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Seminars in
ROENTGENOLOGY

Blunt Cardiothoracic Trauma: Common Injuries and Diagnosis

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Introduction

Traumatic injuries are the leading cause of death for persons under the age of 44.[1] Among causes of blunt traumatic injury motor vehicle accident remains the leading cause of death in the United States.[1,2] Thoracic injury is the third most common cause of trauma, following head and extremity injuries. Thoracic traumatic injuries have a high morbidity and mortality and are associated with 25% of trauma-related deaths.[2] Imaging plays an essential role in the evaluation of nonpenetrating (blunt) trauma patients, as many fatal injuries may not be apparent on direct physical examination. Initial evaluation is often performed with an anteroposterior chest radiograph (x-ray), to allow for detecting of emergent findings and stabilization of the patient. The detection of life-threatening injuries on chest x-ray, such as tension pneumothorax, signs of aortic injury, and hemothorax provide an opportunity for supportive actions such as placement of chest tubes and expediting more complete evaluation with computer tomography (CT).[3] Institutional protocols for trauma pan-scan vary and can include selective imaging or whole body CT. However, CT angiography of the chest should be performed when there is suspicion of traumatic aortic injury.[4]

Mediastinal Injuries

Injuries to the mediastinum are most commonly seen in blunt trauma when there is rapid deceleration of the patient, such as high speed motor vehicle accidents or falls from a height.[5,6] These high mechanism deceleration injuries particularly increase the risk for acute traumatic aortic injury, which has high mortality and requires prompt diagnosis and management.[2,6] Less common sites of trauma to the mediastinum include injuries to the branch vessels, heart and pericardium, diaphragm, esophagus, and trachea.[2]

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Aortic Injury

Thoracic aortic injuries are often the result of deceleration from high velocity. In practice, aortic injuries are being identified with increasing frequency on clinical imaging, either due to better prehospital resuscitation efforts or an increase in the number of motor vehicle collisions. Thoracic aortic rupture is highly fatal; resulting in mortality rate of 75%-90%.[5,6] Most aortic injuries occur at the areas of fixation of the aorta. The 3 major sites of aortic fixation are the aortic root, the level of the ligamentum arteriosum, and the level of the diaphragmatic hiatus. Although the most common site of injury is the aortic root, this injury is highly fatal. The most frequently encountered site of injury on imaging is at the level of the ligamentum arteriosum.[7] Morphologically, traumatic aortic injuries can be grouped into 2 categories: those which result in external contour deformity and those which do not, the latter including intramural and intimal injuries.[8,9]

Contour deforming injuries of the aorta include aortic transections or rupture, and pseudoaneurysms. Aortic transection is accompanied by significant mediastinal hematoma, active bleeding into the mediastinum, and hemothoraces. These findings can be seen on bedside chest x-ray as abnormal aortic contour, mediastinal widening, deviation of the trachea, and apical capping representing a hemothorax (Figure 1). CT angiography (CTA) should be emergently performed and can better identify the site of transection, active bleeding, and mediastinal blood (Figure 2). Traumatic aortic transection occurs most commonly between the distal aortic arch and descending aorta with the mechanism attributed to deceleration and compression.[6,7] Aortic pseudoaneurysms are a type of rupture of the aorta, most often due to focal transection which is contained by only the aortic adventitia. Aortic pseudoaneurysms characteristically occur along the undersurface of the aortic isthmus, near the ductus arteriosus, and are characterized by their acute angles with the descending aorta. In contrast, aortic pseudoaneurysms often have a smooth angle and absence of other findings of mediastinal injury. Traumatic aortic dissections are less common, and mortality is highest when there is involvement of the ascending aorta, which can progress to cardiac tamponade, or occlusion of a coronary artery. CTA is helpful for defining extension of the injury, as

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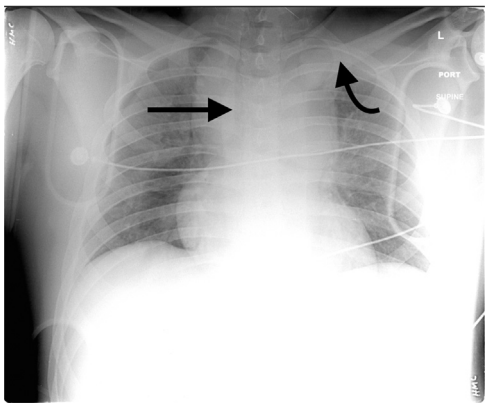

Figure 1 Portable chest radiograph of a patient in a high-speed motor vehicle collision shows radiographic findings of acute traumatic aortic injury. There is abnormal widening of the mediastinum, lack of definition of aortic contour, left apical cap (curved arrow), and deviation of the trachea (arrow). There is also a right pneumothorax. Based on the radiographic appearance CT angiography was emergently performed.

well as the number of false lumens and origin of branch vessel ostia (Figure 3).[7] The aortic contour should be evaluated independently on CT, as mediastinal blood can be present with injuries to adjacent structures or represent venous bleeding. False positives can occur when there is motion artifact, and requires careful evaluation of the scan quality. In addition to detecting and characterizing aortic injuries, a trauma CTA assists with operative planning. Aortic contour deforming injuries and type-A dissections require vascular surgical consultation, particularly in the case of aortic transection and are most often treated with endovascular stent grafts.

Smaller intimal injuries and intramural injuries have been classified as minimal aortic injuries and are often conservatively

Figure 2 CT angiography of the same patient shown in Figure 1 confirms acute traumatic aortic injury with transection and active bleeding from the thoracic aorta (arrow). There is a large amount of mediastinal blood which results in the mediastinal widening seen on the prior radiograph. There is mass effect with displacement of the trachea and the esophagus to the right. There is also a left-sided hemothorax. A chest tube has been placed on the right in the interim.

Figure 3 CT angiography of a high-speed motor vehicle collision patient shows a dissection involving the aortic arch (arrow). The patient had no regional atherosclerotic disease. This patient also has sternal and spine fractures (shown in Figure 18).

managed. These injuries include intramural hematoma and short segment intimal flap or intimal injury with thrombus formation, most often occurring in the descending thoracic aorta.[8] Careful evaluation of the aortic lumen is often necessary to define these injuries, particularly small intimal injuries that are characterized by a focal thrombus (Figure 4). Review of coronal and sagittal multiplanar reconstructions is often helpful in confirming the injury. A potential complication is embolism with end organ infarction, most often seen in the spleen and kidneys (Figure 5).[8]

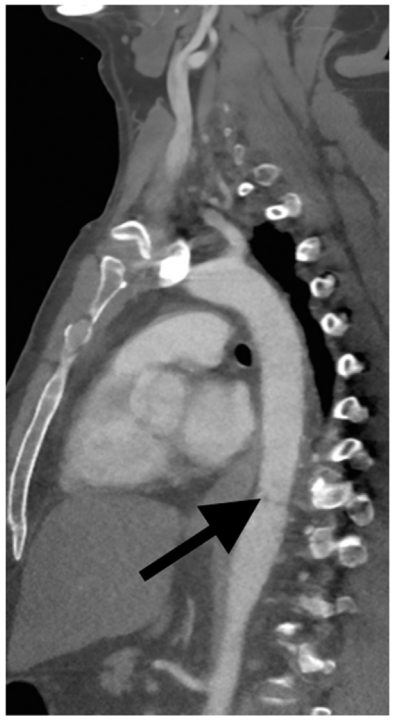

Figure 4 CT angiography of a patient who fell from a ladder with minimal aortic injury. Sagittal reconstruction image shows low attenuation thrombus within the aorta at the level of the diaphragm (arrow).