

Total Arch Replacement with Associated Anomaly of the Left Vertebral Artery

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We describe total arch replacement after ascending aortic replacement for acute type II dissecting aneurysm with associated anomaly of the left vertebral artery. A female patient was recommended at 10 years of age after the initial operation because of an enlargement of the distal ascending aorta. Magnetic resonance angiography revealed an isolated left vertebral artery that arises distal to the left subclavian artery. Total arch replacement was proceeding using selective cerebral perfusion. The isolated artery was reconstructed with a saphenous vein graft interposed between the native left vertebral artery and the side of the graft branch anastomosed to the left subclavian artery. The patient recovered uneventfully after extensive surgical replacement of the thoracic aorta and remains asymptomatic at 1 year after the procedure. To prevent possible neurological complications, we find it critical to assess vascularization in this region prior to conducting surgical procedure. Careful examination and correct identification of the vessels are essential to avoid major complications. (Ann Thorac Cardiovasc Surg 2010; 16: 216–219)

Key words: total arch replacement, left vertebral artery, anomaly

Introduction

Aortic arch branch anomalies pose technical challenges during surgery on the aortic arch for aneurysm or dissection because mistaking the arch vessels during surgery could be life threatening. Careful examination and correct identification of the vessels by a thoracic surgeon are essential to avoid major complications. Several publications describe anomalous origins and variants of the vertebral arteries.^{1–4)} The left vertebral artery often arises directly from the aortic arch between the left common carotid artery and the left subclavian arteries.⁵⁾ Yamaki et al. described that the frequency of this anomaly is 5.8%.³⁾

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However, an isolated left vertebral artery (ILVA) that arises distal to the left subclavian artery is an extremely rare vascular congenital anomaly about which little seems to have been published.⁶⁾ We describe total arch replacement with an associated anomaly of the left vertebral artery, which arose directly from the aortic arch distal to the left subclavian artery.

Case Report

A 66-year-old woman was referred to our institution for repeated surgery to treat distal enlargement after ascending aortic replacement for an acute type II dissecting aneurysm. She was a nonsmoker with no history of diabetes, hypertension, or hyperlipidemia. She was followed up by serial imaging at least annually, and surgery was recommended at 10 years after the initial dissection because the absolute maximal diameter of the distal ascending aorta exceeded 5.0 cm and resembled a pseudoaneurysmal formation. Aortography showed enlargement immediately distal to the ascending replacement site. Magnetic resonance angiography revealed an ILVA that arose distal to the left

