

# Traumatic pseudoaneurysm from the aorta to the left common carotid artery presenting as widened mediastinum

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## ABSTRACT

Diagnosis of pseudoaneurysm of the aorta or its main branches is a challenge in patients with blunt chest trauma. Computed tomography helps to demonstrate intrathoracic hemorrhage and suspected great vascular injury when a chest radiograph reveals widening of the mediastinum. Aortic angiography remains the gold standard in the determination of the site, and severity of vascular injury for definitive surgical intervention. Timing of surgical repair is controversial. Delayed repair of traumatic pseudoaneurysm of the aorta after primary control of associate injuries decreases mortality significantly, thus improving prognosis. We report a case of successful repair of a traumatic pseudoaneurysm of the aortic arch with extension to the left common carotid artery in an 18-year-old female patient. The diagnosis, surgical approaches, and timing of operation are discussed along with case presentation.

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Traumatic tear or rupture of the thoracic aorta and its main branches is uncommon and often causes death. Widening of the mediastinum on a plain chest radiograph usually indicates a severe vascular injury. Further, imaging studies, such as, transesophageal echocardiography (TEE), CT, and magnetic resonance angiography or aortography are needed to confirm the diagnosis.<sup>1</sup> Although CT and TEE are sensitive in detecting small aortic intimal tears, aortography remains the gold standard for a complete evaluation of injury of the thoracic aorta.<sup>1</sup> It is controversial whether patients with traumatic pseudoaneurysm of the aorta should undergo an emergency operation or a delayed repair.<sup>2-4</sup> We present a case of traumatic pseudoaneurysm arising from the aortic arch with extension to the left common carotid artery that was treated by a delayed surgical repair. Indication and

timing of the operation of this rare clinical surgical condition are discussed in this report.

**Case Report.** An 18-year-old helmeted female was sent to our Emergency Room (ER) immediately after a motorcycle collision with a motor vehicle. She had initial loss of consciousness but became alert with headache, chest pain, and dyspnea on arrival at the ER. An anteroposterior chest radiograph revealed fracture of bilateral first and second ribs, left pleural effusion, cardiomegaly, pulmonary contusion, and widened mediastinum (**Figure 1**). A tube thoracostomy was performed for left pleural effusion with an initial drainage of 200 ml of fresh blood. An initial cardiac enzyme, creatinine kinase (CK), was 211 U/L and CK-MB was 204 U/L. Computed tomography of the brain showed focal subarachnoid hemorrhage

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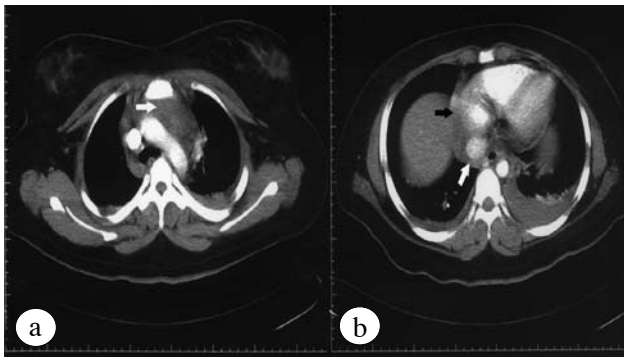
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**Figure 1** - Plain chest radiograph reveals fractures of bilateral first and second ribs, left pleural effusion, cardiomegaly, pulmonary contusion of the left lung, and widened mediastinum.



**Figure 2** - Computerized tomographic scan of the chest showing (a) hematoma in anterior mediastinum, (b) hematoma around the inferior vena cava (white arrow), and a minimal amount of blood collection near the right atrium (black arrow).



**Figure 3** - Thoracic aortogram demonstrates a pseudoaneurysm measuring approximately 1.8 x 1.5 cm over the aortic arch near the origin of left common carotid artery (arrow), consistent with a traumatic pseudoaneurysm.

(SAH) over the right sylvian fissure, and a suspicious fracture of the left orbital floor that needed close monitoring of neurosurgical condition only, as advised by a visiting neurosurgeon. Contrast CT scan of the chest, disclosed a large area of high attenuation in the mediastinum, predominant in the prevascular space, hematoma around the inferior vena cava, and a minimal amount of blood collection near the right atrium (**Figure 2**). Thoracic aortography with digital subtraction showed an aneurysm measuring approximately 1.8 x 1.5 cm over the origin of the left common carotid artery from the aortic arch, consistent with a traumatic pseudoaneurysm (**Figure 3**). She was admitted to the Surgical Intensive Care Unit after initial surveys. Acute respiratory failure developed, and she was intubated with mechanical ventilation. Surgical repair of the false aneurysm was held due to poor pulmonary condition and multiple coexisting injuries. On the fourth hospital day, repeated CT scan of the brain showed resolution of SAH with absence of other abnormalities. She underwent surgical repair of the pseudoaneurysm through a median sternotomy on day 5 after admission. Under general anesthesia, a median sternotomy was made to allow a generous exposure of the heart and aortic arch after opening of the pericardium. Following routine cannulation with infusion of cold cardioplegic solution to achieve cardiac arrest, the pericardium was opened and 100 ml of blood was evacuated. Consistent with results from imaging studies, a traumatic pseudoaneurysm dissecting from the aortic arch to the left common carotid artery was noted. Repair of the aortic arch was carried out, followed by reconstruction of the left common carotid artery with a 6 mm artificial graft (Vascular graft, Model: R06050C50, Edwards Lifesciences, Irvine, California, U.S.A.). The total bypass time was estimated 46 minutes. The entire operative procedure went well without immediate complication. Postoperatively, her blood pressure was controlled with beta-blockers and she was extubated on day 3. There was no neurological deficit noted, and she was discharged uneventfully on day 13 after the operation.

