Successful Ascending Aorta-Abdominal Aorta Bypass Graft through the Left Thoracic Cavity in a Patient with Atypical Coarctation

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A 67-year-old woman admitted with severe hypertension, atrial fibrillation, and dyspnea was found to have hypertension and congestive heart failure due to stenosis of the descending aorta. Atypical aortic coarctation was diagnosed. Extra-anatomical bypass was performed from the ascending aorta to the terminal abdominal aorta and the pulmonary vein was isolated. The graft was arranged to pass through the left thoracic cavity from the pericardium via a transretroperitoneal approach to the terminal abdominal aorta. Direct contact was avoided between the graft and the abdominal organs, and the pressure gradient between the ascending aorta and the abdominal aorta was decreased.

Keywords: atypical coarctation, hypertensive heart failure, ascending aorta-abdominal aorta bypass

INTRODUCTION

Atypical coarctation of the aorta caused by atherosclerotic disease has a predilection for the descending thoracic or abdominal aorta. Extra-anatomical bypass surgery is typically performed in cases of hypertensive heart failure with increased afterload. We present here a case of atypical coarctation of the aorta in which ascending aorta-abdominal aorta bypass grafting passing through the left thoracic cavity was performed successfully, without complications.

CASE REPORT

A 67-year-old woman was referred to our hospital with severe hypertension and general fatigue. She had been diagnosed with hypertension at the age of 23 and started taking medication from age 34. However, despite several years on a β-blocker, calcium antagonist, and angiotensin receptor blocker, her hypertension was poorly controlled, with a systolic blood pressure of >200 mmHg and mild respiratory failure, and therefore underwent a detailed examination. Chest computed tomography (CT) revealed a high-grade stenotic lesion of the descending aorta and she was consequently referred to our hospital and admitted.

On examination, her height was 150 cm, weight 73 kg, and body mass index 34. Blood pressure was 169/63 mmHg in the right upper extremity, 179/63 mmHg in the left upper extremity, 106/59/63 mmHg in the right lower extremity, and 104/55 mmHg in the left lower extremity. Her pulse was irregular and revealed atrial fibrillation. Cardiac murmurs but no crepitations were audible and no remarkable neurological findings were observed.

Chest X-ray revealed cardiomegaly with a cardiothoracic ratio of 60.1% and pulmonary congestion (Fig. 1). Plain thoracic CT showed calcification of the entire circumference of the descending aorta accompanied by stenosis (Fig. 2A). A pressure gradient of approximately 100 mmHg was determined by aortic catheterization (Fig. 2B). Cardiac catheterization indicated no significant
Left Thoracic Ascending-Abdominal Aorta Bypass and extracorporeal circulation was initiated. Blood perfusion was also initiated from the previously anastomosed graft side branches. The pulmonary veins were ablated using a bipolar radiofrequency device (Cardioblate; Medtronic, Minneapolis, Minnesota, USA). On confirming reversion to sinus rhythm and after cross-clamping the ascending aorta, antegrade cardioplegia was induced. The graft was passed sequentially through the left retroperitoneum, the diaphragm, and the left thoracic cavity while under cardiac arrest. Then, an end-to-side anastomosis was created between the graft and the ascending aorta, avoiding the area of calcification in the ascending aorta. Finally, in the left thoracic cavity, an end-to-end anastomosis was created between the proximal and distal grafts and the branched 7-mm graft was ligated. The stenosis of the coronary arteries. An echocardiogram showed an ejection fraction of 75% and left ventricular wall motion was normal, but respiratory fluctuations of the inferior vena cava were decreased to 48%.

