Available online at www.medicinescience.org

REVIEW ARTICLE

Medicine Science International Medical Journal

Medicine Science 2021;10(3):1069-74

Approach of focused assessment with sonography in trauma in primary survey

Adel Hamed Elbaih[1,2], Abdelrahman Gamal Hassan[2]

[1]Suez Canal University, Faculty of Medicine, Department of Emergency Medicine, Ismailia, Egypt
[2]Emergency Medicine, Sulaiman Al-Rajhi University, Clinical Medical Science, College of Medicine, Saudi Arabia

Received 12 January 2021; Accepted 28 January 2021
Available online 15.08.2021 with doi: 10.5455/medscience.2021.01.05

Abstract

Focused Assessment with Sonography in Trauma (FAST) is a significant point of care examination predominantly used by emergency physicians and trauma surgeons to identify free intraperitoneal, intrathoracic, or pericardial fluid. a role of FAST is important as portable, inexpensive, free of ionizing radiation, and allows the health professional to perform assessments quickly and repeatedly to obtain diagnostic data on the bedside. So that's why FAST examination should become widespread. Therefore, we aim to look into FAST for both medical students and new physicians face in the recognition, diagnosis and management of primary survey in trauma patients. FAST newly as a part of primary survey requiring urgent tools in trauma in the ER, So Emergency Physicians need teaching protocol of FAST. So, the aim of the study is appropriate approach of FAST by training protocol to Emergency Physicians. Based to practice gap for preventive death and adverse long-term complications of major trauma. Collection of all possible available data about the FAST with trauma at the emergency department. By many research questions to achieve these aims so a midline literature search was performed with the keywords “critical care”, “emergency medicine”, “FAST principals in different emergencies", "cardiac arrest”. Literature search included an overview of recent definition, causes and recent therapeutic interventions strategies. Most of studies revealed; initial diagnosis of different emergencies cases depend on FAST also the interventions therapy in serious conditions that face patients and physicians at the emergency departments maybe by FAST guided. FAST is considered one of adjunct tools in primary survey for critical ill patients. so FAST is a conventional diagnostic test performed on trauma patients and incorporates pericardium evaluation, looking for hemopericardium and tamponade, and looking for intraperitoneal free fluid from the right flank, left flank, and pelvis.

Keywords: Fast, emergency physicians, skill approach

Introduction

Traumatic injuries can range from minor, isolated cuts and bruises to complex, multi-organ system injuries. All trauma patients need a systematic treatment plan to optimize results and reduce the likelihood of unexposed injuries. This approach is early identification and treatment of life-threatening conditions as an integral part of process. Unfortunately, however, history and physical examination indicated a poor sensitivity and specificity for the proper diagnosis of internal bleeding, which in traumatized patients is one of the leading causes of morbidity and mortality. Since then, ultrasonography has acquired an increasingly important role in the trauma patient assessment [1].

The focused assessment with sonography in trauma (FAST) is a significant point of care examination predominantly used by emergency physicians and trauma surgeons to identify free intraperitoneal, intrathoracic, or pericardial fluid. In 1996 the term "Focused Abdominal Sonography for Trauma" was coined to describe a standard set of ultrasound evaluations for assessing traumatized patients. The meaning of the acronym was changed a year later to Focused Assessment with Sonography for Trauma (FAST), to reflect applications beyond the abdomen [2].

The FAST ultrasound scan is a validated and beneficial procedure for assessing trunk for bleeding following traumatic injury, especially blunt trauma, and it could also be helpful in penetrating trauma. The evaluation for the detection of free intraperitoneal fluid has been shown to be both sensitive and specific. However, it is important to remember that the FAST exam is a screening test, and false-negative results do occur. False-positive tests can also be observed in patients with an ascites history. Until its implementation, the assessment of such patients involved more invasive procedures, such as diagnostic peritoneal lavage and even sometimes laparotomy [3].

