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Original Article

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Comparison of Radical and Partial Nephrectomy in Terms of Oncological and Functional Results

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Abstract

Introduction: This study is an evaluation of the oncological and functional outcomes of radical nephrectomy (RN) and partial nephrectomy (PN).

Methods: A total of 201 patients with a kidney tumor who underwent RN and PN between January 2009 and July 2016 at the hospital were included in the study. Preoperative, operative, and postoperative follow-up data were recorded prospectively and analyzed retrospectively using the Student's t-test and the Wilcoxon signed-rank test. Patient survival was analyzed using the Kaplan-Meier estimator.

Results: In all, 79 patients underwent RN and 122 patients underwent PN. In the RN group, open surgery was performed for 38 patients, laparoscopic surgery for 32, and robotic surgery for 9 patients. In the PN group, open surgery was performed for 41, laparoscopic surgery for 10, and robotic surgery for 71 patients. The mean age of the RN and PN groups was 60.5 years and 55.4 years, respectively (p=0.007). The mean operation time was 207.1±51.3 minutes in the RN group and 193.1±56.5 minutes in the PN group (p=0.078). The mean estimated blood loss was 613.4±280.6 mL in the RN group and 274.2±258.6 mL in the PN group (p=0.005). The length of hospital stay was statistically significantly longer in the RN group (p<0.0001). The preoperative mean estimated glomerular filtration rate value of the RN and PN groups was 92.9±29.1 mL/min/1.73m2 and 108.8±31.8 mL/min/1.73m2, respectively, and decreased to 72.6±25 mL/min/1.73m2 and 101.2±32.7 mL/min/1.73m2, respectively, at postoperative month 6 (p<0.0001). The overall survival rate of the RN and PN groups was 69% and 86%, respectively, at postoperative month 80 (95% confidence interval).

Discussion and Conclusion: PN is a viable option for tumors that are suitable for nephron-sparing surgery and has comparable functional and oncological results compared with RN.

Keywords: Kidney tumor; partial nephrectomy; radical nephrectomy.

Radical nephrectomy (RN) has been performed for years as standard treatment for renal cell carcinoma in patients with a normal contralateral kidney since it was first described by Robson in 1969 [1]. Now, as a result of more frequent use of imaging modalities, such as ultrasound and computed tomography, smaller and earlier-stage renal tumors can be diagnosed. The current guidelines recommend partial nephrectomy (PN) for T1a renal tumors, and RN for T1b tumors as standard treatment modalities, if technically feasible [2, 3].

As has been reported in many literature studies, PN protects renal function better than RN, decreases metabolic and cardiovascular morbidity, and offers a resultant overall survival advantage [4-6]. However, a randomized controlled

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study conducted by the European Organisation for Research and Treatment of Cancer (EORTC) could not clearly demonstrate any advantage of PN over RN [7].

Despite controversial results reported in several studies, with increasing experience, in cases of small tumors (<7 cm), PN has been performed effectively and safely in terms of oncological outcome. Nonetheless, perioperative complications are ¬seen more frequently in PN; this appears to be an advantage of RN over PN [3].

In this study, the functional, oncological, and survival outcomes of patients who underwent RN and PN surgery were compared in an effort to contribute to the literature on this subject.

Materials and Methods

Approval for the study was obtained from our institutional Ethics Committee. A total of 289 patients underwent RN or PN with the indication of a renal tumor between January 2009 and July 2016. Eighty-eight patients with missing histopathological or operative data and those lost to follow-up or whose data could not be obtained were excluded from the study. The remaining 201 patients were included in the study. Preoperative and operative data of the patients were prospectively recorded and retrospectively analyzed. Patients with flank pain, abdominal pain and distension, and hematuria were considered symptomatic patients. The physical status of the patients was evaluated based on the classification recommended by the American Society of Anesthesiologists (ANA) [8]. Pre- and postoperative renal function was evaluated using the following estimated glomerular filtration rate (eGFR) formula [9].

