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A Retrospective Assessment of the Pathological, Perioperative and Clinical Outcomes of Nephrectomy Performed due to Renal Mass

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Abstract: To evaluate the clinical outcomes of nephrectomy performed due to renal mass. Cases of nephrectomy performed due to renal mass at the Samsun University Urology Department between 2015 and 2024 were assessed retrospectively through our database. The patients' sociodemographic characteristics, pre- and postoperative clinical parameters, surgical techniques, pathology findings, and complications were recorded. One hundred seventy-seven patients with a mean age of 62.84 ± 12 years, 61.6% of whom were men, were included in the study. Radical nephrectomy was performed in 62.7% of cases, and partial nephrectomy in 37.3%. Laparoscopic surgical techniques were applied in 67% of the cases. The mean tumor size was 5.41 ± 2.91 cm, mean operative time was 172.18 ± 75.28 min, mean length of hospitalization was 6.42 ± 4.27 days, and time from diagnosis to treatment was 52.37 ± 5.21 days. Partial nephrectomy was superior to radical nephrectomy in terms of preserving kidney functions (p <0.001). Laparoscopic radical nephrectomy was associated with a shorter hospital stay (p <0.001) and a longer operative time (p <0.001). Partial nephrectomy effectively preserves oncological safety while protecting kidney functions in the surgical treatment of renal masses. Laparoscopic techniques are advantageous in terms of length of hospital stay and complication rates, but are associated with a longer operative time. ©2026 NTMS.

Keywords: Spectrometry, Mass, Matrix-Assisted Laser Desorption-Ionization; Automation, Laboratory; Microbiological Techniques.

1. Introduction

Renal cell carcinoma (RCC) is the most common solid lesion in the kidney, constituting approximately 90% of all renal cancers [1]. RCC has a high incidence in the elderly population and represents approximately 2% of all cancers; it is the 14th most frequently observed type of cancer worldwide, and is twice as common in men as in women [2-4].

Improvements in imaging technologies and the growing clinical use thereof have led to a significant rise in the incidental detection of RCC, with such cases now constituting over 50% of newly diagnosed masses [5]. Although mortality rates associated with RCC have decreased consistently since the early 1990s, the clinical course is still largely asymptomatic, with only

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30% of patients exhibiting symptoms at the time of diagnosis [5,6]. Early detection by means of routine surveillance is therefore of crucial importance for improved oncological outcomes and a favorable prognosis. With the increase in incidental diagnoses of renal masses, RCC has become a frequently encountered uro-oncological cancer group in urology clinics, and now occupies third place among urological cancers, after prostate and bladder cancers [7]. Curative treatment of RCC is surgical, with the basic methods being nephron-sparing surgery or radical nephrectomy. These can involve laparoscopic or robotic minimally invasive or open surgery techniques. Nephron-sparing approaches and minimally invasive interventions are currently becoming predominant in suitable patients [8]. European Association of Urology (EAU) guidelines recommend different surgical strategies, depending on the disease grade [9]. Surgery in local disease produces a curative effect, but can also play a palliative role in advanced-grade tumors.

The purpose of this study was to evaluate the surgical, oncological, and functional outcomes of patients who underwent partial and radical nephrectomy using open and laparoscopic methods due to a renal mass in our clinic by analyzing their demographic and pre- and postoperative data. Our objective was to contribute to the existing literature by comparing patients who underwent radical and partial nephrectomy and the techniques employed (open and laparoscopic), and to examine the agreement between our results and the previous literature.

2. Material and Methods

Following the receipt of approval from the Samsun University Medical Faculty local ethical committee (no. GOKAEK 2024/6/6), this observational, retrospective study was conducted with patients who underwent nephrectomy due to renal mass at the Samsun University Training and Research Hospital Urology Clinic, Türkiye, between January 2015 and March 2024. Patients who underwent nephrectomy prior to 2015 were excluded due to insufficient access to the records and data deficiencies that might affect the results. Patients who underwent nephrectomy for reasons other than RCC and those with renal pelvis tumor were also excluded. One hundred seventy-seven patients meeting the inclusion criteria were finally enrolled.