***Corresponding Author:** Adel Hamed Elbaih, Suez Canal University, Faculty of Medicine, Department of Emergency Medicine, Ismailia, Egypt. E-mail: elbaihzico@yahoo.com

Today, other valuable sonographic views are integrated into FAST in the assessment of the trauma patient, as for rapid assessment of the chest for pneumothorax detection (extended FAST [eFAST]). Evidence demonstrates that ultrasonic imaging is even more sensitive to pneumothorax than radiography of the supine plain-film chest. There's also some proof that FAST can be helpful in assessing solid-organ injury and in triage of multiple or mass incidents of casualties. Ultimately, some specialists integrate inferior vena cava (IVC) assessments into the FAST technique to help evaluate the volume status and fluid response of a patient [4].

Scope of The Problem and Rational to this Research skill topic

Trauma is a major national cause of morbidity and mortality. Traffic accidents are indeed the leading cause of death globally seen between ages of 18 and 29, whilst also trauma is the leading cause of death for young American adults and accounts for ten per cent of all deaths among males and females [5].

Every year more than 45 million people worldwide experience mild to serious impairment following trauma. Over 50 million patients expect some form of trauma-related hospital treatment annually in the United States alone, and trauma contributes to about 30 per cent of all admissions to the intensive care unit (ICU). In 2014, road traffic accidents accounted for 1.25 million deaths, as per World Health Organization (WHO), and trauma is predicted to rise to the third leading cause of disability worldwide by 2030. Cases of severe traumatic injuries, however, have a substantially lower probability of death or disability (10.4 versus 13.8 percent; relative risk [RR] 0.75, 95 percent CI 0.60-0.95) once treated in a dedicated trauma center [6].

Within early trauma research, the idea of "golden hour," which stressed the elevated risk of mortality and the need for urgent action within the first hour of caring after severe trauma, was identified and promulgated throughout reference books and instructional courses. There are certainly cases where the outcome of trauma patients changes with quick intervention. Here is where the role of FAST exam glows as portable, inexpensive, free of ionizing radiation, and allows the health professional to perform assessments quickly and repeatedly to obtain diagnostic data on the bedside. Since every condition or injury cannot be detected using the FAST examination in the management of the traumatic event patient, obedience to control guidelines would then optimize the likelihood of first detection of free fluid, hemorrhage, and other abnormal fluids, such as urine and bile, in the intimately trauma patients. The FAST examination facilitates besides assessment of the potential hemopericardium, hemothorax, pneumothorax, solid-organ damage, and retroperitoneal injury in its extended form [7].

Ultrasonic machinery primed for portability enables the FAST examination to be included in the patient's bedside and in the rapid triage of numerous individuals in mass casualty circumstances, as well as field assessments. Mostly as direct consequence, an increasing number of emergency medicine residency programs have integrated comprehensive US courses into their curriculum, further enhancing their position in emergency medicine practice [8].

Personnel of emergency medical services have been using FAST for those kind of purposes at many places worldwide. The importance of the FAST exam in the acutely injured patient should be expanded with improved technology and resolution of the sonography. Finally, this descriptive study aims to highlight the importance of FAST examination in trauma patients and to help undergraduate medical students to have an overview on the basic skills and performance of a FAST examination [9].

Methodology

This section includes Collection of all possible available data about the FAST with trauma at the emergency department in 2020. By many research questions to achieve these aims so a midline literature search was performed with the keywords “critical care”,“emergency medicine”,“FAST principals in different emergencies","cardiac arrest” within recent articles after 2015 scanned from the databases.

Literature search included an overview of recent definition, causes and recent therapeutic interventions strategies.

a role of FAST is important as portable, inexpensive, free of ionizing radiation, and allows the health professional to perform assessments quickly and repeatedly to obtain diagnostic data on the bedside. So that's why FAST examination should become widespread. So aims of the study is initial assessment and evaluate of FAST for both medical students and new physicians face in the recognition, diagnosis and management of primary survey in trauma patients; with cardiac arrest to recognize potentially life-threatening conditions and to convey life-saving treatment so the key note here is that initial diagnosis in suspected cases with rapid emergency interventions.

