Radical nephrectomy and inferior vena caval thrombectomy: outcomes in a lower volume practice

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Introduction: *Surgical volume correlates with improved outcomes for some complex urologic procedures. We reviewed the outcomes of a lower volume practice (1-2 cases per year) experience with radical nephrectomy with infra/retrohepatic vena caval thrombectomy (RNCT).*
Methods: *We retrospectively reviewed 10 patients who underwent RNCT performed by a single surgeon at a single state institution over 7 years (2002-2009). Patient demographics, presenting symptoms, preoperative imaging, intraoperative findings, pathology, hospital course, outcomes, level of caval involvement, renal artery embolization, liver mobilization, blood loss, transfusion requirements and follow up times were recorded.*
Results: *Median patient BMI (n = 8) was 25.7 (18.3-31.9). Eight patients underwent renal artery embolization prior*
to RNCT. A vascular or liver surgeon assisted in all 10 RNCT cases. Six thrombi were infrahepatic and four were retrohepatic requiring liver mobilization. Median operative time was 340 minutes (220-480) with a median vena cava clamp time of 17 minutes (11-22). Eight (80%) patients required intraoperative transfusion. Median pathologic tumor size was 9.5 cm (range 6-21). Median hospital stay was 7.5 days (5-15). Four patients had complications including colonic mesenteric rent (n = 2), abscess (n = 1), retroperitoneal hematoma (n = 1), distal pancreatic injury (n = 1), and splenic capsular tear (n = 1). One patient had postoperative liver metastasis. Two patients died from postoperative metastasis, at 5 months and 11 months.
Conclusions: *RNCT can be performed, with the assistance of a vascular/liver transplant surgeon, for an infrahepatic or retrohepatic thrombus satisfactorily in a lower volume practice.*

Key Words: nephrectomy, thrombectomy, vena cavae, carcinoma, renal cell, health facility size

Introduction

Renal cell carcinoma (RCC) extends into the inferior vena cava (IVC) in 4%-15% of cases and warrants an aggressive surgical approach to cure.[1,2] Radical nephrectomy with infra/retrohepatic vena caval thrombectomy (RNCT) remains the treatment of choice for these patients and affords a similar mean survival time to patients with similar tumors without tumor thrombus. Patients often present with severe symptoms, and one-third will have at least one metastatic lesion.

While other technically challenging operations such as radical prostatectomy and cystectomy have been reported to have outcomes associated with surgical volume or frequency, there is a paucity of data as to whether outcomes of RNCT correlate with surgical volume.[3,4] In an effort to assess the feasibility of performing RNCT at low operative volume and frequency, we reviewed the experience of a single surgeon with a lower volume (1-2 cases/year) RNCT practice and assessed patient demographics, clinicopathological features, intraoperative and perioperative parameters, hospital courses, and postoperative outcomes.

Materials and methods

A total of 10 patients underwent RNCT for renal cell carcinoma at a medium-sized state university from December 2002 to September 2009. All had inferior vena cava involvement (stage T3b). Upon Institutional Review Board approval, a retrospective review was conducted to explore patient demographics, BMI, presenting symptoms, preoperative metastases, imaging methods, pathology staging, renal artery embolization, level of thrombus, and surgical outcomes. Operative factors examined were surgical incision, operative time, vena cava clamp time, transfusion requirements, and estimated blood loss. Postoperative variables were length of stay and perioperative mortality and morbidity. Patients were evaluated preoperatively by computed tomography (CT) of the chest, abdomen, and pelvis. TNM classification was used for clinical and pathological staging.[5] Fuhrman grading was used to evaluate tumor differentiation. Patient follow up was performed at 3 month intervals when possible and included abdominal CT.

Results

Of the 10 RNCT patients, six were male and four were female, with a mean age of 58.4 years (range 22-74). The most common presenting symptom was weight loss (n = 5, 50%), followed by abdominal pain (n = 4, 40%) and hematuria (n = 3, 30%). Five tumors originated in the left kidney and five from the right. Median patient BMI was 25.7 (n = 8, 18.3-31.9). MRI revealed tumor thrombus extending from the renal vein into the IVC in all patients. All 10 patients were classified as T3b upon clinical staging. Three patients had metastasis at diagnosis: pulmonary and hepatic (n = 1), bilateral adrenal (n = 1), and renal hilar lymph nodes (n = 1), while one patient had adrenal metastasis detected during surgery.

Eight patients (80%) underwent renal artery embolization within 4 days prior to RNCT to aid in operative hemostasis and allow for thrombus control prior to tumor and kidney manipulation. A chevron subcostal incision was utilized in all cases, and the assistance of a vascular or liver transplant surgeon was routinely used to gain control of the IVC and excise the thrombus. Liver mobilization techniques were applied in four cases (40%). Eight patients (80%) required intraoperative transfusions with a median of 4.4 U packed RBCs transfused (n = 7, 1-10). Two patients received intraoperative transesophageal echocardiograms to monitor possible thrombus migration but none was found.