All patients were evaluated using computed tomography or magnetic resonance imaging with contrast. Radical or partial nephrectomy using open or laparoscopic methods were performed depending on the tumor size and position. The patients' age, sex, height and weight, body mass index (BMI), and American Society of Anesthesiologists (ASA) scores were recorded. Creatinine and complete blood counts were assessed at pre- and postoperative follow-ups, and creatinine values at the first month postoperatively. Tumor size (cm), orientation (right/left), and polar localization (upper/middle/lower) were noted by examining contrast-enhanced cross-sectional images. The 2017 TNM classification system in the EAU guidelines was employed for clinical grading [9]. Surgical approach, operative time, duration of ischemia, transfusion requirements, and intraoperative complications were recorded from the operation reports. Operative time was defined as the period from the first incision to the suturing of the wound site (min), and duration of ischemia as the period between attachment of the clamp to the renal artery and its removal (min). The pathology reports were examined retrospectively to retrieve information such as differentiation of tumors as benign or malignant, tumor size, histopathological subtypes, pathological tumor grades, Fuhrman/ISUP grades, presence of necrosis, and surgical margins. Postoperative general complications were evaluated using the Clavien-Dindo system, with only major complications (Clavien-Dindo 3-5) being recorded [10]. Length of hospital stay was determined as the number of days between surgery and discharge.

2.1. Surgical Techniques

Open radical nephrectomy (ORN) was performed in a retroperitoneal or transperitoneal manner via intercostal/subcostal flank or thoracoabdominal incision, depending on the tumor size and location. Gerota's fascia was accessed using an appropriate technique, and the kidney was released from the surrounding tissue. The artery and vein were exposed and individually tied off and cut using non-absorbable sutures. The tumoral mass, kidney, and Gerota's fascia and, in case of upper pole tumors, the ipsilateral adrenal gland, were also removed.

In cases of laparoscopic radical nephrectomy (LRN), entry was performed in a retroperitoneal or transperitoneal manner. Gerota's fascia was accessed using three or four ports. The ureter in the inferior part of the kidney was identified, and the renal hilus was visualized. The renal artery and vein were clipped and cut, and the tumoral mass, kidney, and Gerota's fascia and, in case of upper pole tumors, the ipsilateral adrenal gland, were removed.

Open partial nephrectomy (OPN) was performed in a retroperitoneal manner through a flank incision. The kidney was freed from the surrounding tissue. Renal vascular structures were revealed, and warm ischemia was established by clamping the renal artery. The tumoral mass, together with approximately 0.5 cm of normal tissue, was excised using scissors. The procedure was completed with separate suturing of the pelvicalyceal system and parenchyma.

Laparoscopic partial nephrectomy (LPN) was carried out using a retroperitoneal or transperitoneal approach. The kidney was released from the surrounding tissue with sharp and blunt dissection using three or four ports. The renal hilus was identified, the renal artery was clamped by revealing the renal vascular structures, and warm ischemia was established. The mass was excised together with 0.5 cm of normal tissue.

Hemostasis was established using an oxidized regenerated cellulose hemostatic agent and parenchymal suturing, after which the procedure was concluded.

2.2. Statistical Analysis

Statistical analyses were performed using SPSS software (version 21.0; IBM Corp., Armonk, NY, USA). Visual methods (histograms and Q-Q plots) and analytical tests (the Shapiro-Wilk or Kolmogorov-Smirnov test, based on group sample sizes) were employed for the formal evaluation of the normality of distribution of continuous variables (such as age, BMI, tumor size, operative time, and length of hospital stay). Normally distributed continuous variables were presented as mean ± standard deviation (SD) and compared using Student's t-test. Non-normally distributed continuous variables were presented as median (interquartile range [IQR]: 25^{th}-75^{th} percentiles) and subjected to analysis using the Mann-Whitney U test. Categorical variables (such as sex, surgical approach, tumor side, ASA scores, complication development, blood transfusion requirements, and pathological parameters) were presented using frequencies and percentages (N, %). Differences in categorical variables between the study cohorts were evaluated using the Pearson Chi-Square test. Fisher's exact test or the continuity correction Chi-Square test was applied to categorical variables in case of violation of the expected cell count assumptions. A p-value of <0.05 was considered statistically significant for all analyses.

