Diagnostic Accuracy of Extended Focused Assessment with Sonography For Trauma (E-FAST) Keeping Contrast Enhanced CT Chest And Abdomen As Gold Standard

Bibi Gul, Javed Anwar, Hafiz Khalid Pervaiz, Ayesha Niaz, Nasira Sultana, Mehwish Tariq

Combined Military Hospital Quetta/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To determine the diagnostic accuracy of extended focused assessment with sonography for trauma (E-FAST) for detecting thoraco-abdominal trauma, keeping contrast-enhanced CT chest and abdomen as the gold standard.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Radiology, Combined Military Hospital, Quetta, from Jan 2020 to Aug 2021.

Methodology: A total of (n=196) patients, of age 18-60 years, of both genders, who sustained thoraco-abdominal injuries and were referred for contrast-enhanced Computed tomography of the chest and abdomen were enrolled in the study. Patients were subjected to the thorax and abdomen ultrasonographic examination first and then underwent a contrast-enhanced CT scan of the thorax and abdomen. The findings of both modalities were recorded and subjected to statistical analysis to confirm the accuracy of ultrasound, considering CT-scan as a gold standard procedure.

Results: The mean age of the patients was 35 10.6. There were 164 (83.7%) males and 32 (16.3%) females. Blunt trauma was seen in 131 (66.8%) and penetrating trauma in 65 (32.2%) patients. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of E-FAST for chest trauma was 79.4%, 94.7%, 87.6%, 90.7% and 89.8% respectively, for abdominal trauma was 68.6%, 95.2%, 88.8%, 84.5% and 85.7% respectively and for combined chest and abdominal trauma was 77.1%, 95.9%, 85.9%, 92.8% and 91.3% respectively.

Conclusion: E-FAST has good diagnostic accuracy for the chest, abdominal and both thoraco-abdominal trauma and can be incorporated into the routine assessment of patients presenting with trauma.

Keywords: Abdominal injuries, Chest trauma, Focussed sonography for trauma.

How to Cite This Article: *Gul B, Anwar J, Pervaiz K, Niaz A, Sultana N, Tariq M. Diagnostic Accuracy of Extended Focused Assessment with Sonography For Trauma (E-Fast) Keeping Contrast Enhanced Ct Chest And Abdomen as Gold Standard. Pak Armed Forces Med J 2022; 72(Suppl-2): S341-345*
DOI: https://10.51253/pafmj.v72iSUPPL-2.8101

INTRODUCTION

Globally, a leading cause of death is trauma, and traumarelated morbidity and mortality rates are reported to be higher in countries with low and middle income status.[1] Assessing and managing individuals with trauma still is challenging for physicians in emergencies.[2] If in a traumatic patient, bleeding occurs either intra-abdominally or intrathoracically, then without immediate intervention, there is an increase in the risk of death by about 1% every three minutes.[3] On initial abdominal examination, 50% of the individuals who sustain severe traumatic injury to the abdomen either have a normal examination or the mental state of the individuals does not allow a reliable examination to be carried out.[4] Because of unreliable clinical examination and the risk of fatality because of the injuries that are being missed, the physicians have to rely on diagnostic imaging modalities, and this leads to a delay in the provision of treatment to the critical patients, which can affect the outcomes of patients coming to the trauma centres and emergencies.[5]

Although computed tomography (CT) is used widely, certain factors hinder its utility, such as ionizing radiation, moving a critical patient out of the trauma centre, problems related to contrast, and the cost and duration of CT.[6] With advancements in technology, emergency physicians and those in trauma care have widely adopted ultrasound as a cost-effective diagnostic modality and is available readily.[7,8]

