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REVIEW ARTICLE

E-FAST AS A DIAGNOSTIC METHOD TO ACCURATELY ASSESS LESIONS IN A PATIENT WITH TRAUMA

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ABSTRACT

INTRODUCTION: E-FAST is an emergency ultrasound coding protocol for patients with trauma, mainly abdominal, in a synthetic, targeted and simple way. e-FAST visualizes lung bases and lung-related injuries, in addition to intra-abdominal and pericardial bleeding.

OBJECTIVE: To analyze whether e-FAST is a method with good sensitivity to accurately assess injuries in a stable trauma patient.

METHODS: The study was carried out through an online search of scientific productions in international databases, from 2014 to 2022.

RESULTS: Through the descriptors, 34 articles were identified, of which only 18 passed the inclusion criteria and exclusion. Of these, 10 articles were selected that responded to the objective, according to the content analysis.

The overall sensitivity of the e-FAST examination technique (pneumothorax, pleural effusion, spleen injury, liver injury, gastrointestinal injury, pericardial effusion, intra-abdominal free fluid and bladder rupture ranged from 69% to 99% in its sensitivity. the specificity averaged 98%, the positive predictive value averaged 92%, and the negative predictive value averaged 98%, the accuracy rate averaged 98% across the evaluated studies.

CONCLUSION: The main advantage of the method is that the diagnosis is fast, accurate, safe, without radiation effects, with good sensitivity and specificity. Its main disadvantage is that it is operator dependent. However, e-Fast has a high overall sensitivity and should be incorporated into routine assessment as a useful bedside tool to determine pneumothorax, pericardial effusion, and intra-abdominal free fluid in the setting of trauma.

KEYWORDS: E-FAST, SENSITIVITY, ULTRASOUND, INTENSIVE CARE MEDICINE

INTRODUCTION

As a point-of-care tool, emergency ultrasound has the potential to rule out or confirm a diagnosis in most critically ill people[1].

Since the 1990s, ultrasound has quickly established itself as a rapid bedside examination. Several studies, carried out in North America, showed that ultrasound performed by emergency surgeons was not only feasible but, above all, allowed to quickly confirm a lesion with good sensitivity and good specificity. In the same period, many emergency services purchased ultrasound machines. Thus, several attempts at standardization led to the development of a protocol: FAST (Focused Abdominal Sonography for Trauma Patients). This is an emergency ultrasound coding protocol for patients with trauma, mainly abdominal, in a synthetic, targeted and simple way. In the 2000s, in the United States, it is believed to have replaced peritoneal lavage in the diagnosis of hemoperitoneum. It has since continued to be used and is now taught as part of Advanced Trauma Life Support in the North American continent (North American Trauma Management Protocol). In the mid-2000s, assessment of the chest for pneumothorax and hemothorax was added to the traditional FAST exam, resulting in the acronym EFAST (Extended FAST), "extended FAST" for the pleura[2].

The FAST protocol is an important adjunct and extension of clinical examination in an emergency setting that has been used for the past three decades. It may be performed on trauma patients with symptoms of hemorrhagic shock or evidence of intra-abdominal injury. The characteristics of FAST have led this practice to be adopted as an international standard of care in most developed countries. It is a non-invasive, portable, low-cost test that can be performed in less than five minutes, repeatable and without the need for radiation, and can be performed by an emergency physician or surgeon.[3]

The e-FAST visualizes lung bases and lung-related injuries, as well as intra-abdominal and pericardial bleeding. In trauma patients, time is precious. Non-contrast computed tomography (NCCT) of the chest is the gold standard for the evaluation of blunt chest trauma. However, it is cumbersome and time-consuming and leads to increased morbidity and mortality. Therefore, evaluating trauma patients in the trauma room with e-FAST, which is available around the clock, will not only save time, but also the lives of trauma patients[4].

The aim of this study is to analyze through a review whether e-FAST is a method with good sensitivity to accurately assess injuries in a stable trauma patient.

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METHODS

The study was carried out through an online search of international scientific productions, from 2014 to 2022, to respond to the objective of analyzing whether e-FAST is a method with good sensitivity to accurately assess injuries in a stable patient with trauma.

