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E-FAST

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Historical development and definition

The morbidity and mortality of patients in haemorrhagic shock are high and trauma is not the only cause. Haemorrhage can also occur in ectopic pregnancies, coagulation disorders, vascular pathologies and postoperatively. 20–40% of patients with significant abdominal trauma have normal clinical findings [(1)]. Therefore, it is clear that trauma surgeons need reliable diagnostic aids. When searching for appropriate solutions, sonography was discovered at the end of the 1970s. This was after diagnostic peritoneal lavage (DPL) and computed tomography (CT) were introduced. Ultrasound offers great advantages over the somewhat elaborate and invasive DPL and expensive CT with its associated side effects: it is simple, is performed by the attending physician at the bedside in real time, can be repeated as often as necessary, is non-invasive, does not involve radiation, needs only a minimal amount of training and is cost-effective. This technique rapidly became a standard procedure in emergency rooms. The term Focused Assessment with Sonography for Trauma (FAST) was coined at a consensus conference in 1999 [(2)]. FAST focuses on the detection of fluid in the peritoneal cavity and pericardial space, without distinguishing between blood and other fluids. As early as the beginning of the 1990s, the ultrasound examination was extended to include the detection of haemothoraces. In 2004, the term Extended FAST (E-FAST) was born following the incorporation of detection of pneumothoraces into the standard protocol [(3)]. In brief, E-FAST is a focused, rapid ultrasound examination that is easy to learn. It is performed at the bedside to answer three clinical questions [Table 1] transformed into five sonographic questions [Table 2] using information from six standard views [Figure 1]. The main purpose is to establish whether the patient has haemodynamically significant haemorrhages in the peritoneal cavity, pleural or pericardial spaces or a pneumothorax. Together with the overall clinical assessment, this information helps in taking five important diagnostic and clinical decisions [Table 3]. This means that the objective of E-FAST is not to establish whether there is any bleeding at all, nor is it performed to locate the exact source of bleeding which would involve much more complex and time-consuming investigations, but to establish whether there is ongoing bleeding which requires surgical intervention.

Table 1 Clinical questions.

Clinical questions:
➢ Does the patient have blood in their abdomen and/or thorax? ➢ Does the patient have a cardiac tamponade? ➢ Does the patient have a pneumothorax?

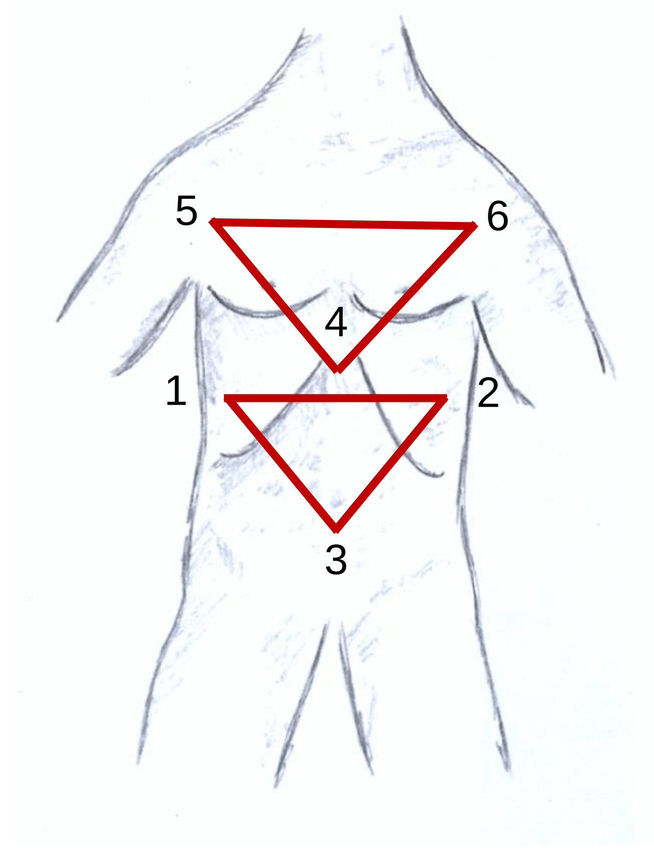
Table 2 Sonographic questions.

Sonographic questions:
➢ Is there any fluid in the peritoneal cavity? ➢ Is there any fluid in the pericardial space? ➢ Are there signs of tamponade? ➢ Is there any fluid in the pleural space? ➢ Are lung sliding, B-lines, the lung pulse and the lung point present?

