Inferior vena cava reconstruction using fresh inferior vena cava allograft following caval resection for leiomyosarcoma: Midterm results

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We present a 56-year-old woman affected by a large leiomyosarcoma originating from the suprarenal inferior vena cava (IVC). A computed tomography (CT) scan revealed near obstruction of the IVC and involvement of the right renal vein. The patient underwent successful en bloc resection of the tumor, right kidney, right adrenal gland, and IVC. Caval reconstruction was performed utilizing a non-type specific allograft, followed by left renal vein re-implantation. The patient tolerated the procedure well without any complications. The use of an IVC allograft allowed for continued graft patency, without the need of immunosuppression or long-term anticoagulation. However, local recurrence did occur. (J Vasc Surg 2007;46:140–3.)

Vascular leiomyosarcomas are rare malignant tumors that originate from the smooth muscle cells of the media. These tumors constitute 2% of all leiomyosarcomas and have a five times greater propensity to affect veins than arteries.1 Leiomyosarcoma of the inferior vena cava (IVC) was initially described in 1871 by Perl.2 It is now known that these tumors are the most common malignant tumors of the IVC and 60% of those of vascular origin affect the IVC.3 Though disease-free survival remains marginal, it is widely accepted that resection and reconstruction of the affected region is required for optimal treatment.1,4-6 Reconstruction of the IVC with biosynthetic and autogenous grafts have been reported in the literature. In this article, we report a new approach to IVC reconstruction utilizing a non-type specific IVC allograft, without the need of adjunct immunosuppression.

CASE REPORT

A previously healthy 56-year-old woman presented with right-sided abdominal pain. On physical examination, the patient was afebrile, with only mild tenderness and no peritoneal signs. The patient underwent an abdominal computed tomography (CT) scan that demonstrated a large lobulated mass between the suprarenal inferior vena cava (IVC) and the right kidney (Fig 1). Superiorly, the mass extended posterior to the left lobe of the liver and compressed the IVC medially. The mass appeared to originate from the IVC and had characteristics of a leiomyosarcoma. No metastases were identified upon staging. A subsequent venacavography revealed narrowing of the IVC without an intra-caval thrombus (Fig 2). Due to the close approximation of the mass to surrounding organs, there was concern that extensive caval resection would be necessary for complete resection.

Following an appropriate approval from the Institutional Review Board (IRB), the patient underwent the following surgical reconstructive procedure. The abdomen was entered via bilateral subcostal incisions. The right colon was reflected medially and all of the ayzygos branches were divided. The right and left lobes of the liver were extensively mobilized to expose the inferior vena cava. The mass was noted to arise from the right wall of the IVC and included the right renal vein. Taking into account the extent of the mass, an en bloc resection of the right kidney, right adrenal gland, and the IVC, from above the confluence of the iliac veins, to below the hepatic veins, was performed. Hemostatic control of the retrohepatic and infrarenal IVC was achieved with clamps. The junction of the left renal vein and IVC cuff was preserved. Reconstruction was performed using a fresh, non-type specific, inferior vena cava allograft (Fig 3). The left renal vein was re-implanted in an end-to-side fashion onto the graft. Histology confirmed the diagnosis of a leiomyosarcoma with negative margins. The patient’s renal function remained normal and she was discharged home on the seventh postoperative day without any complications. No immunosuppression was utilized and full anticoagulation with coumadin was used for only 1 month. At 14-month follow-up, the patient was doing well without any lower extremity edema. CT scan reconstruction with venous phase was performed, revealing a widely patent inferior vena cava. However, local recurrence was apparent within the renal fossa.

The caval allograft used in this patient was procured from a cadaveric organ donor. The techniques of allograft preservation are briefly described. Following the allograft procurement from an organ donor, the vascular allograft was kept in University of Wisconsin preservation solution (ViaSpan; DuPont Pharma, Wilmington, Del.). The vessel was treated within 24 hours with RPMI-1640 with 2.05 mM L-glutamine (JRH Biosciences; Lenexa, Kan) containing cefoxitin (240 μg/mL), lincomycin (120 μg/mL), vancomycin (50 μg/mL), and polymyxin B (100 μg/mL) for 24 hours at −10°C temperature. The caval allografts are transferred aseptically to fresh RPMI-1640 with 2.05 mM L-glutamine, then treated as described in Table 1. Following an appropriate washing of the vessel, the allograft is placed in sterile RPMI-1640 with 2.05 mM L-glutamine, 2.05 mM L-glutamine, 10 mM HEPES, 25 mM N acetyl-L-cysteine, and 25 mM sodium bicarbonate. The use of fresh RPMI-1640 ensures optimal desensitization of the vessel, as described briefly above. The vessel is then transferred aseptically to diethylaminoethyl cellulose (DEAE)-treated RPMI-1640 with 2.05 mM L-glutamine (JRH Biosciences; Lenexa, Kan). The vessel is then treated in a rotating incubator at 37°C for 24 hours. The vessel is then transferred aseptically to fresh RPMI-1640 with 2.05 mM L-glutamine, then treated as described in Table 1.
glutamine (without antibiotics) and kept at −10°C for up to 30 days in case they are needed to vascular reconstruction.