eGFR (mL/min/1.73 m^2)=175x(creatinine/88.4)-1.154x(age) -0.203x(0.742 if female)

Open, laparoscopic, and robotic surgical methods were used. Open RN was applied based on tumor size and preference of the surgeon, using a retroperitoneal or transperitoneal approach. All laparoscopic or robotic nephrectomies were performed through a transperitoneal approach. The data concerning operative time, warm ischemia time, estimated blood loss, and follow-up of the drain were recorded prospectively. Tumor tissue stained with ink was accepted as surgical margin positivity. The TNM Classification of Malignant Tumours (version 7) system was used to categorize the renal tumors [10]. Postoperative complications of the patients were determined based on the Clavien-Dindo classification system. The patients were called for control visits at postoperative month 1, 3, 6, 12, and then once a year. Survival data of the patients were recorded prospectively.

Descriptive statistics (mean, SD, minimum, median, maximum) were used to describe continuous variables. Fitness to normal distribution was evaluated using the Shapiro-Wilk test. Preoperative and postoperative eGFR results were compared using a paired t-test and the Wilcoxon signed-rank test. Matched categorical variables were analyzed using McNemar's test. For all comparisons, the level of statistical significance was p=0.05. The survival rate of the patients was estimated with the Kaplan-Meier curve. Analyses were performed using MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium) and IBM SPSS Statistics for Windows, Version 23.0 (IBM Corp., Armonk, NY, USA).

Results

The study participants underwent RN (n=79) or PN (n=122). The mean age of the RN and PN group patients was 60.5 years and 55.4 years, respectively (p=0.007). Male patients represented 70.9% of the RN group and 61.5% of the PN group. The mean body mass index of the patients in the RN and PN groups was 28±3.4 kg/m^2 and 28.9±3.7 kg/m^2, respectively (p=0.099). Among the RN group, 73.4% were symptomatic at admission, and 45.1% were symptomatic in the PN group (p<0.0001). A larger percentage of patients in the RN group were smokers (59.5% vs 25.4%) (p<0.0001). Any ASA 4 patient was not detected in the RN group, while in the PN group one patient was ASA 1 (Table 1).

Open surgery was performed on 48% of the patients in the RN group and 34% of the patients in the PN group. In the PN group, robotic surgery was performed most frequently, in a total of 58% of the patients. The mean operative time was 207.1±51.3 minutes and 193.1±56.5 minutes in the RN and PN groups, respectively (p=0.078). The mean quantity of blood loss was 613.4±280.6 mL in the RN group, and 274.2±258.6 mL in the PN group (p=0.005). The duration of hospitalization was statistically significantly longer in the RN group (p<0.0001) (Table 2). The analysis of postoperative complications did not reveal any significant intergroup difference (p=0.08) (Table 3).

The mean tumor size of the RN group was 8.4±4.8 cm, and it was 3.8±2 cm in the PN group (p<0.0001). Surgical margin positivity was detected in 7 patients (9%) in the RN group, an in 5 patients (4%) in the RN group. According to the TNM classification, 53% of the patients in the RN group had stage T3a tumors, and 62% of the patients in the PN group had stage T1a disease. Clear cell cancer was the most frequently seen tumor histology in both groups. Details of the TNM classification and tumor histology of both groups are provided in Table 4.

Table 1. Demographic and clinical data

	Radical nephrectomy	Partial nephrectomy	p
N	79	122	
Median age (years)	60.5	55.4	0.007
Gender			
Male (%)	56 (70.9)	75 (61.5)	
Female (%)	23 (29.1)	47 (38.5)	
BMI, mean±SD (kg/m^2)	28±3.4	28.9±3.7	0.099
ASA (%)			
1	16 (20.3)	56 (45.9)	
2	30 (38)	50 (41)	
3	33 (41.8)	15 (12.3)	
4	0 (0)	1 (0.8)	
Symptomatic patients at admission, n (%)	58 (73.4)	55 (45.1)	<0.0001
Smokers, n (%)	47 (59.5)	31 (25.4)	<0.0001
Preoperative eGFR, mean±SD	92.9±29.1	108.8±31.8	<0.0001

ASA: American Society of Anesthesiologists; BMI: Body mass index; eGFR: Estimated glomerular filtration rate.

