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Cardiac

Pericardial rupture and cardiac herniation in blunt trauma

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ABSTRACT

Pericardial rupture in blunt trauma is rarely seen on computed tomography (CT) imaging due to its high initial mortality. We report a case of a 53-year-old man who presented to the Emergency Department in hemodynamic shock after intentional fall from height. Chest radiograph, which was taken in the trauma bay as a part of his primary survey, showed abnormal mediastinum contour with pneumopericardium. Pericardial rupture with cardiac herniation, and tamponade secondary to pneumopericardium, was diagnosed on trauma CT scan. The patient underwent emergent surgical management with thoracotomy to reduce the herniation and repair the pericardium. Immediate suspicion for pericardial and cardiac injury on the initial chest radiograph and rapid diagnosis on CT was indispensable for this patient's favorable outcome.

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Introduction

Injuries to the heart and pericardium in blunt trauma are uncommon and the presence of such injuries indicates the patient suffered a high mechanism of injury. Most commonly pericardial rupture involves the left pleuropericardium, followed by the diaphragmatic and right pleuropericardium. In the setting of trauma, pericardial rupture can be recognized on radiography by abnormal contour and position of the heart, and the presence of pneumopericardium. It is important to recognize these findings early on the portable chest radiograph as blunt trauma patients often have suffered polytrauma and clinical examination may be difficult or unreliable. Prompt recognition of injury on the radiograph allows for expedition of computed tomography (CT) imaging and preparation for emergent surgery. CT aids in making the diagnosis and allows for

evaluation for sequela, including of cardiac herniation through the pericardial defect and strangulation, or tamponade. The imaging findings of tamponade on CT include small heart size with decreased filling of the cardiac chambers, enlarged vena cava, periportal lymphedema, and reflux of CT contrast material into the inferior vena cava and azygos vein. Recognizing blunt pericardial rupture, cardiac herniation, and tamponade is important as these patients are at very high risk of death due to hemodynamic shock without rapid surgical intervention.

Case report

A 53-year-old man jumped 25-feet from a bridge onto concrete and was found to be unresponsive and hypotensive at the scene. Heart sounds were muffled on auscultation and there

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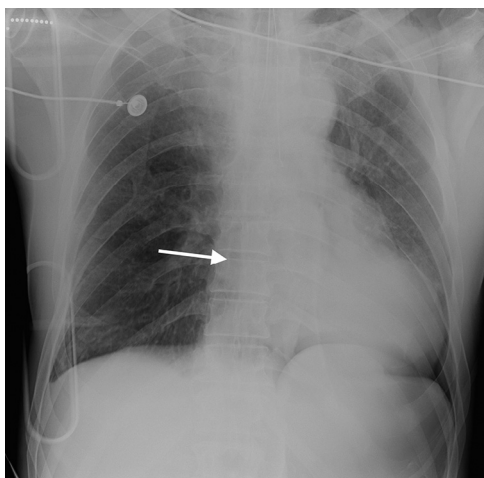


Fig. 1 – Portable chest radiograph shows pneumopericardium (arrow) with loss of the right heart border and leftward shift of the mediastinum. There is a left deep sulcus sign indicating a left pneumothorax in this supine patient.

were decreased left breath sounds. Electrocardiogram showed atrial fibrillation with rapid ventricular response with heart rate of 128 beats per minute. On arrival to the Emergency Department, a bedside ultrasound examination was performed and the heart was not in its normal anatomical location.

The portable chest radiograph performed in the trauma bay showed lucency at left lung base representing an anterior pneumothorax, loss of the left heart border with slight leftward shift of the mediastinum, and pneumopericardium (Fig. 1). Based on these findings, a CT angiogram of the chest was performed, as part of trauma CT protocol, which showed posterior and leftward rotation of the heart, left pneumothorax, and pneumopericardium with compression of the cardiac chambers (Figs. 2 and 3). The presence of pneumopericardium aids

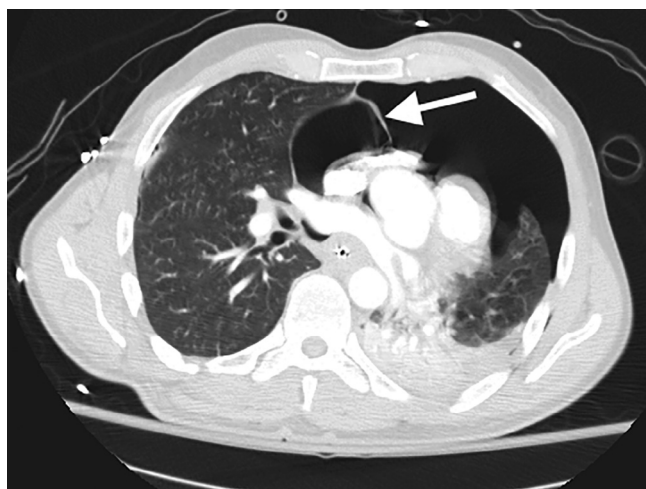


Fig. 2 – Axial image from computed tomography angiography of the chest shows left pneumothorax and pneumopericardium. The pneumopericardium highlights the pleuropericardial membrane (arrow).



