



Evaluation of perioperative complications in open and laparoscopic surgery for renal cell cancer with tumor thrombus involvement using the Clavien–Dindo classification

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Abstract

Objective: To identify risk factors for perioperative complications and morbidity in renal cell cancer (RCC) surgery with tumor thrombus invasion (TTI).

Patients and methods: Retrospective single-center analysis of 128 patients who underwent open (n = 97) or laparoscopic (n = 31) radical nephrectomy (NT) for RCC between 1999 and 2010. TTI was at Mayo-Level 0, I, II, III, IV in 88, 7, 10, 4, and 19 cases, respectively. Cavotomy was performed in 27, liver mobilisation in 20, and cardiovascular bypass in 17 patients.

Results: The rate of any early postoperative complication (PC) by Clavien–Dindo classification was 58.6%, while the severe early PC rate was 29.7%. There was a statistically significant difference in multivariate analysis in the incidence of any early PC and of severe early PC by Charlson score (OR:1.584 (95%CI:1.141–2.199), p = 0.006; OR:3.065 (95%CI:1.218–7.714), p = 0.017) and by tumor thrombus level TNM-UICC 2010 T3a/T3c (OR:10.668 (95%CI:1.266–89.871), p = 0.029; OR:10.502 (95%CI:2.981–36.992), p < 0.001). In pT3a cases open NT was associated with a higher early (57.9% vs. 25.8%) and severe (24.6% vs. 9.7%) PC rate compared to laparoscopic NT. The 30-day mortality rate was 0%. The 90-day mortality rate was 6.3% but 100% cancer-related. In Cox regression analysis tumor thrombus level was not predictive for overall survival.

Conclusions: The strongest risk factor for early and severe PC in patients with TTI is a supradiaphragmatic tumor thrombus. In cases with severe PC, this fact persists when comparing Mayo-Levels II–III and Level IV. In pT3a cases open NT shows a 2-fold higher early PC rate compared to laparoscopic NT.

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Keywords: Kidney cancer; Clavien–Dindo classification; Tumor thrombus; Complications; Surgery; Outcome

Abbreviations: CI, confidence interval; d, days; HR, hazard ratio; i.o., intraoperative; IOC, intraoperative complication; lap., laparoscopic; M, metastases; MT, main trunk; n, number; NT, nephrectomy; OR, odds ratio; PC, postoperative complication; p.o., postoperative; RCC, renal cell cancer; SB, segmental branches; TTI, tumor thrombus invasion; VTT, venous tumor thrombus.

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Introduction

Renal Cell Cancer (RCC) is the third most common cancer of the urinary tract, with an increasing incidence due to the frequent use of tomographic imaging and the aging population over the last two decades.¹ One third of newly-

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diagnosed patients with RCC present with advanced stage (III/IV) tumors.²

Venous tumor invasion (tumor thrombus) is frequently observed in RCCs. The rationale for the aggressive surgical management of RCC with venous tumor extension has been established in recent years. Reports have shown that an expansive surgical resection of these lesions with thrombectomy provides considerable palliation for patients and can produce long-term freedom from disease.^{3–9} The surgical management of RCC with advanced tumor thrombus extension is technically challenging and often requires a multidisciplinary surgical approach.¹⁰ However, surgery in patients with venous tumor invasion remains associated with a considerable risk of morbidity and mortality.

In the present study we analyzed our high volume, single-center results in patients with RCCs and tumor thrombus involvement in terms of surgical technique, complications, morbidity, and outcome, among other values, by using the Clavien–Dindo classification for postoperative complications (PC).

Patients and methods

Renal cell cancer patients with tumor thrombus involvement (UICC TNM 2010: T3a–T3c) were retrospectively identified from the database of the Charité – University Hospital Berlin, Germany. 128 patients, operated between 1999 and 2010, were eligible for the study. Data were collected through review of the clinical records and by contacting the treating outpatient urologists, general practitioners, and patients. The data collection was performed in accordance with the requirements of the local ethics committee of the Charité – Universitätsmedizin Berlin.