Table 3 E-FAST, decision making.

E-FAST = Decision making help for:
➢ Need for immediate laparoscopy or thoracotomy ➢ Choosing the primary site of access (thorax or abdomen) ➢ Treatment of pneumothorax and haemothorax ➢ Transition to secondary survey ➢ Need for abdominal or thoracic CT

Figure 1 Standard views. Right upper quadrant (1); left upper quadrant (2); suprapubic, sagittal and transverse axis (3); subcostal cardiac, long and short axis (4); bilateral anterior longitudinal chest (5 and 6).



E-FAST has become established as an important component of the internationally recognised Advanced Trauma Life Support (ATLS) in resuscitation management. ATLS consists of two phases. The primary survey consists of life saving measures prioritised according to the diagnostic therapeutic ABCDE approach (A = Airway, B = Breathing, C = Circulation, D = Disability and E = Exposure/Environmental Control). Focussed sonography forms part of the assessment in the 'Breathing' and 'Circulation' steps. Depending on the condition of the patient, E-FAST is performed again in the secondary survey (head-to-toe examination) and after discharge from the emergency room on the observation ward. It is also indispensable when examining patients with shock of unclear origin (e.g., cardiogenic or hypovolaemic shock or haemodynamic instability), acute lower abdominal pain in women of child-bearing age and during and after cardiopulmonary resuscitation.

Investigations

Standard views – normal and pathological findings

The E-FAST investigation consists of six standard views. The prescribed sequence of view showed in Figure 1 should always be adhered to because emergency investigations are often performed under great pressure. This is the only way to ensure that no steps in the investigation are missed.

Free fluid is usually echo-free or echo-poor on an ultrasound image. A fresh haematoma, however, may on occasions be echogenic. The characteristic of free fluid is that it changes its position if the patient's position is changed. It is therefore important to identify the spaces in which free fluid may collect. Exact measurement of the amount of fluid is impossible using sonography. There are formulas, however, for different regions, which make it possible to estimate the fluid volume [(4)].

The following sections describe and discuss the six standard views [Figure 1] with comparisons of normal and pathological finding.

Position 1: Right upper quadrant

The right upper quadrant view examines the hepatorenal recess between the kidney and liver, also called Morison's pouch [Figure 2]. Free fluid is visualised as an echo-poor band between the two organs [Figure 3]. If the mean thickness of the band of free fluid in Morison's pouch is wider than 1 cm, it can be assumed that up to 1 litre of intraperitoneal fluid is present [(5, 6)]. However, free fluid in the right upper quadrant of the abdomen does not always collect in Morison's pouch. In these cases, the intraperitoneal fluid can usually be detected along the lower anterior margin of the liver.

Figure 2 Normal findings (right upper quadrant). Liver (1); kidney (2); Morison's pouch (3).

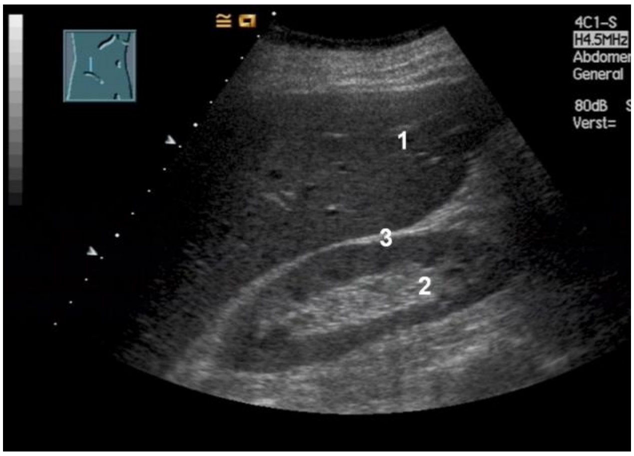
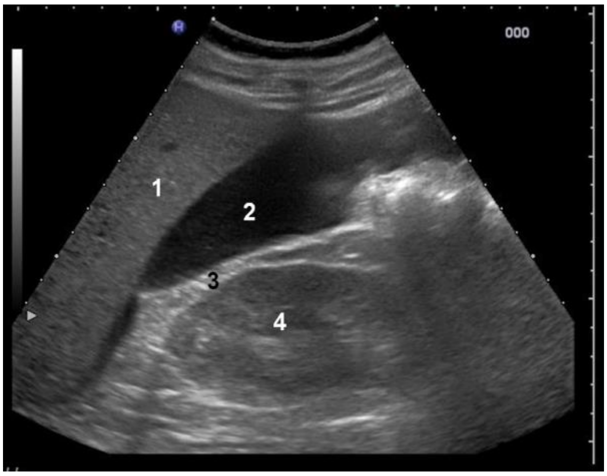


Figure 3 Free intraperitoneal fluid in Morison's pouch (right upper quadrant). Liver (1); fluid (2); fat (3); kidney (4).



