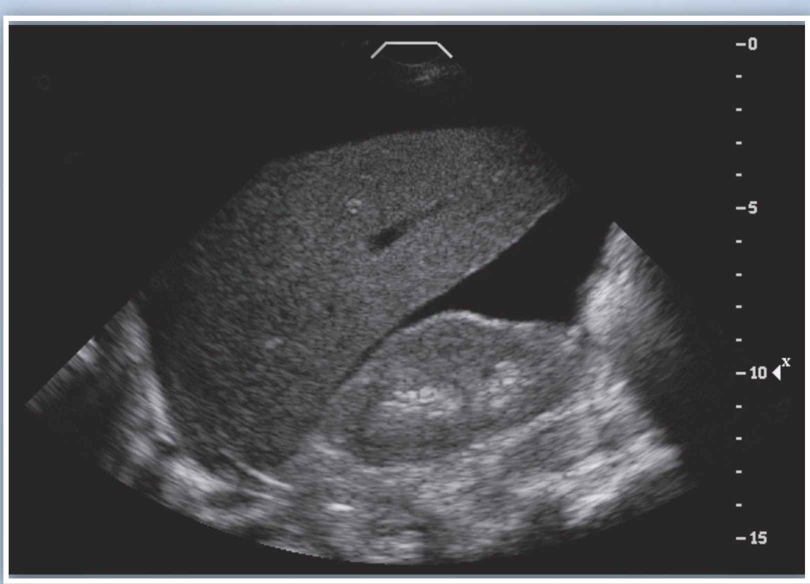
AIUM Practice Parameter for the Performance of the

Focused Assessment With Sonography for Trauma (FAST) Examination

Parameter developed in collaboration with the American College of Emergency Physicians (ACEP).



The association for medical ultrasound
aium
AMERICAN INSTITUTE OF ULTRASOUND IN MEDICINE

The American Institute of Ultrasound in Medicine (AIUM) is a multidisciplinary association dedicated to advancing the safe and effective use of ultrasound in medicine through professional and public education, research, development of parameters, and accreditation. To promote this mission, the AIUM is pleased to publish, in conjunction with the American College of Emergency Physicians (ACEP), this *AIUM Practice Parameter for the Performance of the Focused Assessment With Sonography for Trauma (FAST) Examination*. We are indebted to the many volunteers who contributed their expertise, effort, and enthusiasm to complete this project.

The AIUM represents the entire range of clinical and basic science interests in medical diagnostic ultrasound, and with hundreds of volunteers, the AIUM has promoted the safe and effective use of ultrasound in clinical medicine for more than 50 years. This document and others like it will continue to advance this mission.

Practice parameters of the AIUM are intended to provide the medical ultrasound community with parameters for the performance and recording of high-quality ultrasound examinations. The parameters reflect what the AIUM considers the minimum criteria for a complete examination in each area and are not intended to establish a legal standard of care. AIUM-accredited practices are expected to generally follow the parameters with the recognition that deviations from the parameters will be needed in some cases depending on patient needs and available equipment. Practices are encouraged to go beyond the parameters to provide additional service and information as needed by their referring physicians and patients.

The association for medical ultrasound
aium
AMERICAN INSTITUTE OF ULTRASOUND IN MEDICINE

14750 Sweitzer Ln, Suite 100
Laurel, MD 20707-5906 USA
800-638-5352 • 301-498-4100
www.aium.org

I. Introduction

The clinical aspects of this parameter (Indications/Contraindications, Specifications for Individual Examinations, and Equipment Specifications) as well as Responsibilities of the Physician were developed collaboratively by the American Institute of Ultrasound in Medicine (AIUM) and the American College of Emergency Physicians (ACEP). Recommendations for physician qualifications, procedure documentation, and quality control may vary between these organizations and are addressed by each separately.

