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## E-FAST: A propos of hemopericardium in the Emergency Department

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### ABSTRACT

The extended-focused assessment with sonography in trauma is still recognized as a technique approach to patients whose trauma involves the chest and the abdomen, with the aim of ruling out conditions as pneumothorax, hemothorax, pericardial effusion/cardiac tamponade, and intraperitoneal free fluid. Although CT is the gold standard test, the inconvenience of moving unstable patients and the amount of time it takes to carry it out, makes it not always possible in the Emergency Department, which positions the ultrasound as an ideal tool in the evaluation of patients with trauma in the Emergency Department. In this case report, we presented the case of a patient who complains of multiple stab wounds, and the extended-focused assessment with sonography in trauma confirmed the diagnostic impressions.

## 1. Introduction

Trauma is one of the leading causes of mortality worldwide<sup>[1]</sup>. In emergency departments, it is usually caused by hypovolemic shock (hemothorax, hemoperitoneum) or by obstructive shock (pneumothorax, hemopericardium). Thus, forcing emergency services to actively look for these lesions in patients suffering trauma of the thorax and/or abdomen.

Bedside ultrasound performed in the Emergency Department is positioned as a tool of choice given the precision, speed and safety of its preparation, giving concise answers to specific questions: Is there a pneumothorax? hemothorax? hemopericardium? free intraperitoneal fluid<sup>[2,3]</sup>?

In this article, we reported the case of a patient with trauma whose injuries led to pneumothorax, hemothorax and hemopericardium, being suspected clinically, and confirmed by ultrasonography.

## 2. Case report

A 29-year-old male patient presented to the Emergency Department, no relevant past medical history, brought by pre-

hospital personnel. He complained of being stabbed in the anterior thoracoabdominal area as a victim of an assault. In the physical exam, the patient was found conscious, alert but anxious. Vital signs: blood pressure: 63/48 mmHg, pulse: 81, respiratory rate: 26, SpO<sub>2</sub>: 92%, positive findings: one right precordial wound, with air coming out of it and diminished breath sounds, strongly suggesting pneumothorax, and a left precordial chest wound with small active bleeding (Figure 1, with the authorization of the patient); cardiovascular: regular rate and rhythm, no murmur or click; lungs: unilateral right diminished breath sounds. No injuries in abdomen, soft, non-tender.

In the initial evaluation, we observed an ST segment depression, suggesting heart involvement (Figure 2).

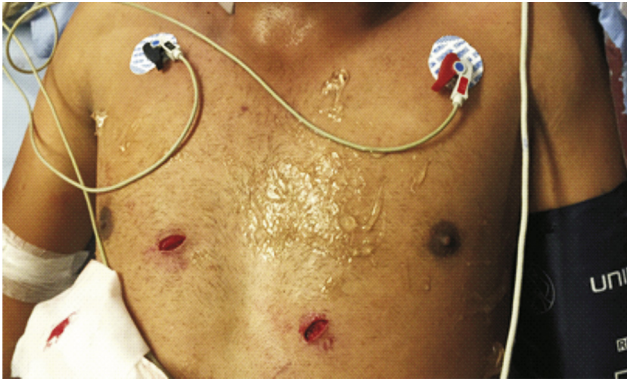
After the primary assessment, our diagnostic impressions were: possible right pneumothorax, possible cardiac injury.

Later, and with the intention of accurate decision-making, extended-focused assessment with sonography in trauma (E-FAST) was performed with palm size ultrasound scanner (Welld 3100-Shenzhen China), using initially convex transducer (2.5–5.5 MHz) for the conventional FAST scan, which was negative for intraperitoneal free fluid, but with a confirmatory image of hemopericardium seen in the subcostal window (Figure 3). Subsequently with linear transducer 7.5–9.5 MHz we looked for pneumothorax, confirming the absence of pulmonary sliding in the right anterior chest (right pneumothorax). It was also found an anechoic image at right costodiaphragmatic recess, suggesting superimposed hemothorax.

