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RESEARCH ARTICLE
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THE ROLE OF NEPHRON-SPARING SURGERY IN THE MANAGEMENT OF SMALL RENAL MASSES COMPARING THE ONCOLOGICAL OUTCOMES, RENAL FUNCTION PRESERVATION, AND COMPLICATION RATES OF PARTIAL NEPHRECTOMY VERSUS RADICAL NEPHRECTOMY

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ABSTRACT

Background: Regarding oncological results and renal function, it is still unknown which patients with renal cell carcinoma (RCC) benefit more from partial nephrectomy (PN) as opposed to radical nephrectomy (RN).

Objective: To evaluate the role of nephron-sparing surgery in the management of small renal masses comparing the oncological outcomes, renal function preservation, and complication rates of partial nephrectomy versus radical nephrectomy.

Methods: This retrospective study was carried out at the Department of Urology Sindh Institute of Urology and Transplantation (SIUT) Karachi Pakistan. This study (n = 120) examines individuals who had RN or PN procedures between 2018 and 2023 in hindsight. Patients were matched by age, sex, RENAL score, and preoperative kidney function (eGFR) and categorized according to RN or PN. The eGFR change between the baseline and the 5-year follow-up was evaluated.

Results: 60 patients in each group for analysis following matching. The PN group showed a greater recurrence incidence than the RN group for patients categorized as low risk ($p = 0.01$). RN patients exhibited lower 1-year postoperative eGFR than PN patients ($p < 0.001$). When compared to PN, RN was more likely to cause new-onset chronic kidney disease (CKD) stage ≥3b ($p < 0.001$). Following PN, the complication rate was much greater ($p = 0.003$).

Conclusion: According to our research, PN has better postsurgical renal function. However, RN is a dependable course of treatment if maintaining renal function is not of utmost importance.

Keywords: Small renal masses, partial nephrectomy, radical nephrectomy, nephron sparing surgery

INTRODUCTION

Renal cell carcinoma (RCC) has been much more common over the past several years and accounts for around 3% of all cancer cases. The increased incidence of incidentally found small renal mass (SRM) [1] can be attributed, in part, to the extensive use of imaging tests. A more sophisticated surgical technique has been made possible by growing understanding of the biology of renal tumors, which has reduced the risk of long-term chronic kidney disease (CKD) and maximized the preservation of renal parenchymal function [2]. Nephron-sparing surgery (NSS) is the standard of care for sickle cell disease (SRM) because it involves fully excising the tumor while leaving as much of the damaged kidney's normal functional parenchyma intact as feasible [4].

Partial nephrectomy (PN) or radical nephrectomy (RN) are the surgical therapeutic options available for up to 25% of these instances with RCC that are staged cT1b [3, 4]. The gold standard for oncologic resections for kidney cancer was radical nephrectomy (RN) with excision of Gerota's fascia, hilar lymphadenectomy, and ipsilateral adrenal gland resection [3]. The traditional and essential reasons for partial nephrectomy (PN) include localized renal tumors that, if removed, would put the patient in an anephric state right away and necessitate hemodialysis (e.g., renal agenesis, irreversible impairment of the contralateral renal function because of a prior dysfunction, tumor in a single functioning kidney, and bilateral synchronous tumors). [5, 6]

Nephron-sparing surgery (NSS) is the standard of care for (SRM) because it involves fully excising the tumor while leaving as much of the damaged kidney's normal functional parenchyma intact as feasible (4). NSS has a high success rate, and its morbidity and death rates (1% to 2%) are regarded as modest [2]. The results of cancer-free survival in RCC for early-stage and localized illness are comparable to those achieved with RN. Recurrence rates range from 2% to 4% (4). Recurrence is considerably less common in tumors that are 4 cm or smaller—between 0% and 3% [2].

Compared to RN, PN surgery is acknowledged to be more difficult and complicated, which raises the risk of postoperative complications [5, 6]. Therefore, when treatment planning, it is crucial to consider possible risk factors and perioperative morbidities related to pressure injuries (PN). Additionally, 4–7% of patients following PN have a positive surgical margin (PSM), which is linked to (local) recurrence [7-9]. It is uncommon for PSM to arise following RN [10]. Only tumors ≤5 cm have been included in the single randomized controlled study (RCT) that compares RN with PN to date. Compared to RN, PN was associated with a decreased incidence of renal impairment [11, 12]. Comparable cancer-specific survival (CSS) rates were shown by survival analysis between PN and RN. It is challenging to make firm judgments about the oncological effects of these treatments since meta-analyses yield inconsistent findings on survival rates for PN vs. RN [13, 14].

Furthermore, solid evidence about the decline in renal function following RN or PN for SRM is currently lacking. The purpose of this research is to examine how nephron-sparing surgery is used to treat tiny renal tumors. Contrasting the risks of complications, maintenance of kidney function, and oncological results between partial and radical nephrectomy

METHODOLOGY

This retrospective study was carried out at the Department of Urology Sindh Institute of Urology and Transplantation (SIUT) Karachi Pakistan. Data was extracted from a retrospective database of people who had PN or RN operations due to a clinical suspicion of RCC between 2018 to 2023. The following criteria were met for inclusion: patients had to be at least eighteen years old at the time of surgery, have clinical suspicion of SRM, and have elective PN or RN procedures. **Exclusion criteria:** Histologically proven N1 or M1 before surgery, focal treatment for RCC before surgery, bilateral RCC tumors, multiple unilateral RCC tumors, and single kidney patients with hereditary RCC, Atrophic kidney and RCC in kidney transplants.