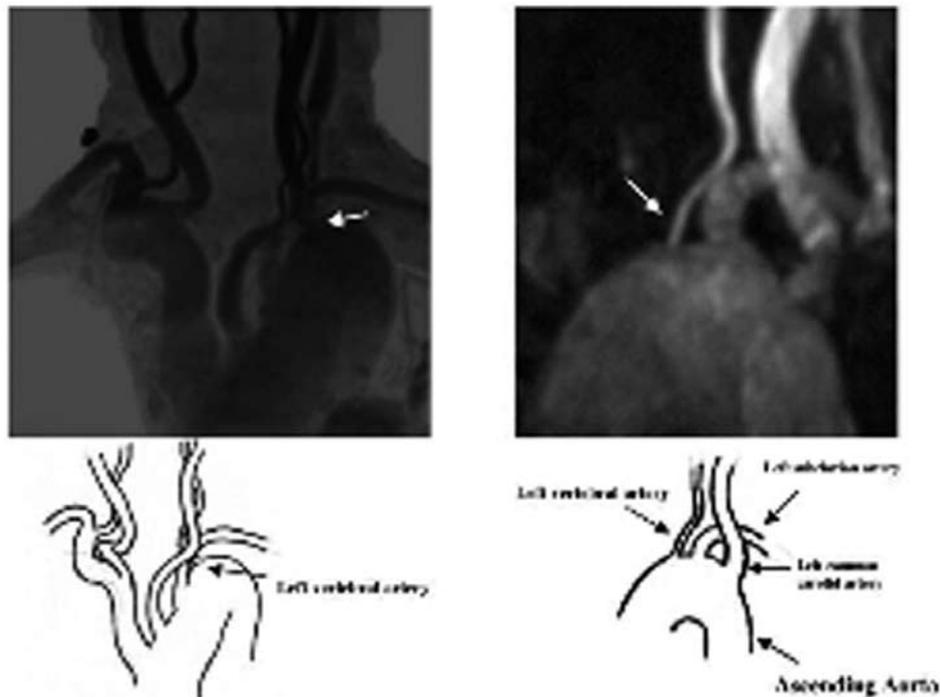


Fig. 1. Preoperative magnetic resonance angiography. Isolated left vertebral artery arises distal to the left subclavian artery (arrow). (A) A-P view; (B) left posterior view.

A | B

subclavian artery (Fig. 1). The arch aorta and descending aorta were dilated to 4.5 cm, but returned to a more normal diameter of 3.0 cm at the level of the diaphragmatic hiatus. Repair of the total arch and descending aortic aneurysm was thus indicated.

The bilateral axillary and right femoral arteries were exposed, and then the heart, ascending aorta, aortic arch, and arch vessels were exposed through a median sternotomy, and sternum transection plus a left thoracotomy at the fourth intercostal muscle. After systemic heparinization, an 8-mm-diameter graft was anastomosed to the bilateral axillary arteries for systemic arterial cannulation, and these grafts were used for selective cerebral perfusion (SCP). After distal anastomosis was finished, the graft was led anteriorly through and into the isolated residual distal arch aorta. Antegrade SCP was established through vascular grafts anastomosed to the bilateral axillary arteries and a perfusion catheter placed directly into the left carotid artery. The ILVA was selectively perfused and separated from the aortic arch. After antegrade SCP was terminated and the arch vessels had been reconstructed, the proximal side of the arch graft was sutured to the stump of the ascending aortic graft that had originally

been reconstructed. The ILVA was reconstructed with a saphenous vein graft (SVG) interposed between the native ILVA and the side of the graft branch anastomosed to the left subclavian artery (Figs. 2A and B). Surgical duration, total cardiopulmonary bypass (CPB) time, cardiac ischemic time, and SCP time were 629, 202, 134, and 126 minutes, respectively. Postoperative angiography showed good patency of the reconstructed left vertebral artery (Fig. 2C). The patient's postoperative course was uneventful, and she remains asymptomatic at 1 year after the procedure.

Discussion

Both the right and left vertebral arteries usually arise from the posterosuperior aspect of the first part of the subclavian artery. Many authors have published different series or reports about anomalies of vertebral arteries that more frequently occur on one side, mostly on the left.¹⁻⁴ The ILVA arises directly from the aortic arch in about 4% of the general population, and it is one of the most frequent aortic arch branch anomalies.^{3,5} The vertebral artery develops in the embryo as a longitudinal channel connecting the cranial intersegmental arteries