This parameter has been developed to provide assistance to practitioners performing focused assessment with sonography for trauma (FAST) ultrasound examinations. The FAST ultrasound examination is a proven and useful procedure for the evaluation of the torso for bleeding after traumatic injury, particularly blunt trauma, but it may also be helpful in penetrating injury. The examination has been shown to be both sensitive and specific in the identification of free intraperitoneal fluid. It is important to note, however, that the FAST examination is a screening test, and false-negative examinations do occur. False-positive examinations may also be encountered in patients with a history of ascites. Before its development, more invasive procedures were required to evaluate these patients, including diagnostic peritoneal lavage and at times laparotomy. Over the last 3 decades, particularly with its widespread growth in the early 1990s, the FAST examination has evolved to now include assessments of the peritoneal cavity as well as analysis of the pericardium and pleural spaces for hemorrhage, particularly in cases of chest trauma. Today, other useful sonographic views in evaluating the trauma patient are incorporated into FAST, including the rapid evaluation of the chest for detection of pneumothorax (extended FAST [eFAST]). Evidence indicates that ultrasound imaging is more sensitive for pneumothorax than supine plain-film chest radiography. There is also evidence that FAST may be useful in the evaluation of solid-organ injury and in the triage of multiple or mass casualty incidents. Finally, some clinicians incorporate inferior vena cava (IVC) evaluation into the FAST examination to help determine a patient's volume status and fluid responsiveness.

Although it is not possible to detect every abnormality or injury using the FAST examination in the management of the traumatized patient, adherence to the following parameter will maximize the probability of first detecting free fluid, hemorrhage, and other abnormal fluids, such as urine and bile, in the acutely injured patient. In its extended form, the FAST examination allows analysis for possible hemopericardium, hemothorax, pneumothorax, solid-organ damage, and retroperitoneal injury. The ready portability of ultrasound equipment allows the FAST examination to be used at the patient's bedside or in the rapid triaging of multiple individuals in mass casualty situations, including assessments in the field. Emergency medical services personnel have begun to use FAST in several locations worldwide for these purposes. With improving technology and imaging resolution, the role of the FAST examination in the acutely injured patient should expand. The use of ultrasound in a particular institution or setting must be based on access to equipment and appropriately trained personnel and should be subject to an organized quality assurance program.

II. Indications/Contraindications

Indications for the FAST examination are primarily to evaluate the torso for evidence of traumatic free fluid suggestive of injury in the peritoneal, pericardial, and pleural cavities (ACEP guidelines). The scope of the traditional FAST examination has now expanded (eFAST) to also evaluate the lungs for the presence of pneumothorax. There are no absolute contraindications, although if it is clear that the patient requires emergent surgical intervention, then a relative contraindication to performing the examination may exist. However, it may be necessary to exclude pericardial tamponade or pneumothorax before transferring a patient to the operating room for emergency laparotomy.

There are limitations to FAST assessments, including limitations in their ability to detect free fluid in some injured children, patients with mesenteric, diaphragmatic, or hollow viscous injury, and patients with isolated penetrating injury to the peritoneum. The FAST examination is also limited in identifying retroperitoneal hemorrhage, although injuries can at times be seen. The potential false-positive diagnosis of free traumatic fluid in the peritoneum may be due to fluid present in patients for physiologic reasons, including ovarian cyst rupture, as well as pathologic reasons, such as patients with ascites or inflammatory processes in the abdomen or pelvis. One must be wary of free fluid typically found intraperitoneally in patients with ventriculoperitoneal shunts, in those who undergo peritoneal dialysis, and in those after recent peritoneal lavage. It can be difficult to identify free fluid in patients with severe polycystic disease. Ultrasound may also be technically limited in the traumatized patient due to bowel gas, obesity, subcutaneous emphysema, patient positioning, the degree of injury and rate of bleeding, adhesions from prior surgery, and often in patients who are either in pain or combative secondary to traumatic injury. The main limitation of the FAST examination is that the operator must be knowledgeable in its clinical use and be aware that it does not exclude all injuries.

Limitations to the pericardial assessment for hemopericardium include pericardial fat pads, cysts, and preexisting pericardial fluid. Limitations to pleural assessment for hemothorax include pleural fluid from preexisting pleural disease as well as extension of fluid into the pleural space from the pericardium or peritoneum.

