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Immediate sonography and intervention in blunt chest trauma: A case report

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Abstract

Cardiac tamponade is a leading cause of death in blunt thoracic trauma. Ultrasound improved the recognition of cardiac tamponade and therefore has a vital role in acute critical situations in the Emergency Department and in the Intensive Care Unit. Besides recognition of cardiac tamponade, treatment protocols are important. In trauma patients with hemodynamic stable cardiac tamponade, time should be taken for a proper workup for an explorative sternotomy. In hemodynamic unstable trauma patients, the pericardium should be drained, and fluid resuscitation should be performed followed by emergency sternotomy. In this case report we describe a blunt thoracic trauma victim, a 28-year-old male patient without any medical history. He suffered from the unique combination of a tear in the left atrial appendage and a papillary muscle rupture of the right ventricle because of blunt thoracic trauma. Transthoracic echocardiography revealed massive pericardial effusion with diastolic collapse of the right ventricle in our patient. Due to his hemodynamic situation, the patient was brought into the OR for immediate sternotomy and cardiac repair. The patient made a full recovery, was discharged home, and is back to work. This case report emphasizes the relevance of early recognition and treatment of cardiac tamponade in blunt thoracic trauma victims and suggests a multidisciplinary management strategy.

Keywords

Blunt thoracic trauma, sonography, cardiac tamponade, sternotomy, case report

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Introduction

Blunt chest trauma requires appropriate management in Emergency Departments using the Advanced Trauma Life Support principles to rule out life-threatening diagnoses.[1] Shock is one of these devastating diagnoses and is still a major cause of early deaths in trauma patients.[2] Hemorrhage is the primary cause of shock in trauma patients, but there are several nonhemorrhagic causes of shock. Cardiac tamponade is one and has to be excluded in the initial assessment.[1] Cardiac tamponade is defined as the accumulation of fluid (blood in trauma patients) in the pericardial space, which is compromising cardiac function.[1] Claude Beck described cardiac tamponade in 1935 as a clinical diagnosis with the classic triad of muffled heart sounds, jugular vein distention, and hypotension. The introduction of ultrasound in the Emergency Department and in the Intensive Care Unit improved the diagnostic accuracy of recognizing cardiac tamponade.[3] The extended Focused Assessment with Sonography in Trauma (eFAST) can identify pericardial effusion.[4] If fluid is present and the patient is in a hemodynamic stable situation, transthoracic echocardiography should determine if there are physiologic signs of cardiac tamponade.[5] In hemodynamic unstable thoracic trauma patients, the pericardium should be drained, and fluid resuscitation should be performed followed by emergency sternotomy.[6]

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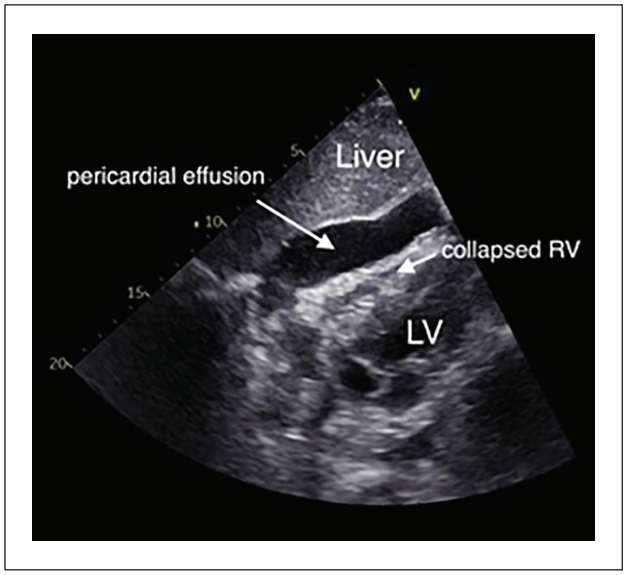

Figure 1. Transthoracic echocardiography subcostal view using eFAST in the Emergency Department; arrows indicate pericardial effusion and diastolic collapse of the right ventricle (RV); left ventricle (LV).
eFAST: extended Focused Assessment with Sonography in Trauma.

Case history

Patient X, a 28-year-old male patient, presented at our Emergency Department after a motor vehicle accident. There had been a head-on traffic collision at a speed of 80 kilometers per hour. Paramedics observed a conscious patient with an oxygen saturation of 85% who was complaining about a painful right leg. The patient was stabilized on a backboard with a cervical collar and brought to the Emergency Department of our hospital.

