

Kidney Cancer

Perioperative Outcomes Following Surgical Resection of Renal Cell Carcinoma with Inferior Vena Cava Thrombus Extending Above the Hepatic Veins: A Contemporary Multicenter Experience

E. Jason Abel^{a,*}, R. Houston Thompson^b, Vitaly Margulis^c, Jennifer E. Heckman^a, Megan M. Merrill^d, Oussama M. Darwish^c, Laura-Maria Krabbe^c, Stephen A. Boorjian^b, Bradley C. Leibovich^b, Christopher G. Wood^d

^a Department of Urology, University of Wisconsin School of Medicine and Public Health, Madison, WI, USA; ^b Department of Urology, Mayo Medical School and Mayo Clinic, Rochester, MN, USA; ^c Department of Urology, The University of Texas Southwestern Medical Center, Dallas, TX, USA; ^d Department of Urology, The University of Texas M.D. Anderson Cancer Center, Houston, TX, USA

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Abstract

Background: Surgery for renal cell carcinoma (RCC) patients with inferior vena cava (IVC) thrombus above the hepatic veins is technically complex and associated with an increased risk of perioperative morbidity and mortality. However, minimal data exist that describe contemporary perioperative outcomes at major referral centers or the prognostic factors associated with poor outcomes.

Objective: To determine the preoperative predictors of major complications and 90-d mortality after surgery in RCC patients who have IVC thrombus above the hepatic veins.

Design, setting, and participants: We reviewed medical records of all RCC patients who had IVC tumor thrombus above hepatic veins and had had surgery between January 2000 and December 2012 at the Mayo Clinic, M.D. Anderson Cancer Center, University of Texas Southwestern Medical Center, and the University of Wisconsin Hospital.

Outcome measurement and statistical analysis: Major complications recorded were defined as $\geq 3A$ according to the Clavien-Dindo system within 90 d of surgery. Univariate and multivariate analyses were used to evaluate associations of preoperative variables with risk of major complications or 90-d mortality.

Results and limitations: A total of 162 patients were identified for study (level 3, 4 in 69, 93 patients, respectively, according to the Neves classification). Cardiopulmonary bypass was used in 60 of 162 patients (37.5%), and 40 patients (24.7%) had preoperative angioembolization. Major complications were reported in 55 patients (34.0%), with the most common being respiratory, cardiac, and hematologic issues. After multivariate analysis, preoperative systemic symptoms and level 4 thrombus were independently associated with increased risk of major complications. Mortality was reported in 17 patients (10.5%) within 90 d after surgery. After multivariate analysis, Eastern Cooperative Oncology Group (ECOG) performance status (PS) and low serum albumin were preoperative factors independently associated with increased risk of 90-d mortality.

Conclusions: Contemporary perioperative mortality and major complication rates for RCC patients who have upper-level thrombus are 10% and 34%, respectively. Patients who have ECOG PS >1 or low serum albumin have increased risk for perioperative mortality.

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* Corresponding author. Department of Urology, University of Wisconsin School of Medicine and Public Health, 750 Highland Ave., Madison, WI 53705, USA. Tel. +1 608 262 2691; Fax: +1 608 262 6453.
E-mail address: abel@urology.wisc.edu (E.J. Abel).

1. Introduction

Renal cell carcinoma (RCC) may invade the venous system, producing thrombus in up to 10% of patients [1], but <1% of RCC patients have tumor thrombus extending into the inferior vena cava (IVC) above the hepatic veins. Several series have demonstrated that long-term cancer-free survival is possible for nonmetastatic RCC patients with complete excision of such an upper-level tumor thrombus [1–3], but surgery in patients with higher-level IVC thrombus is technically complex, and the risk of significant morbidity or perioperative mortality increases. Preoperatively, it is difficult to counsel patients about expectations for immediate postsurgical outcomes, because surgery for upper-level thrombus is rare and published outcomes vary widely [2–5]. Currently, most reports of upper-level thrombectomy are from single institutions with small patient numbers over long time periods when evolving surgical, anesthesia, and critical care techniques may have affected outcomes. Furthermore, minimal data exist using a standardized system to report complications [6] and mortality within 90 d postoperatively.