Table 2. Surgical details

	Radical nephrectomy	Partial nephrectomy	p
Surgical modality			
Open (%)	38 (48)	41 (34)	
Laparoscopic (%)	32 (40)	10 (8)	
Robotic (%)	9 (11)	71 (58)	
Warm ischemia time	-	21.1±8.2	
Operative time, mean±SD, min	207.1±51.3	193.1±56.5	0.078
Blood loss, mean±SD, mL	613.4±280.6	274.2±258.6	0.005
Hospital stay, days	6.2±6.1	4.3±1.8	<0.0001

Table 3. Postoperative complications

Clavien-Dindo complication	Radical nephrectomy	Partial nephrectomy	p
I-II, n	19	18	0.08
III-IV, n	1	1	

The preoperative mean eGFR value of the patients who had undergone RN was 92.9±29.1 mL/min/1.73m^2, which regressed to 72.6±25 at postoperative 6 months (p<0.0001). The preoperative mean eGFR value of the patients who underwent PN was 108.8±31.8 mL/min/1.73m^2, which decreased to 101.2±32.7 mL/min/1.73m2 at postoperative 6 months (p<0.0001) (Table 5).

The survival rate at postoperative 80 months was determined to be 69% [95% confidence interval (CI)] in the patients who underwent RN and 86% (95% CI) in the PN group (Fig. 1). The overall survival rate for patients with T1a and T1b tumors in the RN and PN groups was 83% and 74%, respectively (Fig 2).

Discussion

Although PN has become a standard treatment for T1a renal tumors, RN may still be preferred due to reasons specific to the patient or the tumor, such as tumor localization, closeness to the hilum, and endophytic nature. For such reasons, RN was performed for 5% of the T1a tumors in our study. In the European Organization for Research and Treatment of Cancer (EORTC) Phase 3 study [11], comparable oncological results were demonstrated for RN and PN treatment in tumors smaller than 5 cm in size. The EORTC also reported a slight advantage in overall survival with RN. However, subsequent systemic evaluation and meta-analysis demonstrated a survival superiority for PN over RN with localized tumors [6]. In our study, the survival in cases of tumors <7 cm (T1a and T1b) was better in RN, but when all tumors were considered, PN provided greater overall survival. In the present study, RN offered a survival advantage in T1a and T1b tumors. This finding may be explained by the fact that there were more small tumors (<7 cm) in the PN group, while the RN group had fewer small tumors.

In this study, in the RN group, a significantly greater number of

Table 4. TNM Classification of Malignant Tumours (version 7) and histology

	Radical nephrectomy	Partial nephrectomy	p
Tumor size, mean±SD, cm	8.4±4.8	3.8±2	<0.0001
T stage, n (%)			
T1a	4 (5)	76 (62)	
T1b	11 (14)	35 (29)	
T2a	9 (11)	4 (3)	
T2b	6 (8)	-	
T3a	42 (53)	7 (6)	
T3b	3 (4)	-	
T4	4 (5)	-	
Histology, n (%)			
Clear cell	55 (70)	75 (61)	
Papillary	13 (16)	15 (12)	
Chromophobe	6 (8)	9 (7)	
Other	5 (6)	23 (19)	
Surgical margin positivity, n (%)	7 (9)	5 (4)	

Table 5. Estimated glomerular filtration rate

	Radical nephrectomy	Partial nephrectomy	p
Preoperative eGFR, mL/min/1.73 m^2	92.9±29.1	108.8±31.8	<0.0001
Postoperative month 6 eGFR, mL/min/1.73 m^2	72.6±25	101.2±32.7	<0.0001
p	<0.0001	<0.0001	

eGFR: Estimated glomerular filtration rate.

