Clinical Outcomes of Radical Surgery in Patients with Renal Carcinoma and Associated Venous Thrombosis: Single-Center Experience in a Tertiary Care Institution

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Abstract

Background: Renal carcinoma and associated venous thrombosis cause-specific perioperative and postoperative challenges. We aimed to evaluate the factors affecting clinical outcomes in patients undergoing radical surgery due to renal carcinoma and associated venous thrombosis. Materials and methods: Hospital records were retrospectively reviewed to identify patients with renal carcinoma and associated venous thrombosis treated with radical surgery between 2006 and 2019. Preoperative, perioperative, and postoperative findings were analyzed to determine the associations between clinical and survival outcomes. Overall and disease-free survival was analyzed by the Kaplan-Meier method. Other associated prognostic variables were assessed using univariate and multivariate Cox regression analyses. Results: Thirty-three patients with renal carcinoma and associated venous thrombosis were enrolled for this study. There were 15 (45.4%) patients with level I, five (15.2%) with level II, eight (24.2%) with level III, and five (15.2%) with level IV venous thrombosis according to the Mayo Clinic classification system. The median follow-up was 35.6 months. In the univariate analysis, increased tumor size was associated with poor overall and disease-free survival. Preoperative clinic M1 disease was associated with poor overall survival. A high Mayo Clinic thrombus level was associated with poor disease-free survival. In the multivariate analysis, only tumor size and clinic M1 disease were independently correlated with poor overall survival. No independent statistically significant association was detected between thrombus level and survival outcomes. Conclusions: Although the thrombus level was not associated with overall and disease-free survival, tumor size and clinic M1 disease were found to have an independent prognostic impact on overall survival.

Study design

The present study was approved by the Internal Institutional Review Board (Cerrahpasa Medical Faculty, approval number 21263603-604.02.01-86518). The hospital medical records and charts of the patients were retrospectively reviewed. The data included demographics, tumor characteristics, operative findings, pathological outcomes, postoperative follow-up, and survival outcomes.

Preoperative comorbidities were assessed according to the Charlson Comorbidity Index [8]. The performance status was measured for each patient using the Eastern Cooperative Oncology Group performance score (ECOG PS) [9]. The Mayo Clinic system was used to classify the thrombus level [10]. Preoperative physical status was evaluated by the American Society of Anesthesiologists (ASA) scoring [11]. Surgery-associated complications were assessed based on the Clavien classification [12]. All pathological specimens were examined by a single pathologist team according to the recommendations of the UICC/American Joint Committee on Cancer [13]. Tumor nuclear grade was determined according to the Fuhrman grading system [14]

Overall survival (OS) was described as the time from the operation to the last visit in 18 surviving patients and as the time from the operation to death in 15 deceased patients. Disease-free survival (DFS) was defined as the time from the procedure to the metastatic process in 15 preoperative clinic M0 patients and as the time from the operation to the last visit in nine preoperative and postoperative clinical M0 patients.

Patient selection

Patients included in the study were aged 18 years and older with complete demographics and medical records, who were diagnosed with renal carcinoma and associated venous thrombosis and treated with radical renal surgery and thrombectomy. The exclusion criteria were missing data, the presence of any other malignancy, and patient withdrawal from the study.

Preoperative assessment

Before surgery, all patients underwent a routine evaluation, including medical history, physical examination, complete blood count, serum biochemistry and coagulation tests, and urine culture analysis. The level of thrombus extension into the vena cava was radiologically determined using contrast-enhanced computed tomography (CT) and/or magnetic resonance imaging (MRI). Echocardiography was used to assess cardiac tumor involvement in advanced cases. Cardiothoracic and general surgeons were preoperatively consulted for all cases, and other technical preparations were made based on the complexity of each case. No patients were administered neoadjuvant therapy. Informed consent was obtained from all patients for surgery.

Operative technique

No preoperative arterial embolization was performed. The surgical approach was tailored according to the size and location of the tumor, its relationship with the surrounding tissue, and the level of a tumor thrombus. All patients underwent open or laparoscopic nephrectomy and thrombectomy. Retroperitoneal lymph node dissection was performed in cases that were node-positive based on radiology or those with perioperative suspicion of lymph node involvement. Surgical access consisted of full midline, anterior subcostal (8), L-shaped (16), reversed L-shaped (5), and combined incision (4). The incision was extended in selected cases (**Figure 1**).