Finally, the limitations in the evaluation for pneumothorax include main-stem bronchus intubation, failure to recognize the lung pulse (subtle cardiac pulsation of the parietal pleura at the lung periphery) as cardiac induced movement, patients after pleurodesis, and patients with severe chronic obstructive pulmonary disease or other lung pathology inhibiting adequate visualization of lung sliding. Although sensitivity in the detection of pneumothorax is very high, it is important to note that small apical or localized pneumothoraces may not be visualized even in a focused thoracic ultrasound examination.

III. Qualifications of the Physician

See the training guidelines of the physician provider's respective specialty society (eg, ACEP or AIUM). Training, as defined by these organizations, is accepted as qualifying a physician for performance and/or interpretation of the FAST examination. Credentialing should be based on published standards of the physician's specialty society.

IV. Responsibilities of the Physician

The FAST examination provides information rapidly to aid in decision making regarding further evaluation or testing, clinical management, and therapeutic interventions. Rapid provision and interpretation of such examinations are critical for appropriate patient care. The clinical care of patients in life-threatening situations should always take precedence over these parameters.

Physicians/sonologists from a variety of medical specialties may perform the FAST examination. If appropriately trained, physician extenders, emergency medical personnel, and sonographers can obtain the ultrasound images. Image interpretation should be performed by a supervising physician. Training of physicians in the diagnostic interpretation of FAST examinations should be in accordance with specialty-specific guidelines. Physicians who supervise nonphysician sonographers should render a diagnostic interpretation in a time frame consistent with the management of acute trauma.

V. Specifications for Individual Examinations

The objective of the abdominal portion of the examination is to analyze the peritoneal cavity for free fluid. This requires examination of the abdomen's 4 quadrants as well as the pelvis. The ability to denote free fluid in the pelvis is aided by the presence of a fluid-filled bladder. As with all ultrasound examinations, orthogonal images (transverse, longitudinal, and coronal planes) help elucidate areas of concern seen in any single plane, and all areas of interest should be scanned through completely using a sweeping motion in each plane. Subtle changes in transducer angle and position can help improve analysis of a given area. Images may be obtained through anterior, coronal, or other approaches to denote free fluid in the evaluated areas.

As with most imaging and ultrasound examinations, techniques evolve over time and with increased clinical and imaging experience. The primary FAST examination classically includes the subxiphoid window of the heart to denote pericardial fluid. If pericardial fluid is present, cardiac views should also be used to evaluate for the presence of tamponade. Subxiphoid images can be obtained by placing the transducer on the upper abdomen and pointing superiorly toward the left shoulder using the liver as an acoustic window. Alternative cardiac windows can be additive or may be necessary if an adequate subxiphoid view cannot be obtained in a particular patient. The parasternal long-axis view of the heart is typically the next view used; however, other views, including the apical 4-chamber and subcostal long views, may be used.

Pleural effusion can be identified via a midline transverse plane image in the upper abdomen, concentrating on the area posterior and therefore superior to the echogenic diaphragms. This may be the same image as that used to evaluate the (inferior) pericardium for fluid. Alternatively, scanning superiorly toward the patient's head while evaluating the right and left upper quadrants in the coronal plane will allow the sonographer to visualize the respective echogenic diaphragm and the pleural space above it.

To evaluate for pneumothorax in the supine patient, the transducer is placed on the anterior chest wall in the second or third intercostal space in the longitudinal plane. Pleural sliding with a reverberation artifact is present in the normal lung. M-mode imaging can also aid in the evaluation of the lung for pneumothorax and is also useful for documentation purposes.

