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Case Report

Successful Treatment of *Staphylococcus schleiferi* Infection after Aortic Arch Repair: *In Situ* Aortic Arch Replacement and Domino Reconstruction of the Debranching Graft using Autologous Iliac Artery

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A 62-year-old Japanese male presented with graft infection by *Staphylococcus schleiferi* 50 days after debranching of the left subclavian artery and frozen elephant trunk repair for the entry closure of a Stanford type B aortic dissection. The graft was removed, and the patient was successfully treated using *in situ* reconstruction of the arch with omental flap coverage, removal of the debranching graft, autologous iliac artery grafting, and long-term antibiotics. Domino reconstruction of the infected debranching graft using autologous external iliac artery and a Dacron graft can thus be a good option in similar cases.

Key words: autologous iliac artery graft, *Staphylococcus schleiferi*, graft infection, domino reconstruction, Dacron graft

After an aortic arch repair and reconstruction of its branches, infection of the prosthesis remains a very serious potential complication, and the optimal treatment strategy (including the surgical technique and material) is controversial [1,2]. Here, we report the case of a patient with infection of the prosthetic graft with *Staphylococcus schleiferi* after a frozen elephant trunk repair and extra-anatomical debranching of the left subclavian artery; the patient was successfully treated using multiple, staged treatments.

Case Report

A 62-year-old Japanese male was transferred to our institute for the surgical treatment of an infected prosthetic graft that had been used for aortic arch repair. At 50 days prior to his presentation, he had undergone a frozen elephant trunk repair for a chronic Stanford type B aortic dissection. From an incision on the aorta between the left carotid and left subclavian arteries, an 8-cm-long frozen elephant trunk (J Graft Frozenix, Japan Lifeline Co., Tokyo) had been inserted into the true lumen down to the proximal descending aorta to cover the entry. The proximal end of the graft was sutured to the aortic wall, and the aortotomy was closed, resulting in inclusion of the frozen elephant trunk.

Extra-anatomical debranching of the left subclavian artery was accomplished using an 8-mm graft from the ascending aorta to the left axillary artery through the 3rd intercostal space (Fig. 1). The patient showed an uncomplicated recovery and left the hospital on postoperative Day 29. Eight days later, he began to suffer from

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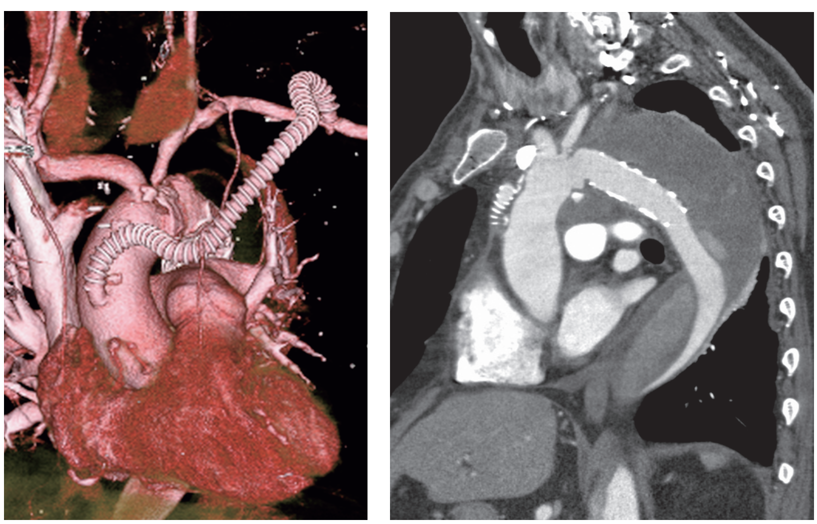
fever and general fatigue. A computed tomography (CT) scan revealed a peri-graft abscess in the mediastinum and around the left axillary artery (Fig. 2).

We diagnosed a graft infection and performed prompt open drainage of the left subclavian cavity under local anesthesia on the day of his admission, followed by mediastinal drainage through an upper L-shaped hemisternotomy under general anesthesia on the next day. Empiric antibiotics, *i.e.*, vancomycin and ceftriaxone, were administered. On Day 5 of the patient's hospital stay, a pus culture from both abscesses showed growth of *S. schleiferi*. Cefazolin (CEZ) was regarded as sensitive, and antibiotics were de-escalated to 4 g of CEZ per day. Despite the systemic antibiotic administration and local treatment with negative pressure wound therapy (NPWT), the patient's aortic wall had been eroded and the inserted graft exposed, indicating uncontrolled infection and impending rupture. On Day 12, he was transferred to our hospital for reoperation.