Patient was treated by our dedicated trauma team following the principles of ATLS.[1] There was a patent airway and he received 15 liters per minute of oxygen from a non-rebreathing mask and was tachypneic. His oxygen saturation was 93% and there were decreased breathing sounds on his left side. A chest X-ray revealed a left-sided pneumothorax, and a chest tube was placed. Patient was hemodynamically stable with a blood pressure of 130 over 80 millimeters of mercury and a heartrate of 90 beats per minute, two normal heart sounds were heard, without murmurs. His sternal capillary refill time was two seconds and there were no signs of blood loss. Transthoracic echocardiography (TTE) according to the eFAST protocol showed a significant pericardial effusion.[4] There were no signs of neurological deficit, and the patient had a luxation of his right hip.

The patient was sedated and intubated for further diagnostic workup. His circulatory condition deteriorated. Repeated TTE revealed a large pericardial effusion with a diastolic collapse of the right ventricle, matching with cardiac tamponade, on abdominal echo, no intra-abdominal fluid was detected (Figure 1). The cardiothoracic team took over and he was brought to the Operating room (OR) for emergency sternotomy. During transport to the OR, his circulatory condition collapsed so he required cardiopulmonary resuscitation with return of spontaneous circulation. A median sternotomy was performed, and 300cc blood was evacuated from the pericardial sac with recovery of hemodynamics. Intraoperative transesophageal echocardiography (TEE) showed a massive tricuspid valve regurgitation due to papillary muscle rupture (Figure 2). Cardiopulmonary bypass was initiated. Exploration for a bleeding focus revealed a tear in the left atrial appendage and was managed with a left atrial appendage closing device. The tricuspid valve was repaired by reimplantation of the papillary muscle. Postoperative TEE showed no tricuspid regurgitation and a good left and right ventricular function.

Patient was brought to the Intensive Care Unit. Trauma screening with a total-body CT-scan was performed: bilateral lung contusions, right acetabulum fracture, stable cervical spine (C1) fracture, and a small dissection of the right iliac artery. There were signs of free fluid in the abdomen without signs of parenchymal organ defects. ICU stay was uncomplicated, and the patient was discharged the next day to the trauma ward. The acetabulum fracture was surgically fixed after a few days. The patient made a full recovery, was discharged home in good condition and is back to work.

Discussion

Anatomy

Blunt cardiac injury is related to motor vehicle accidents and might result in myocardial contusion, cardiac chamber rupture, dissection of a coronary artery, or valvular dysfunction. Aortic rupture is a common cause of immediate deaths in these patients. Patients with an incomplete rupture will survive with proper identification and treatment.[1] The right-side of the heart is more prone to injury because of its anterior position in the chest cavity. Besides that, the sudden deceleration forces and compression of the heart are leading to shear stress and a sudden increase in intracardial pressure in all compartments of the heart.[7] Mitral valve involvement is most common after blunt cardiac injury, followed by aortic, tricuspid, and pulmonary valve involvement.[7]

Pericardial effusion

A traumatic cause of pericardial effusion can result rapidly into cardiac tamponade. The diagnostic accuracy of physical findings of cardiac tamponade are not proven in trauma patients.[8] In acute critical situations it is impossible to take a detailed history and physical examination. Therefore, the role of ultrasound is inevitable in diagnosing life-threatening cardiac tamponade.