Indications, Contraindication and Limitations.

FAST test indications are essentially to examine the trunk for signs of abnormal free fluid that implies damage to the peritoneal, pericardial, and pleural cavities. The spectrum of the conventional FAST test has now extended (eFAST) to also determine the existence of pneumothorax in the lungs. There have been no absolute contraindications, but if it is apparent that the patient needs emerging surgical intervention, therefore there might be a relative contraindication to perform the test. Before transferring a patient to the operating room for emergency laparotomy it may be necessary to exclude pericardial tamponade or pneumothorax [10].

Usually observed intraperitoneal in patients with ventriculoperitoneal shunts, those undergoing peritoneal dialysis, and those performing recent peritoneal lavage, one needs to be careful of free fluid. Free fluid in patients who are suffering from polycystic disease may be difficult to classify. Mostly in traumatized patient, ultrasound also might be technically difficult due to bowel gas, obesity, subcutaneous emphysema, patient positioning, extent of damage and bleeding rate, adhesions from previous surgery, and often in patients who either are in pain- or combative secondary to major trauma. The key drawback of the FAST exam is that the operator must be familiar with its clinical application, and be aware that it never excludes all traumatic injuries [11].

Limitations to hemopericardium pericardial assessment involve pericardial fat pads, cysts and previously existing pericardial fluid. Shortcomings to hemothorax pleural assessment involve pleural fluid from previously established pleural disease, as well as the

extension of fluid from the pericardium or peritoneum into pleural space [12].

Lastly, shortcomings in the pneumothorax evaluation include main-stem bronchus intubation, inability to identify lung pulse (subtle cardiac pulsation of parietal pleura at the lung periphery) as cardiac mediated activity, patients following pleurodesis, and patients with serious chronic obstructive pulmonary disease or other lung disease that prevents sufficient visualization of lung sliding. Although sensitivity for tracing of pneumothorax is very high, it is important to highlight the fact that small apical or localized pneumothoraxes might not be visualized despite of a focused thoracic ultrasonic examination [13].

WHY this study is necessary?

The role of FAST is important as portable, inexpensive, free of ionizing radiation, and allows the health professional to perform assessments quickly and repeatedly to obtain diagnostic data on the bedside. So that's why FAST examination should become widespread. The FAST exam provides guidance on further evaluation or testing, treatment planning, and therapeutic procedures quickly to assist in decision-making. Rapid provision and interpretation of certain testing methods is crucial to proper patient treatment. In life-threatening conditions medical health intervention will still take priority over these parameters.

Focused Assessment with Sonography for Trauma "FAST"

Techniques constantly evolve, just like most imaging and ultrasound examinations, alongside increased clinical and imaging experience. The abdominal part of the test is directed at examining the free fluid in peritoneal cavity. That requires both the 4 quadrants of the abdomen and the pelvis to be examined. The capacity to identify free fluid in the pelvis is supported by the involvement of a bladder filled with fluid. Like in other ultrasonic tests, orthogonal images (transverse, longitudinal, and coronal planes) tend to elucidate areas of concern found on every particular plane, and all areas of interest will be scanned using a sweeping motion in each plane entirely. Minor differences in the angle and position of the transducers can enhance the analysis of a particular area. Images can be collected in the analyzed areas by means of anterior, coronal, or other approaches to signify free fluid. Classically, the primary test on FAST involves the heart's subxiphoid window to reveal pericardial fluid. Whenever pericardial fluid is present, cardiac views must also be used to assess for tamponade existence (Figure 1) [15].

Basic Views of FAST Examination

The use of multiple views greatly increases the sensitivity of the FAST examination.