DISCUSSION

The inferior vena cava is the most commonly involved vessel in leiomyosarcoma and is usually a high-grade tumor.\(^1\) In one study, primary IVC leiomyosarcoma accounted for 0.5% of all soft tissue sarcomas.\(^7\) Mingoli et al described three regions within the IVC for tumor involve-

ment: (1) Upper segment: from the right atrium to the hepatic veins (20%), (2) Middle segment: from the hepatic veins to the renal veins (44%), and (3) Lower segment: infrarenal (57%).\(^8\) They demonstrated that the risk of death is higher for proximal segmental disease and lowest for middle segment involvement.\(^8\) Patients present with a myriad of symptoms, including abdominal pain, abdominal mass, pedal edema, weight loss, and Budd-Chiari syndrome.\(^6\) Leiomyosarcoma of the IVC has a female predominance and a mean age of 56 years.\(^9\)

In 1992, the International Registry of Inferior Vena Cava Leiomyosarcomas was established to study the pathogenesis and natural history of the tumor.\(^8\) The authors determined that there is an increased risk of death associated with upper IVC segment involvement, lower limb edema, Budd-Chiari syndrome, intraluminal tumor growth, and IVC occlusion.\(^8\) On the other hand, the presence of abdominal pain and the absence of a palpable abdominal mass are associated with good outcomes.\(^6\) This disease is associated with a high morbidity and certain death without resection. Therefore, the goal of management is to achieve local control, maintain venous return and to prevent recurrence.\(^9\) Radical resection of the IVC, therefore, serves as the only chance for survival.\(^6\) When the IVC is ligated and not reconstructed, thrombus may form in the blind portion of the IVC and may even extend above the hepatic vein resulting in Budd-Chiari syndrome.\(^10\) However, some authors advocate resection without reconstruction when the IVC is occluded or extensively scarred, well-developed venous collaterals have formed, or for those requiring concomitant intestinal resection.\(^11,12\) As such, complete resection and reconstruction of the IVC is widely recommended and accepted as the mainstay treatment for leiomyosarcoma.

Methods of reconstruction consist of simple repair, patch repair, and segmental replacement.\(^13\) Primary repair
may lead to subsequent narrowing of the lumen, which may be prevented by patch grafting the defect.14 Several materials may be utilized for patch grafting. The utilization of part of the pericardium as an autograft is being advocated since it is readily available and accessible.15 Preliminary results have also shown that an autogenous peritoneo-fascial graft may be a suitable alternative to current biosynthetic materials.14 The graft is comprised of a strip of peritoneum and the posterior rectus fascia.16 In theory, the mesothelial lining of the peritoneo-fascial graft may promote vessel patency by the production of prostacyclin and promotion of thrombolytic activity.16 Segmental replacement can be achieved with autogenous vein or prosthetic grafts, such as polytetrafluoroethylene (PTFE), Teflon, or Dacron grafts.5,17 It is presumed that ringed PTFE grafts resist respiratory compression and prevent collapse, which may be a factor in the promotion of thrombosis.18 Placement of a graft smaller than the native IVC has also been advocated because the ensuing high velocity blood flow may minimize blood-prosthetic interactions that promote thrombosis.18 On the other hand, others advocate the use of grafts larger than 16 mm in diameter because the PTFE grafts tend to form a thick pseudo-intima that may result in obstruction.19 Glutaraldehyde-treated bovine pericardium has also been reported as an effective alternative, due to a lower thrombogenicity seen in repair of congenital cardiovascular myopathies.20 However, to our knowledge there have been no reported cases of IVC reconstruction utilizing an IVC allograft from a nonliving donor.

While lateral venorrhaphy with patch angioplasty is the preferred technique of repair, this option is ideally suited in cases of caval trauma or limited caval compression caused by tumor from adjacent organs. In contrast, primary IVC malignancy, such as leiomyosarcoma in our patient, typically involves a significant caval segment that is rarely amenable to local resection with caval patch angioplasty. Under such a circumstance, caval resection with interposition bypass grafting is the preferred technique of repair. Our patient has been followed closely with radiographic surveillance and has continued to show no signs of thrombosis at 14 months after surgery. The use of an allograft prevented the need for long-term anticoagulation, including aspirin, clopidogrel, and warfarin. Also, the patient did not require immunosuppressive therapy. She did not experience any immune reactions or infections. Although the effectiveness cannot be based on one case study, it is the authors’ belief that IVC allograft is a useful conduit for caval reconstruction. The choice of graft material for IVC reconstruction should not alter tumor recurrence rates or long-term survival.

Radical tumor resection has resulted in 5- and 10-year survival rates of 49.4% and 29.5%, respectively.21 Perioperative mortality for this procedure ranges between 0 to 15%.5,7,8 Despite advances in medical therapy and operative techniques, the major obstacle of preventing recurrence has been illusive. Local tumor recurrence has been found to be as high as 57.3%.21 Although it was initially reported that high-grade tumors increased the risk of death, it has been found that tumor grade did not predict recurrence or survival.8,9,21 Similarly, extended venous resection does not influence local recurrence nor does it affect long-term outcome.21 A retrospective analysis conducted at UCLA also found no difference in survival based on age, gender, tumor size, and lymph node status.9 However, they did report a discernable difference when the resected margins were positive. None of the patients with positive margins were alive at 5 years, compared with 68% of those with negative margins.9 Initially, it was reported that radiation therapy had no effect on recurrence or survival.8,6 However, a recent retrospective study has shown promise that high dose, intraoperative radiation improves local control.7

Treating leiomyosarcoma of the inferior vena cava remains a challenge. Over the years, new techniques have resulted in decreased morbidity and mortality associated with operative management, yet local recurrence remains high. The rarity of this disease poses a great obstacle in its investigation. Prospective randomized trials will remain illusive, so information will continue to be obtained from retrospective studies and case reports. As such, we have shown that our method for reconstructing the vena cava with an IVC allograft provides good patency without requiring long-term anticoagulation or immunosuppression.

REFERENCES


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