Combined Aorto-Caval Reconstruction Using Two Cryopreserved Aortoiliac Allografts Following Retroperitoneal Tumor Resection

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CASE STUDY

Abstract

Oncologic resection of retroperitoneal tumors often requires complex vascular reconstruction. Autologous and/or synthetic grafts are most commonly used; however, they can be associated with significant morbidity. This case describes the successful outcomes and vascular reconstruction of the infrarenal aorta and inferior vena cava using two cryopreserved bifurcated aortoiliac (AI) allografts following resection of a large retroperitoneal tumor with vascular involvement.

Introduction

Large retroperitoneal tumors can be very challenging to manage, with surgical resection as the primary treatment option and often the only hope for patient survival. However, the involvement of major organs and blood vessels has been considered a contraindication for oncological resection due to high surgical risk and the potential for poor clinical outcomes.[1-4] Nonetheless, reconstruction of major blood vessels, including the aorta and inferior vena cava (IVC), following *en bloc* resection of large tumor masses can be achieved with positive clinical outcomes in carefully selected patients.[2-8]

Autologous veins and synthetic grafts are two of the most commonly used graft options for blood vessel reconstruction. However, these options can be associated with significant morbidity, particularly in cases when there is a risk of contamination and infection.[1, 6, 9-13] Cryopreserved human allografts are an alternative option for *in situ* arterial reconstruction, which offer the advantage of avoiding a second surgical site while being resistant to infection.[14, 15] Aortoiliac (AI) allografts, in particular, offer a more complex anatomy through the presence of branch vessels, making them an advantageous choice for reconstructing major vessels like the aorta and IVC. This case describes the successful combined reconstruction of both the infrarenal aorta and IVC using two cryopreserved AI allografts in the setting of retroperitoneal tumor resection. The patient consented to publication of this case report and images.

Case Report

A 20-year-old male patient presented with persistent and worsening abdominal pain, unintentional weight loss, vomiting, and early satiety over a period of three months, after having had no previous health concerns. A testicular mass and abdominal distension were noted upon physical examination. Computed tomography (CT) scans revealed a 15 cm necrotic, multi-lobulated retroperitoneal mass with near-circumferential involvement of the aorta and iliac bifurcation and compression of the IVC (Figure 1).

Figure 1. Initial presentation computed tomography (CT) image showing a 15 cm multi-lobulated tumor mass with near-circumferential involvement of the infrarenal aorta and IVC. The IVC was compressed, and there was thrombus noted in both the IVC and right common iliac vein.

Additionally, there was thrombus noted in both the IVC and right common iliac vein. The patient was diagnosed with metastatic non-seminomatous testicular cancer. Following a full course of neoadjuvant chemotherapy, the tumor regressed to 6 cm, but still showed persistent involvement of the aortic bifurcation and the IVC (Figure 2).

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Figure 2. Preoperative CT image following neoadjuvant chemotherapy. The tumor mass reduced to 6 cm, but still showed involvement of the aorta and IVC.

With the persistent tumor mass involvement of both the aorta and IVC, reconstruction of both blood vessels was planned in conjunction with a retroperitoneal lymph node dissection. Cryopreserved bifurcated AI allografts (LifeNet Health®, Virginia Beach, VA) were chosen for the reconstruction of both the aorta and the IVC given the possibility of greater tumor involvement than perceived on CT, potentially including the venous bifurcation as well as the bowels. In preparation for the vessel reconstructions, measurements of the infrarenal aorta and IVC were made in the axial and coronal planes on the preoperative CT scan (Figure 2). The infrarenal aorta diameter was 13 mm, and the right and left common iliac arteries were 9 mm each. Because the tumor's significant effect on the IVC made planning for its reconstruction more challenging, diameter measurements were taken from the cephalad portion of the mass and each common iliac vein, which were 19 mm and 11 mm, respectively. Based on these measurements, the diameters of the AI allografts used for the aorta and IVC reconstructions were 15 mm and 21 mm, respectively, when distended under pressure (125 mmHg). Distended diameter is used to emulate the diameter of the recipient's vessel under systemic pressure *in vivo*, enabling more accurate caliber matching. Using a distended AI graft diameter of 21 mm for reconstruction of the IVC, which experiences a much lower systemic pressure, would allow for a higher velocity within the venous lumen *in vivo* and decrease the risk of graft thrombosis.

