Unexpected Internal Mammary Artery Perforation During Transradial Access for a Neuroendovascular Procedure

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ABSTRACT

During cerebral angiography via transradial access, the guidewire inadvertently entered the right internal mammary artery. This was not recognized because of its downward trajectory, and it was interpreted to be in the ascending aorta. Catheter manipulation perforated the right internal mammary artery, with development of pectoral hematoma. The perforation was sealed with coils and glue. (Level of Difficulty: Advanced.) (J Am Coll Cardiol Case Rep 2021;3:1187–90) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

An 87-year-old right-handed man presented with sudden right eye blurry vision. Ophthalmologic evaluation revealed decreased visual acuity, afferent pupillary defect, and a pale cherry red spot on the macula consistent with central retinal artery occlusion. He was neurologically intact on examination (National Institutes of Health Stroke Scale score of 0), except for the right vision defect. Imaging demonstrated carotid stenosis. The patient was started on dual antiplatelet therapy (aspirin 81 mg and ticagrelor 90 mg). He was not deemed to be an appropriate candidate for emergency reperfusion because of delayed presentation. Two days later, he was brought to the angiography suite for diagnostic carotid and cerebral angiography with the intention to perform carotid stenting.

Right radial access was obtained, and the patient was anticoagulated with 65 U/kg of unfractionated heparin. A 0.035-inch diameter guidewire (Gladewire, Terumo Medical Corporation, Somerset, New Jersey) was advanced within a 5-F Simmons 2 catheter through the upper extremity vasculature using roadmap visualization. The system was then navigated under simple fluoroscopy into a descending vessel in the chest that appeared to be the innominate artery and the ascending aortic arch per its usual trajectory. Attempts were initially made to direct the catheter toward the patient’s left side into

LEARNING OBJECTIVES

- To recognize inadvertent RIMA cannulation in patients undergoing TRA angiography with tortuous subclavian artery anatomy and a downward angulation so that vessel perforation is avoided.
- To manage RIMA perforation in patients undergoing TRA angiography, especially if this vessel had been used as a coronary bypass conduit, without adverse cardiac events.

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the descending aortic arch (which is the standard site for Simmons catheter formation to enable access to the carotid arteries via a radial approach), but this was unsuccessful. Hence, the wire was advanced directly inferiorly (toward the ascending aortic arch) with the intention to form the Simmons 2 catheter by bouncing it off the aortic valve. After a few unsuccessful attempts to rotate the catheter, we performed a limited subclavian angiogram that revealed that the catheter had been inadvertently advanced into the right internal mammary artery (RIMA) instead of the innominate and ascending aorta (Figure 1A). Contrast injection demonstrated free extravasation at the level of the fourth intercostal space consistent with perforation of an anterior intercostal artery (branch of the RIMA), as depicted in Figure 1B. We also noticed significant tortuosity with an unusual severe caudal angulation of the first segment of the subclavian artery that caused inadvertent advancement of the wire into the RIMA, which had an unusually distal origin. The downward orientation and smooth advancement of the wire led us to believe it was in the ascending aorta.

**MEDICAL HISTORY**

The medical history included hypertension, hyperlipidemia, coronary artery bypass grafting, left carotid endarterectomy (due to left hemispheric transient ischemic attacks), and right face skin cancer with radiation.

**DIFFERENTIAL DIAGNOSIS**

Transradial access (TRA) for cerebral angiography is rapidly gaining adoption. There are few known anatomic variants that can create challenges during upper extremity vascular navigation and Simmons catheter formation in the arch to selectively cannulate the neck vessels. These include unusual extreme tortuosity, bovine arch, aberrant subclavian artery anatomy (i.e., arteria lusoria), and right aortic arch.

**INVESTIGATIONS**

Repeat angiography in the upper extremity and chest can help elucidate the underlying anatomy. Computed tomography angiogram of the neck, which is routinely obtained for most neurointerventions beforehand, can reveal the presence of tortuous or anomalous subclavian anatomy and allow the surgeon to anticipate difficult navigation during the procedure.