An extended-focussed assessment with sonography for trauma (E-FAST) protocol, which includes a thoracic examination to rule out pneumothorax and hemothorax, was introduced in the last two decades and is superior to chest radiography in a recent meta-analysis.[9,10] A study found that E-FAST was sensitive in 94.8%, specific in 99.5%, had a positive predictive value of 98.53%, a negative predictive value of 98.21% and an accuracy of 99.4%, respectively for chest and abdominal injuries.[2] In another study, E-FAST sensitivity and specificity were 42.9% and 98.4%, respectively, for ruling out thoraco-abdominal surgeries.[1]

Correspondence: Dr Javed Anwar, Head of Radiology Department, Combined Military Hospital Quetta-Pakistan
Received: 03 Feb 2022; revision received: 12 Apr 2022; accepted: 14 Apr 2022

Numerous international studies have been conducted on the accuracy of E-FAST for the evaluation of thoraco abdominal trauma. However, there is a paucity of local data in our setting. Therefore, the rationale of the current study is to determine the diagnostic accuracy of extended focussed assessment with sonography for trauma (E-FAST) for detecting chest, abdominal and thoracoabdominal trauma, keeping contrast-enhanced CT chest and abdomen as the gold standard. The study will help in guiding a diagnostic modality that will help in the early detection of trauma or injury to either the thorax or abdomen or both and thus will help in the provision of quick and optimal treatment to the individuals suffering from it and will help in reducing the rates of morbidity and mortality in such patients.

METHODOLOGY

It was a cross-sectional study carried out at the Department of Radiology, Combined Military Hospital Quetta, from January 2020 to August 2021 after taking approval from the Ethical review committee (ERC letter-number CMH Quetta- IRB/009).

Inclusion Criteria: Patients of age 18-60 years, of both genders, who sustained thoraco-abdominal injuries and were referred for contrast-enhanced Computed tomography of the chest and abdomen were included in the study.

Exclusion Criteria: Patients who sustained injuries other than chest and abdomen and those who were hemodynamically unstable were excluded from the study.

The sample size was calculated by keeping the expected percentage of thoraco-abdominal trauma as 15%[11] with a 5% margin of error and 95% confidence interval. Non-probability consecutive sampling technique was used.

All patients enrolled in the study under-went an ultrasonographic examination of the chest and the abdomen. On ultrasound, chest trauma was considered positive if there was the presence of pneumothorax or hemothorax, which was indicated if a lack of lung slide was seen. Abdominal trauma was considered positive if the free fluid was seen in the abdomen on ultrasound. Free fluid was labelled if there was a hypoechoic fluid in the abdominal cavity. The chest and abdominal trauma findings were confirmed by computed tomography (CT scan), which was carried out as a standard gold test.

Statistical Package for Social Sciences (SPSS) version 25 was used for the data analysis. Quantitative data such as age and duration of trauma were presented as mean and standard deviation. Qualitative data such as gender, type of trauma, site of trauma, findings of trauma on the chest and abdominal CT scan, and findings on ultrasound were presented as frequency and percentages. Two by two table was made to detect the sensitivity, specificity, positive pre-dictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of E-FAST, keeping CT scan as the gold standard.

RESULTS

Total 196 patients were enrolled. The frequency of qualitative variables like gender, type of injury and site of trauma on CT scan were shown in Table-I.

Table-I: Frequency of qualitative variables.

Variables	Frequency (Percentage)
Gender	
Male	164 (83.7%)
Female	32 (16.3%
Type of Injury	
Blunt	131 (66.8%)
Penetrating	65 (33.2%)
Site of Trauma on CT Scan	
Chest	63 (32.1%)
Abdomen	54 (27.6%)
Both	43 (21.9%)
No trauma	36 (18.4%)
Chest Trauma on E-FAST	
Yes	57 (29.1%)
No	139 (70.9%)
Abdominal Trauma on E-FAST	
Yes	70 (35.7%)
No	126 (64.3%)
Both Chest and Abdominal Trauma on E-FAST	
Yes	48 (24.5%)
No	148 (75.5%)

The sensitivity, specificity, PPV, NPV and accuracy of E-FAST for chest trauma was 79.4%, 94.7%, 87.6%, 90.7% and 89.8% respectively (Table-II), For abdominal trauma was 68.6%, 95.2%, 88.8%, 84.5% and 85.7% respectively (Table-III) and for combined chest and abdominal trauma was 77.1%, 95.9%, 85.9%, 92.8% and 91.3% respectively (Table-IV).