1. Morison's pouch: This zone is the main view for blunt trauma assessment with US. While this landmarks are easy to recognize, this view is accessed in only 10 seconds with the probe positioned on the 11th–12th intercostal space in the mid-posterior axillary line just under the nipple line. The hepat is regarded as a stable homogeneous tissue, with its corresponding kidney. Morison's pouch, the gap seen between organs, is a potential space which can fill with fluid. Free fluid acts as an anechoic (black) line in the region (Figures 2 and Table 1). The amount of free fluid capable of filling Morison 's pouch varies but it can be traced in as little as 250 ml. Hyperechoic (white or gray) zones around the kidney are natural perinephric fat not to be mistaken with free fluid. Placing the patient in reverse Trendelenburg will boost ultrasound sensitivity in patients with lower concentrations of hemoperitoneum, by making the upper quadrants of the abdomen more focused. After inspecting Morison's pouch, lean the probe more cephalad over and check the diaphragm to search for fluid up or down to it. Pleural fluid over the diaphragm may look anechoic or black (Figure 3). Hemothoraces can be trustworthily spotted with training [16].

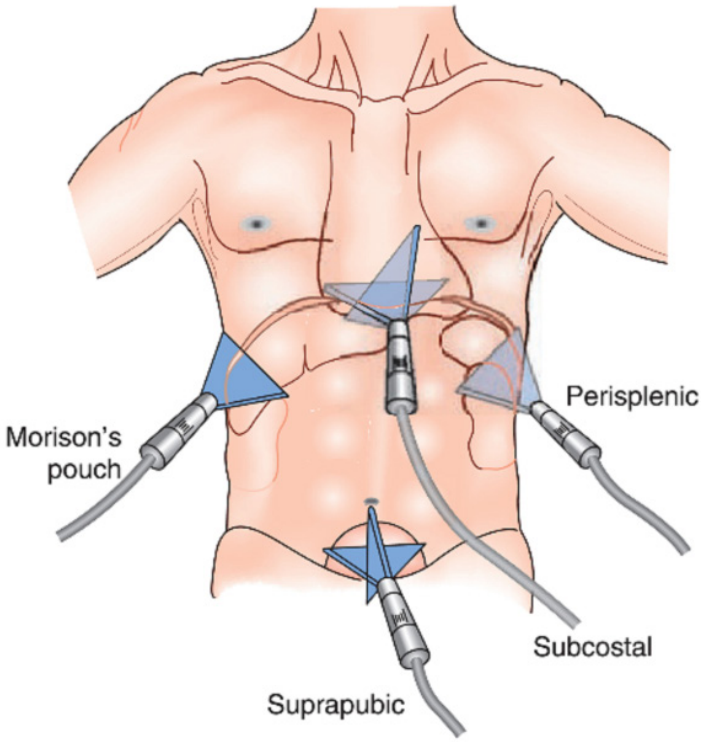

Figure 1. Probe Placement for FAST

View	Transducer position	Findings	Pitfalls
Morison's pouch	Between 11th and 12th ribs mid-axillary line with indicator toward right axilla (coronal plane)	Hemoperitoneum Hemothorax	Avoid excessive rib shadows by rotating probe so it is parallel to ribs
Perisplenic view	Between 10th and 11th ribs in posterior-axillary line with indicator toward left axilla (coronal plane)	Hemoperitoneum Hemothorax	Probe needs to be more cephalad and posterior than the right upper quadrant view; look above the spleen for fluid collections
Suprapubic view	Just superior to pubic bone and tilted caudally	Hemoperitoneum	Probe needs to be angled caudally, turn down gain which may obscure small amounts of fluid
Subxiphoid view	Subxiphoid region with probe under the xiphoid process and directed toward left shoulder (coronal plane)	Hemopericardium Pericardial tamponade	Increase US depth on this view, more pressure is often required; scan in the coronal plane

