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Impact of Radical and Partial Nephrectomy on Renal Function Outcome

Hafiz Dur-e-Furqani, Naveed Ahmed Mahar, Abdul Rehman, Harris Hassan Qureshi, Asad Shahzad, Rehan Mohsin

ABSTRACT

Objective: To evaluate renal function outcomes and new-onset CKD in patients undergoing radical nephrectomy (RN) or partial nephrectomy (PN).

Methodology: In this prospective cohort study, 204 renal tumor patients underwent RN or PN, eGFR was recorded preoperatively and up to 1 year postoperatively. Variables included age, gender, surgery type, and eGFR values. Data were analyzed using IBM SPSS 20. Continuous variables were reported as mean, median, SD, and IQR; categorical variables as frequencies and percentages. Student's t-test, chi-square, and multivariate analysis were applied. $p<0.05$ was significant.

Results: Of 204 patients, 154 (75.5%) had RN and 50 (24.5%) had PN. Mean age was 50.41±12.21 years. Baseline median eGFR was lower in RN (82.46 mL/min/1.73m²; IQR 74.98–93.31) than PN (88.44; IQR 79.07–101.61, $p<0.002$). At 72 hours, RN median eGFR was 63.03 (IQR 53.78–73.08) vs PN 78.23 (IQR 64.87–94.75, $p<0.001$). At 1 month, RN: 59.93 (IQR 48.87–70.58) vs PN: 76.72 (IQR 61.43–94.97, $p<0.001$). At 6 months, RN: 57.48 (IQR 46.36–67.21) vs PN: 73.98 (IQR 62.66–87.51, $p<0.001$). At 1 year, RN: 58.41 (IQR 46.24–67.66) vs PN: 74.40 (IQR 63.09–90.45, $p<0.001$).

Conclusion: Partial nephrectomy, when feasible, better preserves renal function than radical nephrectomy and should be preferred for suitable kidney tumors.

KeyWords: CKD (chronic kidney disease); eGFR (estimated glomerular filtration rate); PN (Partial Nephrectomy); RCC (Renal cell carcinoma); RN (Radical Nephrectomy).

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INTRODUCTION

Renal cell carcinoma encompasses a group of malignant lesions that originates from epithelial cells of renal tubules. It is responsible for approximately 85 to 90% of all renal malignancies. The renal cell carcinoma (RCC) incidence is rising, making it the 12th most common site of primary cancer. It is the 9th most commonly detected tumor in men and 14th in women, making it 5% and 3% of all oncological diagnoses, respectively.[1]

Until 1960, about 70% of the patients suffering from renal tumors were discovered only when they had developed signs and symptoms of the renal lesion, such as flank pain, hematuria, and palpable mass.[2] The mortality rates were exceptionally high because diagnostic and therapeutic options were limited. This scenario had substantially evolved in the last 40 years. With improved diagnostic modalities, 60% to 70% of renal tumors are now identified when they are less than 4 cm and are almost asymptomatic.[2]

Surgical excision of the primary tumor is currently established as the standard treatment option based on evidence that showed a survival benefit with this approach.[3] Over the years, radical nephrectomy was the primary treatment option irrespective of size of the lesion, however PN was indicated for patients with critical conditions, such as bilateral renal tumors, solitary functioning kidney, or pre-existing kidney disease.[4]

Over the years, treatment of small localized kidney tumors has evolved significantly, with considerable focus on preserving the renal tissue and function balancing oncological risk. Although five-year cancer-specific survival is greater than 90% irrespective of surgical procedure, current data

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supports partial nephrectomy (PN) over radical nephrectomy (RN). Therefore, partial nephrectomy (PN) has been evolved into the preferred nephron-preserving surgery in elective settings.[5] It is now recommended to prioritize partial nephrectomy when technically feasible, principally for cT1 lesions due to comparable cancer-specific survival rate, improved renal function parameters with partial nephrectomy, and the possible reduction in cardiovascular risk and overall survival benefit by avoiding chronic kidney disease (CKD).[6]

