Ascending thoracic aortobipopliteal bypass for extensive aortoiliac and femoropopliteal arterial occlusive disease

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This report describes a patient with disabling intermittent claudication resulting from the complex combination of a heavily calcified abdominal aorta, extensive aortoiliac occlusion, bilateral femoropopliteal arterial occlusion, and thrombosis of a previous right axillobifemoral bypass graft, followed by revision of the graft to the left proximal popliteal artery and subsequent graft removal because of chronic infection. The patient underwent successful ascending thoracic aortobipopliteal bypass surgery and had an uneventful postoperative recovery, with ankle pulses palpable bilaterally. After 6 years of follow-up, he could walk unlimited distances, and computed tomography angiography showed patent grafts. (J Vasc Surg Cases 2015;1:180-3.)

Type D aortoiliac occlusive disease with limb-threatening ischemia is usually treated by aortobifemoral or axillobifemoral bypass surgery, depending on the patient's cardiopulmonary status.[1] Progressively disabling intermittent claudication due to aortoiliac occlusion that is unresponsive to medical treatment is also an indication for revascularization procedures.[2] However, if the abdominal aorta, axillary arteries, and femoral arteries are not suitable for vascular anastomoses, conventional arterial bypass procedures cannot be performed.[3] We report a patient who underwent successful ascending thoracic aortobipopliteal bypass surgery for the treatment of complex aortoiliac occlusive disease. Written consent was obtained from the patient for publication of this case report and accompanying images.

CASE REPORT

A 59-year-old man consulted us regarding disabling intermittent claudication in both lower extremities for several months, which did not improve with conservative therapy. His maximum walking distance was 10 m because of severe pain in his calves and thighs. He had undergone three surgical procedures for aortoiliac occlusive disease during the previous 3 years.

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The first procedure was right axillobifemoral bypass surgery, which initially provided good symptom relief. The left limb of the bypass occluded after 2 years (Fig 1, *A*), and he underwent graft revision from the proximal part of the occlusion to the proximal left popliteal artery, which provided adequate circulation to the lower extremity for another year. However, recurrent thrombosis of the revised graft segment developed, with chronic surrounding infection, and the revised graft segment was removed from the suprapubic area to the left upper thigh (Fig 1, *B*). This subcutaneous infection was completely subsided for 3 months before the final operation.

Physical examination revealed bilateral absence of the femoral pulses and an ankle-brachial index of 0.4 on both sides. There was no clinical evidence of residual infection relating to the previously thrombosed arterial bypass. His cardiopulmonary status was not compromised. Computed tomography angiography showed heavy calcification and extensive occlusion of the aortoiliac segment. The clinical situation was complex because of the combined femoropopliteal arterial occlusion and the previous surgical procedures, which precluded conventional arterial bypass surgery.[3]

Surgery was performed under general anesthesia. The patient was placed supine, and the skin was cleaned over the anterior chest wall, anterior abdominal wall, and both legs. Incisions were made on the medial sides of the knee joints, and healthy popliteal arteries were observed bilaterally. The abdominal aorta was approached through a long midline incision. Surgical exploration revealed a heavily calcified infrarenal abdominal aorta, complete occlusion of the iliac arteries, and extensive adhesions around the suprarenal and supraceliac aortic segments. These findings precluded a proximal anastomosis of an arterial bypass graft to the abdominal aorta.

The ascending thoracic aorta was then approached through a median sternotomy. A 24-mm Dacron (DuPont, Wilmington, Del) tube graft was anastomosed to the ascending thoracic aorta, passed from the pericardial cavity through the diaphragm into the peritoneal cavity, and placed behind the left lobe of the liver, left kidney, spleen, and tail of the pancreas (Fig 2). In the midpart of the left retroperitoneal space, the Dacron tube graft was anastomosed to a 24-mm Dacron bifurcation graft. Behind the sigmoid

Fig 1. Evidence of previous arterial bypass procedures. **A,** Thrombosed left limb of the right axillobifemoral bypass. **B,** Residual thrombosed graft after the revision procedure from the left limb of the previous bypass to the left proximal popliteal artery, which was subsequently removed.