Table 1. Documentation Performance of FAST Examination

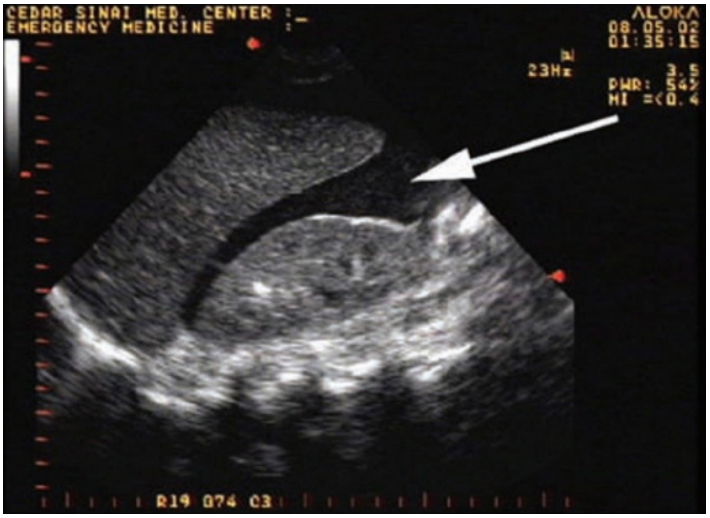

Figure 2. Positive Morison's pouch

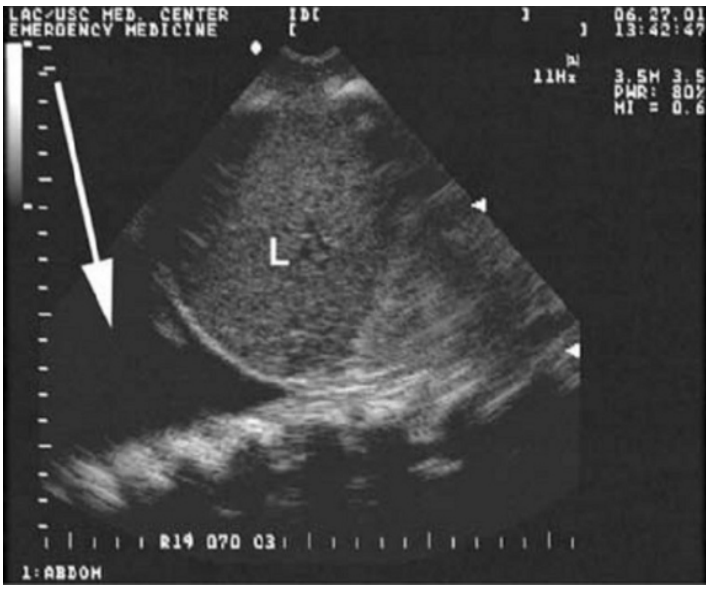

Figure 3. Right pleural effusion

2. Peri-splenic view: To get this view, place the transducer at the 9th–11th intercostal space on the posterior axillary line. A typical error is indeed inadequate posterior positioning of the probe. Once the kidney is located, angle the probe to visualize the spleen slightly to cephalad. Carefully look for the free fluid surrounding it When the spleen and kidney are screened in full, angle the probe more cephalad to check above and below the diaphragm, finding fluids [17].

3. Suprapubic view: Preferably this test is conducted before the Foley catheter is mounted, since the full bladder creates an acoustic window for small volumes of free fluid posterior to the bladder. With the probe located barely cephalad to the pubis it is clearly viewed. The bladder is represented as a collection of fluids showing up as a well-circumcised anechoic region . If the bladder has been located, search for anterior, posterior, and lateral free fluid (Figure 4). The uterus is witnessed posterior to the bladder in female patients. The rectouterine pouch (Douglas pouch) is a very sensitive region of the peritoneal cavity and should be closely checked for tiny amounts of free fluid [18].