**Discussion.** Nonpenetrating traumatic aortic injuries are often associated with high mortalities. Parmley et al<sup>5</sup> reported a high pre-hospital mortality rate around 85% in patients with blunt trauma to the descending thoracic aorta. Without surgical repair, the mortality rate has been reported to reach 30% within the first day, 50% within the first week, and 90% within 10 weeks after injury.<sup>5</sup> Diagnosis and treatment of the aortic injury from blunt trauma are challenges for cardiothoracic surgeons. Patients with blunt chest trauma often come with multiple traumas, including head injury with intracranial hemorrhage,

abdominal and limb injuries. Suspicion of an aortic injury should be raised in view of a high magnitude of collision force with the multiple rib fracture, especially for the first rib, fracture of the sternum or thoracic spine, accompanying associated injuries, and related radiological findings.<sup>6</sup> When first rib fracture is associated with multiple rib injuries, potential aortic or other major vascular injury should always be kept in mind, mandating responsive diagnostic procedures, and an aggressive surgical intervention.<sup>7</sup>

Diagnostic modalities include plain chest radiographs, chest CT scan, TEE, MRI, and thoracic aortic angiography. Widened mediastinum shown on an initial chest radiograph, is an important clue for the diagnosis of unexplained intrathoracic hemorrhage.<sup>5</sup> When combining multiple rib fractures, further radiologic studies should be performed to have differential diagnosis and exclusion of lethal great vessel injuries. The CT scan is a valuable non-invasive screening tool for the patient with blunt thoracic injury, especially when a plain chest radiograph reveals widened mediastinum or first rib fracture, although its sensitivity varies from 67-100%.<sup>8</sup> Positive CT findings may be described solely as mediastinal hematoma without clear evidence of great vascular injury. Most patients with periaortic or superior mediastinal hemorrhage on a CT scan should be considered to have aortic or other great vessel injury, and they should undergo thoracic aortography for confirmation.<sup>9,10</sup> Thoracic aortography provides detailed evaluation of the thoracic aorta, brachiocephalic arteries, and their branches, with a sensitivity reaching 100% and a specificity around 98%. It remains the most valuable diagnostic modality to guide a thorough preoperative evaluation of the vascular condition, and a precise approach for the subsequent surgical repair.<sup>2</sup> Intimal injury of the aorta on an aortography may be demonstrated as intimal irregularity, linear defect, or filling defect from an intimal flap.<sup>2</sup> Pseudoaneurysm is diagnosed when contrast material is retained outside the lumen. In contrast, aortic rupture reveals free extravasation of contrast.<sup>2</sup> Notably, these 2 imaging findings are indicative of transmural laceration.<sup>1</sup>

The timing of surgical repair of traumatic aortic injury and its indications remain controversial. It has been reported that an emergency repair of the aortic injury on arrival to the hospital resulted in a higher mortality and morbidity, than that of a postponed operation due to initial coexisting multiple injuries.<sup>2</sup> Successful delayed repair of traumatic aortic pseudoaneurysm, with the presence of multiple major coexisting injuries, has been reported in the past.<sup>3,4</sup> It is recommended that patients surviving with aortic trauma accompanied by multiple major injuries to the hospital with a confirmed pseudoaneurysm, should

undergo a delayed surgical repair, unless there is a rapid increase of mediastinal hematoma or pleural effusion, persistent anuria, distal limb ischemia, and extravasation of contrast media in the thoracic cavity.<sup>2,4</sup>

In conclusion, it is important to confirm lethal vascular injuries early in blunt thoracic trauma, when a high suspicion is raised from screening imaging studies. Contrast chest CT scan serves as a rapid screening study to evaluate mediastinal hematoma and hemothorax. Aortic angiography remains the gold standard for exact localization, and a complete evaluation of aortic rupture or pseudoaneurysm of the aorta and its main branches. Surgical repair is often indicated for lethal thoracic great vessel injuries, with the optimal timing determined based on a careful evaluation of other life-threatening associated injuries.

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