A New Extra-anatomical Bypass for Atypical Aortic Coarctation with Porcelain Aorta: Reno-iliac Arterial Bypass

Atsushi Fukuda, MD, Ph.D,1 Ryota Fukunaga, MD,2 and Kenichiro Okadome, MD, Ph.D3

We report a case of atypical aortic coarctation with severe calcification of the proximal aorta treated by a new extra-anatomical bypass. This 58-year-old woman with coarctation of the infrarenal aorta had thick circular calcifications of the thoracic aorta and stenosis of the subclavian arteries. To control the progressive claudication, we performed a bypass with an externally supported PTFE graft 6mm in diameter between the right renal artery and the right common iliac artery. Postoperative ankle pressure rose to 84 mmHg (right) and 89 mmHg (left) from zero, and she could walk without pain. Renal function was preserved. Using the proximal anastomosis from the non-diseased aortic branch to avoid the calcified aorta, reno-iliac arterial bypass is a useful alternative for control of ischemic lower limbs.

Key words: extra-anatomical bypass, atypical aortic coarctation, porcelain aorta

INTRODUCTION

Aortitis syndrome (Takayasu's disease), an inflammatory disease with stenosis of the aorta and/or its branches, sometimes presents as atypical aortic coarctation at the origin of the abdominal visceral branches.1, 2) Usually, in the case of atypical aortic coarctation, a thoraco-abdominal aortic bypass3, 4) or an axillo-iliac bypass5, 6) is effective for control of blood pressure in the upper and lower body. However, these bypass procedures have been unsuitable in cases with severe aortic calcification and stenosis of the subclavian arteries because of difficulty in selection of an inflow artery. Here, we report the reno-iliac bypass as a new extra-anatomical bypass procedure for atypical aortic coarctation with severe calcification.

CASE

A 56-year-old woman with a 2-month history of bilateral buttock claudication was referred to our hospital. Femoral arterial pulses were absent and ankle brachial pressure indexes were 0.4. Arterial bruit was audible at the epigastric area. Aortography showed 90% stenosis just below the renal arterial origins (Fig. 1). Plain computed tomography revealed thick circular calcifications of the aorta (porcelain aorta) from the ascending aorta to the upper abdominal aorta at the origin of the renal arteries (Fig. 2A, B), and severe calcification of the coarctated segment (Fig. 2C). Systolic brachial blood pressure was 176 mmHg (right) and 201 mmHg (left). Echocardiogram revealed severe left ventricular hypertrophy. Magnetic resonance angiography showed severe stenosis of the right carotid and subclavian arteries, and moderate stenosis of left subclavian artery. The patient was afebrile but her erythrocyte sedimentation rate was 102 mm at 60 minutes and 132 mm at 120 minutes. This aortic coarctation was suggested to result from aortitis syndrome (Takayasu's disease). Arterial bypass operation was considered to be necessary to improve lower limb ischemia and to control hypertension of the upper body. However, the
Fig. 1  Aortography showed severe stenosis of the aorta just below the renal arteries (arrow). Bilateral arterial flow of the kidneys did not decrease.

Fig. 2  A, B: Computed tomography (CT) showed thick circular calcified aorta (arrow) from its origin to the upper abdomen.
C: Plain CT demonstrated eccentric stenosis of the aorta with severe calcification (arrow) just below the renal arteries.
Thoracic aorta was not suitable for proximal anastomosis because of severe calcification, and the axillary arteries were inappropriate as inflow arteries for a bypass due to subclavian arterial stenosis. At the first admission, we decided to follow the patient with administration of prednisolone (10 mg / day) to stop the progression of aortic inflammation. Over a 2-year period, the lower limb ischemia worsened. She could not walk a few steps without calf pain. Systolic blood pressure was 130 mmHg (right) and 170 mmHg (left) at the brachial arteries, and zero mmHg at both ankles. Preoperative direct systolic pressure measured by cannulation through the left brachial artery was 259 mmHg at the aortic arch and 194 mmHg at the left axillary artery. At that time, no stenotic lesion was observed in the renal arteries despite the coexistence of nephrotic syndrome. Therefore, arterial bypass using a synthetic graft (6-mm ringed polytetrafluoroethylene graft) was performed between the right renal artery and the right common iliac artery via median laparotomy. The right renal artery was exposed with right medial visceral rotation following mobilization and retraction of the right renal vein. Since severe periaortic adhesion prevented us from dissecting the proximal portion, the distal part of the main trunk of the right renal artery was exposed for anastomosis. A prosthetic graft was anastomosed to the right renal artery in end-to-side fashion in 50 minutes without cold solution to protect the kidney. A transient increase in renal enzymes with no aggravation in renal function was observed over a period of 5 days. Postoperative magnetic resonance angiography showed a patent bypass (Fig. 3). Blood pressure measurements were 84 mmHg (right) and 89 mmHg (left) at the ankles, and 130 mmHg (right) and 152 mmHg (left) at the elbows. Temporal systemic edema was controlled with diuretics. The patient was free from claudication and had normal renal function until she died of myocardial infarction 36 months after the surgery. Diffuse thick calcification prevented us from performing a percutaneous coronary arterial intervention. Severe left ventricular hypertrophy (heart weight: 720 g) with diffuse thickening of the intima and the adventitia of the coronary arteries was found at autopsy. Thick fibrous adventitia and severe circular calcification of the media with granular protrusion of calcified plaque at the infrarenal aorta were evident. These histologic findings were specific to aortitis syndrome.

**Discussion**

For atypical aortic coarctation with severe ischemia of the lower limbs and hypertension of the upper body, thoraco-abdominal aortic bypass or axillo-iliac bypass has been performed. Because our case presented with severe calcification of the aorta (porcelain aorta) from the aortic origin to the renal arteries, bypass with proximal anastomosis to the thoracic aorta would be difficult and dangerous. Although several techniques, such as temporary cardioplegia and intraluminal balloon occlusion, prosthetic patch, and mesh reinforcement of adventitia have been used in anastomosis for bypass of the severely calcified aorta, aortic clamping and suturing are hazardous in the presence of a thick, hard aorta. Furthermore, since the bilateral subclavian arteries were stenotic, the axillary arteries were inadequate for an inflow artery of the bypass. Severe calcification of the coarctated segment
also prevented us from performing balloon angioplasty or endoluminal stenting.

On the other hand, for cases with renovascular hypertension, extraanatomical bypass, for example, hepato-renal, spleno-renal, and ilio-renal arterial bypass has been adopted in cases of a severely atherosclerotic aorta. Fortunately, in our present case with the stenotic portion of the aorta just below the renal arteries, renal arterial flow did not appear to be decreased. We therefore performed arterial bypass from the renal artery. To diminish the pressure gradient, a bypass graft having a large diameter (> 8 mm) seemed to be desirable. However, we selected a 6-mm graft equivalent to the renal artery. Distal anastomosis was easy because of the lack of atherosclerotic change throughout the lower infrarenal aorta and iliac artery. This bypass operation is safe and easy without the need of aortic clamping. After the operation, ischemic symptoms of the lower limbs were relieved and blood pressure control became easier. Hepato-renal, spleno-renal, and ilio-renal bypasses have been widely applied to increase blood flow to the kidney. However, the experience with the present patient supports the proposal of a new extraanatomical bypass to improve ischemia of lower limbs. Using a proximal anastomosis from the non-diseased aortic branch, reno-iliac arterial bypass is a useful alternative for atypical aortic coarctation with severe aortic calcification.

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REFERENCES