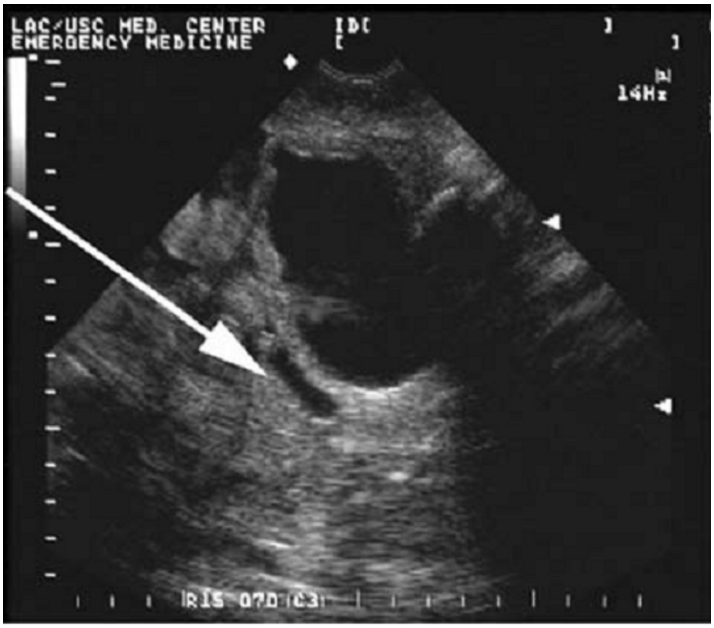

Figure 4. Positive suprapubic view

4. Pericardium: In patients with penetrating thoracic trauma, it is especially important to examine the pericardium since it can comprise asymptomatic pericardial effusions. For this view, put the probe just underneath the xiphisternum in the subcostal zone, and angle it to the left shoulder of the patient. In this sight, increasing the depth of ultrasonographic penetration for better visualization of the heart. The inspector normally gets a clear four chamber view of the heart from a coronal section of the heart (Table 2). The normal pericardium is seen as an acutely surrounding hyperechoic (white) line to the heart. A pericardial effusion is outlined as an anechoic field inside the pericardium that covers the heart (Figure 5). For verification, obtain a sagittal view, since in this view pulmonary effusions can be perplexed with pericardial effusions. For patients with heart-proximal penetrated injuries, FAST examination must then begin with the pericardial view (focused echocardiography) to identify a potential life-threatening pericardial effusion arising from a heart injury [19].