The pre-operative serum creatinine (sCr), eGFR, age, gender, and CKD were determined using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula [15]. To determine the extent of the tumor, all patients received preoperative CT or MRI with contrast [16, 17]. PN or RN candidates were selected based on the patient's characteristics and the EAU requirements. Based on

the risk categorization, follow-up exams were performed in accordance with the EAU's recommendations. There were three risk classifications used: low, intermediate, and high risk.
Follow-up data, including sCr, eGFR, the status of (local) recurrences, and radiographic results, were gathered from these check-ups. Recurrence of RCC in the renal fossa or operated kidney was regarded as local recurrence. If there was any doubt regarding PSM based on the pathology report, the pathologist looked over the slides again.

Primary outcomes

The survival studies comprised recurrence-free survival (RFS), cancer-specific survival (CSS), and overall survival (OS). The OS represented the time interval between surgery and death from any cause, the CSS the time interval between surgery and death related to RCC, and the RFS the time interval between surgery and metastasis or a biopsy-verified (local) recurrence. Postoperative renal function was evaluated using sCr and eGFR. Postoperative eGFR was tracked throughout time during follow-up. Prior to surgery, the degree of disturbance in eGFR and sCr was measured in absolute terms as well as in relation to renal function. Patients' pre- and postoperative CKD stages were classified for comparison [18, 19]. Patients with benign tumors were not included in the survival study.

Secondary outcomes

The secondary outcomes were the surgical technique, ischemia time, operational length, estimated blood loss (EBL), and pathological findings. Assessments were also conducted on the following topics: surgical margin status, complication rate (based on Clavien-Dindo classification), readmission within 30 days, and length of hospital stay (LOS) [20].

Statistical analysis

The cohort was utilized for all statistical analyses after matching was finished. A paired T-test was utilized for parametric data, and the Fisher's exact test for values less than 0.05, as well as the Pearson Chi-squared and Wilcoxon Signed Ranks tests, were applied for non-parametric data. For all statistical studies, STATA 16.0 was utilized.

RESULTS

RN or PN procedures were performed on 120 SRM patients in total during the research period. Each treatment group consisted of sixty individuals (RN and PN group). The matched cohort's patient and tumor characteristics were comparable in terms of age, gender, and According to Table 1, preoperative eGFR was comparable in the two groups: RN 82 (70–95) and PN 85 (73–95) (p = 0.80).

Table1: Patient characteristics

	RN	**PN**	***p*-value**
No. of patients	60	60	
Gender			
Male n (%)	35 (58.4%)	25 (41.6%)	
Female n (%)	20 (33.4%)	40 (66.6%)	
Age years mean (SD)	61 ± 11.1	60 ± 10.2	0.63
Preoperative creatinine (mg/dl) median (IQR)	80 (68–94)	77 (70–95)	0.91
Preoperative eGFR (ml/min/1.73 m2) median (IQR)	82 (70–95)	85 (73–95)	0.80
Preoperative CKD3a (%)	10 (10)	4 (4)	0.21
Preoperative CKD 3b	2 (2)	5 (5)	0.31
tumor size (mm)	53 (45–61)	50 (43–57)	<0.001
Renal score median	10 (9–10)	9 (8–10)	<0.001

Surgical and pathological outcomes Both groups were comparable concerning pathologic RCC subtype, risk group, and readmission rate within 30 days, though there were 4 readmissions among patients who underwent PN, compared to none in the RN group.
There was significantly more pathological upstaging in the RN group than in the PN group [p < 0.03]. Table 2 showed Surgical and pathological outcomes of both groups.

Table 2: Surgical and pathological outcomes of the matched cohort

	RN	**PN**	***p*-value**
Approaches			<0.001
Open	20 (33.4%)	40(66.6%)	
Laparoscopic	40 (66.6%)	20 (33.4%)	
Surgical time (min) median (IQR)	150 (130–200)	199 (160–270)	<0.001
Length of stay (days) median (IQR)	5 (3–6)	5 (4–7)	0.04
Readmission within 30 days n (%)	0	5 (8.3%)	0.05
Histology n (%)			0.31
Clear-cell RCC	40 (66.6%)	30 (50%)	
Papillary RCC	10 (16.6%)	18(29.8%)	
Chromophobe RCC	11 (11)	4 (4)	
Benign lesions	4(6.6%)	5 (8.3%)	
Positive surgical margin n (%)	0	6 (6)	0.03
Risk group n (%)			0.30
Low	37 (61.4%)	28 (46.8%)	
Intermediate	30 (50%)	25 (41.5%)	
High	5 (8.3%)	4 (6.6%)	

univariate and multivariate regression analyses showed high risk group. Postoperative eGFR or CKD group was not predictive of OS. Intermediate (p = 0.018) and high risk groups (HR p = 0.013). Local recurrence occurred only in the PN group as shown in Table 3.

