Case Report

Surgical Treatment of an Aneurysm of the Aberrant Right Subclavian Artery Involving an Aortic Arch Aneurysm and Coronary Artery Disease

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A 55-year-old man presented with clinical signs of an aortic arch aneurysm. Angiography, magnetic resonance imaging (MRI) and computed tomography (CT) demonstrated an aortic arch aneurysm and an aneurysm of the aberrant right subclavian artery (ARSA). Coronary angiography revealed 95% stenosis in the right coronary artery. Right common carotid artery (RCCA)–right subclavian artery (RSA) bypass, arch graft replacement and coronary artery bypass grafting (CABG) were performed successfully. The use of an internal shunt tube, hypothermic circulatory arrest and selective cerebral perfusion were useful methods in the prevention of cerebral ischemia during surgical reconstruction of the aortic arch. To our knowledge, this is the first report in the literature of a successfully managed case with an aneurysm of an ARSA involving an aortic arch aneurysm and coronary artery disease. (Ann Thorac Cardiovasc Surg 2001; 7: 109–12)

Key words: aneurysm of aberrant right subclavian artery, aortic arch aneurysm, coronary artery disease

Introduction

The aberrant right subclavian artery (ARSA) arises as the fourth branch from the aortic arch. This anomalous artery has a tendency to become aneurysmal later in life, and fatal hemorrhages have been reported.[1)] Only a very few demonstrations of this anomaly in combination with an aortic arch aneurysm have been previously reported.[2,3)] We report a case in which an aneurysm of an ARSA involving an aortic arch aneurysm and coronary artery disease was managed successfully.

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Case Report

Case presentation

A 55-year-old man was admitted to the hospital complaining of persistent cough and hoarseness of 3 months' duration. His heart rate was 70 beats/min and blood pressure was 170/98 mmHg. Respiratory sound was clear, and no bruit or abnormal heart murmurs were heard. A chest x-ray study showed enlargement of the upper mediastinal mass. The electrocardiogram on admission showed normal sinus rhythm and Q wave at leads II, III, and aVF. Enhanced computed tomography (CT) demonstrated an aortic arch aneurysm with contained thrombus and an abnormal artery passing behind the esophagus. Magnetic resonance imaging (MRI) showed similar findings (Fig. 1). Intra-arterial digital subtraction angiography demonstrated an aortic arch aneurysm and an ARSA arising from an aneurysmal dilatation of its origin, the so called diverticulum of Kommerell (Fig. 2). Coronary angiography revealed a normal left coronary artery and 95% stenosis in the right coronary artery (RCA) proximal to the acute margin. Left ventriculography showed a small area of hypokinesia involving the

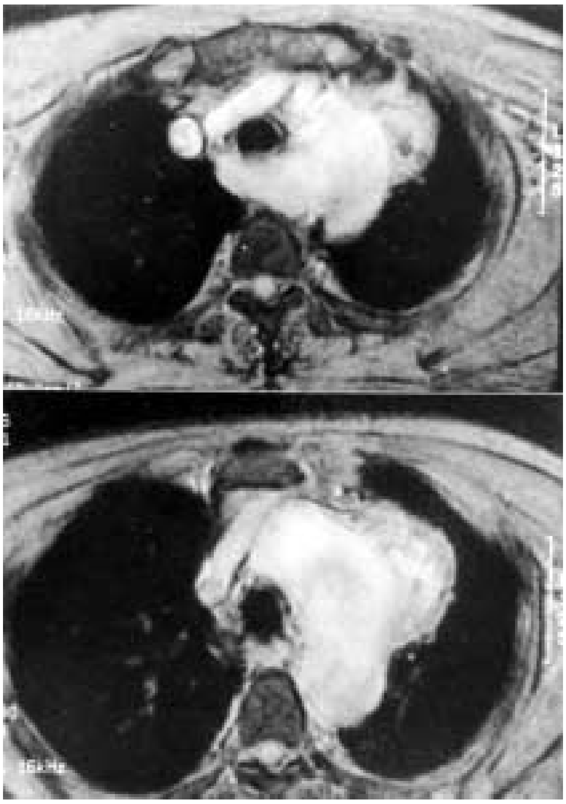

Fig. 1. Magnetic resonance imaging (MRI) on admission showed an abnormal artery passing behind the esophagus and trachea (top) and an aortic arch aneurysm with contained thrombus (bottom).

posterior basal segment. There was an aortic arch aneurysm, with 95% stenosis in the RCA and an ARSA arising from the diverticulum of Kommerell.