Atypical coarctation of the aorta due to Takayasu’s arteritis was strongly suspected as she met the following diagnostic criteria: age at disease onset <40 years, claudication of extremities, difference of >10 mmHg in systolic blood pressure between the arms, and arteriogram abnormality. Descending aortic stenosis was classified as type III, and afterload reduction was considered necessary. However, direct bypass or percutaneous transluminal angioplasty for the lesion in the aortic arch and descending aorta, along with the severe stenosis and calcification present, would be a difficult as well as high-risk procedure. Therefore, we decided to conduct an extra-anatomical bypass operation. The graft used was a 14-mm J-graft. First, a 7-mm graft was used to create a branch in the 14-mm graft. The approach was via a median sternotomy extending to the umbilicus as a midline abdominal incision. The retroperitoneum was cleared, the abdominal aorta was extirpated, and the route for the abdominal aorta was created from the left thoracic cavity to the left retroperitoneum. First, an end-to-side anastomosis was created to the abdominal aorta with the bifurcated graft. Next, aortic cannulas were inserted into the ascending aorta and venous cannulas were inserted into the superior and inferior vena cavae.
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1) Her uncontrollable hypertension over the long term and accompanying hypertensive cardiac failure made her a candidate for surgical treatment. Various surgical techniques can be used in adults with atypical coarctation of the aorta arising from the region of coarctation and its surroundings, including vascular prosthesis implantation, patch-angioplasty, aorto-aortic bypass, and axillo-bifemoral bypass. The reason we selected ascending aorta-abdominal aorta bypass was because, despite it requiring a median sternotomy incision to the abdomen, we were able to use a large caliber vascular graft and thus expected to ensure a reliably alleviated afterload, long-term vascular graft patency, and satisfactory perfusion of the abdominal branching vessels. In addition, as we intended to perform pulmonary vein isolation for the atrial fibrillation, it was possible to obtain a good field of view of the ascending aorta and the expansion of the heart by midline sternotomy, and it was easy and safe to establish extracorporeal circulation.

Routes that can be selected for ascending aorta-abdominal aorta bypass are intra-abdominal, retroperitoneal (anterior pancreatic aspect and posterior pancreatic region), and

**Fig. 3** Postoperative imaging results. (A) Three-dimensional computed tomography (3D CT) shows a satisfactory graft and no stenosis of the abdominal vessels. (B) Thoracic X-ray. Cardiothoracic ratio (CTR) is 57%. Improvement of both cardiomegaly and pulmonary congestion is evident.

**DISCUSSION**

Atypical coarctation of the aorta is an arteriosclerotic disease frequently affecting the thoracic ascending and descending aorta, as well as the abdominal aorta. There is no stenosis of the branches of the aortic arch, and when the stenotic lesions are confined to the abdominal aorta, it is referred to as “midaortic syndrome”. While there are several causes of aortic coarctation, aortitis syndrome is the most common cause. The patient’s condition results in central hypertension and failure of peripheral perfusion in the region of coarctation. Cardiac failure in particular exerted a significant influence on prognosis of the present patient. Her uncontrollable hypertension over the long term and accompanying hypertensive cardiac failure made her a candidate for surgical treatment.

Various surgical techniques can be used in adults with atypical coarctation of the aorta arising from the region of coarctation and its surroundings, including vascular prosthesis implantation, patch-angioplasty, aorto-aortic bypass, and axillo-bifemoral bypass. The reason we selected ascending aorta-abdominal aorta bypass was because, despite it requiring a median sternotomy incision to the abdomen, we were able to use a large caliber vascular graft and thus expected to ensure a reliably alleviated afterload, long-term vascular graft patency, and satisfactory perfusion of the abdominal branching vessels. In addition, as we intended to perform pulmonary vein isolation for the atrial fibrillation, it was possible to obtain a good field of view of the ascending aorta and the expansion of the heart by midline sternotomy, and it was easy and safe to establish extracorporeal circulation.

The patient was started on oral steroids postoperatively, and no pressure gradient was observed between the upper and lower limbs on manometry. Hypertension could be well controlled by a β-blocker alone. Heart rate was maintained in sinus rhythm, and chest X-ray showed improvement of the cardiomegaly (Fig. 3A). Postoperative CT showed good graft patency (Fig. 3B). As the patient’s course was favorable, she was discharged in remission on postoperative day 15.
Ascending aorta-abdominal aorta bypass grafting via the left thoracic cavity may be a safe and useful procedure for patients with uncontrollable hypertension caused by atypical coarctation of the aorta.

**DISCLOSURE STATEMENT**

The authors declare no conflicts of interest.

**REFERENCES**