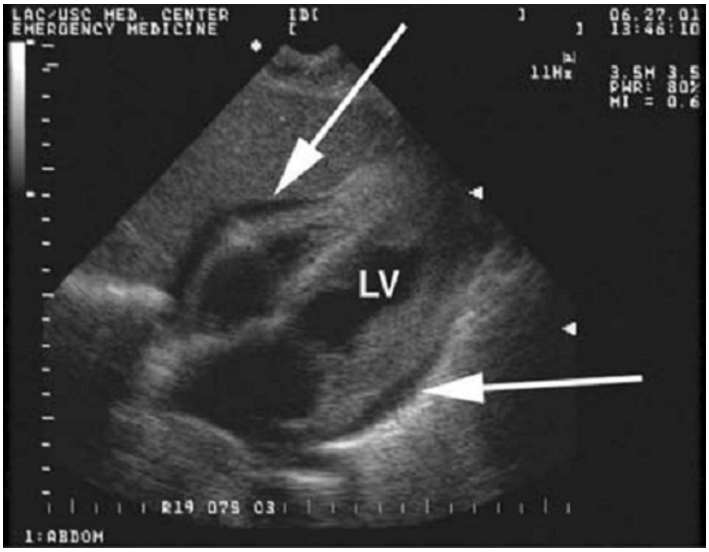

Figure 5. Pericardial effusion

Overall eFAST image optimisation (depth, gain, TGC, focus, use of Lung/Cardiac transducers & presets)	0 (FAIL) Suboptimal image quality or inappropriate transducers/presets	1 (PASS) Optimizes image quality but required minor prompting	2 (PASS) Optimizes image quality appropriately with confidence
RUQ view – Demonstration of kidney, liver, diaphragm, pleural space	0 Incomplete demonstration or incorrect scan planes	1 Structures demonstrated but unsystematic approach or minor corrections required	2 Systematic approach & correct scan planes demonstrating all structures
LUQ view – Demonstration of kidney, spleen, diaphragm, pleural space	0 Incomplete demonstration	1 Structures demonstrated but unsystematic approach or minor corrections required	2 Systematic approach & correct scan planes demonstrating all structures
PELVIC view – Demonstration of bladder, uterus/prostate, rectum, POD	0 Incomplete demonstration	1 Structures demonstrated but unsystematic approach or minor corrections required	2 Systematic approach & correct scan planes demonstrating all structures
SUBXIPHOID/PLAX/APICAL views – Demonstration of pericardium	0 Incomplete demonstration	1 Structures demonstrated but unsystematic approach or minor corrections required	2 Systematic approach & correct scan planes demonstrating all structures
Chest Views – Demonstration of RT & LT lung sliding with M-mode acquisition	0 Incomplete demonstration	1 Structures demonstrated but unsystematic approach or minor corrections required	2 Systematic approach & correct scan planes demonstrating all structures
Overall EFAST scan documentation (protocol EFAST image series & M-mode traces)	0 Inadequate EFAST image series	1 Some minor corrections to EFAST image series or M-mode	2 Confidently acquires EFAST image series & M-mode
Interpretation of sonographic appearances (describes abnormal features & locations expected for each view)	0 Unable to describe/interpret ultrasound appearances correctly	1 Correct but some hesitancy describing/ interpreting appearances	2 Correct and confident description/ interpretation of sonographic appearances

Table 2. Assessment Checklist for Performance of FAST Examination

Documentation

As for all sonograms, FAST sonograms need proper documentation. Images should be produced and preserved as part of the medical record when possible, and a thorough explanation and analysis of the findings is provided. Evaluation of the FAST test results is confined to those same areas evaluated and visualized. A FAST examination, in fact, may not permit the detection of all abnormalities in the chest, abdomen or pelvis (Table 1).

Summary and Recommendations

• Ultrasound is portable, affordable, free of radiation exposure, which allows the clinician to conduct assessments efficiently and continuously in order to gain diagnostic information at bedside. While few randomized controlled trials have been conducted, several prospective observational researches demonstrated that ultrasound offers reliable and valuable data for the clinician conducting the adult patient 's initial examination of abdominal or chest trauma.

• The Focused Assessment with Sonography for Trauma (FAST) is a conventional diagnostic test performed on trauma patients and incorporates pericardium evaluation, looking for hemopericardium and tamponade, and looking for intraperitoneal free fluid from the right flank, left flank, and pelvis. In certain occasions an extended pneumothorax (E-FAST) assessment is carried out. The FAST test is more effective when it is positive, where this circumstance it reduces the amount of time needed for definite intervention. Limited sensitivity, especially in traumatic penetration, hinders further use of ultrasound as a conclusive instrument to address negative intraabdominal or intrathoracic injury. Repeat checkups improves the sensitivity of ultrasound.

• Ultrasound is not capable of recognizing diaphragmatic tears, pancreatic lesions, bowel perforation, mesenteric trauma, and small amounts of free fluid (typically < 200 mL) that may be injurious. The potential of ultrasound to detect kidney injuries is restricted, but it cannot differentiate urine from blood, which in pelvic trauma greatly reduces its sensitivity and specificity.

• Hemodynamically stable patients with an ambiguous injury mechanisms or physical findings are assessed with extra imaging techniques (most often CT) or monitoring periods along with some combined application of serial physical and ultrasonic examinations.

• Each of the essential assessment views involved in the FAST examination and their interpretation is described in the text (Table 2).

Conflict of interests
The authors declare that they have no competing interests.

Financial Disclosure
The financial support no have.

