Cardiac tamponade is one of the critical findings that must be diagnosed early in the emergency department in posttraumatic unstable patient

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Cardiac tamponade is a life-threatening emergency, caused by an abnormal increase in fluid accumulation in the pericardium impeding cardiac filling. Cardiac tamponade is essentially a clinical diagnosis. Echocardiography is the test of choice when tamponade is clinically suspected. We report a case of successful management of traumatic cardiac tamponade. The patient was hemodynamically unstable, although chest radiograph and ultrasound showed only mild to moderate fluid collection. Transthoracic echocardiography helped confirm the diagnosis. The report emphasizes the importance of high possibility of cardiac tamponade in patients with penetrating chest injuries. It also highlights the value of echocardiography in the emergency room.

Keywords:
cardiac tamponade, echocardiography, stab, thoracotomy

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Introduction

The pericardial sac surrounds the heart. It has a serosal visceral layer and a fibrous parietal layer. Approximately 50 ml of fluid exists normally in the pericardial sac [1]. If there is fluid accumulation within the sac exceeding this amount, this is called pericardial effusion [2]. If the rate of fluid accumulation is rapid, the noncompliant fibrous nature of the pericardium leads to a rapid rise in intrapericardial pressure, obstructing normal cardiac filling and causing cardiac tamponade. Rapid bleeding into the pericardium that occurs in patients with penetrating chest injuries is an example. Hemodynamic instability can ensue if the condition is not rapidly managed [3]. Most traumatic pericardial effusion are the result of stab injuries to the chest. This could be owing to a sealing effect of the pericardium, preventing decompression of the bleeding from the wound in the myocardium [4]. The right ventricle is frequently injured [5,6]. Therefore, pericardial collection should be suspected in any patient with penetrating trauma to the chest. Cardiac tamponade manifestations are not specific. Patients usually present with tachypnea, tachycardia, and hypotension [7]. A famous clinical sign of tamponade is pulsus paradoxus [3]. Urgent transthoracic echocardiography (TTE) using both imaging and Doppler techniques is the test of choice for rapid assessment of the severity of effusion whenever cardiac tamponade is suspected [2]. There is no role for medical therapy in cardiac tamponade [8]. Definitive surgical management in traumatic cardiac tamponade includes surgical drainage of blood and repair of the underlying cardiac injury [9]. According to Heus *et al.* [10], the presence of signs of tamponade in a penetrating chest injury patient necessitates thoracotomy.

In this report, our patient was diagnosed to have cardiac tamponade following stabbing in the right ventricle. The diagnosis was based on clinical suspicion and confirmation by echocardiography. The challenge in our patient was that the chest radiograph and ultrasound showed only mild abdominal collection and mild left pleural effusion. There was no explanation for his hemodynamic instability.

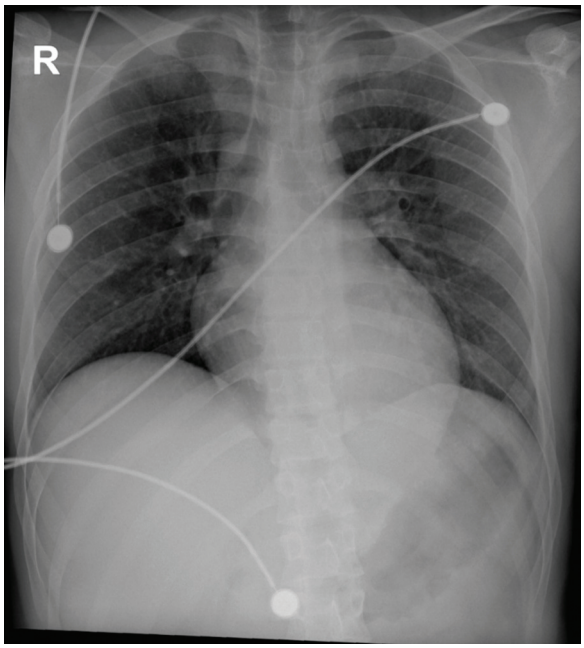
Case report

A 23-year-old male patient presented to the emergency department after being stabbed at the lower chest 30 min before arrival. The following parameters were recorded: weight, 66 kg; height, 170 cm; blood pressure, 90/55 mmHg; and heart rate, 110 beats/

