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Original Article

Retrospective analysis of eFAST ultrasounds performed on trauma activations at an academic level-1 trauma center

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BACKGROUND: Point-of-care ultrasound (POCUS) has become increasingly integrated into the practice of emergency medicine. A common application is the extended focused assessment with sonography in trauma (eFAST) exam. The American College of Emergency Physicians has guidelines regarding the scope of ultrasound in the emergency department and the appropriate documentation. The objective of this study was to conduct a review of performed, documented and billed eFAST ultrasounds on trauma activation patients.

METHODS: This was a retrospective review of all trauma activation patients during a 10-month period at an academic level-one trauma center. A list comparing all trauma activations was cross-referenced with a list of all billed eFAST scans. Medical records were reviewed to determine whether an eFAST was indicated, performed, and appropriately documented.

RESULTS: We found that 1,507 of 1,597 trauma patients had indications for eFAST, but 396 (27%) of these patients did not have a billed eFAST. Of these 396 patients, 87 (22%) had documentation in the provider note that an eFAST was performed but there was no separate procedure note. The remaining 309 (78%) did not have any documentation of the eFAST in the patient's chart although an eFAST was recorded and reviewed during ultrasound quality assurance.

CONCLUSION: A significant proportion of trauma patients had eFAST exams performed but were not documented or billed. Lack of documentation was multifactorial. Emergency ultrasound programs require appropriate reimbursement to support training, credentialing, equipment, quality assurance, and device maintenance. Our study demonstrates a significant absence of adequate documentation leading to potential revenue loss for an emergency ultrasound program.

KEY WORDS: Point-of-care ultrasound; Emergency medicine; Focused assessment with sonography in trauma; Trauma activation; Blunt trauma

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INTRODUCTION

Point-of-care ultrasound (POCUS) has been increasingly utilized in the emergency department (ED) setting in the United States over the past twenty years.^[1] It serves as a useful diagnostic tool which has been shown to improve patient care and decrease length of stay.^[2] POCUS can be applied across all organ systems, and it can be used to guide clinical decision-making and care of critically ill patients.^[3,4] A prime example is the focused assessment with sonography in trauma (FAST) scan, which detects

free fluid in the cardiac, thoracic, and abdominal cavities after trauma, particularly blunt trauma. It has been shown to be highly specific for detecting occult sources of hemorrhage, enabling expedited diagnosis and timely surgical intervention.^[5,6] The speed and convenience of the FAST scan is advantageous for unstable patients who cannot be safely and easily evaluated by computed tomography (CT), which remains the gold standard imaging study for identification of solid organ or hollow viscous injuries.^[5] The efficacy of the FAST scan for

ruling-in pathology has led to its widespread use by emergency physicians and has drastically impacted care of trauma patients in the ED.^[7]

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. FAST is also indicated for penetrating chest trauma which can often lead to pericardial effusion, and if undetected, can result in cardiac tamponade and arrest.

The scope of the traditional FAST has now expanded to the extended FAST examination (eFAST) to also evaluate the lungs for the presence of pneumothorax. It has been shown that an eFAST can be used to rapidly detect hemothorax and pneumothorax as accurately as chest X-ray (CXR).^[8] The most current guidelines published by the American College of Emergency Physicians describe the expanded scope of ultrasound and categorizes various techniques into situations more relevant in emergency care.^[1] In addition, it outlines required documentation and credentialing guidelines for the implementation, maintenance, and growth of an emergency ultrasound program.^[1] These findings should be recorded in a written report in the ED chart as a clinically focused sonographic examination.

In most settings, ultrasound is reimbursed by billing components including current procedural terminology (CPT) codes and their respective value units (RVUs), which require appropriate documentation of procedures. Technical fees support the cost of the machine, supplies, and quality assurance software while the professional fee reimburses the physician performing and interpreting the images.^[1,9] Despite the widespread implementation of ultrasound in EDs, the frequency of ultrasound reimbursements pales in comparison to the number of ultrasounds actually performed and interpreted in the ED.^[10] The objective of this study was to perform a retrospective review of performed, documented and billed eFAST ultrasounds on all trauma activation patients at a single level one trauma center during a 10-month period to evaluate compliance with documentation.