No perioperative deaths occurred. Four patients had complications including descending colon mesenteric rent (n = 2), postoperative abscess (n = 1), retroperitioneal hematoma (n = 1), distal pancreatic injury (n = 1), and splenic capsular tear (n = 1).

On final pathology, Fuhrman nuclear grade 4 was seen in half of patients (50%). Three patients had grade 3, and two patients had grade 2 tumors. Eight patients exhibited clear cell histology while one revealed sarcomatoid features and another had chromophil histology. Median tumor size was 9.5 cm (6-21). Renal vein margin involvement was reported histologically in six specimens, a positive Gerota's fascia margin was present in one tumor, and ureteral margin involvement was observed in another.

Median follow up for all patients was 11 months (1-82). Postoperative metastasis occurred in four cases. One had a large retroperitoneal tumor involving the psoas and IVC, extending from level of the renal vein and IVC to the dome of the right hemidiaphragm but was without mortality. In another patient, liver metastasis was discovered on PET at 44 months postoperatively without subsequent mortality. Two patients died from postoperative metastasis. In the first case, cardiovascular arrest secondary to respiratory distress from pulmonary metastasis occurred at 11 months postoperatively. In the second case, the patient expired from spinal metastases at 5 months postoperatively. In another case, metastasis to the left adrenal gland was suspected during surgery and confirmed on pathology. Of the remaining six patients, none had evidence of disease progression or mortality related to disease at follow up.

Discussion

RNCT is a complex and technically challenging procedure. However, it remains the treatment of choice for RCC with IVC involvement in order to reduce tumor burden and allow for potential cure. With surgical resection of the primary renal tumor and caval thrombus, renal cell carcinoma patients have 5 year survival rates of up to 64%.[6] In cases of metastatic disease, survival rates are decreased to 20%.[5]

Previous authors have reported a correlation between increasing surgical experience and improved outcomes for various complex and technically challenging urologic oncologic procedures, including radical prostatectomy and radical cystectomy.[3,4] Several series evaluating radical nephrectomy found increased complication and mortality rates in low-volume centers ranging from not statistically significant to 1% greater than those of high-volume

centers.[7-10] However, other investigators have cited methodological shortcomings and limitations in such volume-outcome relationship studies.[11] We are aware of no prior study evaluating outcomes of RNCT performed at lower surgical frequency in a lower volume center by a single urologic surgeon.

In an effort to improve the ease and outcomes of this complex operation, some urologists have enlisted the aid of general surgeons (vascular, liver transplant) with success. Previous studies have reported the benefits of employing organ transplantation techniques to isolate and extract the IVC thrombus and mobilize the liver when necessary in RNCT cases.[12,13] We have found this approach to be beneficial.

Renal artery embolization has also been touted as advantageous for the management of RCC with IVC thrombus in order to decrease blood loss, potentially reduce the cephalad extension of the thrombus and allow for initial thrombus control prior to kidney manipulation.[14,15] Conversely, other studies have found that routine renal artery embolization prior to RNCT did not reduce tumor thrombus level, transfusion requirements, operative time, or complications from surgery.[16] Instead, preoperative renal artery embolization was observed to be associated with greater risk of complications and postoperative mortality. In our series, eight patients (80%) underwent preoperative renal artery embolization. Of these, one developed a postoperative abscess, while the remainder were without perioperative complications. The abscess required interventional radiology drainage before discharge and again at approximately 2 weeks and 3 weeks postoperatively with subsequent resolution. A postoperative retroperitoneal hematoma occurred in one of the two patients who did not undergo preoperative renal artery embolization. The hematoma