More specifically, primary ultrasound windows for the FAST examination include the following:

1. The Right Upper Quadrant View (also known as the Perihepatic, Morison Pouch, or Right Flank View)—This uses the liver as an ultrasound window to interrogate the liver as well as the hepatorenal space (Morison pouch) for free fluid. Slight cephalad movement of the transducer allows imaging of the right pleural space for free fluid. Care should be taken to carefully insonate the area between the dome of the liver and diaphragm to identify free fluid that may accumulate there. Caudal probe movement allows visualization of the inferior pole of the right kidney as well as the right paracolic gutter for free fluid assessment.
2. The Left Upper Quadrant View (also known as the Perisplenic or Left Flank View)—This uses the spleen as a window to interrogate the spleen and the perisplenic space above the spleen, below the diaphragm, and the splenorenal recess. Scanning cephalad allows visualization of the left pleural space. Scanning caudad allows visualization of the inferior pole of the left kidney and the left paracolic gutter.
3. The Pelvic View (also known as the Retrovesical, Retrouterine, or Pouch of Douglas View)—This allows assessment of the most dependent space in the peritoneum for free fluid. Analysis through a fluid-filled bladder (which can be filled, if necessary, by fluid placed through a Foley catheter or clamping the Foley catheter) may help analysis for pelvic fluid. When free fluid is present, it is noted most often posterior or superior to the bladder and uterus. The bladder should be scanned in its entirety in both the sagittal and transverse planes.
4. The Pericardial View (also known as the Subcostal or Subxiphoid View)—This uses the left lobe of the liver as an acoustic window for analysis of the heart, particularly its right side. Both sagittal and transverse 4-chamber planes may be used. The potential space of the pericardium is analyzed for the presence of any free fluid in anterior or posterior locations. Slight angulation posteriorly or inferiorly in this view allows visualization of the IVC and hepatic veins, including their normal respiratory variability. A midline to slightly off-midline longitudinal view or coronal view through the patient's sides can also allow analysis of the IVC.
5. The Anterior Thoracic View—The pleura normally appose each other and slide on each other easily. Absence of this sliding and the potential separation of the pleura by a pneumothorax may be imaged typically in the second or third intercostal space with a higher-frequency near-field transducer, although lower-frequency transducers may also be used. Other intercostal spaces may also be used for lung analysis. The identification of a lung point is highly specific for the diagnosis of pneumothorax and should be sought when time allows. A lung point represents the site where the lung adheres to the parietal pleura immediately adjacent to the pneumothorax.

Additional dedicated views may include the following:

6. The Right and Left Pericolic Gutter Views—Longitudinal and transverse views through peritoneal windows inferior to the level of the ipsilateral kidney and next to the ipsilateral iliac crest may reveal free fluid surrounding the bowel. These windows may be of limited use because of the absence of an acoustic window, such as a fluid-filled bladder or a solid organ. Air-filled bowel may also limit these views. The presence of larger amounts of fluid may aid in visualization. The images may be obtained coronally or from an anterior approach.
7. The Pleural Space Views—Each pleural space may be investigated via angulation and cephalad movement of the transducer along the ipsilateral flank. Abnormal fluid collections in the pleural space are visualized as anechoic collections above the echogenic diaphragm. At times, fluid that may be hemorrhagic, proteinaceous, or infectious will appear more echogenic or complex in nature. An upright or slight reverse Trendelenburg position of the patient may assist in the detection of pleural fluid.
8. The Parasternal View—The parasternal window allows visualization of the heart in the long or short axis. These views are used in cases in which a patient's subcostal view is suboptimal.
9. The Apical View—The apical view may allow visualization of pericardial fluid in the difficult patient by placing the transducer at the nipple line at the left fifth intercostal space and aiming it toward the spine or the right shoulder.

Supplemental views:

10. Inferior Vena Cava Views—Multiple views of the IVC are accessible by using either a subxiphoid or lateral approach. The lateral approach makes use of the liver as an acoustic window. The primary aim of IVC evaluation is to aid in the assessment of the intravascular volume status. IVC evaluation is particularly useful in those patients at the extreme ends of the spectrum: either hypovolemic (eg, secondary to massive hemorrhage) or severely fluid overloaded. IVC evaluation has also been shown to be useful in gauging fluid responsiveness in patients requiring volume resuscitation or transfusion of blood products.

Other considerations for the FAST examination include the following points:

Trendelenburg or sitting positions may increase the sensitivity of the ultrasound examination for visualizing abnormal fluid.

