How to Do It

Introduction

Aortitis syndrome is characterized by nonspecific inflammation of the aorta, its major branch, the pulmonary artery or coronary artery, which causes obstructive or dilatational changes in those vessels.1,2) Descending aortic coarctation due to aortitis syndrome causes uncontrollable severe hypertension, intermittent claudication and visceral ischemia or other complications.

Although some case reports of surgical treatment for this condition have been published, there has been insufficient discussion about the optimal route of the prosthetic graft with regard to avoiding complications. In the previous reports, the ascending or thoracic descending aorta were chosen for the proximal anastomosis site, and the routes of prosthetic grafts were the right or left thoracic cavity to the retroperitoneal cavity or abdominal cavity.3–8) These routes may cause complications associated with the anastomotic site related to inflammation, excessive bleeding from the rich collateral vessels and graft contact with intestines, thus leading to adhesion formation.9) In this series, we successfully performed extraanatomical bypass for coarctation of the descending aorta with a median sternotomy and retroperitoneal approach.

Keywords: extraanatomical bypass, coarctation of the descending aorta, retro-peritoneal approach

Case History

Case 1

A 59-year-old female was referred to our department for surgery to treat long segment narrowing of the thoracic descending aorta. She had been pointed out to have hypertension and weak pulsation of the left radial artery when she was 26 years old, and was diagnosed with aortitis syndrome. Her hypertension was poorly controlled in spite of multiple types of antihypertensive medications. She had undergone percutaneous catheter renal arterial intervention for right renal artery stenosis one year before the reference presentation, which resulted in no improvement. Her subjective symptoms were a pulsating headache, paralysis of the left upper limb and intermittent claudication.
Her systolic blood pressure of the right and left upper limbs was 243 mmHg and 126 mmHg, respectively. Her ankle brachial pressure index (ABPI) of the right and left side were 0.66 and 0.68, respectively.

The arterial blood pressure of each segment of the aorta measured in the catheter examination were 299/58 mmHg at the ascending aorta, 283/59 mmHg at the aortic arch, 132/55 mmHg at the thoracic descending aorta and 100/55 mmHg at the abdominal aorta. Multidetector-row computed tomography (MDCT) showed severe diffuse stricture of the descending aorta, occlusion of the left subclavian artery and stenosis of bilateral internal carotid arteries. The diameter of the aorta was 33 mm, 23 mm and 18 mm at the ascending, descending and the infrarenal abdominal aorta, respectively. The minimum diameter of the aorta was 9 mm at the level of the diaphragm. Rich collateral arteries from the right internal thoracic artery to the right femoral artery were developing (Fig. 1A). The patient’s preoperative serum creatinine and blood urea nitrogen levels were 0.60 mg/dL and 8 mg/dL. She had taken no anti-inflammatory drug such as corticosteroid and her preoperative inflammation marker was negative.

Uncontrollable severe hypertension that caused a pulsating headache was considered to be an indication for surgical treatment. We performed an ascending to infrarenal abdominal aorta bypass with reconstruction of the left subclavian artery.

We approached the ascending aorta via median sternotomy and the infrarenal abdominal aorta with a left retroperitoneal approach via a para–rectus abdominal muscle skin incision. A small incision was made on the diaphragm as a route for the graft from the left retroperitoneal cavity to the pericardial cavity. A 16 mm prosthetic graft (Gelweave Vascutek; Terumo, Tokyo, Japan) was anastomosed to the infrarenal abdominal aorta under abdominal aortic clamping. The ascending aorta was partially clamped and the graft was anastomosed to the right side of the ascending aorta with a small resection of the aortic wall (Fig. 2). The ascending and abdominal aortic tissues were somewhat thick at the anastomosis sites. The proximal and distal anastomosis was made with 3-0 polypropylene running suture. An 8 mm prosthetic graft with a ring (Gelsoft Vascutek; Terumo, Japan) was anastomosed between the 16 mm prosthetic graft to the left subclavian artery. The left subclavian artery had long stenotic lesion and the distal perfusion area was poor. The patient was extubated on the first postoperative day, and her headache improved. She was discharged without major complications and her postoperative ABPI improved to 0.93 and 0.91 (right and left), respectively. Her hypertension was controlled with a single oral anti-hypertension agent.