3. Results

Males represented 61.6% of the 177 patients in the study, and females 38.4%. The patients' mean age was 62.84 ± 12 years, and their mean BMI was 27.95 ± 13.21 kg/m². Anesthesia risk assessment revealed that the most common score was ASA 2 (61%). In terms of mass localization, 32.8% were in the upper region, 35.6% in the mid-region, and 31.6% in the lower region; 53.1% of masses were in the right kidney, and 46.9% in the left. The mean mass size was 5.41 ± 2.91 cm. The mean length of hospital stay was 6.42 ± 0.42 days, and the time elapsing from diagnosis to treatment was 52.37 ± 5.21 days. Radical nephrectomy was performed on 62.7% of patients and partial nephrectomy on 37.3%. Laparoscopic surgery was performed in 67% of cases and open surgery in 33%. The mean operative time was 172 ± 75.2 min. In the partial nephrectomy cases, the mean operative time was 16.87 ± 14.2 min. Major complication rates were low, being observed in only 4% of patients. Blood transfusion was necessary in 28.8% of patients. The patients' sociodemographic and clinical data are shown in Table 1.

The most common pathological grades were T1a (38.8%), T1b (38.1%), and T3a (11.3%). Surgical margins were positive in 3.3% of cases. The most common Fuhrman grade was 2 (59.1%), with necrosis being detected in 21% of patients. In terms of histopathological types, the most common was clear cell RCC (75.1%), followed by papillary RCC (7.3%). Lymph node involvement was determined in only 2.8% of patients. Pathological data are shown in Table 2.

The mean mass size was 6.53 ± 2.92 cm in the radical nephrectomy group, compared to 3.54 ± 1.66 cm in the partial nephrectomy group, the difference being statistically significant (p <0.001). The differences between pre- and postoperative creatinine values were 0.32 ± 0.02 mg/dL in the radical nephrectomy group, but significantly lower, at 0.13 ± 0.02 mg/dL, in the partial nephrectomy group (p <0.001). Postoperative first-month creatinine levels were also compared and were significantly higher in the radical nephrectomy group at 1.25 ± 0.6 mg/dL than in the partial nephrectomy arm at 0.89 ± 0.3 mg/dL (p <0.001). Details for the patients who underwent radical and partial nephrectomies are shown in Table 3.

A comparison of clinical findings in the patients who underwent ORN and those who underwent LRN revealed a mean mass size of 7.41 ± 3.78 cm in the ORN group and of 6.05 ± 2.95 cm in the LRN group (p = 0.155). Mean lengths of hospital stay were 8 (6–10) days in the ORN group and 5 (4–6) days in the LRN group, the difference being statistically significant (p <0.001). Operative times were 135 (125–145) min in the ORN group and 175 (165–185) min in the LRN group (p <0.001). Details of the patients who underwent ORN and LRN are shown in Table 3.

The mean tumor size in the OPN group was 3.3 ± 1.01 cm, compared to 3.64 ± 1.91 cm in the LPN group. The difference was not statistically significant (p = 0.989). Mean operative time was significantly shorter in the OPN group, at 134 (125–140) min, than in the LPN group, at 215 (200–230) min (p <0.001). Duration of ischemia was 8 (7–9) min in the OPN group, but significantly longer in the LPN group, at 21 (19–22) min (p <0.001). Clinical data for the patients in the OPN and LPN groups are given in Table 4.

Clavien-Dindo classification Grade 3 (complications requiring surgical, endoscopic, or radiological intervention), Grade 4 (life-threatening complications), and Grade 5 (exitus) complications were observed in seven (4%) patients. All these patients had undergone open surgery. These complications were perirenal urinoma/abscess in two patients, psoas abscess in one, colon perforation in one, duodenal injury in one, capsule injury in one, and exitus in one. The colon perforation and duodenal injury were treated by open surgery repair, splenic injury by splenectomy, and perirenal urinoma/abscess and psoas abscess by percutaneous drainage.

Table 1: Sociodemographic, clinical and radiological findings of the patients.

