American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Blunt Chest Trauma—Suspected Aortic Injury**

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9	CXR is part of the initial screening in blunt chest trauma. It may increase the probability of an aortic injury based on findings suggestive of a mediastinal hematoma.	Min
INV aortography thoracic	9	If there is suspicion of aortic injury, thoracic aortography, if rapidly accessible, remains the gold standard for evaluating the aorta.	Med
CT chest with contrast	8	CT scanning is a reliable way to evaluate the mediastium for possible blood. Multislice scanners can provide exquisite detail of the aorta and may replace thoracic aortography as the "gold standard." The decision of whether to go directly to the angio suite or CT after the initial chest radiograph will depend on availability and local expertise.	Med
US echocardiography transesophageal	6		None
MRI chest without contrast	4	Access to critically ill patients poses a problem.	None
MRA chest (noncoronary)	2		None
US chest intravascular aorta	2		None
US echocardiography transthoracic	2		None
MRI chest with contrast	2		None
X-ray barium swallow	1		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

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Summary of Literature Review

Trauma ranks fifth behind cardiovascular diseases, cancer, cerebrovascular disease, and chronic lower respiratory diseases as a cause of death in the United States. There were greater than 100,000 accidental deaths in this country in 2003. Seventy-five percent of the deaths from blunt trauma are due entirely or in part to chest injuries. Rupture of the thoracic aorta is a common cause of death following blunt chest trauma. In more than 80% of cases, rupture is through all three layers of the aorta, resulting in exsanguination and death at the accident site. Individuals who survive have maintained the adventitia intact but are at risk for subsequent complete rupture. For these near-full-thickness injuries, 30% of initial survivors will die within 6 hours and 20% by 24 hours if the diagnosis is not made and treatment instituted. With technological advancements, a spectrum of disease is now being appreciated. Small tears of the intima can now be diagnosed but the natural history of these "minimal aortic injuries" is not yet known. Imaging may play a role in grading the severity of aortic injuries to help guide clinical management.

Pathophysiology

Traumatic injury of the aorta is thought by most investigators to result from unequal horizontal shear forces that are applied during high-speed deceleration to different parts of the thoracic aorta. During rapid deceleration the mobile ascending and descending portions of the aorta lag behind the transverse aortic arch, which is relatively fixed by the brachiocephalic vessels. Injury occurs most commonly at the ligamentum arteriosum (80%) and less commonly to the ascending aorta. A mechanism involving compressive forces between anterior and posterior bony thoracic structures has also been proposed (the "osseous pinch").

Because the adventitia remains intact as a barrier to exsanguination in survivors, the most common pathologic findings are tears of the intima and media. The hemomediastinum associated with these injuries is therefore most commonly due to rupture of small arteries and veins in the mediastinum. Traumatic laceration of the aorta is the most common lesion seen at autopsy, although survival even from this injury has been reported. In these rare cases, a pseudoaneurysm is contained by periaortic tissue. Chronic pseudoaneurysm has been described and may present many years after the traumatic event.

Clinical Presentation

Variation in clinical presentation is the rule with thoracic aortic injuries. Patients may present in full cardiovascular collapse or complain of chest pain, midscapular pain, or shortness of breath. Almost half of patients with aortic disruption have no external signs of chest trauma. Because of the variable presentation, a high index of suspicion for traumatic rupture of the aorta must exist for any patient who has sustained high-speed rapid deceleration.

Chest Radiograph

Despite the advent of newer imaging modalities, the chest radiograph remains the primary screening method for detecting mediastinal hemorrhage following blunt thoracic trauma. It is included in most trauma center protocols in the initial evaluation of patients with polytrauma.

Because of the trauma setting in which chest radiographs of these patients are obtained, they are usually portable anteroposterior supine films. This results in a lordotic view with a shortened focal spot-film distance, magnifying the width of the superior mediastinum and decreasing resolution. Sitting the patient upright for an anteroposterior film should result in fewer falsely abnormal films.

Most of the radiograph findings in aortic rupture are related to mediastinal hemorrhage rather to the aortic injury itself. The most common chest radiograph finding, widening of the mediastinum, has been defined as a transverse distance of 8 cm from the left side of the aortic arch to the right margin of the mediastinum. It must be emphasized that the vast majority of patients with mediastinal widening do not have aortic injuries. Angiographically confirmed aortic injury is found in only 10%-20% of these patients. Mediastinal widening has 90% sensitivity but only 10% specificity for aortic disruption.