Operation and postoperative course

The patient underwent the operation on 26 April 1994. The operation was performed via median sternotomy and left supraclavicular incision using ice bags on the skull to assist in producing cortical hypothermia. The aortic arch aneurysm was exposed and was remarkably expanded. Extracorporeal circulation was started with cannulation of the left femoral artery and the right atrium. Myocardial protection was accomplished with cold blood cardioplegia and topical cooling. The distal end of the reversed saphenous vein graft (SVG) was anastomosed to the RCA. Cold blood cardioplegia solution was added via the graft. During reduction of the body temperature, a right supraclavicular incision was made to expose the right common carotid artery (RCCA) and the right subclavian artery (RSA). Using a 3-mm internal shunt tube, the proximal end of a 7 mm Hemashield graft was anastomosed to the RCCA end-to-side with a continuous suture of 5-0 polypropylene. Distal anastomosis between the graft and the RSA was performed end-to-side with a running polypropylene suture. Circulation to the right

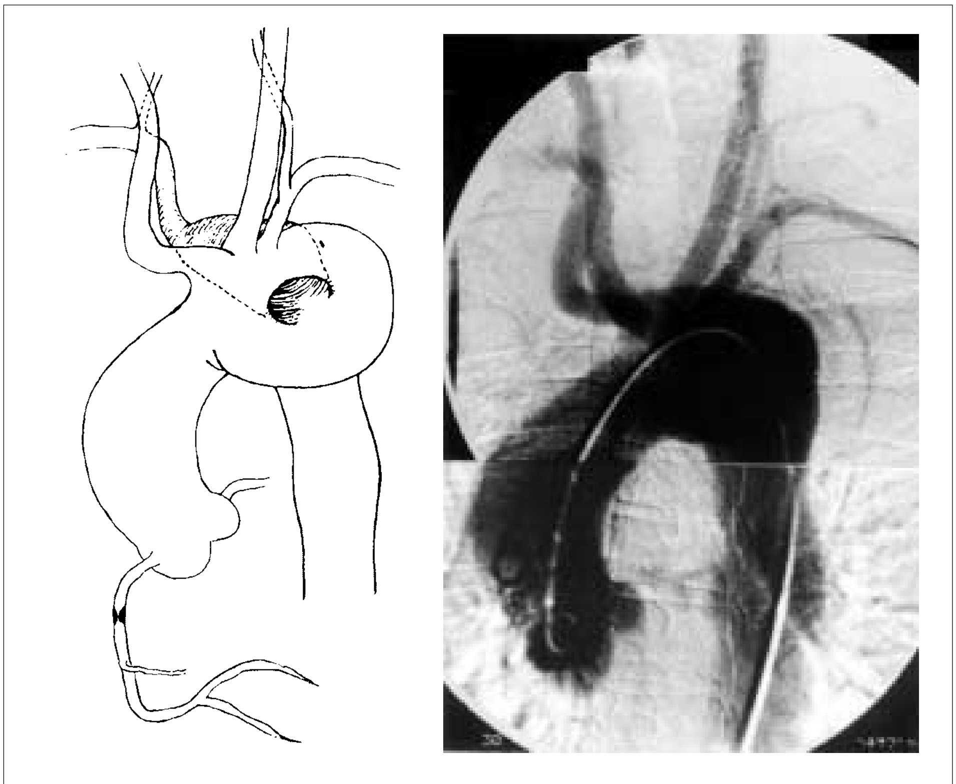

Fig. 2. Preoperative angiogram demonstrated an aortic arch aneurysm and aberrant right subclavian artery (ARSA) arising from an aneurysmal dilatation of its origin.

Fig. 3. Postoperative angiogram showed a nearly normal aortic arch, a patent right carotid-subclavian artery bypass graft, and a patent vein graft to the right coronary artery.

upper extremity was restored through the graft. The ARSA was dissected out at the posterior mediastinum on the right side of the esophagus. It was then ligated just proximal to the right vertebral artery (RVA).