A FAST examination may be repeated during the patient's stay for reassessment of the patient's condition either routinely or as a consequence of clinical decompensation.

Acute hemorrhage appears as anechoic fluid collections described previously in this document. However, as blood clots, often rapidly, these fluid collections may appear complex, hypoechoic, or even isoechoic to surrounding structures.

As a caveat, one must remember that a trauma ultrasound examination provides a picture of a patient's condition at one moment in time. It never eliminates the possibility of injury or fluid collections that are below the detectable threshold of a well-performed ultrasound examination.

Further information may be obtained by referring to the *ACEP Emergency Ultrasound Imaging Criteria Compendium—Trauma*.

VI. Documentation

Focused sonograms, as all sonograms, require appropriate documentation. Whenever feasible, images should be created and stored as part of the medical record, and a full description and interpretation of the findings is required. The analysis of findings on FAST examinations is limited to those areas assessed and imaged. In particular, a FAST analysis may not allow the diagnostic evaluation of all abnormalities in the chest, abdomen, or pelvis.

VII. Equipment Specifications

FAST examinations should be conducted with real-time scanners, preferably using sector or linear (curved or straight) transducers. The equipment should be adjusted to operate at the highest clinically appropriate frequency, realizing that there is a trade-off between resolution and beam penetration. For most preadolescent pediatric patients, mean frequencies of 5 MHz or greater are preferred, and in neonates and small infants, an even higher-frequency transducer may be necessary. For adults, mean frequencies of 3.5 and 5 MHz are most commonly used. Occasionally, very large patients may require a lower-frequency transducer such as 2 MHz for analysis. Thoracic ultrasound examinations for the detection of pneumothorax should be performed with linear or curvilinear array transducers, as phased array probes are not optimal for this application. When Doppler studies are performed, the Doppler frequency may differ from the imaging frequency. Diagnostic information should be optimized while keeping total ultrasound exposure as low as reasonably achievable (ALARA).

VIII. Quality Control and Improvement, Safety, Infection Control, and Patient Education Concerns

Policies and procedures related to image quality, equipment performance monitoring, infection control, and patient safety as well as patient education with regard to the FAST examination should be developed and implemented in accordance with either the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices* or guidelines developed by specialty-specific organizations such as the ACEP.

IX. ALARA Principle

The potential benefits and risks of each examination should be considered. The ALARA principle should be observed when adjusting controls that affect the acoustic output and by considering transducer dwell times. Further details on ALARA may be found in the AIUM publication *Medical Ultrasound Safety, Third Edition*.

Acknowledgments

This parameter was revised by the American Institute of Ultrasound in Medicine (AIUM) in collaboration with the American College of Emergency Physicians (ACEP) according to the process described in the *AIUM Clinical Standards Committee Manual*.

Collaborative Committees

Members represent their societies in the initial and final revision of this parameter.

AIUM

Harris L. Cohen, MD
Jill Langer, MD
John P. McGahan, MD

ACEP

David Bahner, MD
Michael Blaivas, MD
J. Christian Fox, MD
Rajesh N. Geria, MD
Stephen Hoffenberg, MD
John Kendall, MD
Christopher Raio, MD
Paul Sierzenski, MD
Vivek S. Tayal, MD

AIUM Clinical Standards Committee

Joseph Wax, MD, *Chair*
John Pellerito, MD, *Vice Chair*
Bryann Bromley, MD
Pat Fulgham, MD
Charlotte Henningsen, MS, RT, RDMS, RVT
Alexander Levitov
Vicki Noble, MD, RDMS
Anthony Odibo, MD, MSCE
David Paushter, MD
Dolores Pretorius, MD
Khaled Sakhel, MD
Shia Salem, MD
Jay Smith, MD
Paula Woodward, MD

