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Outcomes of arterial bypass preceding resection of retroperitoneal masses involving major vessels

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ABSTRACT

Background: Current surgical management of retroperitoneal masses involving major vessels now includes complete en bloc resection with in situ venous, arterial, or combined reconstruction. No studies have investigated preresection arterial bypass for continuous lower extremity perfusion during definitive resection. Here, we characterize and compare the outcomes of surgery for retroperitoneal masses with major vascular involvement by a two-stage approach (femoral-femoral bypass preceding resection) and the traditional one-stage approach (consecutive resection and in situ vascular reconstruction).

Materials and methods: We retrospectively reviewed patients who underwent resection of retroperitoneal masses and reconstruction of major arterial or venous structures from 2004 to 2016. Outcomes were compared with unpaired *t*-tests, chi-squared tests, and Kaplan–Meier analysis.

Results: Eight patients underwent a two-stage procedure, and seven underwent a one-stage procedure for retroperitoneal masses with vascular involvement. Mean (±SD) oncologic resection time (443 ± 215 *versus* 648 ± 128 min, $P = 0.047$) and postoperative ICU stay (0.9 ± 1.3 *versus* 4.4 ± 2.9 d, $P = 0.018$) were significantly shorter for the two-stage approach.

Conclusions: To our knowledge, this is the first report of a two-stage approach for resection of retroperitoneal masses with major vessel involvement. Femoral-femoral arterial bypass before definitive resection could be a viable option for improving intraoperative vascular control and decreasing perioperative complications in these complex procedures.

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Introduction

Retroperitoneal masses involving major vessels are a very rare and complex set of benign and malignant diseases, the best known of which are sarcomas. Sarcomas constitute just 1% of all adult malignancies, and only 15% of sarcomas are retroperitoneal.[1] Consequently, the best method for surgical resection of these complicated tumors has not been determined by a well-powered study.

In spite of their rarity, complete resection of these masses is frequently technically and physiologically demanding, often requiring multidisciplinary surgical management of multiple organ systems and major vessels. En bloc resection and reconstruction of involved organs and vessels consistently result in extensive bleeding, long operative times, and protracted stays in intensive care units.[2,3] In situ aortic, caval, or iliac reconstructions have been shown to lead to high rates of postoperative complications such as lower extremity edema, deep venous thrombosis (DVT), and graft occlusion.[4,5] Yet, surgeons frequently take on the risks associated with vascular reconstruction to improve the likelihood of gross macroscopic resection. In view of the myriad morbidities resulting from these operations, no alternative to in situ reconstruction (e.g., aortofemoral bypass, iliofemoral bypass) has been adopted for repair after tumor resection, indicating an avoidance of viable options such as extra-anatomic bypass. This is likely attributable to 2015 Society for Vascular Surgery (SVS) guidelines, which described the superiority of in-line reconstruction over extra-anatomic options.[6] However, the applicability of these guidelines in patients *without* aortoiliac occlusive disease—such as a large proportion of cancer patients—should be carefully considered.

To date, no study provides definitive evidence in support of a single reconstruction method for patients who do not have aortoiliac occlusive disease but require aortoiliac reconstruction for reasons such as vascular invasion by tumor. We sought to decrease the rate of complications related to vascular reconstruction at our institution by introducing a two-stage approach to oncologic resection of retroperitoneal masses. Here, we compare the outcomes of the two-stage approach with those of the one-stage approach.

Materials and methods

Study population and data collection

Patients who underwent resection of retroperitoneal masses and reconstruction of major arterial (±venous) structures at our institution from 2004 to 2016 were retrospectively reviewed. Patients were excluded if vascular reconstruction was not carried out or necessary during their oncologic resection or if only venous reconstruction was performed. Demographics, clinicopathologic data, complications, pathologic diagnoses, vascular patency, and oncologic outcomes were collected from medical records. Oncologic resection time was defined as the total length of the operation in which the tumor was completely resected, and total OR time was defined as the combined length of time of the operation(s) required to remove the tumor. Total estimated blood loss, total blood transfusion volume, and total length of stay also include combined data for all operations required to remove the tumor. Vascular encasement was defined as greater than or equal to 180° vascular involvement, and abutment was defined as less than 180° vascular involvement. Clavien-Dindo grades were acquired by scoring each patient's most severe surgical complication according to the Clavien-Dindo classification of surgical complications.[7] The University of California San Francisco Institutional Review Board approved the study and waived the requirement for informed consent.

Surgical approach

At our institution, patients referred for known diagnoses of retroperitoneal masses are first seen by a surgical oncologist. For those patients with suspected vascular involvement by the retroperitoneal mass, a vascular surgeon is consulted, and CT angiography is performed to determine the degree of tumor vascular invasion and the feasibility of performing a two-stage femoral-femoral bypass (FFBP) preceding resection. Patients with radiologic evidence of tumor encasing either aortoiliac system are scheduled for FFBP, which serves as the first stage. However, any indication of tumor involvement of either common femoral artery excludes the patient from consideration for FFBP. Since the introduction of this surgical approach in 2013, patients have either undergone one-stage or two-stage bypass, depending on the fulfillment of the aforementioned criteria.

In the first operation of the two-stage approach, the vascular surgeon routinely ligates and transects the ipsilateral external iliac artery proximal to the FFBP anastomotic site. This eliminates the possibility of any "competitive flow" that may occur between the ipsilateral iliofemoral system and the newly-placed FFBP. In addition, ligation of external iliac artery at a site distal to the intraabdominal tumor serves as distal vascular control of the artery during the second stage operation, aiding oncologic resection. After appropriate recovery, hospital discharge, and routine follow-up examination of lower extremity circulation (2-4 wk), the patient is then scheduled for oncologic resection of the mass and associated vessels. No venous reconstruction is planned in these two-stage patients. Instead, the tumor is resected en bloc with the involved arterial and venous branches *without* in situ reconstruction. Lower extremity perfusion is maintained by the FFBP during the oncologic resection.

Patients who did not fulfill the criteria for undergoing the two-stage approach (i.e., femoral arterial involvement) were instead scheduled for the one-stage approach, wherein oncologic resection occurs with vascular reconstruction in the same operation. In this approach, the resected arterial and venous beds are each repaired with conduit to maintain in-line perfusion.

Statistical methods

Two-tailed, unpaired *t*-tests, Wilcoxon rank-sum tests, and Fisher's exact tests were used to compare outcomes after two-stage versus one-stage procedures. Kaplan—Meier survival analysis was used to compare disease-free survival between

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