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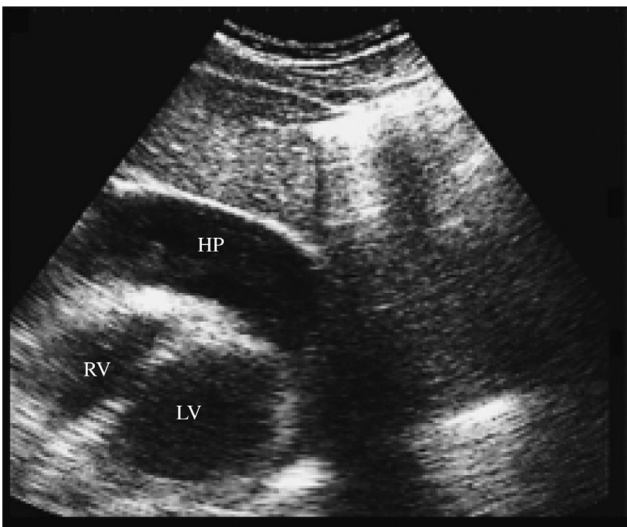
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**Figure 1.** Right thoracic wound with air leakage (pneumothorax). Left: Precordial wound.



**Figure 2.** ST depression suggesting cardiac injury.



**Figure 3.** Hemopericardium. Note that the ventricles are not collapsed. LV: Left ventricle; RV: Right ventricle; HP: Hemopericardium.

After completing the E-FAST, and with the surgery team awaiting for the patient, we concluded that hypotension was not due to hypovolemia but to the combined effects of pneumothorax and hemopericardium, as hemothorax was not significant. We considered this a susceptible patient for low-volume resuscitation or controlled hypotension given his preservation of the state of consciousness<sup>[4]</sup>. Also, given the absence of right cavities collapse, pericardiocentesis in the Emergency Department was

not necessary, as the patient underwent surgery almost immediately after the confirmation of diagnostic impressions.

Finally, in the operating room right hemopneumothorax, one centimeter left ventricle injury, an associated hemopericardium were documented. After a short ICU admission, patient was discharged without complications.

### 3. Discussion

Early mortality in emergency departments by thoracoabdominal trauma usually occurs secondary to hypovolemic shock, and/or the mechanical complications of pneumothorax and/or hemopericardium, leading to tamponade and cardiac arrest. The initial approach of major lesions responsible for mortality can be performed ultrasonographically.

Hemopericardium is an accumulation of blood in the pericardium virtual space, between the visceral and parietal pericardium. In the context of trauma, when it leads to hemodynamic collapse called pericardial tamponade, due to a restrictive mechanism of ventricular filling, initially in the right cavities, significantly reducing preload (and therefore reducing cardiac output), and finally compromising left ventricle filling. It presents in only 2% of penetrating chest trauma, however, 60%–80% of precordial penetrating wounds, will have hemopericardium. Beck triad has been traditionally recognized as a classic triad of signs suggesting pericardial tamponade, which consisted of hypotension, distended jugular veins and diminished heart sounds, but these are only present in 20% of the patients having pericardial tamponade<sup>[5,6]</sup>. The diagnosis requires a high clinical suspicion. Given that clinically, it can be easily confused with tension pneumothorax or massive hemothorax. The diagnosis should be determined rapidly by ultrasound, which shows a hypochoic image that separates the visceral and parietal pericardium. It is usually significant when bleeding is greater than 1 cm in size between the pericardium sheets. Variants in minor bleeding can lead to instability, which should be taken into account<sup>[7]</sup>.

Pericardial tamponade occurs when ultrasound B mode (brightness) is observed right cavities collapse associated with pericardial effusion and hemodynamic instability.

#### 3.1. Pneumothorax definition and diagnosis

Pneumothorax is defined as the presence of air in the pleural cavity, which can lead to lung collapse, making it a medical emergency that requires immediate intervention after diagnosis<sup>[8]</sup>. The symptoms depend on the magnitude of the pneumothorax and the respiratory functional reserve of the patient<sup>[9]</sup>.

Identification of pneumothorax starts with the clinical suspicion and physical examination. The diagnostic images confirm the suspicion, ideally chest X-ray, bedside chest ultrasound, and CT scan, which require the movement of the patient.

#### 3.2. Chest X-ray

Since the patient presenting to the Emergency Department could have a disease that potentially risks his life, a portable chest X-ray should be performed at the bedside, given that the hemodynamic instability, psychomotor agitation and severity of thoracic lesions contraindicate the transfer to radiology room.

Supine chest X-ray, shows the “sign of the deep sulcus”, which represents the presence of air in the pleural space, which places in the non-dependent portion and abnormally distended costophrenic recess, projecting to the ipsilateral upper quadrant of the abdomen<sup>[10]</sup>. One of the disadvantages of this projection is that it is essential that the portable X-ray always include the whole costophrenic angle and the thoraco-abdominal region<sup>[11]</sup>.