min. The rhythm was sinus tachycardia. There was no visible neck venous congestion. He was fully conscious (GCS 15/15) yet complaining of agonizing chest and abdominal pain. Chest plain radiograph showed normal cardiothoracic ratio. There were no significant findings denoting pneumothorax or pleural collection (Fig. 1). Next, ultrasound was rapidly done. It showed mild left-sided subdiaphragmatic collection without splenic injury. Moreover, there was mild left-sided pleural effusion. The report did not comment upon pericardial collection in subcostal view; in this case, it was crucial to comment on this situation. This evaluation depends on operational experience, and as the operator is on call, it encourages all of the emergency physicians to upgrade themselves. Chest computed tomography showed moderate pericardial effusion with the density of blood (Fig. 2).

The patient's blood pressure started to drop, requiring inotropes in addition to fluid resuscitation. Chest radiograph and computed tomography were repeated as an effort to identify the etiology of hemodynamic instability, as echocardiography was not available at the time. They showed the same results. Hemoglobin level was 15 g/dl and decreased to 8.4 g/dl in the operating room, which required urgent blood transfusion. When bedside TTE was done, it showed the picture of massive pericardial collection more than computed tomography chest (Fig. 3). We decided to shift the patient to the operating room immediately for exploration.

Figure 1



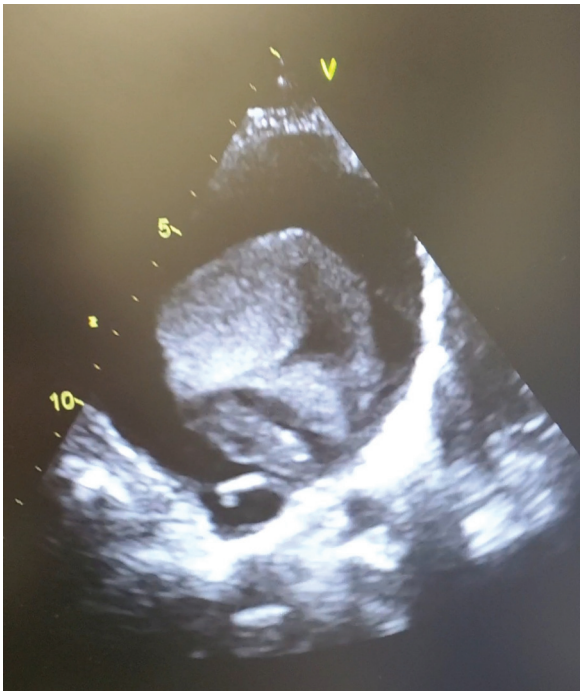
Chest radiograph showed normal cardiothoracic ratio with clear costophrenic angles.

He was hemodynamically unstable and required resuscitation with inotropic support. Surgery was done under general anesthesia and full monitoring,

Figure 2

CT chest showed moderate pericardial collection with radiodensity 70 Hounsfield units. CT, computed tomography.

Figure 3



TTE showed large pericardial effusion with swinging of the heart and right chambers collapse. TTE, transthoracic echocardiography.