Defining and analyzing the contemporary outcomes for patients after upper-level thrombectomy is particularly important considering the historically high but variable rates of perioperative mortality. Consistent with this, some groups have recently questioned the treatment paradigm by using systemic targeted therapy to potentially downstage the thrombus prior to surgery [7,8]. Although decreasing the extent of the thrombus in the IVC would potentially make surgery technically less complex, data regarding reliable shrinkage of thrombus are lacking with the current targeted agents [9]. The objective of this study was to describe and analyze prognostic factors for major complications and perioperative mortality in RCC patients who have IVC thrombus above the hepatic veins by using a multi-institutional contemporary series.

2. Materials and methods

2.1. Patients

After institutional review board approval, medical records were reviewed to identify all RCC patients who had level 3 or 4 IVC tumor thrombus (using Neves' system) [10] and had had surgery between January 1, 2000, and December 31, 2012, at (1) the Mayo Clinic, Rochester, Minnesota (Mayo); (2) the University of Texas M.D. Anderson Cancer Center (MDACC); (3) the University of Texas Southwestern Medical Center (UTSW); and (4) the University of Wisconsin Hospital (UW). Level of thrombus was determined using transesophageal echocardiography when available or preoperative magnetic resonance imaging. Comprehensive clinical and pathologic variables were reviewed for each patient identified. Major complications were recorded if they occurred intraoperatively or within 90 d of surgery and were defined as $\geq 3a$ according to the Clavien-Dindo system [11]. The use of preoperative angioembolization, intraoperative cardiopulmonary bypass (CPBP), or circulatory arrest was at the discretion of the surgical team.

2.2. Statistical analyses

Univariate and multivariate logistic regression analyses were used to calculate an odds ratio (OR) corresponding with the risk of major

complications or 90-d mortality based on clinical and pathologic factors. A two-sided p value <0.05 was considered significant. Factors considered in univariable analyses included age, gender, race, labs at treatment initiation (serum creatinine, hematocrit, calcium, platelet count, alkaline phosphatase, albumin, aspartate aminotransferase [AST], total bilirubin), Eastern Cooperative Oncology Group (ECOG) performance status (PS), Fuhrman grade, World Health Organization 2004 histologic classification, 2009 TNM pathologic stage, radiologic evidence of Budd-Chiari syndrome (BCS) on preoperative imaging, tumor size in centimeters, height of venous thrombus, and presence of perinephric fat invasion or sarcomatoid features in pathology. The presence of local symptoms (pain, palpable tumor, hematuria) or systemic symptoms (weight loss, fatigue, lower extremity swelling) were noted for each patient. For stepwise multivariable analysis, variables were selected if they could be identified preoperatively and if significantly associated with outcomes on univariable analysis. All analyses were performed using SAS v.9.3 statistical software (SAS Institute, Cary, NC, USA).

3. Results

A total of 162 patients were identified who had had surgery for thrombus extending above the hepatic veins during the study period. Tumor thrombus extended above the diaphragm (level 4) in 93 patients and above the hepatic veins but below the diaphragm (level 3) in 69 patients. Patient and disease characteristics are shown in Table 1.

Table 1 – Patient characteristics: (a) baseline clinicopathologic characteristics (n = 162); (b) preoperative serum lab values

(a)	
Median age at diagnosis, yr (IQR)	62.8 (54.7–71.2)
Median tumor diameter, cm	10.5 (8.5–14)
Median BMI, kg/m ²	29.1 (25.9–33.2)
Gender, no. (%)	
Male	104 (64.2)
Female	58 (35.8)
Laterality, no. (%)	
Left	47 (29.0)
Right	115 (71.0)
Race/ethnicity, no. (%)	
White	133 (82.1)
Black	5 (3.1)
Hispanic	17 (10.5)
Asian	4 (2.5)
Other	3 (1.9)
Smoking status, no. (%)	
Current	25 (15.4)
Former	72 (44.4)
Never	63 (38.9)
ECOG PS, no. (%)	
0	78 (48.1)
1	62 (38.3)
2	13 (8.1)
3	7 (4.3)
Missing data	2 (1.2)
Presentation, no. (%)	
Local symptoms	110 (67.9)
Systemic symptoms	91 (56.2)
Incidental	25 (15.4)
Fuhrman grade, no. (%)	
1 or 2	13 (8.1)
3	84 (52.2)
4	64 (39.8)
Histologic subtype, no. (%)	
Clear cell	145 (89.5)
Papillary	8 (4.9)

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