We performed an emergency surgery; the strategy included (1) replacement of the ascending aorta and aortic arch with a prosthetic graft, (2) omental flap transposition to cover the prosthetic graft, and (3) left subclavian reconstruction with autologous external iliac artery. Prior to accessing the infected lesion, a pararectal incision was made, and a 7-cm section of the external iliac artery was harvested for an autologous graft and replaced with an 8-mm Dacron prosthetic graft. After the closure of the incision, the left subclavian and left common carotid arteries were exposed via a supraclavicular approach for reconstruction of the left subclavian artery prior to removal of the infected debranching graft. Because of the distance between these two arteries, the autologous iliac artery was used to bypass them.

Thereafter, the infected 8-mm graft was removed from the left axillary artery, and the defect on the left

Fig. 2 CT angiogram obtained at the time of presentation of infection shows a mediastinal abscess and a peri-debranching graft abscess around the left axillary artery (*arrows*).



A B

Fig. 1 CT angiogram after the frozen elephant trunk repair and left subclavian artery debranching. A, Extra-anatomical debranching from the ascending aorta to the left axillary artery; B, Incomplete thrombosis of the thoracic false lumen was revealed after the entry closure of the Stanford type B aortic dissection.

axillary artery was closed using the autologous iliac artery patch. No foreign material was left behind for reconstruction of the left subclavian and axillary arteries. A median sternotomy was performed, and cardiopulmonary bypass was established. Under moderate hypothermic circulatory arrest and selective cerebral perfusion, total arch replacement with a branched prosthetic graft was carried out. The proximal descending aorta was transected distal to the entry, and the thrombus inside the false lumen was removed as extensively as possible. The false lumen of the distal stump was closed by sutures buttressed with a felt strip.

The branched prosthetic graft was anastomosed to the true lumen of the distal stump. The distal anastomosis was reinforced with a stent graft. The patient was transferred to the intensive care unit with the sternum kept open, though draped. After the confirmation of hemostasis the following day, omental flap transposition was performed to cover the prosthetic aortic graft.

On postoperative Day 4, cultures of both the frozen elephant trunk and thrombus showed growth of *S. schleiferi* that was resistant to CEZ and oxacillin. Linezolid (LZD) was administered, which was replaced with daptomycin (DPT) on postoperative Day 33 due to the development of thrombocytopenia as a side effect of LZD. Because the infection seemed to be controlled on postoperative Day 80, the intravenous DPT was discontinued and replaced with oral minocycline, which is currently being continued. Postoperative CT showed a patent autologous graft (Fig. 3). Despite the operative complications of stroke, the patient was ambulatory and was transferred to a nursing facility on postoperative Day 115.

Discussion

S. schleiferi is a coagulase-negative microorganism, and the majority of *S. schleiferi* infection cases are reported in dogs; it was first reported in human clinical specimens by Freney *et al.* in 1988 [3]. *S. schleiferi* has been reported as a pathogen for infection mostly in patients with immunosuppression, malignant neoplasm [4], and implanted devices [5,6]. To the best of our knowledge, aortic graft infection by this species has not been previously reported.

After our detection of this species in the culture from the drainage, therapy consisting of systemic cefazolin, irrigation, and NPWT was continued, but the erosion of the aortic wall covering the frozen elephant trunk progressed, presumably because of progression of the *S. schleiferi* infection and its resistance to CEZ (which was discovered later) and direct stimulus by the foam dressing of NPWT to the aorta. Although recent technological advances enable us to use NPWT even when the organ is exposed in an infected field [7], it was not available at that time. After definitive repair, LZD was administered to the patient for 30 days, followed by DPT for 47 days. Removal of the infected prosthesis — combined with an appropriate long-term antibiotic regimen — eradicated the *S. schleiferi* infection, despite the incomplete removal of the extensive culture-positive thrombus inside the false lumen.

