Original Article

Comparing the long-term prognosis and renal function changes of partial nephrectomy (PN) and radical nephrectomy (RN) in T1 stage renal cell carcinoma patients

Yudong Cao[1#^], Yushuang Cui[1#], Ruojing Li[1#], Xingxing Tang[1], Chen Lin[1], Xiao Yang[1], Jia Liu[1], Qiang Zhao[1], Jinchao Ma[1], Artur de Oliveira Paludo[2], Benjamin N. Schmeusser[3], Shuo Wang[1], Peng Du[1]

[1]Key Laboratory of Carcinogenesis and Translational Research (Ministry of Education), Department of Urology, Peking University Cancer Hospital & Institute, Beijing, China; [2]Department of Urology, Hospital Moinhos de Vento, Porto Alegre, Rio Grande do Sul, Brazil; [3]Department of Urology, Indiana University School of Medicine, Indianapolis, IN, USA

Contributions: (I) Conception and design: Y Cao, S Wang, P Du; (II) Administrative support: P Du; (III) Provision of study materials or patients: Y Cui, R Li; (IV) Collection and assembly of data: X Tang, C Lin, X Yang; (V) Data analysis and interpretation: Y Cui, R Li, J Liu, Q Zhao, J Ma; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Peng Du, MD; Shuo Wang, MD. Key Laboratory of Carcinogenesis and Translational Research (Ministry of Education), Department of Urology, Peking University Cancer Hospital & Institute, 52 Fucheng Road, Haidian District, Beijing 100142, China. Email: dupeng@bjmu.edu.cn; wangshuoarea@pku.org.cn.

Background: Radical nephrectomy (RN) and partial nephrectomy (PN) are common surgical treatments for T1 stage renal cell carcinoma (RCC). However, the long-term impact of these surgical approaches on prognosis and renal function remains an area of ongoing investigation. This study compared the effects of these procedures on prognosis and renal function.

Methods: The data of 1,030 T1 stage RCC patients treated at Peking University Cancer Hospital & Institute between January 2014 and August 2022 were analyzed. The primary endpoints of the study were overall survival (OS) and cancer-specific survival (CSS). The secondary endpoints included the annual mean estimated glomerular filtration rate (eGFR) and the average annual eGFR change rates.

Results: Based on a median follow-up time of 57 months, the OS and CSS rates were 96.6% and 98.5% in the overall cohort, respectively. The multivariate analysis identified age [hazard ratio (HR), 2.664; 95% confidence interval (CI): 1.147–6.192; P=0.02], tumor grade (HR, 2.247; 95% CI: 1.050–4.810; P=0.04), and surgical approach (HR, 2.585; 95% CI: 1.056–6.325; P=0.04) as adverse prognostic factors for OS, and age (HR, 4.603; 95% CI: 1.035–20.471; P=0.045) and tumor grade (HR, 4.972; 95% CI: 1.752–14.111; P=0.003) as adverse prognostic factors for CSS. Throughout the follow-up period, the eGFR of the RN patients showed a gradual increase, while that of the PN patients remained stable (P<0.001). Among the patients with preoperative diabetes, the eGFR of the RN patients decreased significantly compared to that of the PN patients (P=0.03).

Conclusions: T1 stage RCC has a favorable prognosis with surgery, and PN is an oncologically safe option. A persistent eGFR difference was observed between the PN and RN groups, with RN showing a gradual upward trend. However, patients with pre-existing diabetes experienced a greater decline in renal function after RN, which highlights the advantages of PN for such patients.

Keywords: Partial nephrectomy (PN); radical nephrectomy (RN); kidney cancer; renal function; chronic kidney disease (CKD)

^ ORCID: 0009-0009-5544-3339.