The Latin American and Caribbean Literature in Health Sciences (LILACS) and the Medical Literature Analysis and Retrieval System Online (MEDLINE) databases were used, which uses the Virtual Health Library and Pubmed as a search engine. The descriptors used were: E-fast, trauma, sensitivity in English.

The following inclusion criteria were considered: articles published between 2014 and 2022; in Portuguese, English and Spanish; released in full for reading. Articles that did not respond to the guiding and bibliographic review question were excluded.

Access to the database and collection took place in November 2022. All articles were analyzed by the author. Through the descriptors, 34 articles were identified, of these, only the inclusion and exclusion criteria were applied, remaining 18 articles, being selected 10 articles that answered the guiding question, according to the content analysis.

RESULTS

Through the descriptors, 34 articles were identified, of which only 18 passed the inclusion and exclusion criteria. Of these, 10 articles were selected that responded to the objective, according to the content analysis. Flowchart in figure 1.

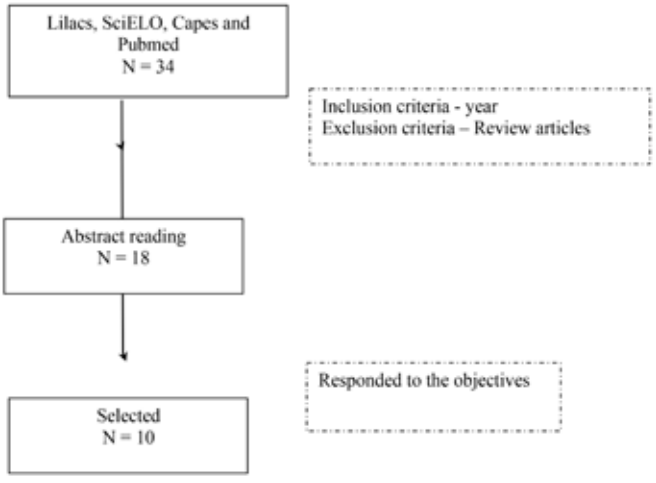

Chart 1 - illustrates the selected studies in terms of purpose, interventions and results.

Chart 1: Distribution of studies according to authors, year of publication, objective, interventions and results.

STUDIES	OBJECTIVE	INTERVENTIONS
Devadoss et al., 2021	To analyze the diagnostic accuracy of e-FAST in stable chest trauma	Observational, prospective study 110 patients
Netherton et al., 2019	Systematically review the published literature on the diagnostic accuracy of all components of the eFAST exam	Systematic review with meta-analysis 75 studies representing 24,350 patients
Akoglu et al., 2018	To compare the diagnostic accuracy of the E-FAST exam performed by EM residents with the results of computed tomography as the gold standard.	Observational, prospective study 140 patients
Ianniello et al., 2014	To evaluate the diagnostic accuracy of extended focused assessment with trauma ultrasonography (e-FAST) in the diagnosis of pneumothorax, compared with the results of multidetector computed tomography (MDCT) and invasive interventions (thoracostomy tube placement).	Retrospective observational studies involving 368 patients
Ianniello et al., 2014	Show the sensitivity of Enhanced Focused Assessment with Sonography for Trauma (e-FAST) for detecting pneumothorax, hemothorax, and intra-abdominal injury.	Observational, prospective study 33 patients
Xu et al., 2018	To investigate the diagnostic value of extended focused assessment with trauma ultrasound (E-FAST) in multiple trauma patients in the intensive care unit (ICU).	Observational, prospective study 76 patients
Basnet et al., 2020	To evaluate the accuracy of extended focused assessment with trauma ultrasound (EFAST) for chest and abdominal injuries performed by rescuers in a tertiary hospital in Nepal.	Observational, prospective study 267 patients
Gul et al., 2022	To determine the diagnostic accuracy of extended focused assessment with trauma ultrasound (E-FAST) to detect thoracoabdominal trauma while maintaining contrast-enhanced CT of the chest and abdomen as the gold standard.	Observational, prospective study 196 patients
Adelin et al., 2020	To evaluate the contribution of EFAST ultrasonography in the management of blunt thoracic and abdominal trauma.	Observational, prospective study 63 patients
Bagheri-Hariri et al., 2019	To examine the effect of using E-FAST on the clinical judgment of physicians treating patients with blunt abdominal and chest wall trauma.	Observational, prospective study 115 patients

Chart 1: Distribution of studies according to authors, year of publication, objective, interventions and results.

