CASE REPORT

Fresh arterial homograft for bypass in critical limb ischaemia with infection

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SUMMARY

We present what we believe is Australia's first fresh peripheral arterial transplant for revascularisation of an ischaemic limb. Although cryopreserved homografts are accepted as a management option for revascularisation of critical limb ischaemia in infected fields, cryopreserved peripheral vascular tissue is not currently available in Australia. We describe a 72-year-old man without autologous conduit in whom infected prosthetic grafts were explanted, causing critical limb ischaemia of a below knee stump. Fresh peripheral arterial tissue was procured via the Australian organ donation authority, DonateLife, and was used to revascularise the stump with an axillofemoral bypass. This permitted successful healing of the stump within 6 weeks and mobilisation with a prosthesis. This case illustrates that fresh arterial homografts are a viable bridging solution for revascularisation of limb ischaemia with infection. However, it also highlights the need to establish a peripheral homograft bank so that cryopreserved conduits are readily available for similar scenarios.

BACKGROUND

Arterial homografting was first performed by Hoefner in 1903 with a canine donor and recipient.¹ It has become increasingly used since the world's first vascular tissue bank was started by the US Navy in the early 1950s,² with methods including direct implantation of fresh grafts, and storage via cryopreservation.¹ Arterial specimens are usually harvested from donation after brain death (DBD) donors.^{3–6} Typical uses for homografts include replacement of infected aortoiliac grafts, repair of mycotic thoracic and thoracoabdominal aneurysms, and lower limb revascularisation in the setting of critical limb ischaemia (CLI), in the presence of infection and absence of autologous conduit.^{7–16} Cryopreserved homografts are known to be subject to aneurysmal degeneration and thrombotic complications.¹⁷ However, in the management of “major peripheral bypass graft infection”, cryopreserved homograft reconstruction is “a useful option for treating one of the most dreaded vascular complications”.¹⁷ Cryopreservation has been studied much more extensively than fresh donation, as freezing is thought to eliminate or minimise immunogenicity of donor grafts.

Cryopreserved cardiac tissue is readily available in Australia, and cryopreserved peripheral vascular tissue is commercially available globally outside Australia. However, at the time of this patient's treatment, no facility stocked cryopreserved peripheral arterial homografts in Australia. From the

1980s until recent years, our institution had a facility for cryopreservation at -70°C , however, due to changes in cryopreserved tissue storage regulations including requirements for colder storage temperatures, this programme was terminated.⁵

We present the case of a 72-year-old man who was the recipient of a fresh arterial cadaveric homograft for peripheral revascularisation. This was performed in the setting of CLI following explantation of infected prosthetic grafts with no available autologous conduit. The authors believe this case to be Australia's first published report of successful peripheral revascularisation with a fresh cadaveric arterial homograft. We propose this technique as a viable interim solution to the issue of homograft access while awaiting the establishment of a cryopreserved peripheral homograft facility.

CASE PRESENTATION

The patient, a 72-year-old man, previously lived independently at home, alone, and had been a life-long smoker of more than 100 pack years. He underwent an aortobiiliac bypass in 2011 with a polyester graft in the setting of disabling claudication. The graft occluded after 10 months, precipitating CLI with left leg rest pain and right leg short distance claudication. Medical comorbidities and a poorly healed abdominal wound precluded a revision of the abdominal graft; the patient therefore underwent bilateral axillofemoral bypasses, the right leg with gelatin-coated polytetrafluoroethylene (PTFE) and the left using gelatin-sealed polyester.

Seven months later, the patient presented with occlusion of the left axillofemoral graft. It was excised and replaced with a ring-reinforced gelatin-sealed PTFE right-to-left femorofemoral cross-over graft (anastomosed onto the right axillofemoral graft). Unfortunately, within 3 weeks, he re-presented with sepsis and was found to have infection involving all grafts, with a perigraft collection on imaging. All grafts were explanted, and groin wounds were left open, with a sartorius flap created to cover the left common femoral artery (CFA) due to fat necrosis in the left groin.

Postoperatively, the left foot succumbed to irreversible ischaemia, necessitating below knee amputation (BKA). The right foot was viable with no rest pain. Persistent left BKA stump rest pain due to ongoing ischaemia required significant analgesia, and the wound broke down. Serial blood cultures demonstrated methicillin-resistant staphylococcus aureus bacteraemia presumed secondary to his wound infections. Transthoracic echocardiography revealed a small possible valvular vegetation and

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was treated presumptively for bacterial endocarditis. The combination of ischaemic rest pain, high-dose analgesia and sepsis contributed to the patient's fluctuant delirium and bedridden state.