Variables	All (N = 177)	Radical nephrectomy (N = 111)	Partial nephrectomy (N = 66)
Age (year, mean ± SD)	62.84 ± 11.98	63.36 ± 12.8	61.95 ± 10.4
Sex (men; N, %)	109, (61.6%)	68, (61.3%)	41, (62.1%)
BMI (kg/m^2, mean ± SD)	27.95 ± 13.21	28.21 ± 4.21	27.21 ± 2.33
Side (Right; N, %)	94, (53.1%)	59, (52.3%)	35, (53%)
Surgical technique (N, %)			
Open	59, (33.3%)	39, (34.5%)	20, (30.3%)
Laparoscopic	118, (66.7%)	72, (65.5%)	46, (69.7%)
Surgical approach (N, %)			
Transperitoneal	128, (72.3%)	76, (68.5%)	52, (78.8%)
Retroperitoneal	49, (27.7%)	35, (31.5%)	14, (21.2%)
Tumor size (cm, mean ± SD)	5.41 ± 2.91	6.53 ± 2.92	3.54 ± 1.66
Time from diagnosis to treatment (day, mean ± SD)	52.37 ± 5.21	48.65 ± 5.3	58.62 ± 5.03
Operation time (min, mean ± SD)	172.18 ± 75.28	161.3 ± 60.3	190.3 ± 93.1
Hospitalization (day, mean ± SD)	6.42 ± 4.27	6.63 ± 5.1	6.06 ± 2.04
ASA score (N, %)			
ASA 1	21, (11.9%)	14, (12.6%)	7, (10.6%)
ASA 2	108, (61.3%)	69, (62.2%)	39, (59.1%)
ASA 3	46, (26.1%)	27, (24.3%)	19, (28.8%)
ASA 4	2, (1.2%)	1, (0.9%)	1, (1.5%)
Blood transfusion (N, %)	51, (28.8%)	35, (31.5%)	16, (24.2%)
Complications (N, %)	7, (4%)	6, (5.4%)	1, (1.5%)

Abbrevations: ASA, American Society of Anesthesiologists; BMI, body mass index; SD, standart deviation.

Table 2: Pathological findings of the patients.

Variables	Value (N, %)
Histopathological type (N, %)	
Benign	17, (9.6%)
Clear cell RCC	133, (75.1%)
Chromophobe RCC	9, (5.1%)
Papillary RCC	13, (7.3%)
Others	5, (2.8%)
Pathological stage	
pT1a	62, (38.8%)
pT1b	61, (38.1%)
pT2a	13, (8.1%)
pT2b	3, (1.9%)
pT3a	18, (11.3%)
pT3b	1, (0.6%)
pT4	2, (1.3%)
Surgical margin positivity	
Positive	6, (3.3%)
Negative	171, (96.7%)
Lymph node metastasis	
Positive	5, (2.8%)
Negative	172, (97.2%)
Furhman grade	
1	10, (7.6%)
2	78, (59.1%)
3	23, (17.4%)
4	21, (15.9%)

Abbrevation: RCC, Renal cell carcinoma.

Table 3: Comparison of clinical data of patients undergoing open and laparoscopic radical nephrectomy.

Variables	Open Radical Nephrectomy (N = 39)	Laparoscopic Radical Nephrectomy (N = 72)	p
Age (year, mean ± SD)	65.97 ± 13.35	61.94 ± 15	0.092[a]
Sex (men; N, %)	21, (53.8%)	47, (65.3%)	0.277[*]
BMI (kg/m^2, mean ± SD)	30.04 ± 2.7	27.22 ± 3.8	0.034[a]
Side (Right; N, %)	20, (51.3%)	39, (54.2%)	0.829[*]
Surgical Approach (N, %)			
Retroperitoneal	5, (12.8%)	1, (1.4%)	<0.001[†]
Transperitoneal	34, (87.2%)	71, (98.6%)	
Tumor size (cm, mean ± SD)	7.41 ± 3.78	6.05 ± 2.95	0.155[a]
Operation time (min), median (IQR)	135 (125-145)	175 (165-185)	<0.001[b]
Time from diagnosis to treatment (day, mean ± SD)	44.64 ± 5.73	50.82 ± 4.5	0.290[a]
Hospitalization (day), median (IQR)	8 (6-10)	5 (4-6)	<0.001[b]
ASA score (N, %)			
ASA 1	6, (15.4%)	8, (11.1%)	
ASA 2	22, (56.4%)	47, (65.3%)	0.68[†]
ASA 3	11, (28.2%)	16, (22.2%)	
ASA 4	-	1, (1.4%)	
Blood transfusion (N, %)	17, (43.6%)	18, (25%)	0.103[*]
Complications (N, %)	6, (15.4%)	-	0.001[†]

[a]Student's t-test, [b]Mann-Whitney U test, [*]Pearson Chi-Square test, [†]Fisher's exact test.
Abbrevations: ASA, American Society of Anesthesiologists; BMI, body mass index; SD, standart deviation; IQR, Interquartile range.

Table 4: Comparison of clinical data of patients undergoing open and laparoscopic partial nephrectomy.