Fig. 3 – More caudal axial computed tomography image shows complete dependent levoposition of the heart. There is compression of the ventricles, particularly the right ventricle, indicating decreased cardiac chamber filling and tamponade.

in visualization of the pleuropericardial membrane, which shows a defect at its left aspect. This pericardial defect was sufficient in size to allow herniation of right and left ventricles into the pleural space, pulling the proximal ascending aorta and the central vena cava into the pericardial space. These CT imaging findings were pathognomonic for the diagnosis of pericardial rupture with cardiac herniation, and tamponade.

As the CT findings confirmed diagnosis, and provided anatomical information regarding the tear and tamponade as the cause of the patient's hemodynamic lability, the patient was taken emergently to surgery. Video assisted thoracoscopic surgery through a left approach affirmed the CT findings of a large pericardial laceration lateral to the phrenic nerve and extending from the aortic root to the diaphragm. The laceration measured up to 9 cm in length. The presence of cardiac herniation through the pericardial defect made repair technically difficult and the case was converted to thoracotomy. The cardiac herniation was manually reduced but primary repair of the pericardial defect was not possible due to swelling of the herniated heart limiting pericardial closure. A Gore-Tex patch was sewn over the defect in the pericardium to repair the defect and prevent re-herniation (Fig. 4).

This blunt trauma patient had multiple additional injuries, including orthopedic fractures requiring fixation, and required a lengthy hospital stay. He subsequently recovered well and suffered no adverse cardiac outcome.

Discussion

Pericardial rupture is seen in less than 0.5% of patients presenting after blunt trauma, and cardiac herniation through a pericardial defect is a rare complication of this injury [1]. Most commonly the tear involves the left pleuropericardium,



Fig. 4 – Postoperative computed tomography performed approximately 2 weeks later, for assessment of hospital acquired pneumonia, shows the thin linear hyperdensity of the patch repair along the left pericardium (arrow).

followed by the diaphragmatic pericardium, and much less commonly the right pleuropericardium. If the pericardial opening is large enough, measuring approximately 8 to 12 cm in size, the heart can herniate through the pericardial defect [2]. Cardiac herniation can cause torsion of the inferior vena cava and great vessels, or strangulation of the herniated heart, leading to cardiogenic shock and sudden death [1,3]. In some instances, the cardiac herniation can be asymptomatic and go unrecognized [2].

Radiographic findings of pericardial rupture may include a continuous diaphragm sign or unusually clear contour of the heart due to pneumopericardium. There is often an accompanying ipsilateral pneumothorax. In right pericardial rupture the radiograph may simulate dextrocardia with a left aortic arch. In left pericardial rupture the cardiac silhouette may be boot-shaped [3].

On CT, the defect in the pericardium may be directly visible when outlined by air. If there is accompanying cardiac herniation, the heart will be displaced through the tear and will be dependent in position in the pleural space. A collar or waist can be visible where there is constriction by the pleuropericardial defect at the site of herniation [2,3]. Differentiation of pneumopericardium from pneumomediastinum is important. Pneumopericardium, unlike pneumomediastinum, is limited by the pericardial reflection and surrounds the heart and origins of the aorta and main pulmonary artery. Also with pneumopericardium the air is contiguous and

nondependent in the supine patient, rather than streaky air between intervening connective tissue representing pneumomediastinum. Pneumopericardium is air within a limited potential space and can result in cardiac tamponade and resultant hemodynamic instability [3]. Tamponade in pericardial rupture is due to the pericardial flap functioning as a one-way valve between the pleura and the pericardium, allowing influx of air which is trapped within in the pericardial space [4]. Cardiac tamponade can be seen on CT as compression of the heart chambers by the air in the pericardial space which results in a small heart size. Limited ability of the heart chambers to expand and fill results in enlargement of the superior or inferior vena cava, periportal lymphedema, and reflux of contrast material into the inferior vena cava or azygos vein [3]. Paradoxical bowing of the interventricular septum towards the left ventricle may also be seen following contrast administration [5].

Though pericardial rupture is rarely seen in patients presenting with blunt trauma, it carries a significant risk of complication and high mortality, especially if there is tamponade or cardiac herniation. When present, pericardial rupture also indicates the patient suffered a high-energy mechanism of blunt trauma and these patients often have multiple other coexisting injuries which contribute to increased morbidity and mortality [1]. The early recognition of pericardial rupture by the radiologist is imperative to raise suspicion of cardiac tamponade as cause for hemodynamic instability, and warrants evaluation for cardiac herniation or strangulation. Timely thoracotomy, alleviation of tamponade, and reduction of cardiac herniation can be lifesaving.

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