TREATMENT

Revascularisation of the left leg was deemed preferable to an above knee amputation principally due to concern that this too may not heal. Additionally, if successful, it would provide a better functional outcome for the patient, with a higher chance of successful mobilisation with a prosthetic limb. Implantation of a prosthetic graft was contraindicated given the infected field, and no autologous conduit was available. Although available in Europe and the USA, no cryopreserved peripheral homograft was available in Australia at this time. A fresh homograft was therefore felt to be the most appropriate treatment option. Concerned by the potential effect of immunosuppression especially given the patient's comorbid infective endocarditis, we proceeded without immunosuppression. Hospital medical ethics approval was obtained, and informed consent was given by the patient and his family. The patient was registered with Australia's organ donation authority, DonateLife, and donor consent was obtained.

Within a fortnight an ABO-matched DBD donor became available in our centre. At the time of organ harvesting, bilateral arterial segments from the CFA to distal popliteal arteries were harvested. These lengths were irrigated in Belzer UW solution (Preservation Solutions, Inc, Wisconsin, USA) and stored on ice in the manner of procured solid organs. Total cold ischaemic time from explantation to implantation was 3 h. The two homograft segments were anastomosed in an end-to-end fashion to provide adequate length. The left axillary artery was exposed via a left infraclavicular incision, and the profunda femoris artery (PFA) was exposed by extending the groin incision and mobilising the sartorius flap. After the axillary anastomosis, the graft was tunneled subcutaneously with distal anastomosis to the left PFA (due to occlusion of left CFA and superficial femoral artery (SFA)).

OUTCOME AND FOLLOW-UP

On day 1 postoperatively the patient was alert and lucid, with markedly reduced pain. One week later, the BKA stump was debrided to a healthy bleeding base. Within 2 weeks, antibiotics were ceased, as axillary, groin and stump wounds were clean and healing. The patient was able to ambulate with a frame and actively engage with rehabilitation. On Day 17 postoperatively he was discharged to an amputee rehabilitation facility and soon fitted with a prosthesis. Subsequent duplex surveillance at 6 weeks demonstrated good graft flow with no evidence of failure, stenosis or aneurysmal degeneration. He has since returned home. Most recent clinical review at 12 months revealed a healthy left BKA stump. The patient has been ambulating comfortably with a prosthesis. In the event of recurrent critical ischaemia, given the absence of infection, and with healed wounds, the patient will once again be a candidate for revascularisation using prosthetic grafts.

DISCUSSION

Although most experience has been gained and research carried out, regarding vascular homografts, using cryopreserved conduits, some centres have investigated the use of fresh non-cryopreserved arterial homografts.^{6 17–23} Much of this addresses infected aortic grafts, whereas a smaller subset deals with peripheral bypass grafting. Prager *et al*¹⁹ examined the hypothesis

that endothelial integrity, preserved in fresh solid organ transplants, may be maintained in fresh arterial homografts, whereas it is lost in cryopreserved homografts, and that this may be crucial to prevent biodegradation. From the cohort of 13 fresh homograft recipients, they found that "limb salvage was possible in 75% at 12 months in otherwise difficult circumstances", concluding that fresh arterial homografts for peripheral limb bypass "may well lead to limb salvage long enough for the limited lifespan of these morbid patients".¹⁹

Mirelli *et al*,^{18 20} studying a cohort of 23 fresh and 7 cryopreserved homograft recipients, found that both cryopreserved and fresh homografts are strongly immunogenic, eliciting an anti-human leucocyte antigen (HLA) antibody response. Although endothelial cell HLAs are lost through cryopreservation, vascular smooth muscle cell HLAs may remain intact. Furthermore, cyclosporine "delayed and retarded [HLA] antibody production" but "did not seem to influence the clinical outcome".¹⁸ Chiesa *et al*²¹ studied 44 patients with aortic or peripheral prosthetic graft infections who were bypassed with homograft (13 fresh, 31 cryopreserved), noting that these were not ABO blood group or HLA matched. They observed no "significant difference in terms of clinical outcome by using fresh rather than cryopreserved homografts".

There are currently no clear guidelines on homograft donor selection. Vascular tissue has been harvested from DBD and donation after circulatory death (DCD) donors. We used the European Homograft Bank's donor-suggested criteria of DBD donors being aged under 55 (males) and under 60 (females) years, and having no known cardiovascular risk factors.⁴ Additionally, guided by one of the larger fresh arterial homograft transplantation studies,¹⁹ we chose to match our recipient to the correct ABO blood group donor, in addition to the usual DonateLife processes including serological testing prior to procurement.

Patient's perspective

I don't remember much from that time. I was in and out of hospital for many months before the transplant operation. Although it's not as easy as before the amputation, I am able to walk pretty comfortably with my prosthesis. I am able to get around by myself and I live at home alone with some council services such as shopping help. I don't completely understand the process of what happened back then, but I know it got me out of hospital.