In addition to this, surgical approaches have also evolved to treat renal tumors from open approach to laparoscopic approach since the 1990s. More recently, robot-assisted and other minimally invasive procedures have gained ground in treating renal neoplasms.[7]

The biological behavior of renal lesions is not well understood, so the exact reason for increased mortality cannot be attributed directly to renal tumors, but to clinical factors such as age, hypertension, diabetes, type of surgery (RN or PN) and especially the history of low preoperative glomerular filtration rate (GFR).[8,9] Radical or partial nephrectomy reduces the renal mass resulting in the reduction of GFR, development of AKI (acute kidney injury), or new-onset CKD (chronic kidney disease).[9]

According to the current definition of CKD (chronic kidney disease), it is an estimated glomerular filtration rate (eGFR) below 60 mL/min per 1.73 m^2 for 3 months or longer. The significant impacts of CKD (chronic kidney disease) are damage to renal tissue, potentially causing renal failure; leading to complications, such as anemia, hypertension, neuropathy, and compromised quality of life. Studies have demonstrated that decreased GFR is a significant predictor of cardiovascular hospitalization, ESRD (end-stage renal disease), and increased risk of death.[10] So, any therapeutic method that has an impact on the preservation of renal tissue effects directly the survival of patients with renal tumors. Thus, the accurate estimation of renal function is critically important in patients suffering from renal neoplasm.

Patients with renal tumors are sometimes treated with anti-cancer drugs, evaluation of remaining kidney function is necessary for the optimization of dose of anti-cancer drugs since they have the potential to exhibit nephrotoxicity.[11] Given these circumstances, it is important to preserve renal function not only in healthy individuals, but also in patients at risk of developing chronic kidney disease, such as those undergoing renal surgeries, elderly population, and patients with hypertension, diabetes, obesity and cardiovascular diseases.

According to existing information, no comprehensive prospective research has been conducted in Pakistan to calculate the eGFR (estimated glomerular filtration rate) in patients suffering from renal tumors who underwent radical or partial nephrectomy. This study is aimed at calculating and compare the change in eGFR after surgical removal of the tumor via Radical or Partial nephrectomy and diagnose CKD after the treatment procedure.

METHODOLOGY

With the approval of ethics review committee (SIUT-ERC-2020/A-207), this prospective cohort study was carried out at the department of Uro-oncology at Sindh Institute of Urology and Transplantation (SIUT), Karachi, Pakistan, from March 2020 to December 2022. Adult Patients of any age and either gender with kidney tumors who went through radical nephrectomy (RN) or partial nephrectomy (PN) at SIUT, and had no prior history of AKI or CKD were enrolled in this study after informed written consent was acquired from all the study subjects. Patients with eGFR (estimated glomerular filtration rate) <60 mL/min/1.73m^2, patients with tumor in solitary kidney, patients with recurrent tumor were not included in this study.

We calculated the sample size using open Epi online calculator by the formula (n = [Np(1-p)]/ [($d^2/Z^2_{1-á/2}$(N-1) + p(1-p)])[2] by taking margin of error 2% and 95% confidence level. Nonprobability consecutive technique was used to raise sample. All the patients were admitted in ward at least one day prior to surgery where their serum creatinine levels, serum cystatin levels and eGFR (estimated glomerular filtration rate) were calculated preoperatively. The eGFR was calculated by CKD- EPI Equations. CKD-EPI equations combine both serum creatinine and serum cystatin-C levels.[12]

The surgery was performed by experienced consultant urologist under general anesthesia (GA). Serum creatinine, serum cystatin C and eGFR were calculated again at 72 hours after surgery. Patients were discharged after drain removal when fully ambulant. Post discharge patients were kept on regular scheduled follow up till 1 year (12 months) and their Serum creatinine, serum cystatin and eGFR were calculated at 1, 3, 6 and 12 months of surgery. Patient's data such as demographic details, tumor site, size of the tumor, surgical approach, serum creatinine, serum cystatin and eGFR pre-operatively and post-operatively during each follow-up was entered in the proforma. The patients were categorized into two distinct groups, either radical nephrectomy group or partial nephrectomy group.