DISCUSSION

Patients who present with undifferentiated trauma can pose diagnostic and management challenge.[12,13] An e-FAST examination is a bedside tool that can help the doctors by providing additional infor-

mation to the basic survey and help in prioritization of provision of care to the patients.[14,15]

Netherton *et al,* revealed that the pooled sensitivity and specificity of e-FAST were 69% and 99%, respectively, for chest trauma.[17] Similar levels of sensitivity

Table-II: Diagnostic accuracy of extended focussed assessment with sonography for trauma for chest trauma.

Diagnostic Parameters	Values
Chest Trauma on Extended Focussed Assessment with Sonography	
Yes	70 (35.7%)
No	126 (64.3%)
Chest Trauma on CT Scan	
Yes	54 (27.6%)
No	142 (72.4%)
Values	
Sensitivity=True Positive/(True Positive+False Negative)	79.4%
Specificity=True Negative/(True Negative+False Positive)	94.7%
Positive Predictive Value=True Positive/(True Positive+False Positive)	87.6%
Negative Predictive Value=True Negative/(True Negative+False Negative)	90.7%
Diagnostic Accuracy=(True Positive+True Negative)/All Patients	89.8%

Table-III: Diagnostic accuracy of e-fast for abdominal trauma.

Diagnostic Parameters	Values
Abdominal Trauma on Extended Focussed Assessment with Sonography	
Yes	57 (29.1%)
No	139 (70.9%)
Abdominal Trauma on CT Scan	
Yes	54 (27.6%)
No	142 (72.4%)
Values	
Sensitivity= True Positive/ (True Positive+False negative)	68.6%
Specificity= True Negative/ (True negative+False positive)	95.2%
Positive Predictive Value= True Positive/(True Positive+ False Positive)	88.8%
Negative Predictive Value= True Negative/(True Negative +False Negative)	84.5%
Diagnostic Accuracy=(True Positive +True Negative)/All Patients	85.7%

Table-IV: Diagnostic Accuracy of E-Fast for Thoraco-Abdominal Trauma.

Diagnostic Parameters	Values
Thoraco-Abdominal Trauma on Extended Focussed Assessment with Sonography	
Yes	48 (24.5%)
No	148 (75.5%)
Thoraco-Abdominal Trauma on CT Scan	
Yes	43 (21.9%)
No	153(78.1%)
Values	
Sensitivity= True Positive/ (True Positive+False negative)	77.1%
Specificity= True Negative/ (True negative+False positive)	95.9%
Positive Predictive Value= True Positive/(True Positive+ False Positive)	85.9%
Negative Predictive Value= True Negative/(True Negative +False Negative)	92.8%
Diagnostic Accuracy=(True Positive +True Negative)/All Patients	91.3%

The current study evaluated the diagnostic accuracy of e-FAST examination for assessing chest, abdominal and thoracoabdominal trauma. For chest trauma, e-FAST was 79.4% sensitive and 94.7% specific and had an accuracy of 89.8%. Staub *et al,* determined the accuracy of e-FAST for chest trauma that included the presence of hemothorax or pneumothorax or both and found it to be 81% sensitive and 98% specific and had an accuracy of 97.9%.[16] In a systematic review, and specificity of e-FAST for diagnosing chest trauma were revealed by current study findings, which showed that e-FAST was more specific for ruling out chest trauma and had moderate level sensitivity for its detection.