Suggested Reading

1. Rozycki GS, Ballard RB, Feliciano DV, Schmidt JA, Pennington SD. Surgeon-performed ultrasound for the assessment of truncal injuries: lessons learned from 1540 patients. *Ann Surg* 1998; 228:557–567.
2. Wherrett LJ, Boulanger BR, McLellan BA, et al. Hypotension after blunt abdominal trauma: the role of emergent abdominal sonography in surgical triage. *J Trauma* 1996; 41:815–820.
3. Rozycki GS, Feliciano DV, Ochsner MG, et al. The role of ultrasound in patients with possible penetrating cardiac wounds: a prospective multicenter study. *J Trauma* 1999; 46:543–552.
4. Plummer D, Brunette D, Asinger R, Ruiz E. Emergency department echocardiography improves outcome in penetrating cardiac injury. *Ann Emerg Med* 1992; 21:709–712.
5. Boulanger BR, Kearney PA, Tsuei B, Ochoa JB. The routine use of sonography in penetrating torso injury is beneficial. *J Trauma* 2001; 51:320–325.
6. Kirkpatrick AW, Sirois M, Laupland KB, et al. Hand-held thoracic sonography for detecting post-traumatic pneumothoraces: the Extended Focused Assessment With Sonography for Trauma (EFAST). *J Trauma* 2004; 57:288–295.
7. Dulchavsky SA, Schwarz KL, Kirkpatrick AW, et al. Prospective evaluation of thoracic ultrasound in the detection of pneumothorax. *J Trauma* 2001; 50:201–205.
8. Ball CG, Kirkpatrick AW, Laupland KB, et al. Factors related to the failure of radiographic recognition of occult posttraumatic pneumothoraces. *Am J Surg* 2005; 189:550–556.
9. Lichtenstein D, Meziere G, Lascols N, et al. Ultrasound diagnosis of occult pneumothorax. *Crit Care Med* 2005; 33:1231–1238.
10. Tayal VS, Beatty MA, Marx JA, Tomaszewski CA, Thomason MH. FAST (focused assessment with sonography in trauma) accurate for cardiac and intraperitoneal injury in penetrating chest trauma. *J Ultrasound Med* 2004; 23:467–472.
11. McGahan J, Richards J, Fogata M. Emergency ultrasound in trauma patients. *Radiol Clin North Am* 2004; 42:417–425.
12. Jehle D, Guarino J, Karamanoukian H. Emergency department ultrasound in the evaluation of blunt abdominal trauma. *Am J Emerg Med* 1993; 11:342–346.
13. Kimura A, Otsuka T. Emergency center ultrasonography in the evaluation of hemoperitoneum: a prospective study. *J Trauma* 1991; 31:20–23.
14. McGahan JP, Rose J, Coates TL, Wisner DH, Newberry P. Use of ultrasonography in the patient with acute abdominal trauma. *J Ultrasound Med* 1997; 16:653–662.
15. Soudack M, Epelman M, Maor R, et al. Experience with focused abdominal sonography for trauma (FAST) in 313 pediatric patients. *J Clin Ultrasound* 2004; 32:53–61.
16. Hahn D, Offerman S, Homes J. Clinical importance of intraperitoneal fluid in patients with blunt intra-abdominal injury. *Am J Emerg Med* 2002; 20:595–600.
17. Blaivis M, Debehenke D, Phelan B. Potential errors in the diagnosis of pericardial effusion on trauma ultrasound for penetrating injuries. *Acad Emerg Med* 2000; 7:1261–1266.
18. Dolich M, McKenney M, Varela J, Compton RP, McKenney KL, Cohn SM. 2,576 ultrasounds for blunt abdominal trauma. *J Trauma* 2001; 50:108–112.
19. Scalea TM, Rodriguez A, Chiu WC, et al. Focused assessment with sonography for trauma (FAST): results from an international consensus conference. *J Trauma* 1999; 46: 466–472.
20. Melniker LA, Leibner E, McKenney MG, Lopez P, Briggs WM, Mancuso CA. Randomized controlled clinical trial of point-of-care, limited ultrasonography for trauma in the emergency department: the First Sonography Outcomes Assessment Program Trial. *Ann Emerg Med* 2006; 48:227–235.
21. American College of Radiology. *ACR Appropriateness Criteria—Blunt Abdominal Trauma*. Reston, VA; American College of Radiology; 2012.