The assessment of renal function outcome was performed by the development of post-surgery new onset CKD (defined as a drop in the estimated glomerular filtration rate to <60 mL/min/1.73m^2 3 months after surgery in patients who had preoperative eGFR >60mL/min/1.73m^2).

All the data was assessed by utilizing SPSS version, 20. We used descriptive statistics to analyze data of continuous and categorical variables. Shapiro-wilk test was applied to check the normality. Continuous normally distributed variables were presented as mean and standard deviation, and non-normally distributed continuous variables were reported as median and inter quintile range (IQR). Categorical variables such as gender, stage of tumor, grade of tumor and

development of new onset CKD were presented as frequencies and percentages. Data was stratified to counter confounders and post stratification student t-test and chi square test was applied where applicable. Multivariate analysis was performed for the comparison of outcomes between RN and PN. p value <0.05 was considered as statistically significant.

RESULTS

A total of 204 patients were enrolled in this study, out of which 75.5% (n=154) of participants had radical nephrectomy and 24.5% (n=50) of patients underwent partial nephrectomy.

The mean age of study population was 50.41±12.21 years, and median body mass index (BMI) was 22.97 Kg/m^2 (IQR=19.81 – 26.44). The majority of patients were males (n=120, 58.8%). Study subjects of different ethnicity including Urdu speaking (n=85, 41.7%), Sindhi (n=59, 28.9), Punjabi (n=17, 8.3%), Saraiki (n=14, 6.9%), Pakhtoon (n=19, 9.3%) and Baloch (n=9, 4.9%) participated into the study (Table 1).

Computed tomography (CT Scan) was used as modality to diagnose most of patients (n=186, 91.2%), whereas biopsy was performed to confirm the diagnosis of RCC in few cases (n=18, 8.8%). Nearly half of the patients had tumor on the right side (n=95, 46.6%).

The most-frequent TNM stage was stage II (n=85, 41.7%), followed by stage I (n=69, 33.8%), stage III (n=47, 23%) and stage IV (n=3, 1.5%).

Flank pain was the most common (64.2%) presentation among both groups followed by hematuria (42.6%). For frequency of presenting complaints refer to Figure 1.

For radical nephrectomy, the open surgical approach was the most common, performed in 101 cases, accounting for 65.6% of the total. The laparoscopic approach was used in 25 cases, representing 16.2% of the total. The robot-assisted surgical technique was employed in 28 cases, comprising 18.2% of the total.

For partial nephrectomy, the open surgical approach was also the predominant choice, used in 39 cases, making up 78% of the total. The laparoscopic approach was performed in 5 cases, which is 10% of the total. The robot- assisted approach was utilized in 6 cases, constituting 12% of the total.

Median hemoglobin drop was significantly higher in partial nephrectomy (PN) group than radical nephrectomy (RN) treated patients (p=0.004) Figure 2. The mean R.E.N.A.L Nephrometry score was 5.54 ± 1.38. Thirty-nine (78%) of the participants who underwent PN had low tumor complexity score and 22 percent of participants had moderate complexity score.

Both groups share a comparable histopathological profile, with clear cell carcinoma being the most frequent subtype Among patients undergoing radical nephrectomy and partial nephrectomy, the predominant tumor histopathology in both groups was clear cell carcinoma, accounting for 77.2% and 82%, respectively. Papillary carcinomas, including Type 1 and Type 2, were present in similar proportions across the groups, making up approximately 17.5% of the total cases in each group. Chromophobe carcinoma was rare, with a slightly higher occurrence in the radical nephrectomy group. Sarcomatoid variant tumors were exclusively found in patients undergoing radical nephrectomy (Table 2).