DISCUSSION

Performing e-FAST is a common practice in the initial evaluation of trauma patients. The studies selected here highlighted that it is a fast, safe diagnostic method, without radiation effects, with good sensitivity and specificity.

Cross-sectional studies, mostly prospective, were analyzed. A study carried out in a trauma center from November 2017 to 2019, including 110 patientshe showed that e-FAST is a better complement for the diagnosis and treatment of patients with blunt chest trauma[5].

In a systematic review to analyze the diagnostic accuracy of all components of the eFAST exam, with seventy-five selected studies representing 24,350 patients, pooled sensitivities and specificities were calculated for the detection of pneumothorax (69% and 99%, respectively), pericardial effusion (91% and 94%, respectively) and intra-abdominal free fluid (74% and 98%, respectively). Subgroup analysis was completed for detection of intra-abdominal free fluid in hypotensive patients (74% sensitivity and 95% specificity), normotensive adults (76% sensitivity and 98% specificity), and pediatrics (71% sensitivity and 95% specificity). The study suggests that e-FAST is a useful bedside tool to determine pneumothorax, pericardial effusion and intra-abdominal free fluid in the trauma setting[6].

Another study to evaluate the diagnostic accuracy of e-FAST in the diagnosis of pneumothorax, compared with the results of multidetector computed tomography (MDCT) and invasive interventions (thoracostomy tube placement), with 368 unstable adult patients (273 men and 95 women; mean age, 25 years; range, 16-68 years), admitted to the emergency department for major trauma (injury severity score ≥ 15). Of the 736 lung fields included in the study, 87 pneumothoraxes were detected on chest CT (23.6%). The e-FAST detected 67/87 and 20 pneumothoraxes were not identified (17 mild, 3 moderate). The diagnostic performance of ultrasound was: sensitivity 77% (74% in 2011 and 80% in 2012), specificity 99.8%, positive predictive value 98.5%, negative predictive value 97%, accuracy 97.2% (67 true positives; 668 true negatives; one false positive; 20 false negatives); 17 missed mild pneumothoraxes were not immediately fatal (thickness less than 5mm). The results show that chest ultrasound (e-FAST) is a rapid and accurate first-line bedside diagnostic modality for diagnosing pneumothorax in unstable patients with major chest trauma during the primary assessment in the emergency room[7].

The sensitivity of e-FAST was also evaluated in another study for the detection of pneumothorax, hemothorax and intra-abdominal injury. The relationship between e-FAST and the need for invasive treatment was also analyzed. The study included patients who suffered polytrauma. The results of computed tomography (CT) of the abdomen and thorax were reviewed and the size of the pneumothorax was scored. Compared to CT, e-FAST sensitivities for intra-abdominal injury and hemothorax were 54.5% and 71%, respectively. The diagnosis of pneumothorax was established in 27 patients with e-FAST (sensitivity 81.8%) out of 33 (30.8%) patients with pneumothorax. According to the CT grading, no pneumothorax less than 1 cm wide and not exceeding the mid-coronal line in length were identified. The e-FAST was positive for all patients undergoing tubular thoracostomy. The authors conclude that e-FAST can be used with high sensitivity for the determination of pneumothorax that requires an invasive procedure. It has low sensitivity in the diagnosis of intra-abdominal injury and hemothorax; however, e-FAST can predict the need for invasive procedures[8].

