

Use of ultrasound in blunt abdominal trauma in critical careMada Muzhir Alzahrani ⁽¹⁾, Nouf Saleh Sadun ⁽¹⁾

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Correspondence Author: Mada Muzhir Alzahrani, College of Medicine, Umm Al-Qura University, Saudi Arabia**Type of publication:** Original Research Paper**Conflicts of Interest:** Nil**Abstract**

Portable ultrasound is a simple, noninvasive modality that has gained increased acceptance in the evaluation of abdominal trauma patients. In major trauma, four main uses of ultrasound were identified include assessment of basic blood circulation state, focused assessment with ultrasound in trauma. Ultrasound is usually used as a diagnostic method in pediatric because it is noninvasive and avoids anesthesia and irradiation. Ultrasound is extremely difficult to interpret in obese patients and patients with subcutaneous emphysema, and information on specific organ injuries is limited with ultrasound.

Introduction

Over the past few decades, mortality rates associated with multiple organ failure among patients with multiple injuries have been reduced due to improvements in rescue systems, intensive care and trauma management. However, the result in seriously injured patients remains heavily influenced by primary life support and early surgical care. In these factors, time plays a key role, especially with regard to early management of major acute abdominal trauma and perforation of trunk injuries[1].

Portable ultrasound is a simple, noninvasive modality that has gained increased acceptance in the evaluation of abdominal trauma patients[2]. Ultrasound has been used as an investigation in patients with abdominal signs after blunt injury. Ultrasound has been available for many years

and, during this time, equipment has become more compact and the quality of definition improved. The investigation has not, however, found an established role in the management of abdominal trauma[3].

With improved technology, ultrasound has been proved to be an important diagnostic tool in the assessment of the traumatic patients in Asia and Europe [4]. German surgeons, for example, routinely perform ultrasound examinations on their patients and ultrasound training have been included into their surgical residency programs [5].

Abdominal and pelvic injuries are the leading causes of early death after severe trauma, and therefore it is important to focus on initial assessment and management [6]. In the case of uncontrolled bleeding, immediate diagnosis and urgent laparotomy provides the only chance to survive. This raises the question of how to get the diagnosis as soon as possible in order to decide on surgical treatment. In blunt abdominal trauma, any physical signs related to providing adequate information on the need for surgery cannot be trusted. Even patients with completely normal vital signs and clinical examination may have abdominal diseases[7]. Recently, it has been shown that abdominal bleeding can be detected before entering the hospital using prehospital focused abdominal ultrasound for trauma (PFAST) [8].

A study of **Knochel et al.** found an accuracy of more than 90% of US in identifying intra-abdominal hemorrhage [8].

The sonographic appearance of fresh blood is dark region (anechoic) with sharp borders against the peritoneum. Older bleeding has more complex echoes (white) spots within the dark area varying in appearance depending on the age and organization of the hematoma. Large amounts of intra-abdominal hemorrhage allow visualization of loops of the intestines which are usually poorly seen with ultrasound. ultrasound can also provide information on extra-abdominal injuries such as hemothorax and cardiac tamponade [9].

Uses of ultrasound in trauma

In major trauma, four main uses of ultrasound were identified include assessment of basic blood circulation state, focused assessment with ultrasound in trauma (FAST), blood vessels filling condition, and extended FAST (EFAST).

The term (FAST) focused assessment with ultrasound for trauma was coined by [10]. The primary (FAST) examination was an only one view of Morison's pouch (hepatorenal fossa [11]. And soon realized that more comprehensive investigations of the abdomen improved free fluids detection. This included an examination of each upper quadrants, pelvis and parabolic gutters [12].

Focused assessment with ultrasound for trauma is a very rapid, four-view sonographic scan conducted during the initial survey is performed for assessment of haemopericardium and haemoperitoneum [13]. EFAST adds evaluation for pneumothorax, haemothorax and intravascular filling to FAST exam. Describes a limited ultrasound evaluation (four view) of the heart looking for haemopericardium, and of the abdomen looking for haemoperitoneum. The goal is to determine a life threatening intra-abdominal hemorrhage or cardiac tamponade with a view to speed up the final surgical management. FAST has no aim to rule out abdominal injury or injury of the thorax it helps in detection of

hemopiritonium and hemopiricardium. The key benefit is to direct appropriate interventions quickly in unstable patients and useful in both penetrating and blunt abdominal trauma [14].

FAST is associated with more rapid disposition in the operating room, it indicates a more rapid search for other reasons of hypotension when negative, it decreases the number of computed tomography scans, and diagnostic peritoneal lavage performed and it is related with fewer complications, shorter hospitalization, and lower fees [15]. However, at this stage, there is a little conclusive evidence that its use improves the survival of the patient. FAST changes the management of patients with trauma [16]. Despite of the documented fact that the sensitivity of the ultrasound to free fluid detection can be improved by the presence of the full bladder. Often in patients with trauma a Foley catheter is placed and the bladder is decompressed, eliminating the acoustic window needed to detect moderate or small amounts of free fluid [17].

Sonographic findings

Free fluids usually appear as hypoechoic area within the pelvis or peritoneal cavity and are usually triangular or linear. Liquid form depends on its compression by surrounding structures. For example, in a Morison's pouch, the fluid between the liver and kidney usually appears as linear shape [18]. The fluid that surrounds the bowel often has a triangular shape. The fluid often accumulates at the site of injury, then it flows throughout the abdomen and into the pelvis. At the injury site blood may appear echogenic as it forms a clot adjacent to the injured organ [19].

Solid organs injury

Although ultrasound was first described in determination of traumatic spleen injuries more than thirty years ago [20]. Ultrasound was initially used to detect injury of

specific organ rather than free fluid related to injury. There were limitations in the sensitivity and ability of ultrasound to show the injured organ directly. It was not until the 1990s that the focused abdominal ultrasound for trauma (FAST) was developed for the primary purpose of detecting free fluid in patients with blunt abdominal trauma [12]. Recently, contrast-enhanced abdominal ultrasound has been used in the assessment of injuries of solid organ in patients with trauma such as in a study of **Martegani et al.**[19] presented the initial assessment micro-bubble-enhanced ultrasound of abdominal organs in penetrating and blunt abdominal trauma.

FAST in children

Ultrasound is usually used as a diagnostic method in pediatric because it is noninvasive and avoids anesthesia and irradiation. In trauma, however, 31-37% of children intra-abdominal injuries do not have associated hemoperitoneum[21]. Many abdominal injuries to pediatrics do not have related hemoperitoneum. The sensitivity of the FAST detection of hemoperitoneum is 80% and specificity 95%. FAST sensitivity in detecting any intra-abdominal injury is 66% (because many abdominal injuries within children do not have a free fluid). Sensitivity of comprehensive abdominal US in detecting hemoperitoneum and/or intraabdominal injury is 82%. Ultrasound should not be used as the evaluation tool for the abdomen in children abdominal trauma, but it is useful when used as a part of clinical evaluation protocol[15].

Limitations

Ultrasound is extremely difficult to interpret in obese patients and patients with subcutaneous emphysema, and information on specific organ injuries is limited with ultrasound. Previous laparotomy may prevent free flow of blood into Morrison's pouch [9]. The assessment of area around the empty bladder becomes more difficult after

Foley catheter insertion. Caution must be used in patients with previous liver disease, because ultrasound cannot differentiate ascites from intra-abdominal bleeding[22]. Ultrasound may also be inaccurate in determining patients with early bowel injuries of their course[23].

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