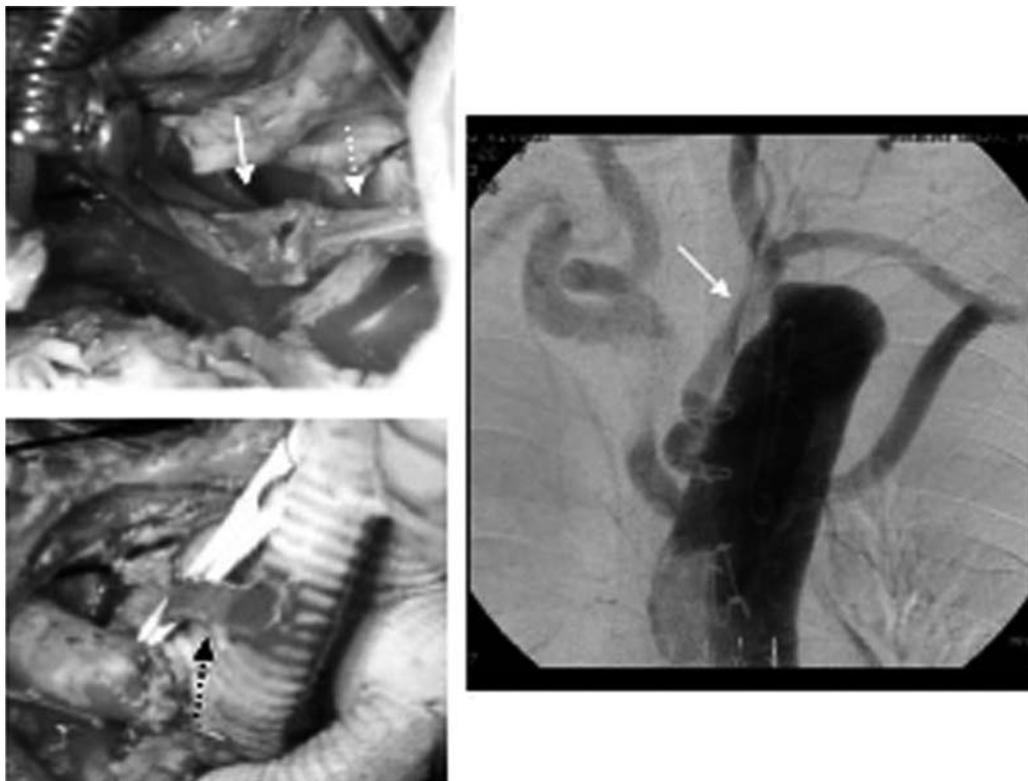


Fig. 2. Intraoperative and postoperative findings.

(A and B) Intraoperative findings. The isolated left vertebral artery was reconstructed with a saphenous vein graft (dotted arrow) interposed between the native left vertebral artery (arrow) and the side of the graft branch anastomosed to the left subclavian artery.

(C) Postoperative angiography shows good patency of reconstructed left vertebral artery (arrow).

A	C
B	

and is therefore usually a branch of the subclavian artery. Incorporation of the proximal left seventh intersegmental artery into the developing aorta could result in the left vertebral artery arising directly from the aortic arch. If small intersegmental connections persist with development of the cervical spine, the left vertebral artery might originate distal to the left subclavian artery.⁶⁾

Anatomical and morphological variations of the vertebral artery are significant for diagnostic and surgical procedures involving the aortic arch. Because the overall incidence of anomalies in the prevertebral segment of the vertebral artery is very low,^{3,5)} it is extremely important to be aware of this. The origin and course of the vertebral artery must be understood in detail, and possible variations must be considered. Such anomalies can cause ischemia as well as infarction of the brain stem and cerebellum if the vertebro-basilar axis is left dominant and communication at the arterial circle of Willis is poor.

We performed total arch replacement through a median sternotomy with left anterolateral thoracotomy

for this patient. Some controversy surrounds indications for this approach in patients with arch aneurysm because of suboptimal surgical results after extended arch replacement. We believe that the ability to visualize and protect the phrenic and recurrent laryngeal nerves contributes to improved patient recovery. Moreover, the prevention of cerebral embolism is an important consideration during repair of an aortic arch aneurysm, and it is a major goal of cerebral protection techniques. Toward this end, a selection of the arterial cannulation site for CPB is critical. Since 2000, we have preferentially used bilateral axillary arteries for perfusion with total arch replacement, and none of these patients developed neurological injury. We doubt whether whole brain perfusion is sufficient with only right axillary artery perfusion. The best approach for cerebral protection during these procedures remains a matter of controversy. Although the procedures are continually undergoing refinement with improved results, associated brain injury can still arise despite the application of all cerebral protection techniques

suitable for these operations. Thus we added left-side brain perfusion. Moreover, vertebral perfusion is important for spinal protection, as well as for cerebral protection.

Approaches to ILVA reconstruction include en bloc reconstruction of the arch branches, direct anastomosis to the graft branch corresponding to the left subclavian artery, and direct anastomosis to the native left subclavian artery.^{1,7)} Although no long-term results regarding patent reconstructed ILVAs have been published, we used an SVG interposed between the ILVA and the graft branch. An ILVA is difficult to preoperatively diagnose because other large arch branches in angiography often obscure this artery. However, it is critical to assess vascularization in this region before conducting medical procedures to prevent complications.

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