The procedure was started as in standard radical nephrectomy. Then the vena cava inferior (VCI), lumbar veins, and the renal vein on the opposite side were isolated by careful dissection from the surrounding tissues. The general surgeon undertook liver mobilization. After achieving complete vascular control, longitudinal cavatomy was performed from the renal vein ostium. Digital milking or balloon catheter retraction was used to remove the thrombus. Sternotomy was added to the surgery of cases of advanced supradiaphragmatic thrombus excision, intracardiac tumor excision, or additional cardiac intervention by the thoracic and cardiovascular surgeon. After the control of bleeding, surgical plans were closed anatomically. Perioperative blood loss, operation time, and transfusion rates were noted.

Postoperative follow-up

All patients were followed up with chest and abdominal CT at the third and sixth months after the operation, and every six months thereafter, adhering to the recommendations of the EAU guidelines [15]. Follow-up data were collected survival, and oncological outcomes were analyzed during patient visits.

Statistical analysis

All data were stored using an Excel database, and analyses were performed using SPSS v. 21.0 (IBM Corporation, NY, USA). The distribution of OS and DFS was evaluated using the Kaplan-Meier method. The differences between the subgroups were assessed by the log-rank test. The parameters found to be statistically significant in the univariate analysis were further evaluated using multivariable models. The Multivariate Cox proportional risk regression model was fitted to the data to estimate the independent prognostic importance of survival. Statistical significance was accepted as a p-value of <0.05.

Results

Radical nephrectomy was performed on 703 patients with histologically confirmed renal carcinoma diagnosed from 2006 to 2019. Renal carcinoma and associated venous thrombosis were detected in 38 of 703 (5.4 %) patients. Two patients were excluded from the study due to perioperative death, and a further three due to missing data. Thirty-three patients diagnosed with renal carcinoma and associated level I to IV venous thrombosis, according to the Mayo Clinic classification system, were enrolled in the study.

There were 22 male (66.7%) and 11 female (33.3%) patients. The median age was 57.6 years (27 to 77 years), with a median follow-up of 35.3 months (8 to 108 months). A total of 15 patients (45.5%) died during the follow-up. There were 15 patients (45.4 %) with level I, five (15.2%) with level II, eight (24.2%) with level III, and five (15.2%) with level IV venous thrombosis. A high Mayo Clinic thrombus level was associated with poor DFS in the univariate analysis ($p = 0.002$); however, according to the multivariate analysis, the thrombus level was not independently associated with DFS ($p = 0.066$).

While 24 patients (72.8%) had no distant metastasis, nine (27.2%) had clinical M1 disease at the time of diagnosis. Preoperative clinical M1 disease was associated with poor OS (56 months vs. 25 months) in the multivariate analysis ($p = 0.008$). There were eight (24.2%) patients with clinical N1 disease, and lymph node dissection was performed in 21 (63.6%) patients. Preoperative clinical N1 disease was not associated with OS ($p = 0.973$). Eight patients (24.2%) required sternotomy due to intra-atrial thrombus excision, coronary artery bypass grafting, or valvuloplasty. Other baseline clinical findings, tumor characteristics, and perioperative and postoperative findings are shown in **Table 1a** and **1b** .

The most common histopathological type was renal cell carcinoma (RCC) that presented in 30 patients (90.7%). Poor median OS and DFS were found in patients with non-RCC histopathologies (11.7 months vs. 35.2 months). Sarcomatoid differentiation was seen in eight patients (24.2%). Tumors that coexisted with sarcomatoid differentiation were related to poor median OS (34 months vs. 58 months). However, non-RCC histopathologies and sarcomatoid differentiation were not found statistically associated with median OS and DFS. Postoperative N1 disease was not associated with OS ($p = 0.066$) and DFS ($p= 0.437$). The remaining pathological findings are shown in **Table 1c** .

The median pathological tumor size was 10.9 cm (5 to 20 cm). The median overall survival was 32.1 months in patients with a tumor of 10.1 cm or greater in size, and 47.8 months in those with a tumor sized below 10.1 cm. Increased tumor size (10.1 cm or greater) was associated with poor OS ($p = 0.046$) and DFS ($p = 0.005$) according to the univariate analysis. In the multivariate Cox regression analysis conducted by adjusting the remaining clinical and pathological variables, tumor size was independently correlated with poor OS ($p = 0.02$) but not correlated with DFS ($p = 0.129$). The multivariate analyses of the parameters calculated to be statistically significant in the univariate analysis are given in **Table 2** .