When the rectal temperature reached 22°C, hypothermic circulatory arrest was instituted, the aortic arch aneurysm was opened and the mural thrombus was removed, and low-flow perfusion was performed through the femoral artery at a rate of 0.5 to 1.0 L/min.[4] Blood was aspirated from the operative field with a sucker and was returned to the cardiopulmonary bypass circuit. The RCCA, left common carotid artery (LCCA), and left subclavian artery (LSA) were cannulated from inside the aortic arch. Selective cerebral perfusion was then instituted. Blood was perfused into the RCCA, LCCA, and LSA using a single roller pump separated from the systemic circulation. A total blood volume of 10 ml/kg/min was supplied to these vessels. The right radial arterial pressure was adjusted to between 50 and 70 mmHg to regulate the perfusion pressure.

The opening of the aneurysm of the ARSA was 4 × 3 cm in size and was patched within the aortic lumen using a Hemashield graft. The descending thoracic aorta was completely transected and anastomosed to the 26 mm Hemashield graft in an end-to-end fashion with a 3-0 polypropylene continuous suture. The orifices of the arch vessels were then anastomosed to the opening made on the graft in an end-to-side fashion. Selective cerebral perfusion was terminated. Air was evacuated from the descending aorta, aortic arch, and arch vessels. The graft was clamped proximally to the arch vessels, full perfusion was resumed, and rewarming started. Proximal graft anastomosis was performed. The ascending aorta was unclamped and the heart was filled with blood. Proximal anastomosis of the vein graft to the ascending aorta was performed with a partial occlusion clamp on the ascending aorta. The heart was defibrillated and the cardiopulmonary bypass was terminated.

Although the patient suffered from postoperative perforation of a duodenal ulcer and underwent gastro-jejunostomy, he survived the operation, and is leading a normal life 6 years after the operation. Intra-arterial digital subtraction angiography obtained in February 1995 demonstrated a nearly normal aortic arch, a patent right carotid-subclavian artery bypass graft, and a patent vein graft to the RCA (Fig. 3).

Discussion

An ARSA is the most common congenital anomaly of the aortic arch, occurring in approximately 0.5% of the population.[5] However, an aneurysm of this vessel is truly rare, reported in 49 cases as of the review by Knight and Codd in 1991.[6] To our knowledge, there have been no cases of aneurysm of ARSA complicated with an aortic arch aneurysm and coronary artery disease for which an operation was performed.

The important points concerning the operation on this case were myocardial protection and cerebral protection. As myocardial protection, cold blood cardioplegia solution was first infused antegradely from the ascending aorta in the usual manner and then topical cooling was performed. After distal anastomosis between the RCA and the SVG was performed, cold blood cardioplegia solution was infused from this SVG and the ascending aorta as usual.

As cerebral protection, we thought it important to bypass the RCCA and the RSA first after cooling down the surface of the head with ice bags. Then the whole body and head were sufficiently cooled by extracorporeal circulation. In performing the bypass operation, vascular flow into the brain was maintained using an internal shunt tube for anastomosis to the RCCA. After ligating the RSA just before the RVA bifurcation, a balloon catheter was inserted into each trifurcation in the head to perform selective cerebral perfusion. Vascular flow into the RVA was maintained through the newly formed RCCA-RSA bypass.

Opinions differ as to selective cerebral perfusion. In our case, we used the RCCA, LCCA and LSA at the site of perfusion at a rectal temperature of 22°C. Selective cerebral perfusion was performed at a rate of 10 ml/kg/min using a single roller pump separately from systemic circulation. The right radial arterial pressure was adjusted to between 50 and 70 mmHg to regulate the perfusion pressure. This method is simpler than that by which the pressure of the bilateral superficial temporal arteries is monitored.[4]

One of the surgical approaches to an aneurysm of an ARSA consists of left thoracotomy in the right lateral recumbent position after bypassing the RCCA and the RSA in the supine position.[2] However, using hypothermic circulatory arrest, it was possible to observe the diverticulum of Kommerell from the inside of the aorta also in the supine position and it was easy to perform distal anastomosis between the arch graft and the descending thoracic aorta. Furthermore, it was possible to operate on the aortic arch aneurysm and the coronary artery disease simultaneously in this case.

As the operative technique for total aortic arch replacement, we now use the separated graft technique instead of the en bloc repair technique, not only because it allows more precise reconstruction of the arch vessels in patients with compromised arch vessels as a complication, but also because the total bypass and operation times are reduced.[7,8]

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