Patient demographics, tumor characteristics, tumor thrombus level, staging (UICC TNM 2010), surgical characteristics, perioperative (intra- and early postoperative) complications, and late postoperative complications were obtained. Classification of early postoperative complication (PC) was performed using the Clavien–Dindo classification.¹¹ A score ≥ 3 was defined as a major complication.

Tumor thrombus level was classified by using the Mayo classification system⁴ as well as the 2010 UICC TNM staging system. In our cohort of 128 patients, tumor thrombus invasion was at Level I in 95 cases (Level 0: 88 (68.8%)), at Level II in 10 cases, at Level III in 4 cases, and at Level IV in 19 cases (TNM: 88 pT3a, 21 pT3b and 19 pT3c). Level 0 (thrombus limited to renal vein) and Level I (thrombus extending ≤ 2 cm above the renal vein) patients were all defined as Level I, due to the fact that cavotomy in real Level I ($n = 7$, 5.5%) was only completed in three cases by partial clamping the vena cava inferior using an atraumatic Satinsky vascular clamp. In the other four cases thrombectomy was achieved by flushing the incised renal vein before ligation. Preoperative staging procedures included abdominal imaging (ultrasound and CT (computed tomography) or MRI (magnetic

resonance imaging)) and at least a chest x-ray. In cases of an unclear cephal margin of the tumor thrombus, CT of the chest was performed preoperatively.

The surgical approach was determined by tumor thrombus level. Exposure of the kidney, the hilar vessels (renal artery and vein), the vena cava inferior, and the ureter was performed by standardized procedures. In a laparoscopic approach, vessels and ureter were clipped using Hem-o-lok[®] clips or a stapler. In an open approach, small thrombi (Level 0 in all cases and Level I in four cases) were excised after milking the tumor thrombus easily into the renal vein, partially clamping the vena cava inferior with a Satinsky clamp with no extensive vena cava dissection or bypass. More extensive vena cava dissection and possibly lumbar vein ligation was performed for excision of larger thrombi. By clamping the inferior vena cava proximally and distally from the thrombus, the thrombus was resected, if necessary including a part of the vena cava. The cavotomy was closed by running suture. For thrombi extending behind the liver or supradiaphragmatically, liver mobilization was completed for maximum exposure of the vena cava.^{12,13} For Level IV cases with intra-atrial thrombus, cardiovascular bypass with circulatory arrest and profound hypothermia (18 °C) or veno-venous bypass were necessary to remove the thrombus.¹⁴

Data are presented as median and range. Numeric data were compared using the Kruskal–Wallis one-way analysis of variance. Comparison of categorical parameters was performed using Pearson's $k \times 2$ χ^2 -Test in case of dichotomy, or using Pearson's $m \times k$ χ^2 -Test in case of polychotomy. Complications were compared with tumor thrombus extension using the chi-square, Fisher's exact, and Wilcoxon rank-sum tests. Univariate and multivariate regression tests were used to identify factors associated with complications and overall survival (OS). OS was calculated from the day of surgery to the day of last follow-up or day of death and was analyzed according to the Kaplan–Meier method. $P < 0.05$ was regarded as statistically significant. For the statistical analysis the computer program "IBM SPSS Statistics[®]" was used.

Results

Patient demographics and tumor characteristics

Patient demographics and tumor characteristics are shown in Table 1A and B. Median tumor diameter was 8 cm (2–30) with no association between tumor size and thrombus level. 86 (67.2%) patients were symptomatic at time of renal tumor diagnosis. Gross hematuria was seen in 45 (35.2%), pain symptoms in 41 (32.0%), and tumor fever, weight loss, or night sweats in 39 (30.5%) patients. 65 (50.8%) patients were initially diagnosed by ultrasound and 61 (47.7%) by CT or MRI scan. 61 (47.7%) patients had synchronous metastases at the time of surgery, predominantly in the lungs ($n = 38$, 29.7%), bones ($n = 19$, 14.8%), lymph nodes ($n = 29$, 22.7%) and adrenal glands ($n = 14$, 10.9%).

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