By directing the probe through the liver towards the top of the diaphragm, the presence of subphrenic fluid can be excluded or visualised [Figure 4]. Gliding the probe in a craniodorsal direction to the posterior axillary line searches for fluid in the right pleural space directly above the diaphragm. When doing so, respiratory movements should be observed as when the lung is filled with air, it should slide across the liver like a curtain in the costodiaphragmatic angle [Figure 5]. Signs of fluid in the pleural space [Figure 6] are: (1) the presence of the spine sign (demonstration of the spine posterior to the pleural effusion in the supraphrenic thoracic cavity), (2) visualisation of the diaphragm (in the normally aerated lung the diaphragm cannot be seen; in the presence of a pleural effusion it appears as an echo-poor band edged with an upper and lower echo-rich border), (3) absence of the curtain sign (moving lung/air in the costodiaphragmatic angle) and (4) compression atelectasis in moderate to severe effusions [(7)]. The volumetric assessment of the amount of pleural effusions and haematomas is unreliable [Figure 6]. In order to obtain a rough estimate of the volume of the effusion in millilitres, the width of the fluid in the cross-section is measured in millimetres from the interior thoracic wall to the dorsal margin of the lung and multiplied by 20, with the procedure performed with the patient in a supine position [(8)]. The best position for drainage can also be decided at the same time.

Figure 4 Subphrenic organising haematoma of the liver (right upper quadrant). Liver (1); haematoma (2); diaphragm (3); small effusion (4).

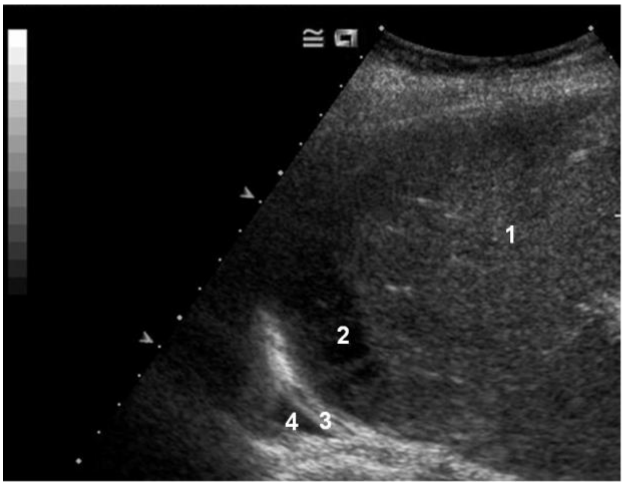


Figure 5 **Normal dorsal costodiaphragmatic angle (right upper quadrant). Liver (1); costodiaphragmatic angle (2); mirror artefact (3); adrenal gland (4); kidney (5).**

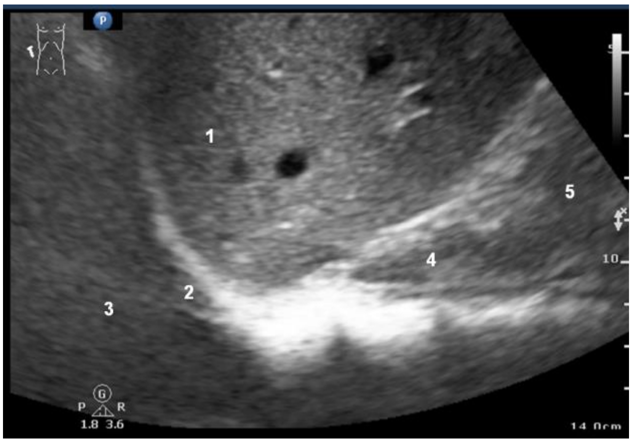


Figure 6 **Haemothorax (right upper quadrant). Haemothorax (1); diaphragm (2); liver (3); spine (4).**