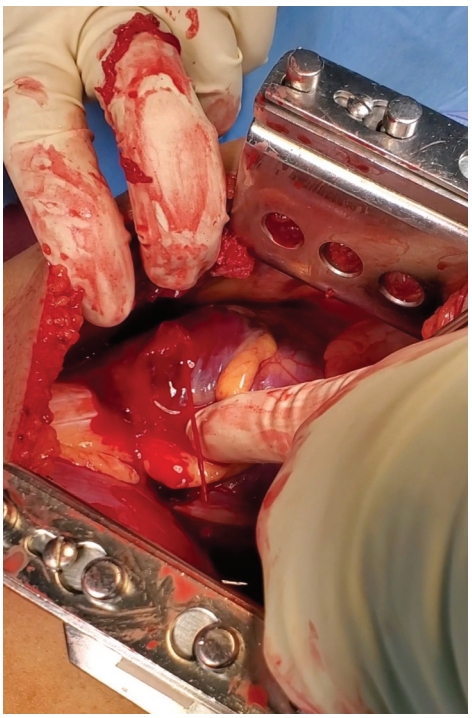
and left anterior mini-thoracotomy was done. It showed a large pleural collection with blood clots, and the pericardium was so tense that the heart pulsations could not be visualized (Fig. 4). After suction, the stabbed pericardium was directed toward the right heart chambers. Pericardial window was done anterior to the phrenic nerve. All blood was sucked out, and the stabbed heart was sealed with compression. The pericardial stitches were taken for better exploration of the heart. The injury was to the right of the left anterior descending coronary artery. Two pericardial patches were used to support the weak thin wall of the right ventricle using 4-0 prolene through the transverse mattress stitch to control bleeding. After the suture had been tied, an extra stitch was added to seal the bleeding site away from the left anterior descending artery. The stab was penetrating the right ventricle (Fig. 5). Blood pressure was stabilized with minimal inotropic support, and hemostasis was done. A chest tube was inserted and connected to an underwater seal. Finally, the thoracotomy wound was closed in layers.

The patient was extubated and transferred to the postoperative cardiac care unit. All inotropes were weaned off by the next day, and he started ambulation and physiotherapy. The chest drain was removed after 36 h. Echocardiography was done on the second day postoperatively. It showed decreased left ventricle function (myocardial stunning), and there was no pericardial effusion. A beta-blocker and an angiotensin-converting enzyme inhibitor were added to the treatment. On the fifth day, echocardiography was repeated before discharge. The left ventricular function improved with no pericardial collection. Moreover, chest radiograph showed fully inflated lungs with no pleural collection. The patient was seen in the outpatient clinic in a satisfactory condition with stable hemodynamics and a dry clean wound. He resumed his normal activities within 2 weeks after discharge.

Discussion

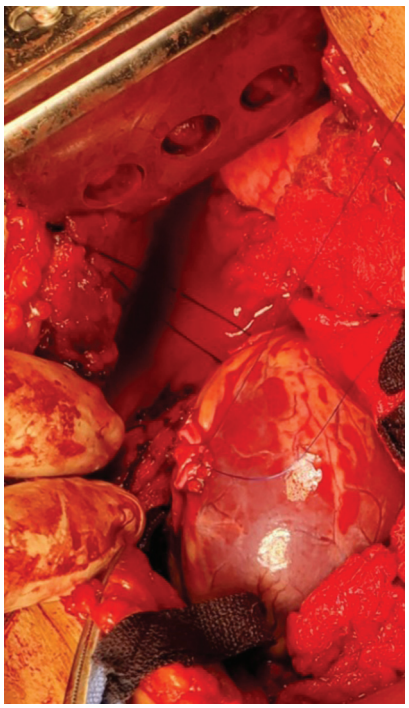
Cardiac tamponade is a medical emergency where an abnormal amount of fluid accumulating in the pericardium compresses the heart, which reduces the venous return and the cardiac output [11]. Rapid diagnosis and well-timed drainage of the pericardial fluid is life-saving, especially in acute traumatic cardiac tamponade, owing to its rapid onset. Cardiac tamponade is mainly a clinical diagnosis. A high level of suspicion must exist when dealing with patients with penetrating chest injuries. Patients present with tachypnea, tachycardia, and hypotension in advanced tamponade. Mishra *et al.* [5] concluded that hypotension at presentation was significantly related to high mortality. Instable hemodynamics and high central venous pressure with congested neck veins are usually present. Beck's

Figure 4



Anterior thoracotomy showed tens pericardium with active bleeding through the stab injury.

Figure 5



Pericardial patch repair of the right ventricular on beating heart.

triad (high jugular venous pressure, severe hypotension, and muffled heart sounds) can aid diagnosis when identified [7]. Unfortunately, Beck's triad is difficult to witness in a hypovolemic patient [5]. Pulsus paradoxus is a clinical hallmark for cardiac tamponade. It is the abnormal decrease in blood pressure with inspiration. More than 10 mmHg decrease in systolic blood pressure is considered significant [12]. However, intubated patients and those on positive pressure ventilation do not experience the normal inspiratory fall in intrathoracic pressure [3].

