Journal of Vascular Surgery: Venous and Lymphatic Disorders
March 2019

Author Disclosures: A. Jayaraj: Nothing to disclose; **W. Walker:** Nothing to disclose; **S. Raju:** stock Veniti, U.S. patent venous stent design, patent holder IVUS.

Comparison of Open Versus Robotic Nephrectomy and Inferior Vena Cava Reconstruction for Renal Cell Carcinoma With Inferior Vena Cava Tumor Thrombus

Victor Davila,[1] Kyle Rose,[2] Kate Peng,[3] Andrew Meltzer,[1] William Stone,[1] Samuel Money,[1] Erik Castle[2]. [1]Vascular Surgery, Mayo Clinic Arizona; [2]Urology, Mayo Clinic Arizona; [3]General Surgery, Mayo Clinic Arizona

Objective: Vascular surgeons are frequently involved in inferior vena cava (IVC) reconstruction during nephrectomy for renal cell carcinoma (RCC) with tumor thrombus. Robotic nephrectomy for RCC claims shorter length of stay (LoS), faster return to work, and decreased pain medication requirements. Our goal was to compare our robotic nephrectomy with IVC reconstruction experience with our open experience.

Methods: We performed a single-institution retrospective review of patients undergoing open or robotic nephrectomy for RCC with IVC tumor thrombus between January 1998 and January 2018. Patients' characteristics, surgical records, and follow-up and survival data were recorded. Tumor level was classified according to the Mayo Clinic venous tumor thrombus (VTT) level.

Results: There were 57 patients (49 male) who underwent nephrectomy with tumor thrombectomy and IVC reconstruction; 38 (66%) had open procedures for RCC with level 1 (n = 6), level 2 (n = 21), and level 3 (n = 11) VTT. Average operative time was 251 minutes (range, 108-375 minutes), and average blood loss was 2482 mL (range, 50-10,950 mL). Average LoS was 10.79 days (range, 1-95 days). There were two (3.5%) deaths within 30 days. Short-term complications included atrial fibrillation (n = 2), ileus (n = 2), seroma (n = 1), sepsis (n = 1), pulmonary embolism (n = 1), urinary tract infection (n = 1), and pneumothorax (n = 1). Long-term complications included deep venous thrombosis (n = 1) and intra-abdominal abscess (n = 1).

Nineteen patients (33%) underwent robotic nephrectomy for RCC with level 1 (n = 1), level 2 (n = 17), and level 3 (n = 1) VTT. Average operative time was 283 minutes (range, 182-382 minutes), and average blood loss was 942 mL (range, 100-3000 mL). Average LoS was 3.11 days (range, 1-8 days). There were no deaths within 30 days. Short-term complications included pulmonary embolism (n = 1) and deep venous thrombosis (n = 1). Long-term complications included pleural effusion requiring thoracentesis (n = 1). All IVC reconstructions were performed by primary closure. Three (15.7%) cases required open conversion, two for control of the retrohepatic IVC and one for posterior lumbar venous bleeding unable to be controlled robotically.

Postoperative imaging was completed in 12 (63.2%) of the patients undergoing a robotic procedure at a median of 340 days postoperatively. The vena cava was patent in all studies. The median percentage of postoperative to preoperative IVC diameter was 58% (axial) and 45% (sagittal). In comparing open vs robotic procedures, the robotic approach had a shorter LoS ($P < .05$), less intraoperative blood loss ($P < .01$), and similar operative times (P = NS).

Conclusions: Robotic nephrectomy and IVC reconstruction for RCC with level 1 to level 3 VTT can be performed safely and effectively. The minimally invasive approach offers patients a shorter LoS, less intraoperative blood loss, and similar operative times compared with open surgery. Postoperative IVC diameter is maintained after robotic reconstruction. Proper selection of patients and robotic expertise are essential to optimize outcomes.

Author Disclosures: V. Davila: Nothing to disclose; **K. Rose:** Nothing to disclose; **K. Peng:** Nothing to disclose; **A. Meltzer:** Nothing to disclose; **W. Stone:** Nothing to disclose; **S. Money:** Nothing to disclose; **E. Castle:** Nothing to disclose.