There is currently no definitive therapy for graft infection. The recommended treatment for an infected thoracic graft comprises the use of appropriate systemic antibiotics, complete debridement of infected and necrotic tissue surrounding the prosthetic material, mediastinal irrigation, *in situ* replacement of the infected aortic graft with a new graft, and graft coverage with viable tissue [2]. Although there are several case reports of successful conservative treatment strategies that preserved the infected graft and local therapy (including drainage, debridement, and NPWT) with or without tissue flap coverage [8], the failure rate seemed to be high; such strategies should therefore be indicated only

Fig. 3 CT angiogram after the redo surgery revealed a patent autologous iliac artery graft (*arrowheads*). The distal anastomosis of the branched graft was reinforced by the stent graft because of fragility of the anastomosis site. The left vertebral artery re-anastomosed to the left common carotid artery.

for patients who cannot undergo aggressive surgery. In our patient's case, the local progression obliged us to perform the most aggressive full-regimen treatment.

Omental flap transposition is an established method for treating various infectious situations including gastrointestinal perforation, infectious aneurysm, and infection of implanted foreign bodies. Its application has been expanded to include cases with mediastinal infection and graft infection [9]. An omental flap can cover the thoracic graft in the mediastinum, but it cannot reach the cervical and subclavian regions. A vascularized muscular flap is another option to compensate for this shortage, but a failure rate of 78% has been reported following this treatment in the groin [10]. Considering the shortfall of the omental flap and the susceptibility of foreign material to infection by *S. schleiferi*, we explored the use of autologous material, which might be the most resistant to infection, for reconstruction of our patient's supra-aortic vessels.

Infection of the supra-aortic debranching graft is a rare complication [11], and reports of its treatment are scarce [1,12]. Although Bellosta *et al.* reported successful local treatment with NPWT without removal of the infected graft [1], the failure rate for retaining the infected graft seems to be high [10,13]. In our patient's case we thus retrieved the infected debranching graft, and we used the autologous iliac artery as a patch and graft for reconstruction. It was harvested immediately before we began the surgery on the infected lesion and was replaced with a Dacron graft in the clean field; *i.e.*, a domino reconstruction was accomplished.

The material most resistant to infection is yet to be determined. A cryopreserved human allograft could be a good alternative to a prosthetic graft [14], but such allografts are not readily available. Autologous grafts are regarded as more resistant to infection than any other foreign materials. The use of autologous venous grafts (*e.g.*, the iliac vein, femoral vein, and saphenous vein) has been reported [15]. Daenens *et al.* reported no incidence of reinfection or aneurysmal dilatation after *in situ* replacement of the infected infrarenal aortic graft with the femoral veins. Some unfavorable outcomes included revision for major bleeding (8%), amputation of the lower extremity (2%), graft limb occlusion (4%), and late graft limb stenosis (4%).

Other reports described similar complications, including early graft disruption and late graft occlusion, revealing the limited strength and long-term patency of the femoral vein graft. This incidence of complications could be deemed acceptable, considering the severity of the baseline condition [16-18]. However, severe venous stasis and, even worse, acute compartment syndrome or lower limb amputation were observed after the femoral and iliac veins were harvested. The greater saphenous vein has also been used as an alternative because it is harvested less invasively and the subsequent venous stasis is mild. To accommodate for size discrepancies, the saphenous vein should be spliced. Spiral saphenous vein grafts and paneled saphenous vein grafts are the best known procedures [19,20], but late aneurysmal degeneration has been reported [21].

Although autologous grafts have been reported to be highly tolerant to infection, vein grafts seemed to have less strength and durability, as noted above. Arterial grafts might have a potential benefit in this regard, but no comparative data are currently available except in the fields of coronary artery bypass and distal extremity bypass. Vein graft disease is known as a loss of the endothelial layer in the early period, followed by intimal hyperplasia and atherosclerosis, leading to graft stenosis and occlusion [22]. The use of arterial grafts is highly recommended because of their confirmed better long-term patency [23]. To date, no comparisons have been conducted between large-caliber arterial and vein grafts, as in our patient's case. To the best of our knowledge, this is the first report of a domino reconstruction of the infected graft with an autologous iliac artery and a Dacron graft.

The additional risks related to domino reconstruction — including infection, bleeding, and occlusion of the prosthetic graft for reconstruction of the iliac artery, where no pathology to be treated is present — must be taken into account. However, the theoretical benefits of infection resistance, durability, and long-term patency of this viable arterial conduit seem to outweigh those drawbacks, although this has yet to be confirmed.

In conclusion, a rare case of *S. schleiferi* infection of the thoracic and debranching graft was successfully treated with long-term antibiotics, thoracic graft removal, *in situ* reconstruction with omental flap coverage, and autologous iliac artery domino grafting after the removal of the debranching graft.

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