Early Diagnosis and Treatment of a Posttraumatic Pseudoaneurysm/Dissection of the Innominate Artery

Fernando Azarcon, MD;[1] Melhelm Ghaleb, MD[2]

1. Texas Tech University Health Science Center – Radiology, El Paso, Texas USA
2. University Medical Center – Radiology, El Paso, Texas USA

Correspondence:
Fernando Azarcon, MD
University Medical Center – Radiology
4800 Alberta Avenue
El Paso, Texas USA 79905
E-mail: joyjrmd@yahoo.com

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Abbreviations:
CCA: common carotid artery
CFA: common femoral artery
CT: computerized tomography
LAO: left anterior oblique
MRI: magnetic resonance imaging

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Abstract:
A 25-year-old male developed a traumatic intimo-medial dissection and saccular pseudoaneurysm at the origin of the innominate artery following a motorcycle accident. On physical examination there was no perceivable trauma to the chest. In addition, there were no clinical symptoms that suggested this serious injury. The patient was managed with successful stent-graft placement on an elective basis.

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Introduction

Aortic arch injuries are rare, even more so with no physical evidence of chest trauma. The innominate artery is the second most commonly injured branch of the mediastinal vessels, with the proximal segment most commonly involved.[1-8] Early diagnosis of innominate artery pseudoaneurysm is imperative because delay may allow rupture, exsanguination, embolus formation, or indolent enlargement, compromising adjacent structures like the other great arteries, superior vena cava, brachiocephalic veins, and trachea. We report successful management of a traumatic intimo-medial dissection with pseudoaneurysm formation at the origin of the innominate artery prior to onset of fatal complications.

Case Report

A 25-year-old male was brought to the emergency department two days after a motorcycle accident. He had sustained multiple injuries to the head (fracture of the facial bones (LeFort II/III), scalp lacerations, skull fracture) and to the appendages (left tibial, femoral, wrist and ulnar fractures). The patient was reported to have lost consciousness temporarily but had no neurologic symptoms. Blood pressure measurements from the upper extremities were equal and normal bilaterally and the patient was hemodynamically stable. There were no physical signs of trauma to the chest.

Routine radiographs and computerized tomography (CT) scan of the body were done to rule out internal injuries. The chest radiograph did not reveal rib or clavicular fractures, or lung consolidations or pleural fluid collection. Mediastinal width was normal (Figure 1, supplementary file online). A CT scan of the chest showed a small lung contusion on the posterosuperior aspect of the left lower lobe as well as minimal subsegmental atelectasis in the right lower lobe. No pneumothorax or pleural effusions in either lung were identified. The heart was normal. No retrosternal/mediastinal hematomas were identified and there was no acute traumatic injury to the chest skeletal structures.

A dissection of the innominate artery with aneurysmal dilatation measuring about 15.9 mm by 5 mm in the craniocaudal and transverse dimensions respectively was seen on the chest CT scan. This vascular injury arose from the arch orifice and extending cephalad to just below the bifurcation of the common carotid with the subclavian artery (Figures 2 and 3, supplementary file online).

With the need to confirm CT findings, an arch aortogram was performed. It revealed a traumatic saccular pseudoaneurysm with intimal flap dissection arising off the proximal portion of the innominate artery, <5 mm from the aortic arch origin and extending cephalad to just below the bifurcation of the common carotid with the subclavian artery (Figures 4 and 5, supplementary file online). Request for endovascular repair was made. The procedure was carried with the patient awake and under conscious sedation.

Procedure

The right common femoral artery (CFA) was accessed using the traditional Seldinger technique and an 11 French sheath (Cook, Bloomington, Indiana USA) was advanced. An arch aortogram road-map technique study was obtained in the 37 degree left anterior oblique (LAO) projection with a SofTouch 5 French pigtail catheter (Merit Medical, South Jordan, Utah USA) followed by its exchange for a Mariner 5 French H-1 Head-Hunter (Angiodynamics, Queensburg, New Jersey USA). With gentle upward motion, the right innominate artery was canalized with the H-1 catheter and a InQwire 0.035 in exchange (300 cm) Bentson wire (Merit Medical, South Jordan, Utah USA) was advanced into the right common carotid artery and was parked in the external carotid artery. The H-1 catheter was then gently advanced over the wire, through the intimal dissection, and a soft hand contrast injection was performed to document the true lumen endoluminal position of the catheter tip. Next, and over a Super Stiff exchange (300 cm) 0.035 inch Amplatz wire (Boston Scientific, Miami, Florida USA), an 11 mm in diameter by 2.5 cm in length Viabahn covered stent (Gore, Flagstaff, Arizona USA) was deployed in the right innominate artery just below the bifurcation of the right subclavian and the common carotid artery (CCA). The stent-graft was then angioplastied with an Evercross 10 mm by 4 cm balloon (EV3, Plymouth, Minnesota USA) × 1 for <10 seconds and then deflated rapidly.

