

## Successful endovascular repair of blunt traumatic innominate artery transection with covered stent graft

Tru Dang, MD,<sup>a</sup> Allen Bui, MD,<sup>a</sup> Marc Katz, MD,<sup>b</sup> and Mathew Wooster, MD, MBA,<sup>a</sup> Charleston, SC

### ABSTRACT

We have presented the case of a 20-year-old woman who had been involved in a motor vehicle collision with innominate artery transection. Because of her concomitant possible cerebral injury, she was deemed at extremely high risk of postoperative neurologic dysfunction if undergoing open surgical repair. Using intravascular ultrasound and angiography, the lesion was evaluated, and covered stents were deployed across the lesion. The patient tolerated the procedure well and was discharged without complications. Duplex ultrasound scans at 1 and 6 months showed satisfactory results. Thus, endovascular repair is a feasible alternative approach to open repair for patients with blunt traumatic innominate artery injury. (*J Vasc Surg Cases Innov Tech* 2022;8:353-5.)

**Keywords:** Endovascular; Innominate artery; Stent; Transection; Trauma

Reports of traumatic injuries to the great vessels of the aortic arch are relatively scarce because patients rarely survive to reach the hospital.<sup>1</sup> Furthermore, blunt traumatic injuries to the innominate artery are an uncommon etiology. Traumatic injuries to the great vessels have been repaired with arch replacement and endovascular repair with polytetrafluoroethylene stitched to a Palmaz stent.<sup>2,3</sup> In the present report, we have described the case of a 20-year-old woman with blunt innominate artery transection who was successfully treated using intravascular ultrasound (IVUS) and endovascular repair with covered stent grafts.

### CASE REPORT

Our patient was a previously healthy 20-year-old woman who had been as an unrestrained driver in her vehicle after a motor vehicle crash. She was transferred to our institution from a level 2 trauma center after a computed tomography angiogram of the chest had shown a large mediastinal hematoma, which appeared to be secondary to traumatic transection of the

innominate artery that extended from the origin to the bifurcation of the right subclavian and common carotid arteries (Fig 1). No extravasation was seen. Concomitant injuries included small bilateral pneumothoraces and a right mandibular fracture, in addition to concerns for a concussion and associated diffuse axonal injury (DAI). The concern for cerebral injury occurred because the patient had presented with disorientation with associated headache, dizziness, and fatigue. She was otherwise strength and sensation intact. Because of the urgency of the repair, we decided to forego magnetic resonance imaging to definitively rule out DAI before proceeding to the operating room.

She was admitted to our cardiovascular intensive care unit for impulse control and blood pressure control before operative repair of the innominate artery injury. The cardiac surgery service first evaluated the patient for her suitability to undergo open repair. However, because of her cerebral trauma, they believed she would be at high risk of postoperative neurologic dysfunction should transient ischemia (from clamping) occur or hypothermia or cardiopulmonary bypass be required.

The patient was taken to the hybrid operating room, where she was placed under satisfactory general anesthesia. She was prepared and draped for both angiographic intervention and possible immediate conversion to sternotomy with right carotid artery exposure. The right femoral artery was accessed percutaneously, and IVUS (Volcano; Philips, Amsterdam, Netherlands) demonstrated no dissection of the aorta. Angiography showed transection of the innominate artery (Fig 2). Systemic heparinization to an activated clotting time of 250 seconds was undertaken. The innominate artery was then catheterized. IVUS demonstrated transection of the innominate artery at the origin and a short segment of normal-appearing intima proximal to the bifurcation with surrounding hematoma. In accordance with the images obtained, endovascular repair was planned with a covered stent graft. A long 8Fr sheath (Terumo, Shibuya,

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From the Division of Vascular Surgery<sup>a</sup> and Division of Cardiothoracic Surgery,<sup>b</sup> Department of Surgery, Medical University of South Carolina.

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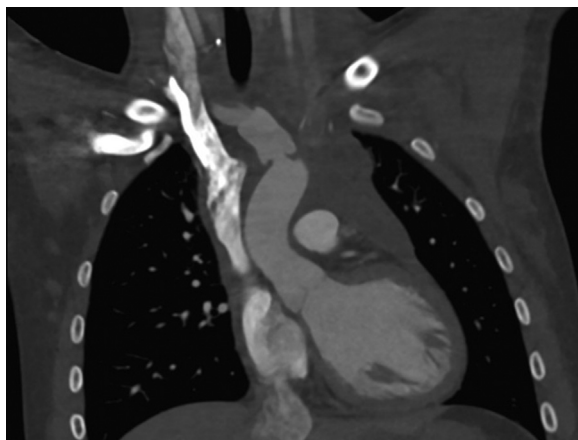
Correspondence: Tru Dang, MD, Division of Vascular Surgery, Department of Surgery, Medical University of South Carolina, 171 Ashley Ave, Charleston, SC 29425 (e-mail: dangtr@musc.edu).

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**Fig 1.** Computed tomography of the chest showed innominate artery injury with surrounding hematoma.