Variables	Open partial nephrectomy (N = 20)	Laparoscopic partial nephrectomy (N = 46)	p
Age (year, mean ± SD)	64.6 ± 9.6	60.78 ± 10.6	0.534[a]
Sex (men; N, %)	13, (65%)	28, (60.9%)	0.751[*]
BMI (kg/m^2, mean ± SD)	28.1 ± 2.71	27.24 ± 2.42	0.086[a]
Side (right; N, %)	10, (50%)	25, (54.3%)	0.955[*]
Surgicall approach (N, %)			
Transperitoneal	14, (70%)	46, (100%)	<0.001[†]
Retroperitoneal	6, (%30)	-	
Tumor size (cm, mean ± SD)	3.3 ±1.01	3.64 ± 1.91	0.989[a]
Operation time (min), median (IQR)	134 (125-140)	215 (200-230)	<0.001[b]
Time from diagnosis to treatment (day, mean ± SD)	61.35 ± 6.6	57.43 ± 4.7	0.534[a]
Hospitalization (day), median (IQR)	6 (5-7)	6 (5-6.5)	1.000[b]
ASA score (N, %)			
ASA 1	2, (10%)	5, (10.9%)	
ASA 2	13, (65%)	26, (56.5%)	0.945[†]
ASA 3	5, (25%)	14, (30.4%)	
ASA 4	-	1, (2.2%)	
Blood transfusion (N, %)	6, (30%)	10, (21.7%)	0.538[*]
Complications (N, %)	-	1, (2.2%)	1.000[†]
Ischemia time (min), median (IQR)	8 (7-9)	21 (19-22)	<0.001[b]

[a]Student's t-test, [b]Mann-Whitney U test, [*]Pearson Chi-Square test, [†]Fisher's exact test
Abbrevations: ASA, American Society of Anesthesiologists; BMI, body mass index; SD, standart deviation; IQR, interquartile range.

4. Discussion

Nephrectomy is the standard method of treatment in all cases of renal tumor. The EAU guideline recommends partial nephrectomy for all pT1 tumors, pT2 tumors (≥7 cm) and, if technically possible, for patients with a single kidney or chronic kidney disease [9]. Partial or radical nephrectomy can be performed in a minimally invasive manner using open, laparoscopic, or robot-aided methods, depending on the expertise of the surgeon. In the present study, the patients were classified as having undergone partial or radical nephrectomy, and the groups were compared within themselves in terms of open and laparoscopic techniques. Important factors in the selection of surgical technique were the position of the tumor, contiguity with vascular structures, and surgeon experience. Radical nephrectomy was performed on 111 of the patients and partial nephrectomy on 66. Seventy-five percent of the partial nephrectomy group was grade pT1a, and the tendency toward radical nephrectomy in our clinic increased in line with the tumor grade.

The mean age of the patients in this study was 62.84 years, and 61.6% were men. In other similar studies from Türkiye, Şahan et al. reported a mean patient age of 60 and that 65.9% were men [11]. Uçar et al. reported values of 61.26 years and 67.34% men [12]. In a large series study from Germany involving 23,753 patients, the mean age was 66 years, and 62.4% were men [13]. An international, multi-center study from Canada and Germany reported a mean age of 61, and that men represented 62% of cases [14]. In terms of age and gender, our patients' characteristics were compatible with previous Turkish and international studies.

The most common pathological type in nephrectomy materials is clear cell cancer, followed by the papillary and chromophobe types in second and third place [9]. Consistent with the previous literature, clear cell cancer was the most common pathological finding in the present study, at 75.1%, followed by papillary RCC at 7.3% and chromophobe RCC at 5.1%. Studies from different regions of Türkiye have reported figures of 68.9%, 63.88%, and 78% for clear cell RCC [12,15,16]. International studies have cited figures of 65% and 75.4% [14,17]. The incidence of clear cell RCC in this study was 75.1%, consistent with both domestic and international publications.

Laparoscopic methods entail a shorter hospital stay, less blood loss, and a lower morbidity rate than open techniques. Although the method to be employed depends on the experience and skills of the surgeon, minimally invasive methods should be kept to the fore as much as possible. Although laparoscopic methods are also advantageous in terms of clinical results, oncological outcomes are comparable for laparoscopic and open methods [9]. Laparoscopic methods were applied to 67% of our patients, and the laparoscopic techniques performed in our clinic increased over time. A study from the Mayo Clinic, in which patients with unilateral RCC, the other kidney being normal, and with normal creatinine levels were observed over a 10-year period determined that the incidences of chronic kidney failure and proteinuria were higher in radical nephrectomy than in partial nephrectomy [18]. Consistent with the previous literature, the protective effect of partial nephrectomy on kidney functions in the present study was significantly superior to that of radical nephrectomy. Evaluation of kidney functions in this study compared pre- and postoperative changes in creatinine and creatinine levels at the postoperative first month, and better results were observed in the partial nephrectomy group. However, no significant differences were observed between the two groups in terms of hospital stay or blood transfusion requirements.