In her postoperative MDCT, although the 8 mm graft to the left subclavian artery was occluded, the main graft was patent and the anastomosis site had no problems (Fig. 1B). The patients had no symptoms except for the paralysis of the left upper limb and no complication related to the graft at the 5-year follow-up time point.

The pathological findings of her aortic wall tissue showed fibrosis of the adventitia and slight invasion.
serum creatinine was 1.17 mg/dL (creatinine clearance: 32.4 ml/min). Uncontrollable severe hypertension and chronic renal dysfunction were decided to be indications for surgical intervention. Therefore, we performed an ascending to infrarenal abdominal aortic bypass with coronary artery bypass grafting to the right coronary artery from the ascending aorta.

We approached the ascending aorta via median sternotomy, and the abdominal aorta through the retroperitoneal cavity. A small incision was made on the diaphragm for the route of the graft. A 16 mm prosthetic graft (Gelweave Vascutek; Terumo, Japan) was anastomosed in an end-to-side fashion to the left side of the infrarenal abdominal aorta during abdominal aortic clamping, and to the right side of lymphocytes and neutrophilic and eosinophilic leukocytes at both anastomosis sites, which may have indicated changes after inflammation. The total evaluation of the pathology was non-specific atherosclerosis (shown in Fig. 1C).

Case 2
A 63-year-old female was referred to our department for uncontrolled severe hypertension with descending aortic coarctation and angina pectoris on effort. She had undergone left nephrectomy for a left nephrolith, and extracorporeal shockwave lithotripsy for a right nephrolith.

She had experienced a right cerebral infarction, and was pointed out to have occlusion of the right vertebral artery, narrowing of the right internal carotid artery and aneurysms of the left vertebral and the left internal carotid arteries. In spite of taking multiple antihypertensive agents, her hypertension was not well controlled. Her preoperative ABPI values were both 0.57. Her coronary angiogram showed 90% stenosis of the #2 segment of the right coronary artery, and 50% stenosis of the #11 segment of the left circumflex artery. Her arterial blood pressures were 210/65 mmHg at the aortic arch, 160/64 mmHg at the descending aorta and 95/65 mmHg at the abdominal aorta. Her thoracic descending aorta narrowed from the bronchial first bifurcation level to the diaphragm level, and the minimum diameter of the aorta was 9 mm at the left atrium level (Fig. 3A). She had taken no anti-inflammatory drug and her preoperative inflammation marker was negative. Her preoperative serum creatinine was 1.17 mg/dL (creatinine clearance: 32.4 ml/min).

Uncontrollable severe hypertension and chronic renal dysfunction were decided to be indications for surgical intervention. Therefore, we performed an ascending to infrarenal abdominal aortic bypass with coronary artery bypass grafting to the right coronary artery from the ascending aorta.

We approached the ascending aorta via median sternotomy, and the abdominal aorta through the retroperitoneal cavity. A small incision was made on the diaphragm for the route of the graft. A 16 mm prosthetic graft (Gelweave Vascutek; Terumo, Japan) was anastomosed in an end-to-side fashion to the left side of the infrarenal abdominal aorta during abdominal aortic clamping, and to the right side of...
the ascending aorta in a side-to-end fashion during side clamping of the ascending aorta. The ascending and abdominal aortic tissues at the anastomosis sites were macroscopically normal.

A saphenous venous graft gathered from the lower extremity was anastomosed to the distal right coronary artery. The left side of the ascending aorta was chosen for the proximal anastomosis site and the saphenous venous graft was passed on the lateral side of the free wall of the left ventricle in order to prevent contact with the prosthetic graft.