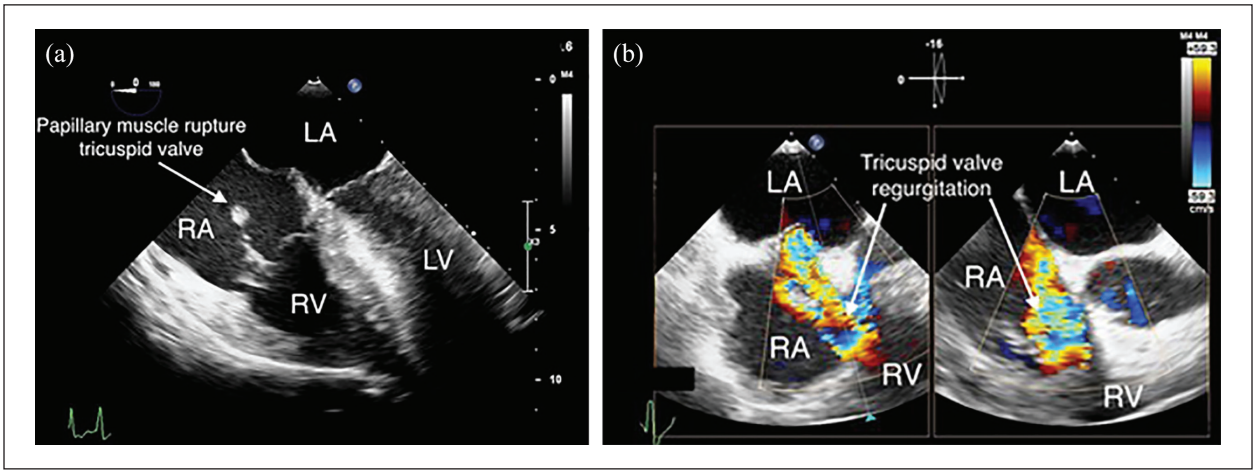

Figure 2. Intraoperative transesophageal echocardiography. (a) Mid-esophageal four-chamber view showing a ruptured papillary muscle of the tricuspid valve seen as an echo dense structure connected to the flail tricuspid valve (arrow) and (b) modified mid-esophageal four-chamber view focused on the tricuspid valve in biplane mode showing massive tricuspid valve regurgitation with color Doppler (arrows).
LA: left atrium; RA: right atrium; LV: left ventricle; RV: right ventricle.

Echocardiographic signs of cardiac tamponade

Since ultrasound has made its way into Emergency Medicine, the diagnostic accuracy to establish a cardiac tamponade has improved.[4] Pericardial effusion becomes a cardiac tamponade when the extra-cardial pressure in the pericardium exceeds the pressure in the cardiac chambers resulting in impaired cardiac filling and decreased cardiac output, therefore pericardial effusion and tamponade are not similar terms. The echocardiographic features of cardiac tamponade are right atrial collapse during systole, right ventricular collapse during diastole, significant reciprocal respiratory changes of right and left ventricular filling, and inferior vena cava dilation with blunted respiratory changes. These signs have a high sensitivity and specificity to diagnose cardiac tamponade in the acute care setting.[5,9]

Management of cardiac tamponade in blunt chest trauma

In all patients with blunt thoracic trauma, a life-threatening pericardial effusion with signs of cardiac tamponade needs to be ruled out. The role of ultrasonography is inevitable in the workup of these patients for a quick diagnosis. Echocardiographic evaluation needs to be repeated if hemodynamics deteriorate. If ultrasound confirmed the diagnosis of cardiac tamponade, immediate drainage of the pericardium and fluid resuscitation should be performed, followed by an emergency sternotomy.[6]

The surgical strategy for tamponade with hemodynamic deterioration and without pericardiocentesis is sternotomy and pericardiotomy to relieve the tamponade directly. This strategy also provides direct access for initiation of cardiopulmonary bypass if necessary. In the case of stable hemodynamics, connection of the cardiopulmonary bypass through femoral access can be considered. If cardiac surgery or cardiopulmonary bypass is not available in the trauma center, the decision should be made based on the hemodynamic situation of the patient. If hemodynamics are unstable, rapid infusion and pericardial drainage, or direct sternotomy/pericardiotomy with an attempt to repair cardiac injury. If hemodynamics are stabilized, the patient should be transferred to a hospital where cardiac surgery is available. If, during prehospital assessment, the suspicion of cardiac injury arises, patients should be directly designated to the right trauma center.

Pericardiocentesis is not a definitive option but can relieve the cardiac tamponade and stabilize the patient hemodynamically before sternotomy. The role of preemptive pericardiocentesis in trauma patients needs to be further investigated.

Conclusion

This case report emphasizes the relevance of early recognition and treatment of cardiac tamponade in blunt thoracic trauma and suggests a multidisciplinary management strategy.

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All the authors contributed equally and were all involved in writing this multidisciplinary case report.

Author contributions

All the authors contributed equally and were all involved in writing this multidisciplinary case report. M.v.M. and H.v.d.W. handled the correspondence with *SAGE Open Medical Case Reports*.

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Ethics approval

Our institution does not require ethical approval for reporting individual cases or case series.

Informed consent

Written informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

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