The overall postoperative median serum creatinine levels at 72 hours, 1 month, 3 months, 6 months and 1 year were 1.06mg/dl (0.89-1.2), 1.05mg/dl (0.89- 1.21), 1.08mg/dl (0.9-1.23), 1.11mg/dl (0.95-1.22) and 1.21 mg/dL (1.05-1.29) respectively, and median cystatin levels at 72 hours, 1 month, 3 months, 6 months and 1 year were 1.22mg/L (1.08-1.34), 1.26mg/L (1.1-1.42), 1.27mg/L (1.1-1.46), 1.29mg/L (1.14-1.46) and 1.39(1.22-1.55) respectively.

On comparison, a statistically significant difference was observed in serum creatinine and cystatin levels among two groups throughout the post-operative period (Table 3). At baseline, the median eGFR was substantially reduced in radical nephrectomy group than partial nephrectomy group, 82.46 mL/min/1.73m^2 (IQR= 74.98-93.31) vs 88.44 mL/min/1.73m^2 (IQR= 79.07-101.61) (p<0.002) respectively. At 72 hours, median eGFR in RN group was 63.03 mL/min/1.73m^2 (IQR= 53.78-73.08) which was significantly lower than median eGFR 78.23 mL/min/1.73m^2 (IQR= 64.87-94.75)] in PN group (p<0.001). At one-month, median eGFR between RN and PN group was 59.93 mL/min/1.73m^2 (IQR= 48.87-70.58) and 76.72 mL/min/1.73m^2 (IQR= 61.43-94.97) respectively, which was statiscally significant (p<0.001). Median eGFR at 6 months between RN and PN group was 57.48 mL/min/1.73m^2 (IQR= 46.36-67.21) and 73.98 mL/min/1.73m^2 (IQR= 62.66-87.51) with was statiscally significant (p<0.001). Median eGFR at one year between RN and PN was 58.41 mL/min/1.73m^2 (IQR= 46.24-67.66) and 74.40 mL/min/1.73m^2 (IQR =63.09-90.45) respectively, which was significantly different (p<0.001) (Table 4)

Table 5 shows significant difference among two treatment groups with lesser frequency of new onset CKD in partial nephrectomy group than radical nephrectomy group at three, six and 12 months.

on stratification, there was no statistically significant relationship between age (p= 0.1) and gender (p=0.9) with new-onset CKD after any of the surgical procedure.

DISCUSSION

Over the last decade, PN has been established as a standard treatment modality for small renal tumors, with procedure increasing year after year.[10] The probability of renal function deterioration can be minimized by retaining functional renal

Table 1: Comparison of participant's Socio demographic characteristics among the two study groups.

		Radical Nephrectomy n(%)	Partial Nephrectomy n(%)
Demographic Features	Age (years) #	50.91±12.08	48.88±12.63
	Body mass index (Kg/m^2)ǂ	22.54(19.66-22.54)	24.17(20.05-27.92)
Gender	Male	97(63)	23(46)
	Female	57(37)	27(54)
Ethnicity	Urdu	64(41.6)	21(42)
	Sindhi	47(30.5)	12(24)
	Punjabi	13(8.4)	4(8)
	Saraiki	10(6.5)	4(8)
	Pakhtoo n	15(9.7)	4(8)
	Balochi	5(3.2)	4(8)
	Others	0(0)	1(2)

#Age is presented as mean ± standard deviation, ? Body mass index is presented as median (inter-quartile range)

Table 2: Comparison of clinical features among radical nephrectomy and partial nephrectomy groups

Tumour Histopathology	Radical Nephrectomy n (%)	Partial Nephrectomy n (%)
Clear cell	119(77.2)	41(82)
Type 1 papillary	14(9.1)	4(8)
Type 2 papillary	13(8.4)	4(8)
Chromophobe	6(3.9)	1(2)
Sarcomatoid	2(1.3)	0(0)
Surgical Approach		
Open	101(65.6)	39(78)
Laparoscopic	25(16.2)	5(10)
Robot assisted	28(18.2)	6(12)
Pre-operative serum creatinine (mg/dl)*	0.86(0.7-0.96)	0.8(0.6-0.9)
Pre-operative serum cystatin (mg/L)*	1.03(0.95-1.08)	0.98(0.86-1.04)

*: Data presented as median (inter-quartile range)