The patient’s postoperative ABPI improved to 1.04 and 1.07, respectively (right and left). Her postoperative MDCT examination showed patent grafts (Fig. 3B). The patients had no symptoms and no complications related to the graft occurred at the point of 4-year follow up.

The patient’s hypertension was sufficiently controlled with oral agents postoperatively. The pathological findings of both the ascending and the abdominal aortic wall tissue showed no specific findings or changes as shown in Fig. 3C.

Discussion

In the past reports of extraanatomical bypass procedure for coarctation of the descending aorta, the ascending or the descending aorta were chosen for the proximal anastomosis site, and the courses of the prosthetic grafts were the left thoracic cavity, abdominal cavity or retroperitoneal cavity. In order to avoid complications such as pseudoaneurysm formation and stenosis around the anastomosis site, we chose the ascending aorta as a proximal anastomosis site because it was far from the inflammatory lesion and there was no calcification in the ascending aorta in the preoperative MDCTs, and this resulted in the ability to avoid a left thoracotomy, which can cause excessive bleeding from the rich collateral arteries in the thoracic wall. This approach also enabled us to perform coronary artery bypass grafting for a coincident coronary lesion. In both cases, the pathological findings of the anastomosed aortic wall tissue did not indicate severe inflammation or calcification. This may indicate that the anastomosis sites were far enough from the severe inflammatory lesion, as we had planned. Although the anastomosis sites of these cases had not severe calcification or inflammation, an anastomotic aneurysm may occur in future and careful follow-up is necessary. When patients undergo coronary surgery concomitantly, the route of the free graft from the ascending aorta to the coronary artery should be chosen to avoid contact between the prosthetic graft and internal organs. In some reports, polytetrafluoroethylene (PTFE) sheets were used to envelop the graft in order to avoid contact with the intestines.

We intended to reduce the risk of long term complications related to the adhesion to abdominal organs by selecting an approach to the abdominal aorta without laparotomy. We selected the retroperitoneal approach because it does not require another prosthesis to envelop the graft. On the other hand, the retroperitoneal approach led to a longer operation, and the prosthetic graft was longer than that used in other routes through the abdominal or thoracic cavity. In these two cases, the postoperative MDCT showed that the grafts had some kind of bent. This may lead to higher resistance of the prosthetic graft and impede a sufficient decrease in the upper limb blood pressure or reduce the patent expectancy in some cases. Because the total length of the graft could not be seen by the surgeons in the operative view and we should avoid the distortion of the anastomosis site (that may be fragile) caused by a too much shorter graft, the grafts might be a little longer than the optimal length. Although the optimal length of the graft cannot be decided exactly preoperatively, preparative estimation of the graft length by MDCT may avoid too much longer grafts that may cause bend of the grafts. And the graft route should be lining the vertebra in order to the graft be as short as possible. In case the anastomosed grafts were too longer, the graft can be shorten by making some tucks after anastomosis to adjust the length.

Conclusion

We successfully performed an ascending aorta to infrarenal abdominal aorta bypass for two cases with descending aortic coarctation via a median sternotomy and retroperitoneal approach.

This approach may reduce the risk of bleeding from the collateral vessels of the left thoracic wall and enable the surgeon to perform surgery for coincident cardiac lesions. The ascending aorta far from the severe inflammatory lesion is suitable for the proximal anastomosis site to reduce the risk of complications.
around the anastomosis site. Although the retroperitoneal approach may result in a longer operation and longer prosthetic graft, which may cause bending of the graft, this approach can reduce the risk of intestine-related chronic complications, such as erosion of the graft.

This procedure can be chosen as the extraanatomical bypass for thoracic descending aorta coarctation, especially for the patients with cardiac disease requiring concomitant surgery, previous laparotomy or in whom there are many collateral vessels in the thoracic wall.

**Disclosure Statement**

None of the authors have any conflict of interest to declare.

**References**