Discussion

In this study, it was found that tumor size and preoperative clinical M1 disease were correlated with poor OS. Although poor DFS was observed in patients with a higher thrombus level and greater tumor size (10.1 cm and over), these parameters did not have a statistically significant effect on DFS in the multivariate analysis.

A venous thrombus is often associated with metastasis at presentation. In most of the series reported in the literature, up to 30% of patients with renal cancer and associated venous thrombosis have clinical M1 disease [7,16]. While patients presenting without distant metastasis have a good prognosis when treated with successful resection, preoperative clinical M1 disease is one of the poor prognostic factor for OS in patients with renal carcinoma and associated venous thrombosis [17,18]. In a study with 87 patients with preoperative clinical M1 disease, Ciancio et al. reported that the median OS was reduced to eight months [19]. Our study also showed a decrease in OS (56 months vs. 25 months) in patients with preoperative distant metastasis ($p = 0.008$) (**Figure 2a**), which is consistent with the literature. A significant decrease in OS despite surgical treatment in preoperative clinical M1 patients led researchers to seek new treatment alternatives. In this context, new oncological treatment options are considered before and after surgery. In addition, systemic treatments are investigated as an alternative to surgery. In a study conducted by Mejean

et al., it was reported that sunitinib treatment without nephrectomy in the patients with metastatic RCC with moderate- or high-risk disease was not inferior to the standard treatment of nephrectomy plus sunitinib [20]. In another study by Bex et al., it was reported that sunitinib treatment prior to surgery in patients with metastatic RCC provided an OS advantage compared to early surgery with no additional sunitinib treatment [21]. Therefore, advanced clinical trials may offer better treatment alternatives in patients with metastatic RCC [22,23].

There are a few studies concerning the association between tumor size and survival outcomes [19,25]. In these studies, the reduction of OS and DFS was emphasized. In our study, tumor size was found to be independently related to poor OS in the multivariate analysis (**Figure 2b**). Additionally, the most significant cut-off value in terms of the reduction of survival was calculated as 10.1 cm, while the literature does not contain an exact cut-off value. Although patients with venous thrombosis are directly classified as T3 according to the TNM staging system, tumor size should also be taken into account for optimal disease management.

In the literature, the OS outcomes of patients with tumor thrombosis are inconsistent. Although some studies reported poor survival in patients with a more cephalad tumor thrombosis [15,26,27], others did not find such differences [24,28]. A critical research investigating this issue was conducted with 1,192 patients over a median follow-up of 61.4 months [24] and determined the median OS was 52 months for renal vein thrombosis, 26 months for subdiaphragmatic IVC thrombosis, and 18 months for supradiaphragmatic IVC thrombosis. However, these differences in survival were not found to be related to the thrombus levels. Similarly, the association between the thrombus level and OS was not statistically significant in the current study (**Figure 2c**).

In the literature, the presence of non-RCC histopathology was found to be related to poor prognosis [28,29]. In a retrospective study, statistically significant poor OS was shown in patients presenting with sarcomatoid differentiation [29]. Although our study revealed a difference in OS between the patients that presented with RCC and non-RCC histopathology (35.2 months vs. 11.7 months), this difference was not found statistically significant ($p = 0.860$). In addition, we did not find any statistically significant difference in the OS of patients that had sarcomatoid differentiation (58 months vs. 34 months,$p = 0.810$). This finding may be due to sampling bias since 90.7% of the tumors in our series showed clear cell histology, while 24.2% had sarcomatoid differentiation.

We acknowledge that the current study had certain limitations. It was conducted in a single center with a retrospective design. In addition, the size of our cohort was relatively small, with a population size of 33 patients. Furthermore, the study population underwent surgery performed by multiple surgeons, and we did not attempt to differentiate venous wall infiltration from the venous thrombus alone. Lastly, the length of follow-up was relatively poor. However, we consider that this study has a potential role in contributing to the literature in terms of the effect of tumor size on the survival of patients with renal carcinoma and associated venous thrombosis. Prospective studies with a long-term follow-up and larger population are needed to validate our findings.