METHODS

Study design

After obtaining institutional review board (IRB) approval, we conducted a retrospective chart review of all trauma activations between the dates of January 1, 2017 and November 3, 2017. We obtained a list of all patients/medical record numbers (MRNs) that were categorized as trauma activations from our billing

department. We also obtained a list of all documented (and thus billed) eFAST scans during this time period. Specifically, the list of billed eFAST included CPT codes 76604 (chest ultrasound), 76705 (abdominal ultrasound), and 93308 (cardiac ultrasound). The list of trauma activations and billed eFAST scans were cross-referenced, and MRNs were used to identify patients who were a trauma activation but did not get billed for an eFAST scan. No patients who presented during this time period as trauma activations were excluded from data analysis. A board certified emergency medicine physician reviewed all provider documentation and trauma run sheets to determine whether patients had indications for eFAST scan. Collected data included mechanism of trauma, whether there was an indication for a FAST scan, presence of documentation of ultrasound in the patient's ED chart (the provider notes), and the presence or absence of an ultrasound procedure note with subsequently billed CPT codes. Images from all ultrasounds were reviewed at weekly QA (quality assurance) meetings to confirm adequate views and interpretations.

Study setting

The study was performed at an urban, level-one trauma center with an annual ED census of approximately 50,000 patient visits. Of these visits, approximately 4,000 patients arrive as trauma runs. The university hospital supports an emergency medicine residency, trauma surgery fellowship, and point-of-care ultrasound fellowship. The decision of whether or not to perform an eFAST ultrasound was at the discretion of the treating emergency medicine and trauma surgery attending physicians. Trauma activations were classified as moderate or critical based on specific criteria regarding mechanism, physical findings, and vital signs (Table 1).

Study protocol

All patients presenting to the ED as moderate and critical trauma victims underwent a primary and secondary survey based on the Advanced Trauma Life Support (ATLS) guidelines. These patients were co-managed by the ED and trauma teams. An eFAST scan was performed as an adjunct to the primary survey by the junior resident physician on the trauma surgery service. The eFAST scan consists of four views to detect free fluid in the peritoneal, pericardial, and pleural cavities: right upper quadrant (RUQ), left upper quadrant (LUQ), pelvic/suprapubic, sub-xiphoid, and trans-thoracic. A phased array transducer (2–5 MHz) is used to display

blood as an anechoic substance in the potential spaces of these cavities presumably created by trauma. A clockwise approach beginning with RUQ is typically performed, followed by sub-xiphoid, LUQ, and suprapubic. Lastly, bilateral lung sliding is evaluated using a linear probe.

In the RUQ view, free fluid can collect in the pleural space, subphrenic space, Morrison's pouch (hepatorenal recess), or at the inferior pole of the kidney. The probe is placed at the mid-axillary line at about the 8th-11th intercostal space with the indicator pointed cephalad. Free fluid is identified as a dark stripe collecting within a dependent region.

The sub-xiphoid view can detect fluid between the parietal and visceral pericardium representing a hemopericardium, or fluid collecting around the heart. In this view, the probe is placed close to the xiphoid process lying almost flat on the abdomen with the indicator towards the patient's right. In sub-xiphoid pathology, a single, echogenic line around the heart is replaced with a black stripe. Blunt or penetrating trauma can cause

a pericardial effusion or hemopericardium, which can lead to cardiac tamponade without rapid detection and intervention.

In the LUQ view, fluid can collect in potential spaces analogous to the RUQ: pleural space, subphrenic space, splenorenal recess, or inferior pole of the kidney. The probe is placed in the posterior-axillary line between the 6th-9th ribs with the indicator pointed cephalad. The presence of free fluid in the splenorenal recess or pleural space will produce an anechoic line and abolished mirror image artifact of the spleen above the diaphragm, respectively. The suprapubic view can portray fluid between loops of bowel or in the recto-vesical space or pouch of Douglas in a male or female, respectively. The probe is placed superior to the pubic symphysis with the indicator towards the patient's right, then rotated 90 degrees cephalad in order to obtain both transverse and sagittal views, respectively.

Lastly, the probe is switched to a linear, high frequency probe (5–10 MHz). The probe is placed in the