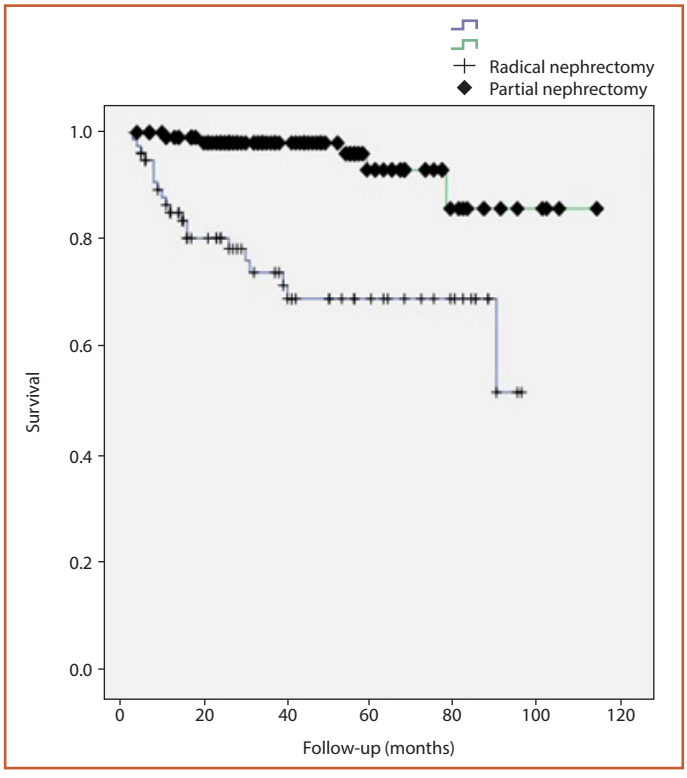

Figure 1. Survival rate at postoperative 80 months.

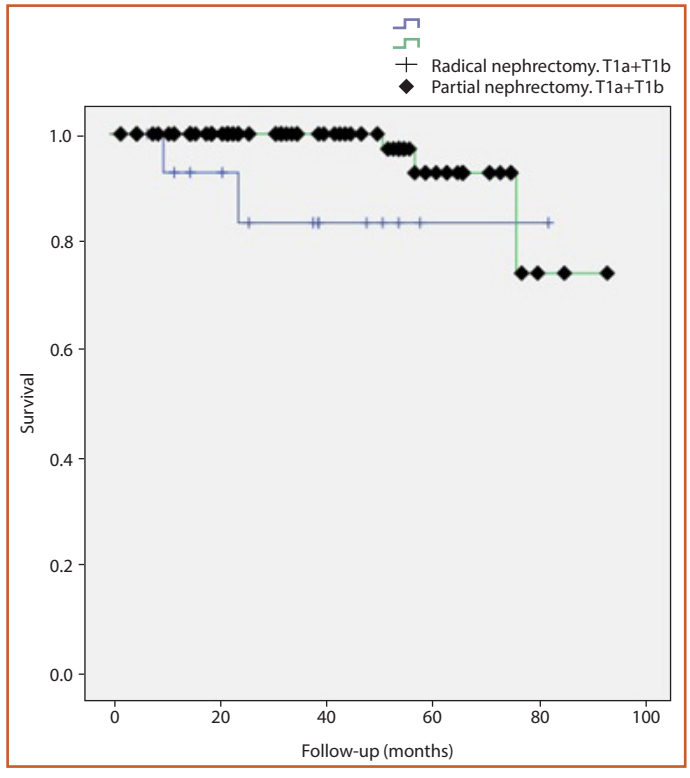

Figure 2. Overall survival rate.

patients were symptomatic at admission when compared with the PN group. Tumor size may be correlated with symptoms. In addition, a significantly greater number of smokers were detected in the RN group relative to the PN group (59% vs 25.4%). Although the correlation between renal cell cancer and smoking is still being investigated, it is known that smoking increases the incidence rate of almost all types of cancer. In a meta-analysis of 24 studies, a 1.38 (95% CI: 1.27-1.50) times higher relative risk of contracting renal cell cancer was demonstrated among smokers compared to nonsmokers[12]. In our study, a correlation may exist between higher rates of smoking and larger tumor size in the RN group, but this issue should be investigated in further studies.