Approximately 7% of patients with aortic rupture have a normal initial chest radiograph. However, the diagnostic evaluation of patients with blunt chest trauma now

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includes chest computed tomography (CT) at most facilities. CT has proven to be very sensitive for the detection of aortic injury. When no mediastinal hematoma is detected on chest CT, the probability of a significant aortic injury is very low.

Thoracic Aortography

Thoracic aortography is widely accepted as the gold standard for evaluating patients with suspected aortic injury. The aortogram establishes the diagnosis, defines the anatomy of the lesion, and, because approximately 20% of patients have multiple tears, identifies additional sites of injury. At most institutions, aortography is performed on patients who have suffered rapid deceleration injury and who have a widened mediastinum or obscure aortic knob and descending aorta on a chest radiograph, or who have indirect or direct signs of aortic injury detected by CT.

Various film sequences have been used, including anteroposterior, lateral, and oblique projections. It should be emphasized that more than one projection may be necessary to detect an aortic injury. Because acutely injured patients are in a hyperdynamic state, high contrast volumes of 60 to 70 cc rapidly injected are needed. Thoracic aortography is a safe procedure; the reported mortality rate is 0.03%.

Intra-arterial thoracic digital subtraction angiography is less expensive, uses less contrast material, and is faster than conventional aortography. The sensitivity, specificity, and diagnostic accuracy of digital subtraction angiography are equivalent to those of cut film arteriography.

Computed Tomography

With the increasing availability of spiral CT, the technique is playing a more prominent role in the assessment of patients with suspected aortic injury. CT's strength lies in its ability to distinguish mediastinal blood from other causes of mediastinal widening detected on initial chest radiographs, e.g., artifacts of magnification, mediastinal fat, or anatomic variation. Also, CT may demonstrate the intimal tear or pseudoaneurysm of the traumatized aorta. Technological advancements with helical and, more recently, multidetector CT scans have placed CT at the forefront of evaluating the aorta in cases of blunt thoracic trauma. If no mediastinal hematoma is detected on CT, the probability of a significant aortic injury is very low, and aortography is generally not needed. If direct signs of aortic injury are identified on CT, patients are sometimes taken to aortography for confirmation or occasionally taken directly to surgery. Many case series show low but consistent false positive examinations.

Magnetic Resonance Imaging of the Thorax

Although magnetic resonance imaging (MRI) of the thorax can demonstrate acute and subacute mediastinal hematoma, it currently does not have a role in the initial evaluation of the critically ill, hemodynamically unstable trauma patient. MRI, however, has proven to be useful in the evaluation of chronic traumatic aortic pseudoaneurysms. At the present time, there has been insufficient experience with other MR techniques to recommend their use in the trauma setting. Access to critically ill patients in the MR scanner also poses a potential problem.

Transesophageal Echocardiography

Transesophageal echocardiography (TEE) is a relatively new technology that has been used in the acute trauma setting to study both the heart (for contusion) and the thoracic aorta. It appears to be much more sensitive than transthoracic echocardiography for detecting cardiac contusions.

TEE is more operator-dependent and more invasive than CT. The procedure usually requires sedation. In some patients, blind spots created by the tracheal-bronchial bifurcation may preclude adequate visualization of portions of the aortic arch. Other blind spots for TEE are the distal ascending aorta and the aortic arch vessels, sites of traumatic injury in up to 20% of patients.

Recent studies have reported excellent diagnostic accuracy using TEE for the recognition of aortic injury. This experience, however, has not been uniformly positive. Further studies are required before TEE can be recommended as part of the imaging workup in patients with blunt chest trauma.

Intravascular Ultrasound

The continued development of intravascular ultrasound (IVUS) has offered an adjunct to standard transfemoral aortography. Although the routine use of IVUS is neither indicated nor practical, in a few cases it has been found to be useful in confirming or excluding thoracic aortic injury when angiographic findings are subtle or uncertain.

Other Modalities

There is no support in the literature for the use of esophagrams, oblique chest radiographs, or intravenous digital subtraction angiography in the evaluation of suspected aortic injury.

The literature supports the continued use of the chest radiograph as the initial screening exam in the patient who has sustained blunt chest trauma. In the appropriate clinical setting and with a chest radiograph demonstrating mediastinal widening or other signs of mediastinal hemorrhage, thoracic aortography or helical chest CT is indicated. The possible role of IVUS and TEE in the setting of suspected thoracic aortic injury awaits further

investigation. The overall accuracy of multidetector CT compared with aortography as the gold standard remains incompletely defined at this time.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations	
Relative Radiation Level	**Effective Dose Estimate Range**
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

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