Table 1. Trauma Activation Criteria

Critical trauma victim: TIER 1	Moderate trauma victims: TIER 2
Unstable ABCs or vital signs <ul style="list-style-type: none"> · Respiration <10 beats/minute or >29 beats/minute · Respiratory compromise/obstruction · Intubated patients · Pulse <50 beats/minute or >130 beats/minute · Systolic BP <90 mmHg Geriatric age ≥ 70 years: <ul style="list-style-type: none"> · Systolic BP <100 mmHg Pediatrics age ≤ 12 years: <ul style="list-style-type: none"> · Systolic BP < 70 mmHg Age ≤ 2 years: <ul style="list-style-type: none"> · Systolic BP < 60 mmHg Mechanism <ul style="list-style-type: none"> · GSW to head, neck, chest, back, abdomen, groin, or extremities proximal to elbow/knee · SW to chest 	Physical findings <ul style="list-style-type: none"> · GCS 11–13 with head injury · Blunt head trauma with LOC > 5 minutes · Flail chest · Pelvic pain or instability · Single femur fracture · Diffuse abdominal tenderness · Significant seatbelt bruise to neck, chest, or abdomen · Crushed, degloved, mangled, or pulseless extremity (excludes fingers/toes) Mechanism <ul style="list-style-type: none"> · SW to neck, abdomen, back, or groin · SW to extremity above elbow or knee · High speed MVC · Ejection (partial/complete) · Pedestrian or bicyclist hit at >20 mph or thrown any distance or run over · Passenger space intrusion > 12 inches · Death in same passenger compartment · Motorcycle crash >20 mph including laying down bike · Explosion · Adult: falls >15 feet · Child: falls >10 feet or 2–3 times child's height Ground level falls: TIER 3 <ul style="list-style-type: none"> · Age >74 years: Ground level fall with GCS 14–15 and evidence of head/facial trauma regardless of anticoagulation status
Neurological status changes <ul style="list-style-type: none"> · GCS ≤10 with head injury · Unequal pupils or focal neurologic deficit Fractures/unstable injuries <ul style="list-style-type: none"> · Open or depressed skull fracture · Bilateral femur fractures Burn <ul style="list-style-type: none"> · Burns >20% TBSA · Suspected inhalation injury · Electrical burns with arrhythmia Other <ul style="list-style-type: none"> · Transfer patients from other hospitals receiving blood to maintain vital signs · Hanging victims with abnormal vital signs listed above 	

mid-clavicular line at the second or third intercoastal space. This view allows for the evaluation of lung sliding as interpreted by the physician performing the scan.^[5,7,8] Following completion of the entire eFAST scan, a separate procedure note is documented in the electronic medical record (EMR). This note provides detail of the procedure, explains the technique and notes all findings. This separate procedure note is required by our institutional billing department. This note is completed by the ED attending physician who is co-managing the resuscitation with the trauma team while also supervising the eFAST procedure and simultaneously interpreting the results. The ED attending is also responsible for completing the ED provider note and documenting physical exam findings in real time throughout the resuscitation.

RESULTS

A total of 1,597 patients met our institutional criteria for trauma activation between the dates of January 1, 2017 and November 3, 2017. Totally 1,056 (66%) were men and 541 (34%) were women. Of these patients, 90 did not have indications for eFAST scan based on their mechanism of injury (drowning patients [11], patients with severe burns [75], and hangings [4]), while 1,507 patients were deemed to have indication for eFAST scan. A total of 1,111 (73%) of these patients had a documented and billed eFAST. However, 396 (27%) of these patients did not have a billed eFAST scan. Of these 396 patients, 87 (22%) had documentation in the ED provider note stating that an eFAST was performed and interpreted but did not have a separate procedure note. The remaining 309 (78%) did not have documentation of the eFAST scan or a separate procedure note although

an eFAST scan was documented in nursing notes and the trauma provider's documentation (Figure 1). Thus, according to the 2018 Medicare Physician Fee schedule, there is a combined professional fee loss of \$84.21 for every unbilled eFAST ultrasound.

DISCUSSION

According to our data, a significant percentage of patients (27%) had indications for an eFAST ultrasound but did not have a separate documented eFAST procedure note and thus were not billed for the scan. Upon review of trauma run details and nursing notes, an eFAST was actually performed in every instance. We have identified some possible reasons for this discrepancy. One reason may be due to the often frenzied nature of trauma resuscitations where there may not be sufficient time to manage these patients, supervise residents, and keep up with charting. Additionally, the EMR system used at our institution requires a separate documented note which requires an additional step in the patient's chart.

Among the variety of emergency ultrasound applications, the eFAST has distinguished itself as a centerpiece of emergency ultrasonography and is now the standard of care in evaluation of traumatic injuries. Compliance with accurate documentation of point-of-care ultrasound, especially with procedures such as the eFAST scan, is essential for appropriate billing and reimbursement mechanisms.^[11] Integration of the eFAST scan in the automated work flow of trauma resuscitation can generate an overall cost savings and significantly increase ultrasound billing revenue.^[2,3] Our data indicates that while a large percentage of trauma activations with blunt and penetrating trauma had documented and billed eFAST scans, there was still a significant proportion of patients with indications for eFAST scan who did not have this documentation in their chart. This unfortunately represents a significant loss in revenue for our center.