**MANAGEMENT**

The patient complained of chest pain and developed a growing hematoma in the right pectoral area (Figure 2A) and developed mild hypotension requiring transient vasopressor support. Protamine was administered to reverse anticoagulation, and the RIMA was selectively cannulated with an Excelsior SL-10 (Stryker, Kalamazoo, Michigan) microcatheter and microwire. Embolization with a platinum coil (6 cm × 2 mm, Axium, ev3/Medtronic, Minneapolis, Minnesota) was performed, followed by infusion of 1 ml of N-butyl cyanoacrylate (or “glue”). Post-embolization angiography confirmed occlusion of the distal RIMA with the stagnation of contrast and absence of extravasation (Figure 3). Post-procedural chest x-ray film confirmed the presence of a small right hemothorax. Computed tomography with contrast of the chest showed a hematoma of the pectoralis major muscle, as well as a small hemothorax (Figure 2B). The patient remained stable during a 24-h observation period. The hemoglobin level dropped from 13.6 to 10.8 mg/dl.
DISCUSSION

We report a case of inadvertent RIMA catheterization and iatrogenic perforation due to attempted Simmons 2 catheter formation in the RIMA, done for cerebral angiography and possible carotid stenting. After negotiating the subclavian tortuosity, the wire followed a downward path into what appeared to be the ascending aorta. However, the wire mistakenly went into the RIMA because of subclavian artery tortuosity and the angulation of the RIMA origin. In addition, the left anterior oblique view typically used for
formation of the Simmons 2 catheter in the aortic arch may have further given the appearance of the wire being in the typically near-midline location of the innominate artery. Important steps included understanding the anatomy (which was confused at first), recognizing the misadventure, diagnosing the bleeding, and planning for embolization to prevent further bleeding.

Over the past decade, the choice of vascular access for cerebral angiography and neurointerventional procedures (including carotid stenting) has increasingly shifted from the transfemoral to the TRA approach. Large comparative studies in patients undergoing coronary interventions have shown that TRA is associated with lower risk of bleeding and vascular complications (1). Despite its safety, TRA requires a skill set associated with a learning curve. Many neurointerventionalists are currently going through the steep part of the learning curve and recognizing anatomic variations in catheter navigation, such as subclavian artery tortuosity (2).

It is worth noting for neurointerventionalists that patients with either prior autologous breast reconstruction or coronary artery bypass grafting may have important revascularized tissue downstream of the RIMA or left internal mammary artery. In general, TRA procedures in these patients require special attention, in particular when using hydrophilic-coated wires, because of the devastating consequences that the loss of an internal mammary artery would portend. When the guidewire does not follow the expected pathway or meets even slight resistance, a limited angiography is useful to better understand the anatomy and act in consequence by directing the guidewire toward the desired target vessel.

In our case, the RIMA did not supply myocardial or transplanted tissue; therefore, we opted to embolize the main RIMA and the anterior intercostal artery that was actively bleeding. Thus, we prevented major chest wall bleeding and hemothorax. We could have attempted temporary tamponade with a balloon, but given the significant anticoagulation and antiplatelet agents, we opted for definitive closure up front. Had we hesitated to coil the perforated vessel, surgical intervention would have been required. Indications for surgery include ongoing active extravasation, intractable pain, skin tension with threatening necrosis, and respiratory distress due to lung compression by the hematoma. This case emphasizes the need for expertise and availability of equipment (coils, plugs, and vascular glue) for the treatment of vessel perforations in the modern multidisciplinary catheterization laboratory. A similar case of inadvertent RIMA cannulation complicated with perforation and large breast hematoma has been previously discussed but was treated with a covered stent (3).

FOLLOW-UP

On post-procedure day 2, the patient developed new onset of atrial fibrillation. He was initially anticoagulated with unfractionated heparin and then transitioned to apixaban on post-procedure day 2. There was complete resolution of the chest wall hematoma at 6 weeks.

CONCLUSIONS

We present an unusual case of RIMA perforation during a TRA procedure, treated with embolization. Surgeons should approach patients with a history of coronary artery bypass grafting or autologous breast reconstruction carefully, because RIMA or left internal mammary artery branches may have important downstream substrates.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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