The Mother of All Carotids

A complex carotid intervention in a patient with a bicarotid trunk and anomalous origin of the right subclavian artery.

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The anatomy of the aortic arch plays a critical role in determining the appropriate technique to be used for treating patients with atherosclerotic disease of the great vessels. Many variations occur in the number and position of vessels arising from the aortic arch. Approximately 80% of the population has the normal three-vessel aortic arch configuration. The most common variation from the usual anatomy is a two-vessel arch, known as the "common origin of the carotid arteries," in which the left common carotid artery arises from the innominate artery (bovine origin), leaving only two branches originating from the aortic arch. Multiple other variations have been reported, and one of the more uncommon configurations of the three-vessel arch is known as the *bicarotid trunk*, in which the common carotid arteries arise from a shared trunk and the subclavian arteries arise separately from the aorta. In this case report, we describe a complex carotid intervention in a patient with a bicarotid trunk and anomalous origin of the right subclavian artery.

Figure 1. A baseline suprarenal angiogram showing moderate renal artery disease and severe aortoiliac disease.

Figure 2. A type II aortic arch with a stenosed bicarotid trunk, aberrant right subclavian origin, and multilevel great vessel disease.

CASE REPORT

The patient was a 77-year-old woman with a known history of carotid artery disease (after undergoing bilateral carotid endarterectomy 18 to 24 months earlier), peripheral vascular disease, coronary artery disease, hypertension, hyperlipidemia, and an 80-pack year history of smoking and quit several years ago. Clinically, the patient was limited by severe claudication with a maximum ambulatory distance of one block. She also had recurrent global transient ischemic attacks despite optimal antiplatelet therapy, characterized by speech disturbance, generalized mental slowing, and episodes of brief coma-like behavior. Her vascular examination was notable for bilateral carotid bruits with delayed upstroke, moderately elevated blood pressure with a 20 mm Hg pressure difference between the upper extremities, and diminished lower-extremity pulses with a resting ankle-brachial index of 0.7 bilaterally. Noninvasive ultrasound testing revealed significant multilevel disease of the lower extremities, as well as significantly elevated velocities in both carotid bifurcations.

DIAGNOSTIC FINDINGS

In light of these findings, the patient underwent diagnostic angiography. In hindsight, and in our current pattern of practice, she would have been an ideal patient for preprocedural CT angiography. Vascular access proved to be somewhat challenging, as the femoral pulses were weak and calcified under fluoroscopy. A suprarenal aortogram with iliac runoff was obtained (Figure 1) and revealed moderate bilateral renal artery disease, a tortuous and calcified infrarenal abdominal aorta with at least 70% distal stenosis, and severe bilateral iliac artery disease. It was challenging to gain access to the thoracic aorta, and pressure measurement at that

Figure 3. Aberrant right subclavian artery with high-grade proximal disease and an occluded right vertebral artery.

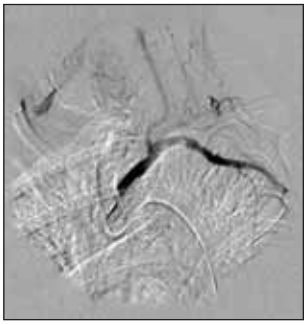

Figure 4. Left subclavian artery with significant proximal and mid-vessel disease surrounding a widely patent left vertebral artery.

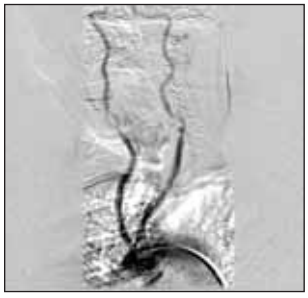

Figure 5. Bicarotid trunk with ostial stenoses of both common carotid arteries and recurrent bilateral internal carotid stenoses (after remote carotid endarterectomy).

Figure 6. Bicarotid trunk engaged with a 9-F multipurpose guide catheter and after bilateral Emboshield deployment.

location showed significant central hypertension with marked mismatch compared to the pressures measured in either arm.

The pigtail catheter was then advanced to the ascending aorta, and a left anterior oblique projection arch aortogram was obtained. The angiogram revealed a type II aortic arch with multiple anomalies (Figure 2), including an aberrant right subclavian artery originating distal to the left subclavian artery and a bicarotid trunk. Selective angiography, performed with a Sos Omni catheter (AngioDynamics, Inc., Queensbury, NY) confirmed severe, multilevel disease of the great vessels. The right subclavian artery was found to have a complex 90% proximal stenosis and an occluded right vertebral artery at its origin (Figure 3). The left subclavian was found to have at least moderate disease of the origin of the vessel and the segment just beyond the take off of the left vertebral artery (Figure 4). The common carotid arteries shared a common trunk off of the aorta, and the origin of each vessel was 90% stenosed (Figure 5). In addition, the internal carotid arteries at the bifurcation were found to have ≥80% stenoses bilaterally. Intracerebral angiography showed that the posterior circulation was solely of left vertebral origin with no anterior communication. The anterior and middle cerebral arteries were supplied by their respective carotid arteries but were clearly underperfused.