Conclusions

Renal carcinoma presenting with associated venous thrombosis is a potentially curable condition that offers reasonable survival. Although there remains controversy regarding the prognostic significance of tumor thrombus involvement and other clinic parameters, there are no prospective studies for predicting mortality, morbidity, and survival findings. The results from our study demonstrate a significant decrease in the OS of patients with clinical M1 and larger tumor size (>10.1 cm). However, there is no statistically significant association between thrombus level and survival (OS and DFS).

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Acknowledgement: None.

Conflict of Interest : The authors declare that they have no conflict of interest.

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Informed consent: Informed consent was obtained from all individual participants included in the study.

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Table Legends

Table 1 – Patient characteristics: **(a)** baseline clinical and tumor characteristics; **(b)** perioperative and postoperative findings; **(c)** pathological findings.

(a)

			OS p value	DFS p value
Age *(years) (mean ± SD)*	57.6 ± 11.4	57.6 ± 11.4	0.752	0.094
Age *(years)*, *n (%)* $> 60 < 60$	13 (39.4%) 20 (60.6%)	13 (39.4%) 20 (60.6%)	0.977	0.370
Gender, *n (%)* Female Male	11 (33.3%) 22 (66.7%)	11 (33.3%) 22 (66.7%)	0.859	0.151
BMI *(kg/m^2) (mean ± SD)*	27.6 ± 4.1	27.6 ± 4.1	0.379	0.317
Smoking, *n* (%) Yes No	20 (60.6%) 13 (39.4%)	20 (60.6%) 13 (39.4%)	0.083	0.547

(a)				
Smoking *(pack years) (mean ± SD)*	39.5 ± 19.1	39.5 ± 19.1		
Alcohol intake, *n* (%) Yes No	3 (9.1%) 30 (90.9%)	3 (9.1%) 30 (90.9%)	0.612	0.148
Symptoms, n (%) Flank pain	14 (42.4%) 11 (33.3%) 4	14 (42.4%) 11 (33.3%) 4	0.709	0.504
Hematuria	(12.1%) 1 (3.1%)	(12.1%) 1 (3.1%)		
Abdominal swelling Weight loss Incidental	3 (9.1%)	3 (9.1%)		
CCI, *n* (%) 0 1 2 3	8 (24.2%) 15 (45.4%) 9 (27.2%) 1 (3.2%)	8 (24.2%) 15 (45.4%) 9 (27.2%) 1 (3.2%)	0.147	0.538
Anticoagulant - antiplatelet medication, *n* (%) Yes No	5 (15.1%) 28 (84.9%)	5 (15.1%) 28 (84.9%)	0.413	0.264
ASA score, *n* (%) ASA I ASA II ASA III	15 (45.4%) 16 (48.5%) 2 (6.1%)	15 (45.4%) 16 (48.5%) 2 (6.1%)	0.362	0.615
ECOG score, *n* (%) ECOG 0 ECOG 1	27 (81.9%) 6 (18.1%)	27 (81.9%) 6 (18.1%)	0.082	0.776
Familial cancer history, *n* (%) Yes No	6 (18.1%) 27 (81.9%)	6 (18.1%) 27 (81.9%)	0.495	0.202
Tumor side, *n* (%) Left kidney Right kidney	10 (30.3%) 23 (69.7%)	10 (30.3%) 23 (69.7%)	0.717	0.392
Clinical tumor size *(cm)* mean ± SD	10.7 ± 4.38	10.7 ± 4.38		
Clinical tumor size *(cm), n* (%) [?]4 cm >4, [?] 7 cm >7, [?] 10 cm >10 cm	0 8 (24.2%) 11 (33.3%) 14 (42.4%)	0 8 (24.2%) 11 (33.3%) 14 (42.4%)	**0.047**	0.249
Mayo Clinic thrombus level, *n* (%) Level I Level II Level III Level IV	15 (45.4%) 5 (15.2%) 8 (24.2%) 5 (15.2%)	15 (45.4%) 5 (15.2%) 8 (24.2%) 5 (15.2%)	0.057	**0.02**
Clinical stage, *n* (%) T3a T3b T3c T4	9 (27.2%) 16 (48.5%) 8 (24.2%) 0	9 (27.2%) 16 (48.5%) 8 (24.2%) 0	0.473	0.294
Preoperative clinical M1 disease, *n* (%) Yes No	9 (27.2%) 24 (72.8%)	9 (27.2%) 24 (72.8%)	**0.014**	-