An important determining factor in the occurrence of cardiac tamponade is the rapidity of fluid accumulation. That is why traumatic hemopericardium can cause hemodynamic instability even if the amount of accumulated blood is small versus pericardial effusions from medical causes as malignancy [11]. This can explain the absence of chest radiograph findings suggestive of significant pericardial collection in our patient. The accumulation of more than 200 ml of pericardial fluid will cause enlargement of cardiac silhouette in chest radiography. Left-sided pleural effusion and an increase in transverse cardiac diameter are specific but not sensitive [13]. Focused assessment by sonography can detect cardiac tamponade in patients with trauma. Different studies remarked its high diagnostic accuracy and sensitivity [14–16]. However, urgent TTE is the test of choice for rapid diagnosis and assessment of the severity of tamponade when there is suspicion based on the history and physical examination [2]. An important sign of tamponade is inferior vena cava plethora [17]. Cardiac chamber invagination is also characteristic. Right atrial invagination occurs first because of its thin wall and low pressure. The right ventricle is the next chamber to collapse. When tamponade is severe, the left atrium can be seen to collapse [3]. According to Mercé *et al.* [14], there is a good correlation between absence of chambers collapse and absence of tamponade. In addition, enhanced reciprocal changes in ventricular dimensions is an echocardiographic marker of pulsus paradoxus [3]. Exaggerated respiratory variations in transvalvular velocities are also characteristic [8,18,19].

Our case report emphasizes the importance of the clinical diagnosis of cardiac tamponade. Close hemodynamic monitoring would reveal early changes, indicating tamponade. Failure to recognize a tamponade owing to the absence of echocardiographic findings can be life-threatening. Thus, echocardiography should be used as a confirmatory tool [20]. There is no role for computed tomography or MRI in acute collection requiring urgent management [8].

There are continued research efforts trying to find a novel screening tool to help early prediction of tamponade. Doukky *et al.* [21] validated oximetry paradoxus as a simple test using respirophasic changes in the amplitude of plethysmography waveforms. Duanmu *et al.* [22] introduced a simplified prediction score with four variables (systolic blood pressure, effusion diameter, right ventricular diastolic collapse, and mitral valve inflow variation). They concluded it can accurately predict the need for urgent pericardial drainage.

Immediate thoracotomy has been considered the definitive option for cardiac penetrating trauma. Groombridge *et al.* [23] mentioned that one of the indications of resuscitative thoracotomy is the presence of a strong clinical suspicion of tamponade or cardiac injury in patients with chest trauma. Although pericardiocentesis had previously been considered a bridge to surgical therapy [24], it is worth mentioning that the evidence supporting that is of evidence level 4 [5,25,26]. The possibility of blood clotting is one of the reasons of the limited use of pericardiocentesis. The clotted blood can give false-negative results if pericardiocentesis is used for diagnostic purposes and may lead to failure to completely relieve tamponade [4]. Although Lee *et al.* [26] in their systematic review concluded that survival rate for patients who had thoracotomy after pericardiocentesis was significantly higher than those who had thoracotomy only, they explained that the reported cases in the included studies were of varying severity and follow-up periods. The number of cases were small, and there was a lack of adequate control groups [26].There is no role for medical therapy in cardiac tamponade, especially in traumatic injured cases, but fluid resuscitation may be helpful in hypovolemic patients while preparing for definitive surgical management [8]. However, after maximum diastolic ventricular filling is reached, increases in intravascular volume and pressure will disproportionately distend the right atrium and ventricle, decreasing the left ventricular end-diastolic volume. The presence of Kussmaul's sign was suggested as a sign that the limit of pericardial constraint has been exceeded [27]. Inotropic agents are generally ineffective [28]. If the heart rate is abnormally low, increasing heart rate and reversing decreased systolic contractility using an inotropic/vasopressor agent may be considered [27].

Conclusion

Cardiac tamponade is a critical, life-threating condition that must be kept in mind, especially in patients with penetrating chest trauma with unexplained hemodynamic instability. Echocardiography is mandatory in the emergency rooms as a confirmatory tool whenever clinical suspicion exists. Rapid synchronization between all team members can help save the patient's life.

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Conflicts of interest

There are no conflicts of interest.

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