Submitted Jan 27, 2025. Accepted for publication Mar 18, 2025. Published online Mar 26, 2025.
doi: 10.21037/tau-2025-136
View this article at: https://dx.doi.org/10.21037/tau-2025-136

Introduction

Renal cell carcinoma (RCC) is a common malignant tumor, and is the 10th most common cancer in men (1). In 2022, there were more than 430,000 new cases of RCC and more than 150,000 RCC-related deaths worldwide (1). About 70% of patients are diagnosed at stage I, with approximately a 93% 5-year survival rate after surgical treatment. However, for patients with locally advanced or metastatic disease, the median survival is only 46 to 56 months (2). Depending on the tumor size, location, and each patient's specific condition, partial nephrectomy (PN) or radical nephrectomy (RN) are the standard treatment for RCC. Additionally, minimally invasive techniques such as robotic-assisted and laparoscopic surgeries have become the preferred approach for the early-stage RCC patients.

According to National Comprehensive Cancer Network guidelines, PN is recommended for all T1 tumors when technically feasible, and is not limited to patients with anatomical or functional solitary kidneys, bilateral renal tumors, or chronic kidney disease (CKD) (3). Several studies and meta-analyses have found no difference in the oncological outcomes of RN and PN (3-6). PN has several advantages over RN; for example, PN spares nephrons, subsequently preserving renal function and preventing progression to end-stage renal disease and cardiovascular events (CEs) caused by CKD (6-12). Additionally, RN is associated with a higher risk of new-onset hypertension and the worsening of pre-existing hypertension postoperatively (13). Some retrospective studies attribute the overall survival (OS) benefits of PN compared to RN to the preservation of renal function, which leads to reductions in renal and cardiovascular risks (6-9). However, other retrospective studies suggest that the differences in OS between the two surgical approaches may be influenced by baseline comorbidities, preoperative renal function, tumor staging, as well as the subjective judgment of the surgeons (12,14,15). Notably, the only prospective randomized clinical trial (EORTC 30904) conducted to date reported no difference in OS between PN and RN after a median follow-up period of 9.3 years (5). Further, in the EORTC 30904 study, while RN was found to be associated with an increased risk of CKD, this did not necessarily translate into poorer all-cause mortality (ACM) or higher cardiovascular-related deaths, and PN was not found to have a survival advantage over RN (5,16).

Given the conflicting results about the oncological and renal function outcomes of various studies, the present study sought to retrospectively analyze the single-center data of T1 RCC cases covering a period of over 8 years. The long-term prognosis and renal function outcomes were assessed, and the effects of different surgical approaches on survival and renal function were compared. We present this article in accordance with the STROBE reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-2025-136/rc).

Highlight box

Key findings
- Partial nephrectomy (PN) was oncologically safe for T1 renal cell carcinoma (RCC), and had comparable cancer-specific survival to radical nephrectomy (RN).
- The PN patients had a higher postoperative estimated glomerular filtration rate than the RN patients, indicating that PN preserved renal function better than RN.
- RN was associated with a significant decline in renal function in patients with pre-existing diabetes.

What is known, and what is new?
- Compared to RN, PN better preserves renal function and reduces risks of chronic kidney disease; however, evidence regarding its survival benefits remains inconclusive.
- This study identified RN as a risk factor for overall survival, and highlighted the superior renal outcomes of PN, particularly in diabetic patients.

What is the implication, and what should change now?
- PN should be considered for T1 RCC patients, especially those with diabetes or other renal risk factors, to prevent long-term renal dysfunction.
- Future prospective studies need to be conducted to confirm these findings and refine surgical decision making for T1 RCC.