Operative Strategies for Inferior Vena Cava Reconstruction in Oncologic Surgery

Colby Ruiz, MS4,[1] Corey Kalbaugh, PhD,[2] Sydney Browder,[2] Katharine McGinigle, MD,[2] Melina Kibbe, MD,[2] Mark Farber, MD,[2] Jason Crowner, MD,[2] William Marston, MD,[2] Luigi Pascarella, MD[2]. [1]School of Medicine, University of North Carolina at Chapel Hill; [2]Department of Vascular Surgery, University of North Carolina at Chapel Hill

Objective: Tumor involvement of the inferior vena cava (IVC) can result from primary caval leiomyosarcoma, local invasion by retroperitoneal malignant disease, or metastases. Whereas ligation of the IVC may be well tolerated if collateral circulation can be adequately preserved, collaterals must often be ligated during oncologic resection. Reconstruction of the IVC may be performed by primary repair, patch angioplasty, or interposition graft. The purpose of our study was to describe different strategies of IVC reconstruction at our institution and to measure outcomes associated with IVC reconstruction among patients with retroperitoneal malignant disease.

Methods: All patients undergoing IVC reconstruction at our tertiary care hospital between November 2004 and February 2018 were identified using billing data (*Current Procedural Terminology* code 34502). Patients who underwent resection of the IVC for tumor involvement were enrolled in our study; data were collected on demographics, operative intervention, type of reconstruction, postoperative course, and 1-year outcomes. Patency rates were assessed by reviewing postoperative imaging including contrasted computed tomography, magnetic resonance imaging, ultrasound, and venography. One-year mortality and patency were calculated using Kaplan-Meier analysis methods.

Results: We identified 52 (46% female) patients who underwent IVC reconstruction for retroperitoneal malignant disease. Mean age was 53.6 years (range, 23-80 years). Procedures performed included primary repair (n = 17 [33%]), patch angioplasty (n = 18 [35%]), interposition grafting (n = 16 [31%]), and primary repair plus bypass (n = 1 [2%]). Mean length of stay was 16 days and did not vary significantly by group. Patients undergoing interposition graft were discharged on aspirin 81 mg daily.

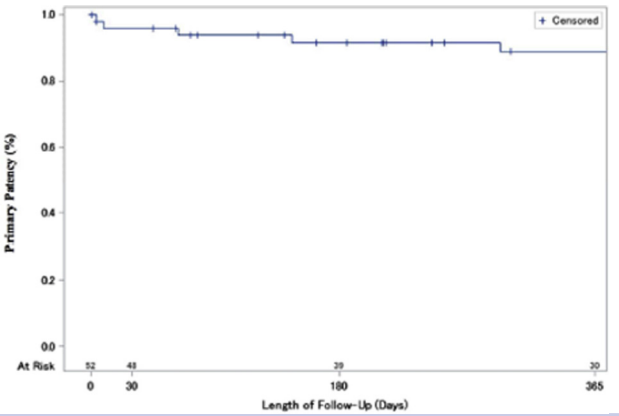

Fig 1. Primary patency after inferior vena cava (IVC) reconstruction (N = 52).

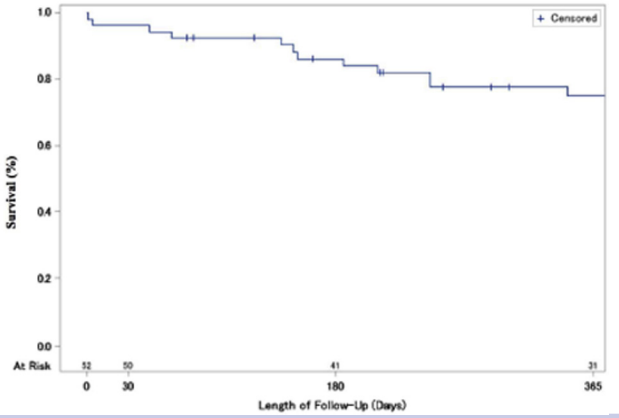

Fig 2. Survival after inferior vena cava (IVC) reconstruction (N = 52)..