Laparoscopic approaches in cases of both radical and partial nephrectomies involved significantly longer operative times than open surgeries ($p < 0.001$ for both). This is consistent with the previous literature, since laparoscopy requires meticulous intracorporeal maneuvering, port placement, and, in case of partial nephrectomy, technically demanding renorrhaphy and tumor excision. Although a number of large-scale case series, such as those by Gill et al., have reported a diminishing gap in operative times as a result of the surgical learning curve, the significantly longer time in our laparoscopic cohort was not reflected in heightened blood transfusion requirements ($p = 0.103$ for RN and $p = 0.538$ for PN)[19]. This suggests that such a prolonged operative time represents a legitimate trade-off for the lower tissue trauma and better visualization associated with laparoscopy.

Partial nephrectomy is the preferred therapeutic option for pT1 renal masses in the EAU guideline. Although the rate of postoperative complications in pT1 RCC patients is higher in those undergoing partial nephrectomy, overall survival and oncological outcomes are comparable to those for radical nephrectomy, and partial nephrectomy is therefore recommended for this patient group [9]. Similarly, a number of studies have reported a longer warm ischemia time and that higher intraoperative complication rates may be seen in laparoscopic partial nephrectomy surgery [20–23]. One critical parameter in partial nephrectomy is the warm ischemia time, which was significantly longer in the laparoscopic group in this research compared to the open group (8 vs. 21 minutes, $p < 0.001$). Gill et al. reported a warm ischemia time of 20.1 min, Deka et al. one of 25.26 min, and Nicaise et al. a figure of 21 min, all values similar to the present study [19,22,23]. Minimizing warm ischemia times in nephron-sparing surgery is vitally important to the preservation of long-term renal function, the traditional conceptual threshold being 20-25 minutes [24]. Although the laparoscopic warm ischemia time in the present study was statistically higher, it was nevertheless safely at the borderline of the clinically significant 20-minute threshold. This prolonged time is frequently noted in laparoscopic partial nephrectomy case studies, and is ascribed to the challenging nature of rapid, non-dominant hand suturing under laparoscopic visualization. The findings of the present study suggest that although OPN entails greater rapidity during vascular clamping, safe ischemia intervals can also be achieved with LPN when carried out by experienced surgeons. The duration of warm ischemia was significantly longer with LPN than with OPN in the present study. However, no statistically significant differences were observed between the two groups in terms of complications.

Analysis of postoperative recovery data revealed an interesting inconsistency in durations of hospital stay between the radical and partial nephrectomy cohorts. In the radical nephrectomy group, the laparoscopic approach was associated with a significantly shorter hospitalization time compared to open surgery (5 vs. 8 days, $p < 0.001$). This is highly consistent with existing urological data. These show that the avoidance of a large, muscle-splitting flank incision results in decreased postoperative pain, lower narcotic requirements, and earlier ambulation and bowel function recovery. Previous research also indicates shorter hospitalization times in radical nephrectomy using laparoscopic methods [25,26]. Conversely, in our partial nephrectomy cohort, lengths of hospital stay were comparable between the open and laparoscopic techniques (6 vs. 6 days, $p = 1.000$). This suggests that the minimally invasive approach failed to produce the expected convalescence advantage in the nephron-sparing setting. In research involving a similar design to that of the present study, Deka et al. reported hospitalization times of 7.98 and 6.57 days ($p < 0.001$) in open and laparoscopic groups, Yu et al. 8.0 ± 1.9 and 7.0 ± 1.7 days, respectively ($p = 0.005$), and Pascal et al. 7.5 and 5 days ($p < 0.001$) [22,27,28]. The length of hospital stay in our partial nephrectomy cohort differs from that in a number of previous high-volume studies and meta-analyses. This variation may be ascribed to our clinical approach involving a more fastidious and intensive postoperative follow-up protocol implemented in order to ensure optimal outcomes. Additionally, since open partial nephrectomy is routinely performed with the use of smaller, muscle-sparing, and more tailored incisions together with meticulous regional anesthesia in our center, immediate postoperative pain and discomfort are minimized such as to allow comparable discharge timelines. Our findings suggest that while laparoscopy results in a clear recovery benefit in the context of radical nephrectomy, its impact on hospital stay in cases of partial nephrectomy is mitigated by the clinical priority of observing parenchymal healing and functional preservation, irrespective of the surgical modality employed.