Learning points

- ▶ Fresh, non-cryopreserved arterial homograft is a viable bridging solution for revascularisation of critical limb ischaemia in infected fields with no available autologous conduit.
- ▶ Immunosuppression may not affect the clinical outcome in this scenario and therefore may be avoided if clinically contraindicated.
- ▶ Jashari *et al*⁴ propound that "arterial allografts have shown excellent results in well-defined indications, particularly for prosthetic and native vascular infections [and] poor periphery [sic] vascular tree." This case again underscores the need to establish a peripheral homograft bank in Australia with multiple conduit options.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Creech O, De Baake ME, Cooley DA, *et al.* Preparation and use of freeze-dried arterial homografts. *Ann Surg* 1954;140:35–43.
- 2 Strong DM. The US Navy Tissue Bank: 50 years on the cutting edge. *Cell Tissue Bank* 2000;1:9–16.
- 3 Pupka A, Skora J, Janczak D, *et al.* In situ revascularisation with silver-coated polyester prostheses and arterial homografts in patients with aortic graft infection—a prospective, comparative, single-centre study. *Eur J Vasc Endovasc Surg* 2011;41:61–7.
- 4 Jashari R, Van Hoeck B, Ngakam R, *et al.* Banking of cryopreserved arterial allografts in Europe: 20 years of operation in the European Homograft Bank (EHB) in Brussels. *Cell Tissue Bank* 2013;14:589–99.
- 5 Wagstaff SA, Grigg MJ. Arterial homografts—a possible solution to an infective dilemma. *Cardiovasc Surg* 1996;4:796–800.
- 6 Magne JL, Farah I, Roux JJ, *et al.* Below-knee bypass using fresh arterial allografts for limb salvage: early results. *Ann Vasc Surg* 1997;11:237–41.
- 7 Noel AA, Gloviczki P, Cherry KJ Jr, *et al.* Abdominal aortic reconstruction in infected fields: early results of the United States cryopreserved aortic allograft registry. *J Vasc Surg* 2002;35:847–52.
- 8 Vogt PR, Brunner-LaRocca HP, Lachat M, *et al.* Technical details with the use of cryopreserved arterial allograft for aortic infection: influence on early and mid term mortality. *J Vasc Surg* 2002;35:80–6.
- 9 McCready RA, Bryant MA, Divelbiss JL, *et al.* Arterial infections in the new millennium: an old problem revisited. *Ann Vasc Surg* 2006;20:590–5.
- 10 Koskas F, Plissonnier D, Bahnnini A, *et al.* In situ arterial allografting for aortoiliac graft infection: a 6-year experience. *Cardiovasc Surg* 1996;4:495–9.
- 11 Knosalla C, Weng Y, Yankah AC, *et al.* Using aortic allograft material to treat mycotic aneurysms of the thoracic aorta. *Ann Thorac Surg* 1996;61:1146–52.
- 12 Pagano D, Guest P, Bonser RS. Homograft replacement of thoraco-abdominal segment of the aorta for leaking mycotic aneurysm. *Eur J Cardiothorac Surg* 1996;10:383–5.
- 13 Pasic M, Carrel T, von Segesser L, *et al.* In situ repair of mycotic aneurysm of the ascending aorta. *J Thorac Cardiovasc Surg* 1993;105:321–6.
- 14 Vogt PR, von Segesser LK, Goffin Y, *et al.* Cryopreserved arterial homografts for in situ reconstruction of mycotic aneurysms and prosthetic graft infections. *Eur J Cardiothorac Surg* 1995;9:502–6.
- 15 Vogt PR, von Segesser LK, Goffin Y, *et al.* Eradication of aortic infections with the use of cryopreserved arterial homografts. *Ann Thorac Surg* 1996;62:640–5.
- 16 von Segesser LK, Vogt P, Genoni M, *et al.* The infected aorta. *J Card Surg* 1997;12 (2 Suppl):256–60.
- 17 Castier Y, Francis F, Cerceau P, *et al.* Cryopreserved arterial allograft reconstruction for peripheral graft infection. *J Vasc Surg* 2005;41:30–7.
- 18 Mirelli M, Buzzi M, Pasquinelli G, *et al.* Fresh and cryopreserved arterial homografts: immunological and clinical results. *Transplant Proc* 2005;37:2688–91.
- 19 Prager M, Hölzenbein T, Aslim E, *et al.* Fresh arterial homograft transplantation: a novel concept for critical limb ischaemia. *Eur J Vasc Endovasc Surg* 2002;24:314–21.
- 20 Mirelli M, Stella A, Faggioli GL, *et al.* Immune response following fresh arterial homograft replacement for aortoiliac graft infection. *Eur J Vasc Endovasc Surg* 1999;18:424–9.
- 21 Chiesa R, Astore D, Piccolo G, *et al.* Fresh and cryopreserved arterial homografts in the treatment of prosthetic graft infections: experience of the Italian Collaborative Vascular Homograft Group. *Ann Vasc Surg* 1998;12:457–62.
- 22 Sebesta P, Stádler P, Sedivý P, *et al.* The seven-year secondary patency of a fresh arterial allograft in the femorocrural position in a heart transplant recipient. *Ann Vasc Surg* 2010;24:953.e7–953.e10.
- 23 Sebesta P, Stádler P, Sedivý P, *et al.* Radical operation of infected aortofemoral prosthesis using fresh arterial allograft: our mid-term experience. *Rozhl Chir* 2011;90:4–13.

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