The patient underwent laparotomy and was systemically heparinized prior to vessel clamping and resection. *En bloc* resection was then performed including the residual tumor with nodes along with the infrarenal aorta with bilateral common iliac arteries and the IVC with bilateral iliac veins. Reconstruction of the IVC and bilateral iliac veins was performed first (Figure 3A), followed by the infrarenal aorta and bilateral iliac arteries (Figure 3B).

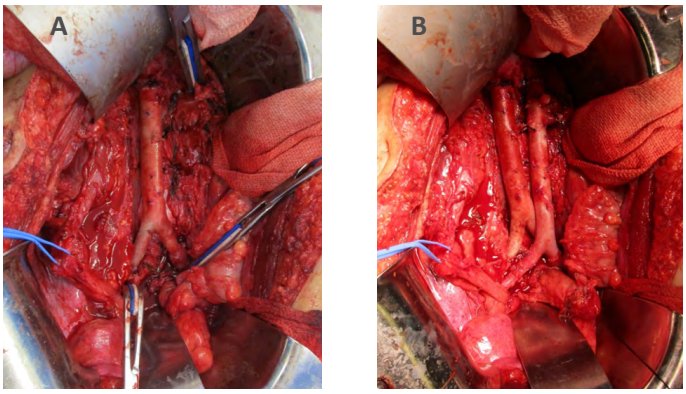

Figure 3. Intraoperative images taken after the reconstruction of the A) IVC and B) infrarenal aorta, each using a cryopreserved AI allograft. The distended diameter of the AI allograft used to reconstruct the IVC was 21 mm, and that for reconstructing the aorta was 15 mm to match the patient's native vessel diameters.

Each reconstruction was performed in an end-to-end configuration for both proximal and distal anastomoses. Immediately postoperative, the patient had palpable peripheral pulses as well as Doppler signals in the proximal vena cava. The patient did not experience any complications and was discharged from the hospital within one week. One-month postoperative imaging revealed patent reconstructions, as well as complete tumor mass resection (Figure 4).

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Figure 4. Postoperative CT image taken after 1 month demonstrating complete tumor resection including the involved blood vessels, as well as patent reconstructions of both the IVC and aorta.

Discussion

Major vascular involvement is traditionally considered a contraindication for oncological resection. However, with precise preoperative planning in carefully selected patients, resection and vascular reconstruction can be achieved. This case demonstrates successful combined aorto-caval reconstruction using two cryopreserved AI allografts in the setting of retroperitoneal tumor and lymph node resection.

Various graft options exist for the reconstruction of major blood vessels. Autologous vein grafts and synthetic grafts are two of the most commonly used; however, each is associated with limitations. Autologous veins, often considered the preferred option[11], require harvesting from a second surgical site, which can be a source of pain and possible infection, and there may be limited availability in some patients due to poor vascularity. Additionally, the potential for caliber mismatch between the autologous vein and the native vessel is a concern.[6, 9, 10] Synthetic grafts are another common choice; however, the use of synthetic grafts should be avoided when contamination is a risk.[1, 13] Cryopreserved allografts present an alternative option, offering the advantages of avoiding a second surgical site and being resistant to infection.[14, 15]

As with autologous grafts, ensuring appropriate caliber matching between the allograft and native vessel is essential for achieving a successful and patent reconstruction. Singular allograft vessels often require surgical modifications in order to match the patient's vessel diameter and anatomy, which can increase operative time. Cryopreserved AI allografts, through the presence of the branch vessels, can form direct anastomoses with nearby vessels, providing conduits for reconstruction of complex vascular anatomy.[15] Moreover, because AI allografts distend when exposed to arterial pressure (the extent of which can be variable between grafts) measuring the pressurized distended versus flaccid diameter of the allograft reduces the possibility of caliber mismatch upon implantation. The AI allografts used in this case were measured under distended pressure (125 mmHg) by LifeNet Health, allowing for accurate caliber-matching during the preoperative planning and eliminated the need for surgical modifications. This resulted in the AI implants being well-matched anatomically with the patient's native vessels, leading to patent reconstructions and successful clinical outcomes, overall.

Conclusion

This case study describes the positive clinical outcomes in a challenging case of a large retroperitoneal tumor with involvement of major blood vessels, and the successful combined reconstruction of the infrarenal aorta and IVC using two cryopreserved AI allografts. While not generalizable, the results from this case support the use of cryopreserved AI allografts for major vessel reconstruction following *en bloc* oncological resection.

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