A subsequent arch aortogram was obtained which showed residual opacification of the caudal portion of the pseudoaneurysm. Therefore, and in a similar step-by-step process, a second 11 mm by 2.5 cm Viabahn covered stent was deployed within the first one but extending it caudally to almost the arch orifice origin of the innominate artery (Figures 6 and 7, supplementary file online). The overlap between the two stent-grafts was 1 cm. Angioplasty with the same balloon was done for better apposition and a completion arch aortogram was then obtained. Satisfactory seal of the traumatic pseudoaneurysm with widely patent right CCA and subclavian arteries was documented. However, a small, type-II endoleak blush was appreciated near the end of the arterial run at the arch/innominate artery junction. A decision was made to observe it and re-scan the patient with CT angiography after one week. The patient received a total of 4 mg of intravenous midazolam (Versed, Roche Pharmaceuticals, Nutley, New Jersey USA) and 25 mcg of IV fentanyl (Hospira Inc., Lake Forest, Illinois USA). He was transferred then to the operating room for right groin sheath removal and arteriotomy closure.

Five days after the stent-graft placement, a CT angiogram of the neck and upper thorax was performed. The endoleak previously seen was no longer appreciated (Figure 8, supplementary file online).

Discussion

Innominate artery pseudoaneurysm alone is uncommon, however, it is the second most commonly affected great vessel after the isthmus of the thoracic aorta.[2,5,7] The symptoms may vary from minimal signs or, more commonly, extensive signs of trauma.

Radiologic clues of thoracic vascular injury include widening (> 8 centimeters) of the superior mediastinum, apical pleural capping, obscuration of the aortic knob, fractured first rib, depression of the left main bronchus (> 140 degrees from trachea) and deviation of nasogastric tube in the esophagus away from the midline.[9]

In a hemodynamically stable patient, angiography is mandatory. Computerized tomography and magnetic resonance imaging (MRI) are not recommended because they provide only circumstantial evidence of aortic injury. The sensitivity and specificity of transesophageal echogram is 100% in detecting traumatic pseudoaneurysm. However, this imaging modality is not available at the authors' institution. Prompt diagnosis of a traumatic pseudoaneurysm is key to preventing potential lethal complications.

The majority of innominate artery peusoaneurysms are due to a deceleration accident associated with motor vehicle accident. In this case study, the pseudoaneurysm is believed to be brought from the shearing force produced by the hyperextension of the neck and rotation of the head causing longitudinal tension on the innominate artery. Another proposed theory is anteroposterior compression of the space between the sternum and the vertebral column with displacement of the heart posteriorly and to the left side of the chest producing tension in the aortic arch and outlet vessels.[2,7,8] Both theories produce maximal stress on the origin of the innominate artery because of the tightly fixed aortic arch and mobile innominate artery, thus making the proximal innominate artery more prone to injury.

In this case study, the first imaging modality used was CT scanning, which is the screening tool for intrathoracic injuries. It was possible to detect the aneurysm even though no physical signs of chest trauma were present. Furthermore, CT scanning can detect true and false arterial lumen dissections, intraluminal clots, aneurysmal dilatation and local effects of hematoma or aneurysm against the adjacent structures.

There are various methods used for the treatment of pseudoaneurysms. Surgical (open) repair is highly invasive and is done by cutting off blood flow to the pseudoaneurysm (proximal and distal ligation) and then rerouting blood around the damaged segment of the artery. A vein or synthetic graft is connected to the artery before and after the pseudoaneurysm and blood then flows around this damaged segment. Surgical repair should be done in patients who need reconstruction of damaged arteries. Endovascular stent-grafts have been quite successful in many clinical applications, including successful stenting of an innominate pseudoaneurysm, as in this case.[4,6,7] This case highlights the relative "ease" and fast repair (less than 35 minutes) for what used to be considered a major and long operation. There was no general anesthesia involved and almost no recovery time from the endovascular repair besides the right arteriotomy closure. The patient was discharged home four days after the vascular and is doing well.

Conclusion

This case report is of an acute posttraumatic intimo-medial dissection and pseudoaneurysm of the origin of the innominate artery with no apparent chest injury. Prompt diagnosis is the key to preventing further complications. All posttraumatic innominate artery pseudoaneurysms need to be corrected to prevent complications such as rupture, thrombosis, embolism and enlargement causing compression of other vital thoracic structures. In trained hands, endovascular repair can be performed promptly and efficiently, while reducing the high procedural potential complications associated with the traditional open surgical repair. It should be considered as a first line of treatment modality and not as an alternative to surgery.

In blunt force traumas, thoracic vascular injuries cannot be entirely ruled out because of a clear chest X-ray and unremarkable thoracic physical exam. Proper work-up should be done to detect any injuries for prompt treatment and prevent further complications.

Supplementary Materials

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1049023X14000107

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