(a)				
Preoperative clinical N1 disease, *n* (%) Yes No	8 (24.2%) 25 (75.8%)	8 (24.2%) 25 (75.8%)	0.973	-
(b)				
Operation type, *n* (%) Open radical nephrectomy Laparoscopic radical nephrectomy Open nephroureterectomy	31 (93.8%) 1 (3.1%) 1 (3.1%)	31 (93.8%) 1 (3.1%) 1 (3.1%)	0.998	0.1
Additional procedure, *n* (%) Thrombectomy LND CABG Intracardiac tumor excision Valvuloplasty Sternotomy Metastasectomy Cholecystectomy Hepatic lobectomy	33 (100%) 21 (63.6%) 3 (9.1%) 3 (9.1%) 3 (9.1%) 8 (24.2%) 1 (3.1%) 2 (6.2%) 1 (3.1%)	33 (100%) 21 (63.6%) 3 (9.1%) 3 (9.1%) 3 (9.1%) 8 (24.2%) 1 (3.1%) 2 (6.2%) 1 (3.1%)		
Mean blood loss *(cc) (mean ± SD)*	1064.8 ± 1288.97	1064.8 ± 1288.97	0.763	0.819
Operative time *(min) (mean ± SD)*	264.5 ± 91.8	264.5 ± 91.8	0.191	0.370
Mean transfusion, per patient *(mean ± SD)* ES FFP	1.8 1.5	1.8 1.5	0.248	0.328
Perioperative complication, *n* (%) Hemorrhage	3 (9.1%)	3 (9.1%)	0.451	0.378
Postoperative early complication, *n* (%) Infection Hemorrhage	7 (21.2%) 4 (12.1%)	7 (21.2%) 4 (12.1%)	0.217	0.285

(a)					
Clavien score, *n* (%) Clavien I Clavien II Clavien IIIa Clavien IIIb Clavien IV Clavien V	11 (33.2%) 19 (57.5%) 1 (3.1%) 2 (6.2%) 0 0	11 (33.2%) 19 (57.5%) 1 (3.1%) 2 (6.2%) 0 0	0.184		0.122
(c)	**(c)**	**(c)**	**(c)**	**(c)**	**(c)**
Histopathology, *n* (%) RCC Invasive urothelial carcinoma Mesenchymal malignant tumor PTEN-Ewing group sarcoma	Histopathology, *n* (%) RCC Invasive urothelial carcinoma Mesenchymal malignant tumor PTEN-Ewing group sarcoma	30 (90.7%) 1 (3.1%) 1 (3.1%) 1 (3.1%)	0.224		0.311
RCC, subtypes, *n* (%) Clear cell RCC Chromophobe RCC Papillary RCC Conventional RCC Unclassified	RCC, subtypes, *n* (%) Clear cell RCC Chromophobe RCC Papillary RCC Conventional RCC Unclassified	19 (63.4%) 2 (6.7%) 1 (3.3%) 3 (9.9%) 5 (16.7%)	0.873		0.805
Sarcomatoid differentiation, *n* (%) Yes No	Sarcomatoid differentiation, *n* (%) Yes No	8 (24.2%) 25 (75.8%)	0.810		0.283
Histological pattern, *n* (%) Solid Solid, alveolar Solid, tubular Solid, trabecular Tubular, microcystic Tubular, tubulopapillar Alveolar, fascicular Invasive	Histological pattern, *n* (%) Solid Solid, alveolar Solid, tubular Solid, trabecular Tubular, microcystic Tubular, tubulopapillar Alveolar, fascicular Invasive	11 (33.3%) 11 (33.3%) 4 (12.2%) 2 (6.1%) 2 (6.1%) 1 (3.0%) 1 (3.0%) 1 (3.0%)	0.210		0.053
Pathological cancer size *(cm) (mean ± SD)* Mean	Pathological cancer size *(cm) (mean ± SD)* Mean	10.9 ± 4.9			

