Emergency ultrasound in the acute assessment of haemothorax

A Brooks, B Davies, M Smethurst, J Connolly

Aims: To evaluate thoracic ultrasound for the detection of haemothorax in patients with thoracic trauma against established investigations.

Methods: Thoracic ultrasound was performed as an extension of the standard focused assessment with sonography for trauma (FAST) protocol used at the Queen’s Medical Centre for the assessment of adult patients with torso trauma. Fluid was sought in both pleural cavities using a hand portable ultrasound system by one of two non-radiologists trained in FAST. Findings were compared against subsequent investigations/procedures performed at the discretion of the attending emergency physician—supine chest radiography, intercostal drain, computed tomography, or thoracotomy. The sensitivity of the technique and the time taken to diagnosis for each investigation were recorded.

Results: Sixty one patients, 54 (89%) after blunt trauma, underwent thoracic ultrasound evaluation during the study. Twelve patients had a haemothorax detected by ultrasound and confirmed by computed tomography or by tube thoracostomy. Four haemothoraces detected on ultrasound were not apparent on trauma chest radiography. There were 12 true positives, 48 true negatives, no false positives, and one false negative scan. The sensitivity of ultrasound was 92% and specificity 100% with a positive predictive value of 100% and negative predictive value 98% for the detection of haemothorax after trauma.

Conclusions: Emergency ultrasound of the chest performed as part of the primary survey of the traumatised patient can rapidly and accurately diagnose haemothorax and is a valuable tool to augment the immediate clinical assessment of these patients.

Methods
A prospective study was performed over a six month period in the emergency department of Queen’s Medical Centre, Nottingham, UK. Adult patients triaged to the resuscitation room with thoracic trauma were enrolled if one of the investigators were available. The study was conducted in accordance with the ethical approval obtained from the Queen’s Medical Centre Ethics Committee reference GS040102.

FAST was performed on the supine trauma patient in parallel with the primary survey, which proceeded unhindered. In addition to the four conventional FAST views oblique views were obtained to visualise both hemithoraces for the presence of free intrapleural fluid. Fluid detected either in the chest or abdomen was reported to the trauma team leader at the time, as required by the ethics committee.

Results
Sixty one patients, 54 (89%) after blunt trauma, underwent thoracic ultrasound evaluation during the study. Twelve patients had a haemothorax detected on ultrasound scanning, eight were confirmed by chest radiograph or tube thoracostomy that drained blood, or both. There were no false positive ultrasound scans. Figure 1 provides a summary of the results. Tables 1 and 2 give a detailed breakdown of the results for blunt (sensitivity 90%, specificity 100%) and penetrating trauma (sensitivity 100%, specificity 100%). A single false negative scan was reported in a pedestrian hit by a car resulting in a subdural haematoma and facial

Abbreviations: FAST, focused assessment with sonography for trauma; CT, computed tomography
injuries. Supine chest radiography was reported as showing small bilateral effusions that were treated conservatively. Views were incomplete in three patients because of surgical emphysema from associated pneumothoraces and were excluded from analysis; none had haemothorax diagnosed on the chest radiograph. Four traumatic effusions detected by ultrasound were confirmed by CT, but were not initially detected on the supine trauma chest radiograph. Three were clinically not significant and were managed by observation without complication, while one had an intercostal drain that drained about 100 ml of blood.

Overall, thoracic ultrasound had a sensitivity of 92% and specificity of 100% for the detection of haemothorax after trauma. The accuracy of the technique was 98%, with a positive predictive value of 100% and negative predictive value of 98%.

In 42 (84%) cases, the ultrasound result was available to the trauma team before the plain radiographs.

**DISCUSSION**

FAST has become accepted as the initial abdominal investigation of choice in trauma patients in many institutions. Positive results in unstable patients permit early decision making, appropriate triage, and management. Extending this modality routinely to the diagnosis of haemothorax would potentially further improve the evaluation of haemodynamic instability during the circulation assessment of trauma resuscitation. We have evaluated the technique of thoracic trauma ultrasound when performed by non-radiologists in the UK, using a number of comparators of which plain radiography was one, and shown that ultrasound can rapidly and accurately diagnose haemothorax in trauma, providing a sensitive and specific tool to augment clinical examination and assessment of the patient in the circulation phase of the resuscitation. This study has shown that thoracic ultrasound is at least comparable to a supine trauma chest radiograph for the detection of haemothorax, but this should not be interpreted as a proposal for replacing the supine chest radiograph as the plain films provide valuable detail on other injuries, although Bokhari has brought into question the value of obtaining a chest radiograph in blunt trauma, as they found that it added little information to a normal physical examination in a stable patient.

The value of thoracic ultrasound has been assessed previously in work undertaken in North America, however the technique is not widely practised especially in the United Kingdom. Ma et al. found that ultrasound was comparable to chest radiograph in detecting haemothorax and sensitivities for the detection of haemothorax of 81% to 96% have been reported. Sisley showed that the performance time for ultrasound was one, and that this should not be interpreted as a proposal for replacing the supine chest radiograph as the plain films provide valuable detail on other injuries, although Bokhari has brought into question the value of obtaining a chest radiograph in blunt trauma, as they found that it added little information to a normal physical examination in a stable patient.

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