

## EDITORIAL COMMENT

# Focused Ultrasound

## A Masterpiece in the Puzzle of Chest Trauma Evaluation\*



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Chest trauma proves challenging in terms of diagnosis and management. Potentially complex injuries may go unnoticed due to the subtlety of clinical findings, especially in extreme settings and environments. Due to the potential presence of multiple associated traumas and frequent respiratory failure and hemodynamic instability, recognition and management of the lesions must be rapid and often focused on damage control to ensure patient survival. Not infrequently, these patients require specialized evaluation and management for the treatment of injuries.

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The case presented by Karagodin et al. (1) in this issue of *JACC: Case Reports* is an excellent example of how focused cardiovascular ultrasound and, subsequently, three-dimensional echocardiography were decisive in patient care and the resolution of cardiac injuries. From the present case we can learn some valuable lessons: 1) a focused ultrasound examination should be part of the initial assessment of every

patient with chest trauma; 2) after initial management, a complete echocardiographic examination is strongly recommended to exclude injuries that might have gone unnoticed; 3) in the presence of traumatic anatomic injuries, the 3-dimensional echocardiogram has an essential role in the decision-making process; and 4) percutaneous interventions are also a feasible alternative in trauma patients.

Currently, the initial assessment of the patient with suspected chest trauma consists of information about the event and the assessment of the B (ABC of the trauma), complemented by a simple chest radiograph searching for thoracic wall, pleuropulmonary, cardiac, and aortic abnormalities. The diagnosis of the thoracic injury and the treatment planning often depend on complementing the diagnosis with the use of focused ultrasound or computed tomography imaging. According to the Advanced Trauma Life Support Program guideline, eFAST (extended focused assessment with sonography for trauma) is usually performed in the primary examination, during the assessment of circulation and bleeding control (letter “C” of the ABC of trauma). It starts with a subxiphoid view to exclude the presence of cardiac tamponade and gross heart injuries, considered to be the most life-threatening lesions (Figure 1).

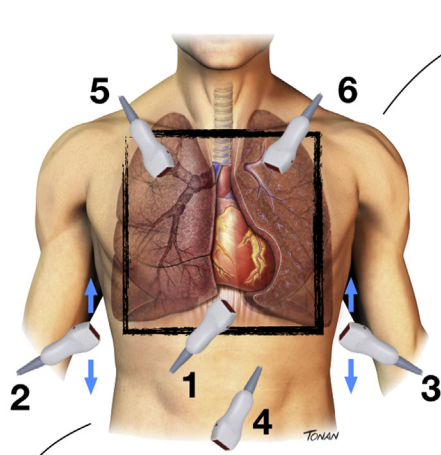
The diagnosis of cardiac trauma is usually not easy, and ultrasound evaluation, through the eFAST, is the method of choice to provide initial information about the presence of pericardial effusion (sensitivity of 100% and specificity of 97%) and gross changes in the function and structure of the heart (2). Subsequently, a comprehensive transthoracic echocardiogram (TTE) should be performed in all patients with blunt chest trauma or refractory shock without a clear etiology, with the goal of identifying changes that may require immediate intervention (3-6).

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**FIGURE 1** Penetrating Cardiac Trauma and the eFAST Evaluation



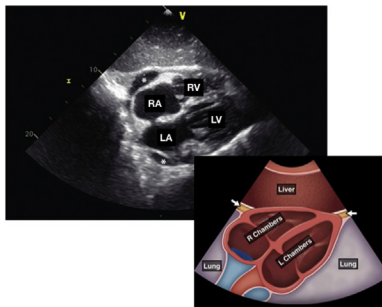
### The "Cardiac Box"

Also known as "Ziedler area" or "Sauer-Murdock area"

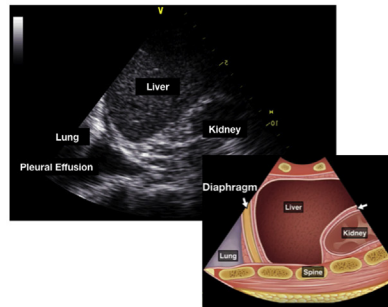
- Limits (black square): superiorly defined by the clavicles and sternal notch; laterally by vertical lines through the nipples; and inferiorly by the costal margins.
- Penetrating injuries within these borders should raise awareness of a possible cardiac injury.
- Wounds outside the confines of the "Cardiac Box" do not exclude cardiac injury.
- The size, shape, and direction of the entrance of the object give a somewhat idea of the potential cardiac lesions

### The eFAST (extended Focused Assessment Sonography for Trauma)

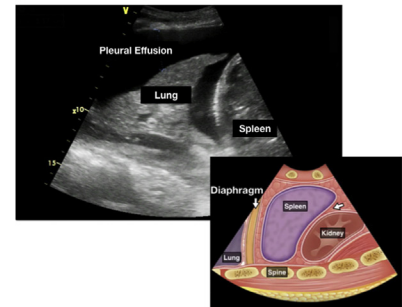
**1** - Subcostal view



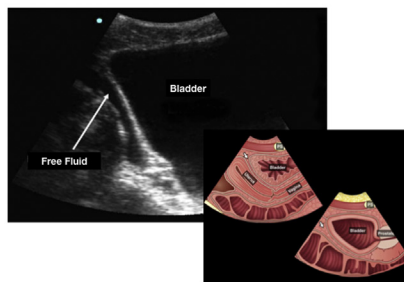
**2** - Right upper quadrant view



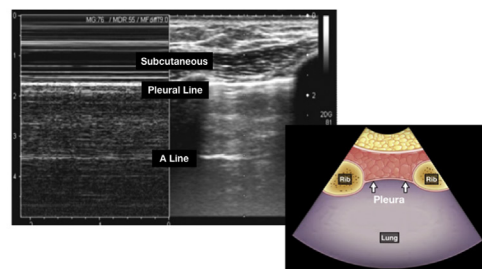
**3** - Left upper quadrant view



**4** - Pelvic view



**5 and 6** - Anterior thoracic view



Schematic view demonstrating the topographic anatomic landmarks that delimit the cardiac box. The probes illustrate the topographic locations to scan for the eFAST (extended focused assessment with sonography for trauma) examination. Illustration by Rodrigo Tonan. LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle.

In penetrating chest trauma, physical examination alone is not sufficient for the detection and evaluation of the extent of the cardiac injury. The size, shape, and direction of the entrance of the object give

an approximate idea of the potential lesions. Lesions located in the precordial topography (cardiac box) should raise awareness of a possible cardiac injury (Figure 1). In these cases, TTE must be used to rule out

cardiac involvement (7-10). Due to the concomitance of associated thoracic injuries, the TTE may present suboptimal images due to an unfavorable acoustic window and, therefore, a transesophageal approach may be necessary. A prospective study showed that the transesophageal echocardiogram is superior to the transthoracic modality for investigating persistent hemodynamic instability or trauma-related cardiac injuries, providing excellent quality images in 98% of cases compared with 60% by using the transthoracic approach (6). Moreover, multiple serious injuries, including wall and valvular ruptures, were often not visible on TTE.

In the case by Karagodin et al. (1), echocardiography was an essential tool in diagnosing the presence of the ventricular septal defect, as well as in

categorizing the morphology, type, location, and degree of severity. As a final message, it is essential to notice that the complementary 3-dimensional evaluation was the cherry on top. Throughout multiple cropping reconstructions, it allowed a precise recognition of the intact surrounding myocardium and anatomic structures for the percutaneous closure planning and guidance.

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