Figure 1: Frequency of presenting complaints for overall study cohort

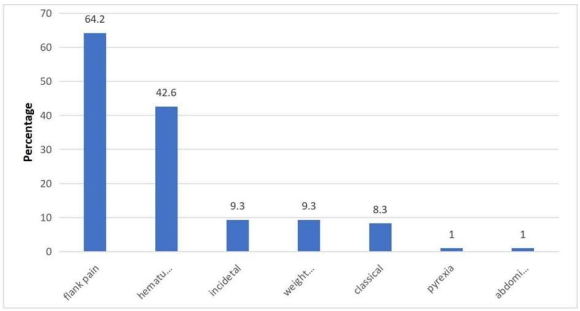

Figure 2: Median drop in haemoglobin (g/dl) in radical nephrectomy and partial nephrectomy groups

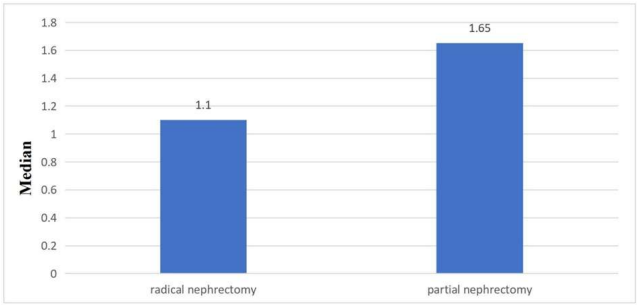

Table 3: Comparison of serum creatinine and cystatin levels at 72 hours, one month, 3 months, 6 months and 12 months among the two study groups

	Radical Nephrectomy Median (IQR)	Partial Nephrectomy Median (IQR)	p-value
Before surgery (Preoperative)			
Serum creatinine (mg/dl)	0.86(0.7-0.96)	0.8(0.6-0.9)	0.06
Serum cystatin (mg/L)	1.03(0.95-1.08)	0.98(0.86-1.04)	0.08
Outcomes at 72 Hours			
Serum creatinine (mg/dl)	1.1(0.92-1.23)	0.89(0.7-1.07)	<0.001
Serum cystatin (mg/L)	1.26(1.15-1.4)	1.08(0.93-1.2)	<0.001
Outcomes at 1 Month			
Serum creatinine (mg/dl)	1.09(0.96-1.25)	0.9(0.7-1.07)	<0.001
Serum cystatin (mg/L)	1.28(1.16-1.49)	1.1(0.89-1.25)	<0.001
Outcomes at 3 Months			
Serum creatinine (mg/dl)	1.12(0.99-1.27)	0.9(0.73-1.09)	<0.001
Serum cystatin (mg/L)	1.31(1.19-1.52)	1.1(0.91-1.27)	<0.001
Outcomes at 6 Months			
Serum creatinine (mg/dl)	1.13(1.01-1.29)	0.96(0.72-1.08)	<0.001
Serum cystatin (mg/L)	1.36(1.21-1.54)	1.12(0.94-1.26)	<0.001
Outcomes at 1 Year			
Serum creatinine (mg/dl)	1.14(1.05-1.29)	0.94(0.74-1.08)	<0.001
Serum cystatin (mg/L)	1.36(1.22-1.55)	1.10(0.92-1.23)	<0.001

Table 4: Comparison of eGFR (mL/min/1.73m2) among the two study groups at different time points

Median eGFR (mL/min/1.73m^2)	Radical Nephrectomy n (%)	Partial Nephrectomy n (%)	p- value
At 72 Hours			
eGFR >90	12(7.8)	14(28)	†0.001
At 1 Month			
eGFR >90	11(7.1)	14(28)	†<0.001
At 3 Months			
eGFR >90	10(6.5)	13(26)	†<0.001
At 6 Months			
eGFR >90	10(6.5)	9(18)	†0.001
At One Year			
eGFR >90	8(5.2)	14(28)	†<0.001

† Fisher-exact test was reported

Table 5: Comparison of new onset CKD between the two study groups at 3, 6 months, and 1 year