Table 3: Recurrences (%) after RN and PN

Risk group n	**RN**	**PN**	***p*-value**
Low	1	8	0.02
Intermediate	4	3	0.70
High	3	3	0.79
Total n	8	14	0.20
Progression type n (L(low), M(medium), H(high) risk group)			0.03
Local recurrence	1 (1 L, 0 M, 0 H)	9 (5 L, 3 M, 1 H)	
Contralateral kidney	1 (0 L, 1 M, 0 H)	3 (0 L, 3 M, 0 H)	
Metastasis	7 (1 L, 3 M, 3 H)	4 (2 L, 2 M, 0 H)	

Table 4: Post-surgery renal function outcomes RN vs. PN

	RN			**PN**		
	Pre operative	**1 year post operative**	***p*-value**	**Pre operative**	**1 year post operative**	***p*-value**
New-onset CKD ≥ 3b n (%)	20 (33.4)			4 (6.4)		<0.001
Pre-op CKD1 (eGFR ≥ 90)	0			0		
Pre-op CKD2 (eGFR 60–89)	10 (16.7)			4 (6.4)		

Pre-op CKD3a (eGFR 45–59)		4 (6.4)			2(3.2)	
eGFR median (IQR)	82 (70–95)	56 (44–65)	<0.001	85 (73–95)	72 (61–88)	<0.001
sCr median (IQR)	80 (68–94)	106 (89–128)	<0.001	77 (70–95)	89 (72–105)	<0.001

DISCUSSION

According to our matched study, in a 5-year follow-up of patients with SRM PN had better renal function than RN. Both groups' eGFR stabilized 6–12 months following surgery, however after RN compared to PN, eGFR remained considerably lower. These outcomes correspond with the conclusions reported by previous researchers [11, 21]. While this was not the case for severe kidney disease (eGFR < 30) or kidney failure (eGFR < 15), the EORTC 30904 study demonstrated that PN decreased the risk of at least mild renal impairment (eGFR < 60) [11]. Retrospective research indicates that maintaining kidney function may reduce the incidence of cardiovascular events, leading to better survival and quality of life (QoL) as compared to RN [22–24].

We did not find a poorer OS in the RN group, despite a considerable deterioration in renal function and higher incidence of new-onset CKD. This is consistent with the findings of Lane et al. [25], who suggested that surgically induced CKD would result in a greater survivability than medically produced CKD. They did note a worse survival rate in patients with postoperative eGFR less than 45, though. This emphasizes how crucial it is to anticipate postoperative eGFR accurately. According to our research, 22% of patients who had RN had a postoperative eGFR of less than 45, and all of them had a preoperative eGFR of less than 90. Furthermore, this implies that RN is a feasible choice for those with healthy renal function prior to surgery. However, while deciding between PN and RN, one needs take into account factors including QoL, prior medical history, and cardiovascular events, which were not assessed in this study [26]. Renal function and quality of life following PN versus RN in patients with tumors ≤7 cm are analyzed in the ongoing PARTIAL randomized controlled study, which may yield novel information [27]. The findings of earlier research comparing RN and PN for T1b tumors revealed inconsistent survival rates. The EORTC study revealed that PN had a worse overall survival than RN; however, in the targeted RCC group, this impact was no longer significant [12, 28]. Similar CSS, RFS, and OS rates were seen in two meta-analyses comparing PN and RN for T1b tumors [13, 14]. Similar outcomes were also discovered by us: The OS, CSS, and RFS rates did not show any differences between PN and RN, indicating that PN is a therapeutic choice that makes sense when taking oncological outcomes and kidney function in mind. While there was no statistically significant difference in RFS between RN and PN, the low-risk group experienced considerably more local recurrences following PN than did the RN group. The recurrence rates of the intermediate and high-risk groups did not differ from one another. Six of the seven recurrences observed in the low-risk group were local. Metastases to the retrocaval lymph nodes occurred in the remaining patient. This greater (local) recurrence rate's cause is yet unknown.

The rate of postoperative complications was another secondary result of this investigation. Compared to RN, PN is a more complicated technique with a greater risk of complications [6]. The PN group experienced noticeably more difficulties than the RN group did. This is consistent with earlier research [29, 30] that examined the results of surgery for T1b tumors. Two of the problems were categorized as CD grade 4. Since the benefits of maintaining renal function may not always exceed the greater risk of problems following PN, it is essential to evaluate this risk carefully. However, new information indicates that improving the RENAL score does not degrade the prognosis for cancer [31]. Moreover, confounding variables that have not been tested can yet exist. Furthermore, even though all of the procedures were carried out by skilled urologists, the switch from an open and laparoscopic to a robotic method, as well as the PN procedure's learning curve, could have affected the outcomes.

CONCLUSION

The survival rates of SRM patients receiving PN or RN are comparable. Even though the PN group saw higher local recurrences, the similar survival estimates imply that local salvage methods are successful. While it might be claimed that RN is better when maintaining renal function is not a concern, PN has better preservation of renal function than RN.

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