TABLE 1. Comparison of intraoperative and perioperative results of RNCT series

	Sweeney et al[19]	Parekh et al[20]	Current series
Years (# patients)	1985-2001 (16)	1998-2002 (4)	2002-2009 (7)
Case frequency (per year)	6	12	1.4
Metastasis at presentation	27 (28%)	10 (20%)	4 (40%)
Thrombus level (neves criteria)			
I (renal vein only)	0	7 (14%)	0
II (IVC infrahepatic)	39 (41%)	23 (47%)	6 (60%)
III (IVC intra/retrohepatic)	28 (29%)	18 (37%)	4 (40%)
IV (IVC supradiaphragmatic)	21 (22%)	1 (2%)	0
Mean tumor size (cm)		10	9.5
Preop renal artery embolization	42 (44%)		8 (80%)
Median OR time (hours)	6.5 (5-10)		5.4 (3.4 - 8)
Liver moblization		14 (29%)	4 (40%)
Median IVC clamp time (min)			17 (11-22)
Median EBL (mL)	2500 (200-30,000)	950 (250-8500)	2180 (450-4500)
for level II	1400 (200-15,000)		705 (450-3000)
for level III	3500 (600-7000)		2250 (2000-4500)
Patients receiving transfusion	42 (44%)		
Median transfusion given (units)	5	6	4
Patient complication rate (%)*	37 (39%)	10 (22%)	4 (40%)
Major (%)	19 (20%)	3 (6%)	1 (10%)
Minor (%)	18 (19%)	7 (16%)	3 (30%)
Perioperative mortality (%)	5.20%	8%	0
for level II/III	1.50%		0
Intraoperative (%)	0	4%	0
Length of hospital stay (days)	10 (3-57)	6 (4-23)	8 (5-15)

*independent of thrombus level

subsequently resolved but the patient required a total transfusion of eight units packed RBCs. We did not detect any major perioperative complications nor did we observe patient mortality unrelated to postoperative disease progression. Two other patients who underwent renal artery emolization experienced minor complications. One had an intraoperative descending colon mesenteric laceration that was repaired without further complication. A second patient with an upper pole renal tumor involving the tail of the pancreas also had a mesenteric rent in the descending colon along with a distal pancreatic injury and splenic capsular tear. Distal pancreatectomy and splenectomy were subsequently performed without sequelae.

Intraoperative thrombus embolization during nephrectomy and tumor thrombectomy is a rare but potentially fatal event with 1.49% incidence and 75% mortality.[17] Although studies on the use of a temporary IVC filter are conflicting, other strategies to minimize the risk include gaining control of the IVC above the tumor thrombus followed by completing vascular control prior to caval entry and thrombus manipulation.[18,19] In select cases with a minimal caval thrombus, careful milking of the thrombus from the IVC into the renal vein may be performed. In one of our cases, there was intraoperative concern that a portion of thrombus tip had embolized. However, liver ultrasound revealed no evidence of the thrombus in the intrahepatic portion of the IVC or at the level of the diaphragm. An intraoperative transesophageal echocardiogram was performed and revealed no apparent thrombus in the heart or lungs. In addition, back bleeding of approximately 100 cc into the IVC was performed in an attempt to retrieve the possible embolus, but no evidence of a thrombus tip was discovered. The remainder of the surgery was completed without incident, and the patient experienced no postoperative complications related to an embolus.

We believe this retrospective review of 10 patients undergoing RNCT over a 7 year period demonstrates satisfactory results approaching or similar to results from higher volume centers and surgeons, Table 1.[20,21]

In comparison to these series, our series included patients with a similar age, tumor size, hospital length of stay, Fuhrman grading, and outcomes. The percentage of level II/III tumor thrombi was greater in our series compared to other series, which included level I renal vein thrombus patients. This may serve as an explanation for several of the following findings. Our patients had a higher rate of metastases at presentation (40% versus 28% and 20%), and we performed a greater percentage of renal artery embolizations (80%) and

liver mobilizations (40%). We did, however, observe decreased perioperative mortality (0% versus 5.2% and 8.2%) despite an increased rate of complications (40% versus 39% and 22%). Follow up times were comparable to those in the larger series.

Conclusion

RNCT remains the preferred surgical intervention for RCC cases with caval involvement. When performed in conjunction with a vascular or liver transplant surgeon and with liberal utilization of renal artery embolization, surgical removal of renal malignancies with infra/retrohepatic caval thrombi can be safely performed infrequently and achieve results comparable to higher volume tertiary centers. □

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EDITORIAL COMMENT

Re: Radical nephrectomy and inferior vena caval thrombectomy: outcomes in a lower volume practice

The authors are to be congratulated on their excellent outcomes regarding a challenging surgical problem. There are several points that deserve emphasis. First, the correlation with surgical volume and better outcomes holds true in high volume operations where an individual surgeon may have performed hundreds or thousands of a particular procedure. No one individual has that depth of experience with vena caval thrombi, even at academic centers.

In this report, the value of teamwork is correctly emphasized. Vascular and transplant surgeons contribute valuable expertise and the collective skill and experience of the entire surgical team is important. Like these authors, I also use a chevron subcostal incision on all these cases. It provides a versatile exposure and facilitates going on bypass or rolling the liver (Langenbeck maneuver). I have not personally utilized renal artery embolization which has at least a theoretical risk of necrosis and pulmonary embolization of the distal thrombus. The anesthesiologists at my institution frequently use transesophageal ultrasound and we find it quite useful to monitor removal of the thrombus.

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