(a)				
Pathological cancer size *(cm), n* (%) [?]4 >4, [?] 7 >7, [?] 10 >10	Pathological cancer size *(cm), n* (%) [?]4 >4, [?] 7 >7, [?] 10 >10	0 5 (15.2%) 16 (48.5%) 12 (36.3%)	**0.046**	**0.005**
Fuhrman grade, *n* (%) Grade I Grade II Grade III Grade IV	Fuhrman grade, *n* (%) Grade I Grade II Grade III Grade IV	0 2 (7.4%) 12 (44.4%) 13 (48.2%)	0.750	0.260
Surgical margin, *n* (%) Negative Positive	Surgical margin, *n* (%) Negative Positive	32 (96.9%) 1 (3.1%)	0.591	0.935
Vascular invasion, *n* (%) Yes No	Vascular invasion, *n* (%) Yes No	30 (90.9%) 3 (9.1%)	0.562	0.252
Capsule and perinephric tissue invasion, *n* (%) Yes No	Capsule and perinephric tissue invasion, *n* (%) Yes No	18 (54.5%) 15 (45.5%)	0.506	0.163
Lymph node invasion, *n* (%) Yes No	Lymph node invasion, *n* (%) Yes No	11 (33.3%) 22 (66.7%)	0.066	0.437

(a)					
OS = overall survival; DFS = disease-free survival; BMI = body mass index; CCI = Charlson comorbidity index; ASA = American Society of Anesthesiologists; ECOG = Eastern Cooperative Oncology Group; SD = standard deviation; LND = lymph node dissection; CABG = coronary artery bypass graft; ES = erythrocytes suspension; FFP = fresh frozen plasma; RCC = renal cell carcinoma; PTEN = phosphatase and tensin homolog.	OS = overall survival; DFS = disease-free survival; BMI = body mass index; CCI = Charlson comorbidity index; ASA = American Society of Anesthesiologists; ECOG = Eastern Cooperative Oncology Group; SD = standard deviation; LND = lymph node dissection; CABG = coronary artery bypass graft; ES = erythrocytes suspension; FFP = fresh frozen plasma; RCC = renal cell carcinoma; PTEN = phosphatase and tensin homolog.	OS = overall survival; DFS = disease-free survival; BMI = body mass index; CCI = Charlson comorbidity index; ASA = American Society of Anesthesiologists; ECOG = Eastern Cooperative Oncology Group; SD = standard deviation; LND = lymph node dissection; CABG = coronary artery bypass graft; ES = erythrocytes suspension; FFP = fresh frozen plasma; RCC = renal cell carcinoma; PTEN = phosphatase and tensin homolog.	OS = overall survival; DFS = disease-free survival; BMI = body mass index; CCI = Charlson comorbidity index; ASA = American Society of Anesthesiologists; ECOG = Eastern Cooperative Oncology Group; SD = standard deviation; LND = lymph node dissection; CABG = coronary artery bypass graft; ES = erythrocytes suspension; FFP = fresh frozen plasma; RCC = renal cell carcinoma; PTEN = phosphatase and tensin homolog.	OS = overall survival; DFS = disease-free survival; BMI = body mass index; CCI = Charlson comorbidity index; ASA = American Society of Anesthesiologists; ECOG = Eastern Cooperative Oncology Group; SD = standard deviation; LND = lymph node dissection; CABG = coronary artery bypass graft; ES = erythrocytes suspension; FFP = fresh frozen plasma; RCC = renal cell carcinoma; PTEN = phosphatase and tensin homolog.	OS = overall survival; DFS = disease-free survival; BMI = body mass index; CCI = Charlson comorbidity index; ASA = American Society of Anesthesiologists; ECOG = Eastern Cooperative Oncology Group; SD = standard deviation; LND = lymph node dissection; CABG = coronary artery bypass graft; ES = erythrocytes suspension; FFP = fresh frozen plasma; RCC = renal cell carcinoma; PTEN = phosphatase and tensin homolog.

Table 2 – Multivariate analysis of parameters found to be statistically significant in the univariate analysis based on OS**(a)** and DFS **(b)** .

(a)	
Tumor size (cm)	
Metastasis	
(b)	
Tumor size (cm)	
Mayo Clinic thrombus level	
CI = confidence interval; DFS = disease-free survival; OS = overall survival.	CI = confidence interval; DFS = disease-free

Figure Legends

Figure 1- Radiologic and perioperative images of the patients with venous thrombosis.

Figure 2- Kaplan-Meier curves showing overall and disease-free survival based on (a) metastasis, **(b)** tumor size and**(c)** thrombus level.

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`Figures.pdf` available at https://authorea.com/users/357651/articles/483312-clinical-outcomes-of-radical-surgery-in-patients-with-renal-carcinoma-and-associated-venous-thrombosis-single-center-experience-in-a-tertiary-care-institution