References

1. Cormack C, Lavender I, Coombs P, et al. Sonographer credentialing in extended focused assessment by sonography in trauma (eFAST). Sonograph.2019;6;2:50-5.
2. Elbaih A, Abu-Elela S. Predictive value of focused assessment with sonography for trauma (FAST) for laparotomy in unstable polytrauma Egyptians patients. Chin J Traumatol. 2017;20,323-8.
3. Elbaih A, Ali M, Attia Y. Accuracy of predictive factors and focused assessment with sonography for trauma (fast) in management of adult blunt abdominal trauma and its outcome. Int J Surg Med. 2016;2,52-8.
4. Krause C, Krause R., Krause R, et al. Effectiveness of a 1-Hour Extended Focused Assessment with Sonography in Trauma Session in the Med Stude Surg Clerkship Surg. 2020;3;2-34.
5. Cohen H, Langer J, McGahan J. AIUM Practice Guideline for the Performance of the Focused Assessment with Sonography for Trauma (FAST) Examination. J Ultrasound Med. 2015;33:2047-56.
6. Elbaih AH, Housseini AM. Validity of shock index, modified shock index, central venous pressure, and inferior vena cava collapsibility index in evaluation of intravascular volume among hypovolemic Egyptian patients. American J Of Diagnostic Imaging. 2018;4;1:5-13.
7. Taha M, Elbaih A. Review Article, Pathophysiology and management of different types of shock. NMJ. 2017;6:14-39.
8. Stewart R, Brasel K, Henry S. Advanced Trauma Life Support® Student Course Manual (10th ed.). 2018; Chicago: American College of Surgeons.
9. Elbaih AH. Different Types of Triage. Arşiv Kaynak Tarama Dergisi. Archives Med Review J. 2017;26:441–67.
10. Elbaih AH, Basyouni FH. Teaching Approach of Primary Survey in Trauma Patients. Int J Intern Emerg Med. 2020;3:1035.
11. Mahadevan S, Garmel G. An introduction to clinical emergency medicine (1st ed.). Cambridge: 2015;Cambridge University Press.
12. Pariyadath, M, Snead, G. Emergency ultrasound in adults with abdominal and thoracic trauma. Retrieved from. https://www-uptodate-com.ezproxy.ub.unimaas.nl/contents/emergency-ultrasound-in-adults-with-abdominal-and-thoracic-trauma?search=primary%20survey&topicRef=13854&source=see_link. 2020.
13. Poland S, Frey J, Khobrani A, et al. Telepresent Focused Assessment with Sonography for Trauma Examination Training Versus Traditional Training for Medical Students: A Simulation-Based Pilot Study. J Ultrasound In Med. 2018;37:1985-92.
14. Raja A, D Zane R.: Initial management of trauma in adults. Retrieved from https://www-uptodate-com.ezproxy.ub.unimaas.nl/contents/initial-management-of-trauma-in-adults?search=primary+survey&source=search_result&selectedTitle=1%7E58&usage_type=default&display_rank=1. 2020.

15. Elbaih AH, Housseini AM, Khalifa ME. Accuracy and outcome of rapid ultrasound in shock and hypotension (RUSH) in Egyptian polytrauma patients. Chinese J Traumatol. 2018;21:156-162.

16. Elbaih AH, Abu-Elela ST. Patterns and outcome of missed injuries in Egyptians polytrauma patients. Int J Surg Med. 2018;4:13-21.

17. Elbaih AH, El-sayed DA, Abou-Zeid AE, et al. Patterns of brain injuries associated with maxillofacial fractures and its fate in emergency Egyptian polytrauma patients. Chinese J Traumatol. 2018;21:287-92.

18. Elbaih AH. Resuscitation of polytrauma patients: an overview. Narayana Med J.2016;5:126-40.

19. Tintinalli J, Ma O, Yealy D, et al. Tintinalli's emergency medicine (9th ed.). [New York]: McGraw-Hill Education.2020;23-45.