Multiple trauma patients in the intensive care unit (ICU) were also analyzed to verify the diagnostic value of e-FAST in a prospective clinical study[10]. Eighty polytrauma patients admitted to the ICU of Anhui Provincial Hospital were included. The e-FAST for trauma check was performed at baseline, and for those who had positive findings, the diagnosis was immediately confirmed by CT scan or surgical exploration. If negative, patients underwent e-FAST every morning for seven days (defined as D-EFAST) and, for those with positive findings, immediate CT or surgery was performed to clarify the diagnosis. 76 patients participated in the study. The overall sensitivity of the e-FAST scanning technique for pneumothorax, pleural effusion, splenic injury, liver injury, gastrointestinal injury, pericardial effusion, and bladder rupture was 75.9% (66/87) and the specificity was 98.3% (587/597), the positive predictive value was 86.8% (66/76) and the negative predictive value was 96.5% (587/608), the hit rate was 95.5% (653/684) and the missed diagnosis rate was 24.1% (21/87). Most late injuries in polytrauma patients occurred 2-7 days after the injury with an incidence of 4.8% (33/684). The diagnostic sensitivity of D-EFAST for late injury was 98.3% (118/120), specificity was 99.8% (563/564), positive predictive value was 99.2% (118/119), the negative predictive value was 99.6% (563/565), the diagnostic accuracy rate was 99.6% (681/684), and the missed diagnosis rate was 1.7% (2/120). When the final clinical diagnosis was defined as the gold standard, the D-EFAST technology for detection rate was 98.3% (118/120) for patients with multiple trauma in organ damage, while the detection rate of e-FAST was 75.9% (66/87), with a statistically significant difference ($P < 0.01$), indicating that D-EFAST was better than e-FAST in checking polytrauma patients with organ damage. While e-FAST technology can quickly diagnose polytrauma patients and gain rescue time for critically ill patients, polytrauma patients injured after 2-7 days are prone to late damage and difficult to detect, while D-EFAST can be used to find damage earlier and reduce the rate of misdiagnosis of patients with multiple trauma [9].

In Nepal, a study was conducted to evaluate the accuracy of e-FAST for thoracic and abdominal injuries. All trauma patients who had an injury severity score ≥15 or direct trauma to the trunk at Dhulikhel-Kathmandu University Hospital were included. The e-FAST results were then compared with contrast-enhanced CT (CECT), radiological ultrasonography (USG)/chest X-ray, or intraoperative findings when e-FAST was positive. Of the 267 cases, 261 patients

underwent the e-FAST exam. Sensitivity and specificity were 94.8% and 99.5%, respectively. The negative predictive value was 98.53%, while the positive predictive value was 98.21%. Overall accuracy was 99.4%. The e-FAST showed high specificity (99.5%) and positive predictive value (98.21%), which indicates that it is an effective technique for detecting intra-abdominal or thoracic injuries. However, the effectiveness of e-FAST is limited by operator dependence and therefore by human error. For negative e-FAST cases, we recommend a monitoring period of at least four hours, serial rapid scan or further investigation by other methods such as CECT [10].

In another study of the diagnostic accuracy of the e-FAST assessment to detect thoracoabdominal trauma, keeping CT of the chest and abdomen with contrast as the gold standard, performed at the Combined Military Hospital, Quetta. A total of 196 patients, aged 18 to 60 years, of both genders, referred for contrast-enhanced chest and abdomen computed tomography were included in the study. The patients were first submitted to a chest and abdomen ultrasound and then to a contrast-enhanced chest and abdomen computed tomography scan. Findings from both modalities were recorded and submitted to statistical analysis to confirm the accuracy of ultrasound, considering computed tomography as the gold standard procedure. Blunt trauma was observed 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 it was 77.1%, 95.9%, 85.9%, 92.8% and 91.3%, respectively. The results indicate that e-FAST has good diagnostic accuracy for thoracic, abdominal and thoracoabdominal trauma and can be incorporated into the routine assessment of trauma patients[11].

Another study evaluated the contribution of e-FAST in the management of blunt thoracic and abdominal trauma in the emergency and intensive care units of the Centro Hospitalar Universitário de Parakou. 63 patients were analyzed and the e-FAST was positive in 50.79% of the patients. Five patients (7.93%) received emergency treatment due to hemodynamic instability and positive e-FAST in a mean of 3.46 ± 2 hours. Eighteen patients (27.58%) underwent surgery in nine hours and 12 minutes (hemoperitoneum) and 27 hours and 58 minutes (hemothorax), after monitoring by e-FAST. The authors concluded that the introduction of an e-FAST ultrasound as a screening tool in a resource-limited setting is desirable and feasible[12].

