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Pseudoaneurysm of the Proximal Innominate Artery after Blunt Trauma

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Blunt injuries to the innominate artery in the civilian setting are relatively rare. The majority of patients who sustain this injury will die at the scene. Those that survive transport to the hospital present difficult challenges for trauma surgeons with mortality rates that range from 10 to 25 per cent. The proximal innominate artery is more commonly injured by blunt trauma mechanisms. On the other hand, penetrating trauma more commonly involves the distal innominate artery.

A 23-year-old male presented to our trauma service after a motor vehicle collision. He was an unrestrained passenger partially ejected from the vehicle. The patient was hemodynamically stable on arrival to the emergency department. He was noted to have tenderness of the neck and chest wall. On initial evaluation the patient had no signs of neurologic injury. The chest radiograph revealed a left-sided pneumothorax and a widened mediastinum. A CT scan of the chest (Fig. 1) demonstrated a mediastinal hematoma, acute extravasation of contrast adjacent to the superior vena cava, proximal filling defect of the brachiocephalic vessels, and three left rib fractures. This prompted a formal thoracic aortogram (Fig. 2) that showed an injury consistent with a pseudoaneurysm anterior to the origin of the in-nominate artery with a short segment occlusion likely due to an intimal flap distal to the pseudoaneurysm.

Our patient was taken to the operative room where a median sternotomy was performed and was found to have a midinnominate artery transection. He underwent an aorto-innominate artery bypass with Dacron graft and the injured proximal innominate was oversewn. The patient tolerated the procedure well and made a good recovery and was discharged from hospital after 2 weeks on aspirin. At a subsequent follow-up visit, he was well and had returned to moderate activities.

Less than 5 per cent of patients who sustain blunt trauma to the ascending aorta survive transportation to the hospital. These injuries present difficult challenges to trauma surgeons with in-hospital mortality rates that range from 10 to 25 per cent.¹ The proximal innominate artery is more commonly injured by blunt trauma; however, the distal innominate artery is usually injured by penetrating trauma.

Multiple mechanisms of injury have been attributed to causing innominate artery injury. Vertical deceleration, as in a fall from heights (> 15 ft), as well as posterior displacement of the sternum that occurs in horizontal displacement injuries have been described.^{2, 3} What is common between these mechanisms is shear and stretching forces between the immobile ascending aorta and the fairly mobile proximal innominate artery. An additional mechanism includes sudden compression of the artery between the sternum and the vertebrae, accompanied by hyperextension of the neck place.

Diagnosing innominate artery injuries requires a high index suspicion. Often, the clues to this injury are a combination of the mechanism, chest pain, and radiologic findings of widened mediastinum. A sudden deceleration mechanism should also raise suspicion of these types of injuries. In the case of the innominate artery, the most frequent location of injury is at the origin from the aortic arch.⁴ In blunt chest trauma, the innominate artery is the most common aortic branch injured.⁴ The pathologic finding is an intimal tear with variable size hematoma and thrombus within the media and adventitia. A small intimal defect can eventually lead to thrombus formation and occlusion.

Commonly, the patient's complaint of anterior chest wall pain is nonspecific. Chest radiographs will often reveal a widened mediastinum. In a series reported by Weiman et al., five out of five patients with blunt injury to the innominate artery had a widened mediastinum on chest radiograph. If radiologic evaluation of a patient suggests a major vascular injury, an arteriogram is indicated to delineate the injury. CT angiography or formal arch aortographies are the mainstay of diagnosis in the hemodynamically stable patient.

Repair of innominate artery injuries involves basic principles of thoracic vascular injury. Median sternotomy is used and can be combined with a cervical extension for more distal vascular control, if needed. Primary repair of the vessel is the preferred choice if technically feasible. In patients with partial tears, primary repair with 4-0 polypropylene suture is often possible. In the majority of cases, innominate artery injuries are best managed by the bypass exclusion technique. This approach allows management without the use of systemic heparinization, cardiopulmonary bypass, or hypothermic circulatory arrest. Angioplasty and interposition grafting have been reported, both with and without use of cardiopulmonary bypass or intra-arterial shunting.

Endovascular stent grafts were initially reported for the treatment of abdominal aortic aneurysms. Studies have shown that these stent grafts are beginning to play a larger role in traumatic aortic injuries. The advantages include minimal physiologic insult and no need for heparinization allows treatment of even the most critically injured or frail patients. Disadvantages include device failure, particularly with finding an adequate length and landing zone for proximal innominate artery injuries. Home-made devices have been used with success, but multi-institutional trials with more flexible grafts are still needed.

Traumatic injury to the innominate artery are rare, however, surgeons providing care for the surviving patients should have a high index of suspicion with sudden deceleration mechanisms and chest pain. In unstable patients with presumed undiagnosed thoracic vascular injury, the appropriate incision is a left anterolateral thoracotomy. In the

hemodynamically stable patient, median sternotomy with or without cervical extension is the preferred exposure. The bypass exclusion technique allows for repair without the sequelae and risks from systemic heparinization and cardiopulmonary bypass.

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Fig. 1.
CT scan of chest showing abrupt narrowing of the innominate artery.

Fig. 2.
Formal aortogram showing short segment occlusion/intimal flap distal to pseudoaneurysm.