For abdominal trauma, it was found that e-FAST was 68.6% sensitive and 95.2% specific and had an accuracy of 85.7%. Stengel *et al,* (2001) revealed that for all types of abdominal trauma, e-FAST was sensitive in

68% and specific in 95% of patients.[18] These findings are very similar to current study findings, which yielded similar sensitivity and specificity. In the systematic review, Netherton *et al,* also revealed almost similar rates of sensitivity and specificity of e-FAST for detecting abdominal trauma, i.e., 69% and 99%, respectively.[17]

In our study, the sensitivity, specificity and accuracy of E-FAST for combined chest and abdominal trauma were 77.1%, 95.9% and 91.3%, respectively. Basnet *et al,* revealed that the sensitivity and specificity of e-FAST for diagnosing thoraco-abdominal trauma were 94.8% and 99.5%.[2] Bode *et al*. found the sensitivity and specificity of 92% and 100%,[19] whereas Hsu *et al,* revealed it as 80% and 100%, respectively.[20] Basnet *et al,*[2] and Bode *et al,*[19] revealed higher sensitivity of e-FAST for detecting both thoraco-abdominal traumas. In contrast, the findings of Hsu *et al,*[20] and the current study reveals moderate level sensitivity. This difference between our findings and other study findings maybe because of the difference in the experience of the physicians carrying out e-FAST. Specificity rates were similar to previous studies, i.e., e-FAST has a high specificity for ruling out thoraco-abdominal trauma.

This research on the performance of E-FAST as a diagnostic modality gives evidence that supports its use as a diagnostic method for torso injury. In resource constrained nations where contrast-enhanced computed tomography is not commonly available or economical for most patients, we recommend that for the early detection, E-FAST be used to aid in the clinical evaluation of injuries to the thorax and abdomen.

The current study findings concluded that E-FAST has good diagnostic accuracy for the chest, abdominal and both thoraco-abdominal trauma and can be incorporated into the routine assessment of patients presenting with trauma. To give effective conservative or laparotomy treatment, sophisticated imaging modalities such as computed tomography, serial evaluation by using E-FAST or clinical moni-toring done closely should be sought. Furthermore, an emergency USG for trauma should focus on doing E-FAST and looking for the presence of free fluid in the right upper quadrant in front of the liver, pelvic region and paracolic gutters, along with close observation for clinically ruling out injuries present within the abdomen.

LIMITATIONS OF STUDY

There were certain limitations of the current study. Firstly, as the sample size was small and the study was conducted at one centre, there was an issue of generalizability of the results. Furthermore, despite that efforts were made to instruct the first-responders in terms of inter-pretation of E-FAST scans, the ultimate interpretation depends on the individual's knowledge and experience. It was also dependent on the factors affecting the patients externally. The current study showed a risk of yielding a false-negative result in patients with gut injuries.

CONCLUSION

E-FAST has good diagnostic accuracy for the chest, abdominal and both thoraco-abdominal trauma and can be incorporated into the routine assessment of patients presenting with trauma.

Conflict of Interest: None.

Authors' Contribution

BG:, AN: Data collection, JA: Conception, design, intellectual, interpretation, HKP: Substential contributionin acquisition of data, NS: Data monitoring, MT: Final approval of the draft.

REFERENCES:

1. Akoglu H, Celik OF, Celik A, Ergelen R, Onur O, Denizbasi A. Diagnostic accuracy of the extended focused abdominal sonography for trauma (e-fast) performed by emergency physicians compared to CT. Am J Emerg Med 2018; 36(6): 1014-1017.
2. Basnet S, Shrestha SK, Pradhan A, Shrestha R, Shrestha AP, Sharma G, et al. Diagnostic performance of the extended focused assessment with sonography for trauma (EFAST) patients in a tertiary care hospital of Nepal. Trauma Surg Acute Care Open 2020; 5(1): e000438.
3. Gleeson T, Blehar D. Point-of-care ultrasound in trauma. Semin Ultrasound CT MR 2018; 39(4): 374-383.
4. Trinci M, Piccolo CL, Ferrari R, Galluzzo M, Ianniello S, Miele V. Contrast-enhanced ultrasound (CEUS) in pediatric blunt abdominal trauma. J Ultrasound 2019; 22(1): 27-40.
5. Long MK, Vohra MK, Bonnette A, Parra PDV, Miller SK, Ayub E, et al. Focused assessment with sonography for trauma in predicting early surgical intervention in hemodynamically unstable children with blunt abdominal trauma. J Am Coll Emerg Physicians Open 2022; 3(1): e12650.
6. Kumar A, Agarwal H, Gupta A, Sagar S, Banerjee N, Kumar S. Imaging modalities in trauma and emergency-a review. Indian J Surg 2021; 83(1): 42-52.
7. Makin E. Blunt abdominal trauma in children: Clinical perspective. Contrast-enhanced ultrasound in pediatric imaging: Edition 1, Springer Nature Switzerland AG 2021. Pediatr Radiol 2021; 51(12): 2253-2269.
8. Newbury A, Dorfman JD, Lo HS. Imaging and management of thoracic trauma. Semin. Ultrasound CT MR 2018; 39(4): 347-354.
9. Qamar SR, Evans D, Gibney B, Redmond CE, Nasir MU, Wong K, et al. Emergent comprehensive imaging of the major trauma patient: a new paradigm for improved clinical decision-making. Can Assoc Radiol J 2021; 72(2): 293-310.
10. Smith J. Focused assessment with sonography in trauma: Should its role be reconsidered? Post-grad Med J 2010; 86(1015): 285-291.
11. Cooper JG, Smith R, Cooper AJ. The incidence of abdominal injury in patients with thoracic and/or pelvic trauma. Injury Extra 2005; 36(7): 259-263.

12. Kirkpatrick AW, Sirois M, Laupland KB, Liu D. Hand-held thoracic sonography for detecting post-traumatic pneumothoraces: The extended focused assessment with sonography for trauma (EFAST). J Trauma Acute Care Surg 2004; 57(2): 288-295.
13. Nandipati KC, Allamaneni S, Kakarla R, Wong A, Richards N, Satterfield J, et al. Extended focused assessment with sonography for trauma (EFAST) in the diagnosis of pneumothorax: experience at a community based level I trauma center. Injury 2011; 42(5): 511-514.
14. Sauter TC, Hoess S, Lehmann B, Exadaktylos AK. Detection of pneumothoraces in patients with multiple blunt trauma: Use and limitations of eFAST. Emerg Med J 2017; 34(9): 568-572.
15. Flato UA, Guimarães HP, Lopes RD, Valiatti JL, Flato EM, Lorenzo RG. Usefulness of extended - FAST (EFAST- extended focused assessment with sonography for Trauma) in critical care settings. Rev Bras Ter Inten siv 2010; 22(3): 291-299.
16. Staub LJ, Biscaro RR, Kaszubowski E, Maurici R. Chest ultrasonography for the emergency diagnosis of traumatic pneumothorax and haemothorax: a systematic review and meta-analysis. Injury 2018; 49(3): 457-466.
17. Netherton S, Milenkovic V, Taylor M, Davis PJ. Diagnostic accuracy of e-FAST in the trauma patient: a systematic review and meta-analysis. Can J Emerg Med 2019; 21(6): 727-738.
18. Stengel D, Bauwens K, Sehouli J, Porzsolt F. Systematic review and meta-analysis of emergency ultrasonography for blunt abdominal trauma. J Br Surg 2001; 88(7): 901-912.
19. Bode PJ, Niezen RA, van Vugt AB, Schipper J. Abdominal ultrasound as a reliable indicator for conclusive laparotomy in blunt abdominal trauma. J Trauma 1993; 34(1): 27-31.
20. Hsu JM, Joseph AP. The accuracy of focused assessment with sonography in trauma in blunt trauma patients: experience of an Australian major trauma service. Injury 2007; 38(1): 71-75.