Variables	Groups	Radical Nephrectomy n(%)	Partial Nephrectomy n(%)	p-value
New onset CKD at 3 months	Yes	77(50)	11(22)	**0.001
	No	77(50)	39(78)	
New CKD onset at 6 months	Yes	87(56.5)	12(24)	**0.001
	No	67(43.5)	38(76)	
New CKD onset at one year	Yes	83(53.9)	11(22)	**0.001
	No	71(46.1)	39(78)	

parenchyma. The perioperative complications risk escalate as the tumor size and its intricacy rises.[10] There is no obvious threshold to the amount to which the risks exceed potential benefit of a partial nephrectomy, therefore the surgeon must determine whether to do a partial nephrectomy or radical nephrectomy when faced with a larger or more complicated renal tumor.

In this study 204 participants were enrolled out of which 154 patients (75.5%) underwent RN, and 50 participants (24.5%) underwent PN. Majority of the study participants were males (n=120, 58.8%). The average age of participants in RN group was 50.91±12.08, and in PN group was 48.88±12.63. On the basis of age, there was no statistically significant difference between the two study groups (p=0.309). The identical results were noted in the study carried out at Brazil which reported that the mean age of participants had no intergroup difference.[2]

Our research revealed that the mean age of the patients was between 49 to 51 years, which is younger than the age range traditionally linked to kidney tumors. This may be due to the expanded application of imaging in investigation and prevention strategies, which has amplified the frequency with which small and subclinical renal tumors are diagnosed. Furthermore, several patients may be detected incidentaly during the medical evaluation of concurrent diseases. According to our study a notable difference emerged between two groups on the basis of TNM stages (p<0.001). PN was performed in 80% of participants with TNM stage I, while RN was performed in 19% of patients with TNM stage I. Similarly in TNM stage III, 30% of participants had RN, however there was no individual in TNM stage III who had PN. As tumor staging progressed, more patients received RN. The mean R.E.N.A.L nephrometry score in PN group was

5.54 ± 1.38, and 78% of the participants had low complexity (score 4-6), 22% of the participants had moderate complexity (score 7-9). None of the participants had higher complexity (score >10) in this study. Regarding blood loss during surgery, the result of our study revealed that the overall reduction in hemoglobin (Hb) value was 1.2 g/dl (0.80 – 1.86). Drop in median Hb level was 1.1 g/dl in RN group, 1.65 g/dl in PN group, and that is significantly higher in partial nephrectomy group than the patients treated with radical nephrectomy (p=0.004). The literature also indicates that PN appears to have a greater susceptibility of perioperative blood loss, with 3% risk of serious hemorrhage versus 1% risk of grave bleeding for RN.[13] In accordance to our study, the result of a meta-analysis noted that lower estimated blood loss during radical nephrectomy (p < 0.001).[14]

Another research found that PN for complex renal lesions, which requires more skills in terms of tumor excision and renal reconstruction than RN, was linked to a prolonged duration of surgery and more significant estimated loss of blood than RN.[15]

Kopp R.P et al conducted comparison analysis and concluded that partial nephrectomy may delay deterioration of renal functions in patients with renal lesions; however, in more complicated tumors defined by R.E.N.A.L nephrometry score >10, the effect is nullified.[16] The advantage of partial nephrectomy (PN) in preventing CKD increases as the R.E.N.A.L score decreases. Linear regression analysis showed that PN patients maintained significantly better kidney function compared to radical nephrectomy (RN) patients, with RN patients experiencing an eGFR decline of over 20 units relative to PN patients. These findings suggest that the R.E.N.A.L nephrometry score can be a key tool for classifying patients with renal tumors who would derive the greatest benefit from PN. Additionally, this score has a predictor power for preservation of renal functions and a resource for mittigating perioperative complications, enhancing its role in renal function prognosis.[17]

Studies demonstrate that PN has renal functional benefits over RN for T1 renal tumors.[16] Larger tumors are less well understood, although there is mounting evidence that PN can be used for both urgent and elective purposes.[16] According to these findings, size of tumor should not be considered an absolute contraindication to partial nephrectomy.