COURSE OF ACTION

The decision was made to first proceed with aortoiliac reconstruction to improve access for carotid intervention and to alleviate the patient's claudication symptoms. This was successfully carried out by deploying a 14-mm X 40-mm Smart Control self-expanding, nitinol stent (Cordis Corporation, a Johnson & Johnson company, Miami, FL) in the distal abdominal aorta with balloon angioplasty using a 12-mm X 20-mm balloon at low pressure. The iliac bifurcation was treated in kissing fashion via simultaneous delivery of a pair of 7-mm X 40-mm Express balloon-expandable stents (Boston Scientific Corporation, Natick, MA). The final angiogram (not pictured) revealed a widely patent aortoiliac junction with unobstructed flow to the common femoral arteries.

At a later date, and after the patient had demonstrated tolerance to dual antiplatelet therapy, we proceeded with complex carotid intervention. Given the fact that the common carotid arteries were both severely diseased at their common origin, and in light of the fact that our universal intent is to perform carotid procedures with embolic protection, we elected to proceed with bilateral revascularization in a single setting. The patient was anticoagulated with standard heparin to an activated clotting time of 300 seconds, and a 9-F multipurpose guide catheter (Cordis Corporation) was positioned at the origin of the bicarotid trunk. A pair of Zebra wires (Abbott Vascular, Santa Clara, CA) were then advanced through the ostial stenoses of the common carotid arteries, through the internal carotid stenoses and positioned in the petrous portion of each carotid artery. A pair of 6-mm Emboshield filters (Abbott Vascular) were then advanced sequentially over each wire to the desired position in the distal C1 segment of each internal carotid artery (Figure 6). We then performed predilation balloon angioplasty at each of the four interventional targets with a 4-mm balloon. Subsequently, a 6-mm X 8-mm X 40-mm Xact carotid stent (Abbott Vascular) was deployed across the left internal carotid artery stenosis and postdilated with a 5-mm Sterling balloon (Boston Scientific Corporation), with an excellent angiographic result. Stenting of the right internal carotid artery was then performed in similar fashion using a 7-mm X 9-mm X 40-mm Xact carotid stent and a 5-mm Sterling balloon, also resulting in the desired angiographic outcome.

Finally, we turned our attention back to the ostial common carotid lesions. At this location, we elected to use a pair of 6-mm Herculink Plus balloon-expandable stents (Abbott Vascular). In the right common carotid artery, we

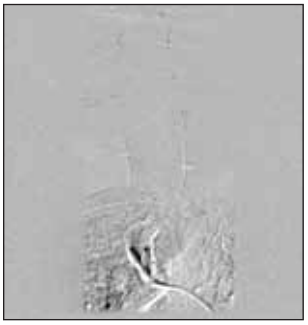

Figure 7. Kissing stent placement at the origin of the common carotid arteries.

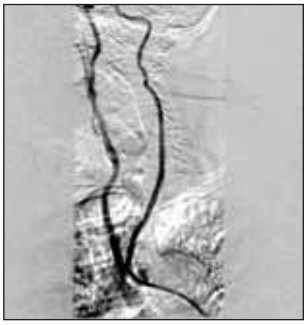

Figure 8. Final angiogram showing widely patent bilateral common and internal carotid arteries.

positioned a 6-mm X 18-mm stent, and in the left common carotid, we used a 6-mm X 15-mm stent. Both stents were simultaneously deployed using kissing stent technique with slight protrusion into the aortic arch (Figure 7). The Emboshield filters were then sequentially reconstrained and removed without difficulty.

RESULTS AND CONCLUSION

Final angiograms were then obtained (Figure 8), revealing a widely patent bicarotid trunk, widely patent bilateral internal carotid arteries, and brisk distal flow with markedly improved intracerebral perfusion.

The patient tolerated the procedure well with no hemodynamic or neurologic sequelae. The femoral artery sheath was removed successfully using a StarClose device (Abbott Vascular), and the patient was discharged without incident the next day. Over the course of the past 6 months, she has had no recurrence of her initial neurologic symptoms and has demonstrated significant cognitive improvement. Ultrasonography at 6 months also demonstrates her interventional targets to be widely patent. ■

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