In Iran, a cross-sectional study was performed evaluating trauma patients with abdominal or blunt chest trauma and for whom e-FAST was performed. 115 patients were examined. The correlation coefficient between the possibility of hemorrhagic shock, pneumothorax, hemoperitoneum, solid organ injury and hemothorax before and after E-FAST based on the Kappa criteria was 0.803, 0.642, 0.430, 0.331 and 0.318, respectively, showing that the performing e-FAST increases the sensitivity of the history and physical examination in the diagnosis of pneumothorax, hemoperitoneum, damage to solid organs and hemothorax[13].

In Europe, few studies were found on the use of e-FAST by emergency physicians. One study compared the diagnostic accuracy of the E-FAST scan at 132 for abdominal scans and 130 for chest scans. Sensitivity was 42.9% and specificity 98.4% [7]. The results indicate that the e-FAST test has excellent specificity. However, the sensitivity of the test is not high enough to rule out thoracoabdominal injuries in trauma patients when performed by emergency physicians [14].

Table 1 illustrates the sensitivity and specificity of the main traumas such as pneumothorax, pericardial effusion, intra-abdominal fluid and hemothorax described in previous studies, as well as the calculated average.

	Pneumotórax		Derrame Pericárdio		Liq. Intra-abdominal		Hemotórax	
Autor	Sens	Esp	Sens	Esp	Sens	Esp	Sens	Esp
Netherton et al. 2019	69,0	99,0	91,0	94,0	74,0	98,0	-	-
Ianniello et al, 2014	77,0	99.8	-	-	-	-	-	-
Ianniello et al, 2019	81,8	-	-	-	54,5	-	71,0	-
Basnet et al, 2020	75,9	98,3	75,9	98,3	-	-	-	-
Média	**75,8**	**99,0**	**83,5**	**96,2**	**64,3**	**98,0**	**71,0**	

Table 1. Shows the sensitivity and specificity of the main traumas such as pneumothorax, pericardial effusion, intra-abdominal fluid and hemothorax. Sens – sensitivity; – specificity

Figures 2 and 3 illustrate ultrasound images using the E-fast method in a case of hemoperitoneum and pneumothorax, respectively [9].

Figure 2. Ultrasonographic image of the upper right quadrant of the abdomen, showing an anechoic image suggestive of hemoperitoneum between the liver and kidney, in an abdominal trauma. (courtesy Basnet et al [9])

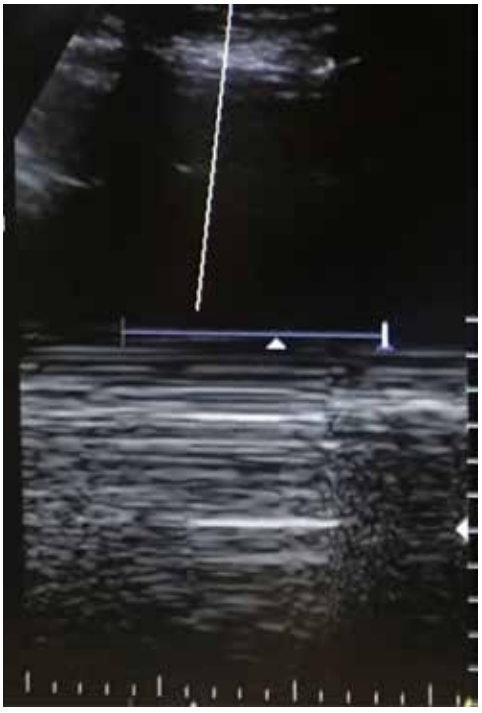

Figure 3 . Ultrasound image of the anterior thorax using the M-mode with identification of the "bar code" sign suggestive of pneumothorax. (courtesy Basnet et al [9])

CONCLUSION

The main advantages of the method is that the diagnosis is fast, accurate, safe, without radiation effects with good sensitivity and specificity. Its main disadvantage is that it is operator dependent.

The overall sensitivity of the e-FAST examination technique (pneumothorax, pleural effusion, spleen injury, liver injury, gastrointestinal injury, pericardial effusion, intra-abdominal free fluid, and bladder rupture ranged from 69% to 99% in its sensitivity

The specificity was on average 98%, the positive predictive value was on average 92% and the negative predictive value was 98%, the accuracy rate was on average 98% among the evaluated studies. Therefore, e-Fast can be incorporated into the routine assessment of trauma patients.

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