Although PN tend to have a relatively more complication rates than RN, the hospital expenditures and hospitalization period do not differ much, and PN better retains renal function, resulting in a superior health-related quality of life.[18] Since AKI is linked to increased morbidity and mortality, along with increased utilization of health-care resources and expenses. Acute kidney injury tends to occur more common in patients undergoing urologic surgery. Notably, AKI arises in 43 percent of patients undergoing RN or PN, making nephrectomy a known risk factor for AKI.[19] We studied the natural history of renal function for 12 months following RN or PN, there was significant difference on the basis of baseline creatinine (p=0.023). In the RN group the mean preoperative serum creatinine was 0.86 mg/dl (0.7-0.96) and in the PN group the mean preoperative creatinine was 0.8 mg/dl (0.6-0.9).

Despite having normal preoperative serum creatinine levels, approximately 30% of patients receiving partial nephrectomy or radical nephrectomy may have underlying chronic kidney disease (CKD) [10]. Our study showed that 68.6% patients undergoing RN, and 52% patients of PN group had mild renal impairment (eGFR 60-90ml/min/1.73m^2) preoperatively. Similar to our results, Schmid M et al found that prior to surgery 66.7 percent of patients undergoing RN or PN have mildly or moderately impairment of kidney functions, which increases the risk for not only 30-day acute kidney injury (AKI), but also non-renal complications like increased length of hospital stays, cardiovascular events, and death.[20] Because preoperative kidney function is most

significant prognostic factor of AKI postoperatively, our findings underscore the necessity of evaluating renal function prior to radical or partialnephrectomy.

The results of this study depicts the comparison of eGFR between radical and partial nephrectomy treated group at different time points. At baseline, median eGFR was substantially lower in RN group than PN group 82.46 ml/min/1.73 m^2 (IQR= 74.98-93.31) vs 88.44 ml/min/1.73 m^2 (IQR= 79.07-101.61), p<0.002]. At 72 hours, median eGFR in RN group was 63.03 ml/min/1.73 m^2 (IQR= 53.78-73.08), which was significantly lower than median eGFR 78.23 ml/min/1.73 m^2 (IQR= 64.87-94.75)] in PN group (p<0.001). At one month, median eGFR between RN and PN group was 59.93 ml/min/1.73 m^2 (IQR= 48.87-70.58) and 76.72 ml/min/1.73 m^2 (IQR= 61.43-94.97) respectively which is significantly different (p<0.001). Median eGFR at 6 months between RN and PN group was 57.48 ml/min/1.73 m^2 (IQR= 46.36- 67.21) and 73.98 ml/min/1.73 m^2 (IQR= 62.66-87.51) with significant difference (p<0.001). Median eGFR at one year between RN and PN was 58.41 ml/min/1.73 m^2 (IQR= 46.24-67.66) and 74.40 ml/min/1.73 m^2 (IQR =63.09- 90.45) respectively which was different significantly (p<0.001). In agreement to our result, a research led by Kim CS et al described that individuals undergoing RN had considerably lower postoperative eGFR than those undergoing PN. Patients who received RN were at higher risk of several unfavorable renal outcomes (such as acute kidneyinjury, new-onset chronic kidney disease and a 25% drop in eGFR after one year) than those who received PN. Moreover, RN enhanced the risk of adverse renal outcomes in patients with small lesions (4 cm) and moderate size (4 cm to 7 cm) tumors.[21]

It has been established after meta-analysis of 21 studies that better postoperative eGFR (12.4 ml/min/1.73 m^2; p<0.001), reduced incidence of postoperative CKD (RR 0.36; p<0.001), and attenuated decline in eGFR (8.6 ml/min/1.73 m^2; p<0.001) were also connected to PN. Cancer relapse (OR 0.6; p 0.001), cancer-specific mortality (OR 0.58; p =0.001), and overall mortality (OR 0.67; p = 0.005) were much lower in the PN group [22]. Other studies revealed that partial nephrectomy was associated with improved renal function outcomes, including greater eGFR and a lower risk of CKD postoperatively.[16,22]