Consistent with our results, the EORTC 30904 and other studies have demonstrated higher renoprotective effects with nephron-sparing PN surgery compared with RN [7, 13]. In a study conducted by Forbes et al. [5], 1615 PN and 743 RN patients with T1 stage tumors were compared. At the postoperative first and third years, a significantly higher eGFR was found in the PN group. Yet, in a recent meta-analysis, it was demonstrated that compared with RN, PN decreased the potential risk of chronic renal failure by 73% in all tumors, and by 65% in tumors larger than 4 cm [14]. In small or large, non-endophytic tumors, nephron-sparing surgery (NSS) should be preferred for the long-term protection of renal function. In a recent comprehensive literature review, the effect of PN on renal functions was investigated. It was concluded that recovery of normal renal function was very strongly correlated with the quantity and quality of the remaining renal tissue, and also that warm ischemic time should be kept to the minimum possible [15]. If prolonged warm ischemia time is predicted preoperatively, cold ischemia may be applied.

Previously, no difference had been demonstrated between RN and PN in terms of cardiovascular events (CVEs) (coronary artery disease, cardiomyopathy, hypertension, vasculopathy, heart failure, dysrhythmia, or cardiovascular disease). However, in a recent study by Capitanio et al.[4], 1331 patients with renal T1a and T1b tumors but normal preoperative renal function were divided into RN (n=462) and PN (n=869) groups and followed up with respect to CVEs. At postoperative year 1, 5, and 10, CVEs were observed in 5.5%, 9.9%, and 20.2% in the PN group, and 8.7% 15.6%, and 25.9% in the RN group (p=0.001).

Factors such as progression to chronic renal failure, pre- and postoperative complications, and hospital stay affect the surgeon's decision about operative method. However, surgeons must consider not only the optimal surgical method, but also what will enable patients to continue their life with minimal morbidity. In the literature, PN surgery has been demonstrated to have a greater rate of complications compared with RN. However, in our study, we didn't observe any significant difference in complication rates [3, 13]. This difference may be related to the preference for minimally invasive surgical methods (laparoscopic or robotic) for PN of more than one surgeon in our clinic who had specific surgical experience. RN was performed mostly using open surgery and those patients had a significantly longer hospital stay. In our study, 91% of the patients in the PN group and 19% in the RN group had T1 stage tumors. While interpreting the results, the potential effects of this intergroup difference on complications and surgical morbidity should be taken into consideration. In a current systematic review and meta-analysis investigating 3418 patients from 8 studies where robotic (n=757) and open PN (n=2661) procedures were compared, fewer perioperative complications, a shorter hospital stay, and less blood loss were observed in patients who had undergone robotic PN [16]. Choi et al. [17] performed a systematic review and meta-analysis of 2240 patients from 23 studies to compare robotic and laparoscopic PN. The advantages of robotic PN were fewer conversions to RN, greater improvement in eGFR, shorter hospital stay, and decreased warm ischemia time.

Based on the outcomes of the research, it appears that NSS can be performed in patients with small tumors and a contralateral intact kidney with better long-term results [13, 18]. NSS may also be performed in large, complex tumors that can be safely excised. In a randomized prospective study performed by Kim et al.[19], the authors suggested that in the decision to perform PN with anatomically complex tumors, the greater risk of complications and oncological concerns should be considered in addition to the potential advantages.

Conclusion

In small tumors suitable for NSS, PN has short- and long-term oncological and functional results comparable to those of RN.

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Conflict of Interest: None declared.

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