Billing and coding for eFAST involves three separate CPT codes. This includes 76604 which is the CPT code for chest ultrasound, 76705 for abdominal ultrasound and 93308 for cardiac ultrasound. The 2018 Medicare Physician Fee Schedule national average professional fee reimbursement for each code is \$27.71 for 76604, \$30.23 for 76705 and \$26.27 for 93308. Thus, for every unbilled eFAST ultrasound there is a combined loss of \$84.21. We suspect that centers with a less established ultrasound program would be greatly affected by this type of loss, making it difficult to justify buying new equipment, spending money to train providers in extended applications, and expanding the program. EDs with

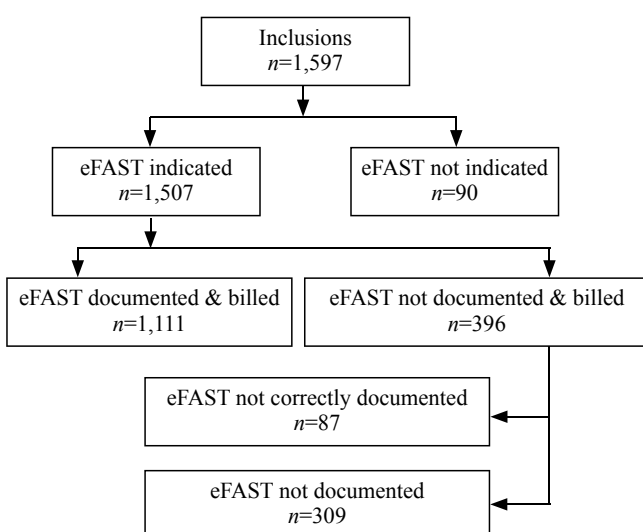


Figure 1. Flowchart of enrolled patients.

significant eFAST performance and revenue loss could consider establishing a protocol during quality assurance meetings when documented and archived eFAST scans are performed but not billed. Feedback could be given to providers through the medical records to help ensure that scans are billing appropriately.

Establishing a financially viable emergency ultrasound program is beneficial to a department and the institution as a whole. Emergency medicine residency training has also codified ultrasound in the Accreditation Council for Graduate Medical Education (ACGME). As of 2013, the ACGME mandates procedural competency in emergency ultrasound, and highlights emergency medicine ultrasound as one of the 23 sub-competency milestones of residency training. However, substantial costs come with an emergency ultrasound program including physician training, credentialing, purchasing ultrasound machines and equipment, quality assurance, and device maintenance. One paper explored the fiscal impact of developing an emergency ultrasound program at an academic institution and found that documentation rates were drastically lower than utilization rates. Despite this, return on investment was achieved in less than 5 years and positive revenue was subsequently accrued.^[12]

We believe that the eFAST scan is an important aspect of ED care for patients with blunt and penetrating trauma. The aim of a successful emergency ultrasound program goes beyond coverage of implementation costs but strives to continually improve patient care and physicians' ultrasound skills and diagnostic accuracy. Thus, it is in the interest of the department and hospital to regularly review documentation compliance to ensure all eFAST are performed and documented in the emergency medical record when indicated to avoid loss of revenue that may be essential to the continued viability of the ultrasound program.^[13]

Limitations

There are several limitations to this study. This was a single center study performed at an academic emergency department with an advanced emergency ultrasound department, emergency medicine residency and trauma surgery fellowship. The results of this study may not be generalizable to other emergency departments. This was a descriptive study utilizing a retrospective chart review. A large scale, prospective study would be needed to validate these results. Indications for eFAST scan were based on written documentation in the patient's medical record as documented by the treating physicians. The number of eFAST scans performed on patients that did not meet trauma activation criteria was not evaluated in

this study but may be useful to help understand the true percentage of unbilled eFAST scans.

CONCLUSIONS

Our data indicates that a large percentage of trauma activations with blunt and penetrating trauma had documented and billed eFAST scans. However, a significant proportion of patients with indications for eFAST scan did not have documented or billed procedure templates. This multifactorial lack of documentation can result in loss of revenue that may be essential to the continued viability of the ultrasound program. Specifically, for every unbilled eFAST ultrasound there is an average professional fee loss of \$84.21.

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Ethical approval: The study was approved by institutional review board.

Conflicts of interest: Dr. J Christian Fox receives stock options from Sonosim for consulting. However, no Sonosim products were used in this research project.

Contributors: SS, SL and JCF were involved in study conception, study design, IRB preparation, data collection and manuscript preparation. LW was involved in IRB preparation, manuscript drafting, data collection, manuscript editing and literature review. EK and IS were involved in manuscript drafting, review of literature, data collection, preparation of tables and figures.

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