Our result showed that at one month, 55.9% (n=52) of hypertensive patients of RN group progressed to develop decrease eGFR between 45 to 60 ml/min/1.73 m^2 (p=0.001), while only 25% (n=8) of hypertensive patients of PN group progressed to decrease eGFR between 40-59 ml/min/1.73 m^2 (p-<0.01). It was seen that disease stage in diabetic patients were not different significantly at baseline (p=0.066), one month (p=0.279), three months (p=0.619), six months (p=0.502) and 1 year (p-**†<0.001). At 72 hours, more than half of the patients developed decrease in eGFR between 45 to 59ml/min, while 16.7% patients in PN treated developed same level of decline in eGFR (p=0.031). One patient has advanced to stage IV, and one patient has advanced to stage V at the one-year follow-up in the RN group (p-**†<0.001).). After a thorough search of the literature, we were unable to find any research comparing the eGFR between patients with diabetes, hypertension, and ischemic heart disease who received PN and RN at various levels of follow-up.

With regard to acute and long-term kidney function deterioration, our result also depicts that at 3 follow up period of 3 months, the frequency of new onset of CKD is 50% in RN group, and 22% in PN group (p-0.001). CKD at 6 months further increased to 56.5% in RN group and 24% in PN group which is comparatively lower than individuals who underwent RN, the difference between two treatment group is statistically significant (p-<0.001). At follow up period of one year, the frequency of new onset of CKD is 53.9% in RN group, and 22% in PN group (p-<0.001).

According to Mühlbauer J et al, at end of follow-up period, two-thirds of all patients with worsening of renal function had reached CKD stage III, with 73 percent in the radical nephrectomy group against 41 percent in the partial nephrectomy group (P = 0.005).[19] Kim CS et al discovered that patients undergoing radical nephrectomy developed a greater incidence of new-onset CKD than those having partial nephrectomy (55.7 percent vs. 6.2 percent, respectively).[21]

In a two- center study of 202 cases with T2 kidney tumors undergoing RN or PN , Kopp et al. discovered that de novo CKD developed in 40.2 percent (n = 122) and 16.3 percent of patients, after radical nephrectomy and partial nephrectomy respectively [16]. They concluded that, in comparison to PN, with a R.E.N.A.L score of <10, RN was related with decreased renal function in T2 tumors, but not in T2 tumors with a RENAL score of =10.[16] This study has few limitations. To begin with, the partial nephrectomy group had a limited number of patients. Moreover, the non-randomized study design causes a substantial selection bias in the observed functional differences between PN and RN patients. As a result, the surgeon's preference on the basis of the patient's preoperative parameters could have influenced the choice of surgery. Another drawback of our study is that eGFR data was only collected up to 1 year after surgery. There was no data on crucial variables like warm and cold ischemia time, and oncological recurrence.

LIMITATIONS

This study has several limitations. Firstly, the relatively small sample size in the partial nephrectomy group may have limited the statistical power to detect differences in subgroups. Secondly, despite being prospective, the non-randomized design introduces potential selection bias, as surgical choice was influenced by tumor complexity and surgeon preference. Additionally, parameters such as warm

ischemia time, tumor complexity beyond the R.E.N.A.L score, and long-term oncological outcomes were not included in this analysis. Finally, the follow-up period of one year may be insufficient to evaluate late renal function outcomes following radical or partial nephrectomy.

CONCLUSION

Our findings imply that deterioration of renal functions and new-onset CKD was higher in patients undergoing radical nephrectomy than that of patients receiving partial nephrectomy. A greater decline in GFR was observed in patients with hypertension, diabetes, and ischemic heart disease undergoing radical nephrectomy for renal tumors. Consequently, partial nephrectomy should be considered as the surgical treatment for renal tumors whenever it is feasible, since it provides better renal function maintenance.

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Abdul Rehman: Interpretation of data
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Asad Shahzad: Oversight, guidance and mentorship

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