The usefulness of chest X-ray and CT in the study of the pneumothorax is perfectly defined<sup>[12]</sup>, however, in emergency departments that have the availability of ultrasound, the realization of point of care thorax ultrasound, actively looking for pneumothorax is a validated alternative, with a sensitivity of 93%, and a specificity of 96%.

### 3.3. Signs of pneumothorax on ultrasound

#### 3.3.1. Lung sliding

The displacement of the lung into the chest cavity during breathing produces an alteration in the pleural line called ultrasonographically “lung sliding”. It is a basic sign of normalcy due to movement of the visceral pleura over the parietal pleura<sup>[12,13]</sup>. The presence of pulmonary sliding excludes pneumothorax with a sensitivity of 100% and a negative predictive value. Its absence, however, is not synonymous with pneumothorax, because it can be abolished in patients with massive atelectasis, intubation in a main bronchus, pulmonary contusion, chronic obstructive pulmonary disease or acute respiratory distress syndrome<sup>[14]</sup>.

#### 3.3.2. B lines

B lines are lines that originate in the pleura, with a vertical trajectory that usually move together with pleural sliding, their presence excludes pneumothorax in the evaluated area.

#### 3.3.3. Lung point

Representing the transition of a normal pleural sliding to the point where the pneumothorax begins, in B mode, it can be observed an area of slide and an area of absence of sliding, in the same picture. In motion mode (m), it can be seen the pattern of normal sea and sand and at the same image the transition to the sign of the stratosphere, corresponding to the lung point.

Taking into account the earlier facts, in an unstable patient with chest pain, shortness of breath and hyperresonance, a standard ultrasound without the sign of pulmonary sliding, and the lung point signs, pneumothorax are confirmed<sup>[12,13,15]</sup>.

### 3.4. Ultrasound vs. decubitus X-ray comparison

The thorax ultrasound has greater specificity than chest radiography in the detection of pneumothorax in the patient lying<sup>[16,17]</sup>.

Systematic reviews have demonstrated the superiority of the thorax ultrasound compared with supine X-ray in the initial approach<sup>[18,19]</sup>. This is how the chest ultrasound becomes a diagnostic aid that provides higher sensitivity compared to radiography in the detection of pneumothorax in patients with penetrating chest trauma or polytrauma, particularly in those pneumothorax which are of medium and small size.

Regarding hemothorax, the images are similar to those of a pleural effusion, corresponding to an anechoic image that initially is seen in the costodiaphragmatic angles when

performing the E-FAST, and according to the extent of the bleeding, it can be found in the upper portions of the thorax<sup>[20,21]</sup>.

The evolution of ultrasound for the approach of patients with trauma has allowed it to pass from FAST to the E-FAST. The conventional FAST involves the completion of 4 traditional windows, searching free fluid. In the hepatorenal area (Morrison area), an anechoic image between the liver and the kidney suggests bleeding.

In the cardiac window (below xiphoid process), the objective is to evaluate the heart, looking for collapse of cavities that suggests secondary tamponade and hemopericardium.

In the splenorenal window, it applies the same concept as in the hepatorenal window, and finally the suprapubic window, which seeks for liquid in the retrovesical portion.

The incorporation of the extension of the FAST to chest has allowed the active search for the additional two pathological pneumothorax and hemothorax<sup>[22–24]</sup>.

With the ultrasound performed by physicians (not radiologists), ultrasound allows the complement to the physical examination and the confirmation of an initial diagnosis that can lead the patient to death if it is not treated early. In the context of trauma the major lesions are pneumothorax, hemothorax, hemopericardium and hemoperitoneum.

The cost effectiveness of ultrasonography and its learning curve, make this a necessary skill in the Emergency Department receiving polytrauma patients in which successful decision-making contribute to decrease the morbidity and mortality<sup>[19]</sup>.

### Conflict of interest statement

The authors report no conflict of interest.