**Fig 2.** Aortic arch angiogram showed enlargement of the innominate artery.

Japan) was advanced into the innominate artery. A 10 × 29-mm Viabahn VBX balloon expandable covered stent (W. L. Gore & Associates, Newark, DE) was placed. The stent was found to be short of the coverage needed distally; therefore, a second 10 × 39-mm Viabahn VBX stent was placed at the innominate artery bifurcation (Fig 3). The stent was sized <10% greater than the native vessel diameter in a landing zone ~7 mm of the length proximally and 1 cm distally. Postprocedure imaging studies confirmed patency of the carotid and subclavian arteries. Possible placement of kissing stents into the carotid and subclavian arteries was considered but was deemed not indicated. If kissing stents were required, brachial access from the right upper extremity was readily available. The mean



**Fig 3.** Image showing the covered stents had successfully isolated the innominate artery injury.

arterial pressure in the bilateral radial arterial catheters placed before the procedure remained symmetric. Protamine reversal was undertaken, the sheath was removed, and Perclose Pro-Glide closure system (Abbott Laboratories, Chicago, IL) was used to achieve hemostasis.

Postoperatively, the patient recovered well and was neurologically intact. Her concussive symptoms at admission had completely resolved by postoperative day 1. She was, therefore, thought unlikely to have had DAI from her trauma, as previously concerned. A diagnostic magnetic resonance imaging was no longer thought to be indicated. She was discharged on postoperative day 2 after all concomitant injuries had been addressed. Her medical management included daily aspirin, clopidogrel, and statin. At her 1- and 6-month clinic visits, duplex ultrasound showed normal carotid artery velocities without evidence of stenosis and a patent innominate stent. The patient will continue with dual antiplatelet and statin therapy indefinitely with annual duplex ultrasound studies and follow-up visits.

The patient provided written informed consent for the report of her case details and imaging studies.

## DISCUSSION

Injuries to the innominate artery are rare, and blunt traumatic injury to the innominate artery is even more

rare. Johnston and Wall<sup>2</sup> reported the largest series for innominate artery injuries, which included 43 patients within a 30-year period. In their series, 34 injuries had resulted from penetrating trauma, 7 from blunt trauma, and 2 from other mechanisms.<sup>2</sup> Patients with blunt trauma of the thoracic aorta and the great vessels will usually die at the scene or during transportation to a medical center.<sup>1</sup> When such patients can be brought to a medical center, their hemodynamic status will usually be stable.

Following blunt chest trauma, isolated innominate artery injury represents the second most common traumatic thoracic great vessel injury after that of the aorta.<sup>4</sup> Innominate artery injury secondary to blunt trauma will usually have a proximal injury at the junction of the innominate artery and the aorta.<sup>2</sup> When injuries are located close to the origin of the innominate artery, bypass grafting from the ascending aorta to the distal innominate artery and closure of the innominate origin will be required. This has usually been performed via median sternotomy, with postoperative care in the intensive care unit.<sup>2,5</sup> Hypothermic circulation arrest has been instituted as a neuroprotective measure in the case of hemodynamically unstable patients.<sup>6,7</sup>

Endovascular repair of innominate artery pathologies, including aneurysms and transections, has been described.<sup>3,5,8-10</sup> The feasibility of endovascular therapy is largely dependent on the anatomic suitability and hemodynamic status of the patient. In particular, extension of the injury to include the aorta itself would preclude safely treating using the method we have described. However, when possible, endovascular treatment will be less invasive and is preferable for patients potentially unable to tolerate open surgery. For our patient, IVUS was used to evaluate the extent of the injury to the aorta and the innominate artery. Without an ability to ensure that the thoracic aorta itself was not injured, this would not have been a well-advised strategy. Assessment of the possible extent of injury into the aortic arch is best performed with IVUS from a femoral access. Covered stent grafts were successfully deployed in our patient, largely because to the origin of dissection was immediately distal to, rather than at, the innominate origin. We would further emphasize the critical importance of a team approach, with cardiothoracic support on immediate standby should the injury be found to be anatomically inappropriate for endovascular repair or should the endovascular attempt lead to catastrophe (ie, complete transection), especially given the off-label use of devices in this region.

Shalhub et al<sup>11</sup> reported a retrospective review of 34 patients who had presented with blunt injury involving the innominate, subclavian, and axillary arteries during an 11-year period. Their study found that covered stents can offer shorter operative time, less blood loss, and decreased overall morbidity.<sup>11</sup> In the present report, we have demonstrated that endovascular repair of innominate artery injuries can be considered as a feasible alternative to open repair for patients with blunt traumatic injuries to the great vessels.

## CONCLUSIONS

Blunt traumatic injury to the innominate artery is relatively rare. Isolated innominate artery injury represents the second most common traumatic thoracic great vessel injury after that of the aorta. We have demonstrated that endovascular repair of innominate artery injuries can be considered a feasible alternative to open repair for patients with blunt traumatic innominate artery injury.

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