Coarctation, aneurysm, carotid agenesis, oh my! Complex arch anatomy requires thoughtful operative planning for safe repair

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Similarities to interrupted aortic arch type B2 with aberrant right subclavian artery.

Central Message

A complex case of an adult with near interruption of the aortic arch, saccular arch aneurysm, and a single carotid artery demonstrates the importance of thoughtful operative planning for safe repair.

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In the current issue of the *Journal*, Rajagopalan and colleagues¹ present an interesting case report that doubles as an educational brain teaser on the surgical approach to complex arch pathology. The patient is an adult woman who presented with a symptomatic saccular arch aneurysm associated with near interruption of the transverse arch and an aberrant right subclavian artery, reminiscent of the congenital anomaly of interrupted aortic arch type B2 (Figure 1). The key factor that further confounded the operative approach was the presence of a single right carotid artery, with presumably atresia or agenesis of the left carotid artery. The surgeons carefully reviewed the anatomy and designed an operation guided by 3 principles. First, given that the single carotid artery appeared to be the sole source of anterior cerebral circulation, they wanted to avoid any manipulation of this vessel whatsoever to prevent catastrophic stroke from inadvertent surgical injury. Second, the proximity of the single carotid artery to the saccular aneurysm was considered too short to allow for placement of a clamp proximal to the aneurysm. Third, the degree of coarctation was considered too severe to allow simultaneous perfusion of the head and body with a single arterial cannulation site.

The surgeons then designed an operative plan taking into account this unique set of limitations. The final operative repair involved interposition graft placement across the involved arch segment, with aneurysm exclusion and left subclavian artery reimplantation. The repair was performed via left thoracotomy on cardiopulmonary bypass with both ascending aorta and femoral arterial perfusion. The patient was cooled to 18°C, and an open proximal anastomosis was performed during a 31-minute period of total body

circulatory arrest. After completion of the proximal anastomosis, perfusion was restored to both the upper and lower body, and a closed distal anastomosis was performed. The repair was a success, and the patient recovered uneventfully without stroke or paraplegia.

So, what would *you* have done? Presumably, different surgeons may have approached this case differently, based on personal expertise, skill sets, and differential adherence to the guiding principles outlined previously. The case likely could have been performed via sternotomy, thoracotomy, or a clamshell incision. For those willing to manipulate the single carotid artery, the case could have been approached by debranching with endovascular aneurysm exclusion (assuming the tortuous arch could be navigated)² or open repair with regional cerebral perfusion via the carotid artery. For those willing to attempt clamping of the arch between the carotid artery and the aneurysm, the case could have been completed with a closed proximal anastomosis without circulatory arrest, and perhaps left heart bypass alone. Another approach facilitated by proximal clamp placement could have included ascending-descending aortic bypass with aneurysm resection.³ Last, might some bold surgeon have attempted interposition grafting

FIGURE 1. Similarities to interrupted aortic arch type B2 with aberrant right subclavian artery.

or ascending-descending bypass and aneurysm resection without cardiopulmonary bypass at all?

This case report is unique and intriguing because of the rarity of the arch anatomy and the myriad of operative approaches that can be devised, each with a different risk calculus. Although there is clearly no right answer for how to approach this case, we agree that completion of the repair under circulatory arrest with an open proximal anastomosis is a safe, judicious approach that avoided manipulation of the carotid artery and aneurysm, and one that served the patient well in this instance. We further found the process of outlining the various operative strategies and their attendant risks to be a helpful teaching exercise, one that may be of use for trainees who are learning the nuances of arch surgery and the available repair techniques and perfusion strategies.

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