity, specificity and accuracy of 94.44%, 50% and 90%, respectively.[21]

The bedside clinical decision-making process for blunt abdominal injury is critical because of the possibility of internal organ injury with a high mortality risk. Whereas currently, the clinical utility of FAST is considered strong enough to make therapeutic decisions for laparotomy if intraperitoneal fluid is found, the authors of this systematic review maintain that studies showing high sensitivity of FAST had methodological flaws; therefore, Multi-slice CT abdomen should be the modality of choice for therapeutic decisions whereas FAST should be used as a screening tool.

LIMITATIONS OF STUDY

The study had the limitation of an absence of comparison with serial FAST examinations and the lack of inclusion of hemodynamically unstable patients with blunt abdominal injury.

CONCLUSION

FAST Ultrasound is a sensitive and specific tool in screening and diagnosing intra-abdominal injury sustained secondary to blunt abdominal injury. Its place in the diagnostic algorithm will depend on the availability of multi-slice CT abdomen and the operator's expertise.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

SA & YK: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

LA & IM: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

MA & FZ: Concept, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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