### References

- [1] Durso AM, Caban K, Munera F. Penetrating thoracic injury. *Radiol Clin North Am* 2015; **53**(4): 675-93.
- [2] Mandavia DP, Joseph A. Bedside echocardiography in chest trauma. *Emerg Med Clin North Am* 2004; **22**(3): 601-19.
- [3] Tayal VS, Beatty MA, Marx JA, Tomaszewski CA, Thomason MH. FAST (focused assessment with sonography in trauma) accurate for cardiac and intraperitoneal injury in penetrating anterior chest trauma. *J Ultrasound Med* 2004; **23**(4): 467-72.
- [4] Bickell WH, Wall MJ Jr, Pepe PE, Martin RR, Ginger VF, Allen MK, et al. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. *N Engl J Med* 1994; **331**(17): 1105-9.
- [5] Lee TH, Ouellet JF, Cook M, Schreiber MA, Kortbeek JB. Pericardiocentesis in trauma: a systematic review. *J Trauma Acute Care Surg* 2013; **75**(4): 543-9.
- [6] Schiavone WA. Cardiac tamponade: 12 pearls in diagnosis and management. *Cleve Clin J Med* 2013; **80**(2): 109-16.
- [7] Saito Y, Donohue A, Attai S, Vahdat A, Brar R, Handapangoda I, et al. The syndrome of cardiac tamponade with “small” pericardial effusion. *Echocardiography* 2008; **25**(3): 321-7.
- [8] Zarogoulidis P, Kioumis I, Pitsioux G, Porpodis K, Lampaki S, Papaiwannou A, et al. Pneumothorax: from definition to diagnosis and treatment. *J Thorac Dis* 2014; **6**(Suppl 4): S372-6.
- [9] Grupo de Trabajo de la SEPAR. Diagnostic criteria and treatment of pneumothorax. *Arch Bronconeumol* 2002; **38**: 589-95.
- [10] Tseng YH, Liu KL, Shih IL. Deep sulcus sign. *Emerg Med J* 2012; **29**(7): 608.
- [11] Gordon R. The deep sulcus sign. *Radiology* 1980; **136**: 25-7.
- [12] Lichtenstein D, Mezière G, Biderman P, Gepner A. The “lung point”: an ultrasound sign specific to pneumothorax. *Intensive Care Med* 2000; **26**(10): 1434-40.

- [13] Volpicelli G. Lung ultrasound for pneumothorax: elementary considerations. *Am J Emerg Med* 2014; **32**(12): 1545.
- [14] Slater A, Goodwin M, Anderson KE, Gleeson FV. COPD can mimic the appearance of pneumothorax on thoracic ultrasound. *Chest* 2006; **129**: 545-50.
- [15] Lichtenstein D, Mezière G, Biderman P, Gepner A. The comet-tail artifact: an ultrasound sign ruling out pneumothorax. *Intensive Care Med* 1999; **25**(4): 383-8.
- [16] Alsalim W, Lewis D. Towards evidence based emergency medicine: best BETs from the Manchester Royal Infirmary. BET 1: is ultrasound or chest X ray best for the diagnosis of pneumothorax in the emergency department? *Emerg Med J* 2009; **26**(6): 434-5.
- [17] Raja AS, Jacobus CH. How accurate is ultrasonography for excluding pneumothorax? *Ann Emerg Med* 2013; **61**(2): 207-8.
- [18] Wilkerson G, Stone MB. Sensitivity of bedside ultrasound and supine anteroposterior chest radiographs for the identification of pneumothorax after blunt trauma. *Acad Emerg Med* 2010; **17**: 11-7.
- [19] Lichtenstein DA. Ultrasound in the management of thoracic disease. *Crit Care Med* 2007; **35**(5 Suppl): S250-61.
- [20] Hyacinthe AC, Broux C, Francony G, Genty C, Bouzat P, Jacquot C, et al. Diagnostic accuracy of ultrasonography in the acute assessment of common thoracic lesions after trauma. *Chest* 2012; **141**(5): 1177-83.
- [21] Rippey JC, Royse AG. Ultrasound in trauma. *Best Pract Res Clin Anaesthesiol* 2009; **23**(3): 343-62.
- [22] Abdulrahman Y, Musthafa S, Hakim SY, Nabir S, Qanbar A, Mahmood I, et al. Utility of extended FAST in blunt chest trauma: is it the time to be used in the ATLS algorithm? *World J Surg* 2015; **39**(1): 172-8.
- [23] Brun PM, Bessereau J, Chenaitia H, Pradel AL, Deniel C, Garbaye G, et al. Stay and play eFAST or scoop and run eFAST? That is the question! *Am J Emerg Med* 2014; **32**(2): 166-70.
- [24] Ianniello S, Di Giacomo V, Sessa B, Miele V. First-line sonographic diagnosis of pneumothorax in major trauma: accuracy of e-FAST and comparison with multidetector computed tomography. *Radiol Med* 2014; **119**(9): 674-80.