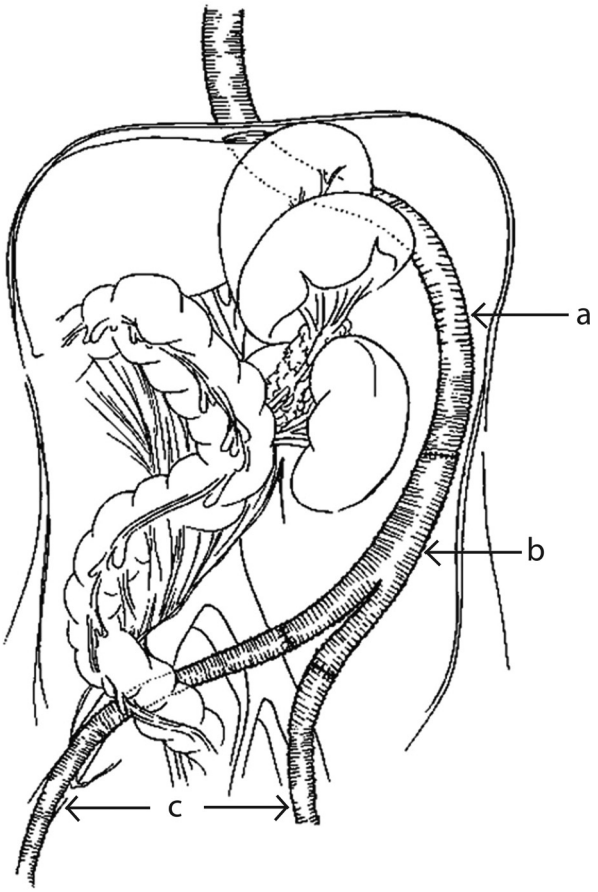

Fig 2. Vascular conduit tunneling and placement. After an anastomosis to the ascending thoracic aorta, a 24-mm Dacron (DuPont, Wilmington, Del) tube graft (*a*) was passed from the pericardial cavity through the diaphragm into the peritoneal cavity. Subsequent to medial rotation of the left-sided abdominal viscera towards the midline, the Dacron tube graft was placed in the left retroperitoneal space and anastomosed to a 24-mm Dacron bifurcation graft (*b*). Each limb of the Dacron bifurcation graft was anastomosed to an 8-mm ring-reinforced polytetrafluoroethylene (PTFE) graft (*c*) behind the sigmoid mesocolon. The PTFE grafts were tunneled behind the inguinal ligament to the popliteal fossa on each side.

mesocolon, each limb of the Dacron bifurcation graft was anastomosed to an 8-mm ring-reinforced polytetrafluoroethylene (PTFE) graft. The PTFE grafts were tunneled through the pelvic retroperitoneal space, under the inguinal ligament along posteromedial aspect of left femoral vein, behind the subsartorial space into adductor muscles, and towards the popliteal fossa on each side. These areas had never been contaminated by previous infection. The great saphenous veins were used as the final vascular conduits between the distal ends of the PTFE grafts and the popliteal arteries behind the knee joints.

The patient was fully heparinized during the surgical procedure. Hemostasis and wound closure were meticulously performed. The patient's postoperative recovery was uneventful, and the ankle pulses were easily palpable on both sides.

At the 6-year follow up, the patient was walking unlimited distances and the ankle-brachial index was 0.96 on both sides. Annual follow-up computed tomography angiography showed patent ascending thoracic aortobipopliteal grafts providing good blood flow to the distal parts of both lower extremities (Fig 3).

DISCUSSION

Aortoiliac occlusive disease is a high-risk condition, particularly in patients with critical limb ischemia. If revascularization is not possible in a patient with extensive aortoiliac occlusion and a critically ischemic limb, major amputation cannot be successfully performed because the inadequate blood supply prevents healing of the amputation stump.[4,5] Our patient had disabling intermittent claudication and required revascularization before the ischemia progressed to a critical level.

Because our patient had healthy bilateral popliteal arteries and distal arteries to the foot, he was a suitable candidate for extensive arterial bypass to these arteries. The profunda femoris arteries could not be used for the distal anastomoses because of his previous vascular surgery. The abdominal aorta could not be used for the proximal anastomosis because of the heavy calcification, extensive aortoiliac occlusion, and extensive adhesions around the suprarenal and supraceliac aortic segments. The left axillary artery was not considered for the proximal anastomosis because the vascular conduit to the popliteal

Fig 3. Postoperative computed tomography angiography at 1 month, 1 year, and 6 years after surgery shows the continued patency of the ascending thoracic aortobipopliteal grafts.

arteries would have to be tunneled through the area of the previous graft infection, which carried a risk of further graft infection.

Furthermore, arterial bypass from the axillary artery has limited long-term patency,[6] and further graft failure would have been very difficult to manage in this patient. Using the descending thoracic aorta for the proximal anastomosis would be complicated because the operation would have to be performed through a left lateral thoracotomy with the patient in the right lateral decubitus position,[7] and the arterial bypass to the bilateral popliteal arteries would have to be performed with the patient the supine with lateral rotation of both hip joints. Changing the patient's position during an extensive vascular procedure is difficult. The ascending thoracic aorta was therefore selected for the proximal anastomosis because this procedure could be performed with the patient supine.

Our review of the literature did not find any previous reports of arterial bypass from the ascending thoracic aorta to the bilateral popliteal arteries for the treatment of lower extremity ischemia. However, this aortic segment has successfully been used for arterial bypass to the bilateral femoral arteries.[8] This case illustrates that it is possible to use the ascending thoracic aorta to provide a substantial blood supply to the ischemic lower extremities in patients with both aortoiliac and femoropopliteal arterial occlusion. The long prosthetic vascular conduits can safely be tunneled from the pericardial cavity through the diaphragm and into the abdominal cavity, retroperitoneal space, pelvic cavity, subsartorial space, and popliteal fossa. The great saphenous veins can be used as the final vascular conduits for anastomosis to the popliteal arteries because of the high degree of flexibility of the native veins in the popliteal fossae and the similar sizes of the great saphenous veins and the popliteal arteries.

The arterial bypass procedure was successful, and our patient had an unlimited walking distance and continued graft patency after 6 years of follow-up. The ankle-brachial index on both legs dramatically increased from 0.4 to 0.96 after this procedure and remained stable for 6 years of follow-up.

CONCLUSIONS

Ascending thoracic aortobipopliteal bypass can be considered for the surgical treatment of extensive

combined aortoiliac and femoropopliteal arterial occlusive disease with limb-threatening ischemia.

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