In our study, a significantly higher rate of complications was observed in the ORN group compared to the LRN group (15.4% vs. 0%, $p = 0.001$). However, this finding should be interpreted with caution due to an inherent selection bias. The mean tumor size was notably larger in the ORN cohort than in the LRN cohort (7.41 ± 3.78 cm vs. 6.05 ± 2.95 cm). In clinical practice, larger, locally advanced, or anatomically challenging renal masses are preferentially managed via an open approach to ensure oncological safety and optimal vascular control [10]. Consequently, we consider that the increased complication rate in the open surgery group reflects the higher baseline complexity and advanced stage of these tumors, rather than a deficiency in the surgical technique itself.

When evaluating the functional outcomes within the nephron-sparing surgery cohorts, we directly compared the impact of OPN and LPN on postoperative renal function. In our study, both the OPN and LPN groups demonstrated highly stable and comparable postoperative creatinine profiles, with no statistically significant difference in early functional deterioration between the two surgical modalities. We believe that the preservation of renal function depends primarily on the quality and volume of the remaining vascularized parenchyma rather than the surgical approach itself. Consequently, our findings suggest that when a partial nephrectomy is successfully executed, both laparoscopic and open techniques offer equivalent safety and efficacy in terms of preserving short-term postoperative kidney function.

The standard treatment recommended in the current guidelines for tumors with a pT2 or higher rating, or for tumors that are too small to be treated using partial nephrectomy, is LPR. Studies comparing LRN and ORN groups have reported similar long-term oncological outcomes with both techniques, but that the former has a lower morbidity rate and gives better cosmetic results [29]. In their 835-case study, Wang et al. reported no significant difference between LRN and ORN groups in terms of complication rates and oncological outcomes [30]. Laird et al.'s prospective study followed up patients for a mean period of 11 years and reported a shorter hospital stay, less bleeding, and lower complication rates in the laparoscopy arm [29]. In the present study, LRN was associated with fewer complications and shorter hospital stays than ORN. In contrast, operative time was significantly longer in the LRN group. A meta-analysis of 18 studies published in 2023 also reported a significantly longer operative time with LRN [30]. Our findings concerning complication rates, operative time, and length of hospital stay are comparable with those in the literature.

5. Conclusion

This study revealed the efficacy and reliability of radical and partial nephrectomy in the surgical treatment of renal masses. Partial nephrectomy emerged as superior in terms of renal function protection. Laparoscopic surgery was observed to shorten the length of hospital stay, and not to increase complication rates. The findings obtained through the retrospective analysis of 177 cases treated in our clinic are entirely consistent with the current literature, and we think that they will contribute to controversial areas and provide important data concerning surgical strategies in the treatment of RCC.

Limitations of the Study

There are a number of limitations to this study. These include its single-center and retrospective design, the relatively low total patient number, the lack of sufficient homogeneity in the patient distribution between the groups, the fact that the surgical techniques were not all performed by the same surgeon despite their technical similarity, pathological examinations not being performed by a single uro-pathologist, kidney functions not being subjected to long-term follow-up, and the fact that recurrence-free survival and cancer-specific survival could not be calculated due to data deficiencies.

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Conflict of Interests
The authors declare that they have no conflicts of interest.
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Author Contributions
Conception: ME, EA, MKA. Design: MEK, EA, EK, RO. Supervision: MU, MKA. Materials: MEK, MŞ, EK, İY. Data Collection and/or Processing: MEK, İY, MŞ, EK. Analysis and/or Interpretation: MEK, İY, EA, MU, MKA, MŞ, EK. Literature Review: EA, MŞ, EK. Writing: MEK, İY, EA. Critical Review: RO, MŞ, MU, MKA. All authors have read and approved the final version of the manuscript.

Ethical Approval
The study was approved by the Samsun City Hospital Ethics Committee and informed consent was not required.

Data Sharing Statement
The data presented in this study are available on request from the corresponding author.

Consent to participate
No consent to participate was required for this study.

Informed Statement
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