Methods

Subject selection

This retrospective study collected the data of 1,084 patients with pathological T1a–T1b RCC who underwent RN

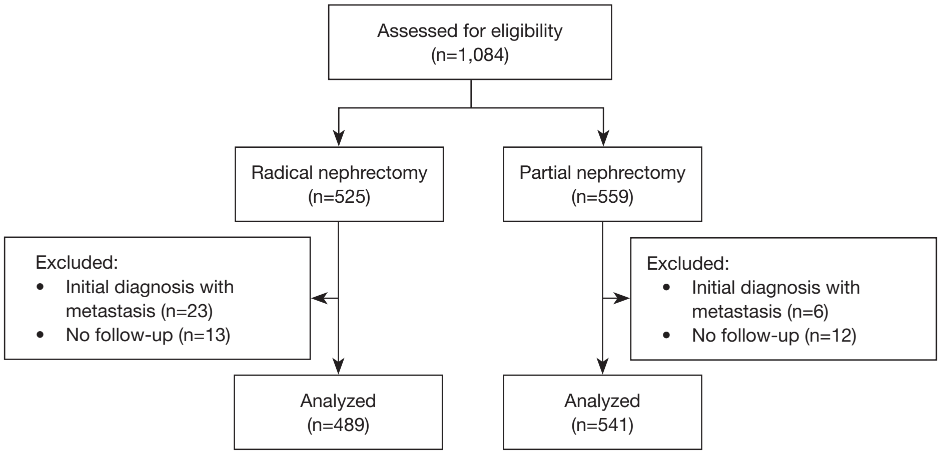

Figure 1 Diagram of the consolidated reporting research standards.

or PN at Peking University Cancer Hospital & Institute between January 2014 and August 2022. Of these patients, 54 were excluded because they met the following exclusion criteria: (I) had an initial diagnosis of metastasis (23 in the RN subgroup, six in the PN subgroup); and (II) were lost to follow-up (13 in the RN subgroup, 12 in the PN subgroup). Thus, ultimately, a total of 1,030 patients were enrolled in the study, of whom 489 underwent RN and 541 underwent PN (*Figure 1*). The surgical procedures and approaches were determined by urological surgeons based on the tumor location, individual patient circumstances, and the surgeons' clinical judgment. This study was approved by the Ethics Committee of Peking University Cancer Hospital & Institute (No. 2024YJZ127), and was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Informed consent was obtained from all participants.

Clinical and pathological data

The following clinical information was collected from the patients' medical records: age, gender, cell type, tumor grade, surgical method and preoperative complications. Tumor diameter was determined based on preoperative imaging and defined as the greatest tumor diameter in centimeters. Tumor-node-metastasis (TNM) stages were classified according to the 2017 American Joint Committee on Cancer. Tumor grade was classified according to the World Health Organization/International Society of Urological Pathology (WHO/IUSP) grading system (17). The serum creatinine (SC) of all patients was tested preoperatively and on the first postoperative day. The estimated glomerular filtration rate (eGFR) was calculated according to two study formula from the Modification of Diet in Renal Disease, referencing the formula from the EORTC Randomized Trial 30904 (16); eGFRs >150 mL/min/1.73 m^2 were set to 150 mL/min/1.73 m^2, as this equation tends to overestimate eGFRs with low SC values (18).

Outcomes and renal function analysis

The primary endpoints of this study were OS and cancer-specific survival (CSS). The secondary endpoints included eGFRs from 1 to 5 years postoperatively. The subgroup analyses focused primarily on the prognostic differences between the T1a and T1b subgroups.

The mean eGFR values for all patients in each treatment group and subgroup were calculated separately for each year of follow-up. Patients were divided into subgroups based on whether they had pre-existing hypertension, diabetes, or coronary artery disease preoperatively. For the patients with postoperative creatinine data available for more than 2 years, the average annual rate of change in the eGFR was determined by calculating the slope of a least-squares regression line fitted to the individual eGFRs over time (in years). These subject-specific average annual rates were summarized within each treatment group using medians and interquartile ranges (first and third quartiles).

For the sample size calculation in the subgroup analysis, we assumed an intergroup difference of 3 mL/min/1.73 m^2 (based on actual data, the difference between the two groups exceeded that). With an alpha level of 0.05 and a sample size of 30 per group, the calculated power under different standard deviation (SD) values (SD =2, 3) was consistently above 0.8.

Statistical analysis

R version 3.6.3 (R Foundation for Statistical Computing, Vienna, Austria) and SPSS software 27.0 (IBM Corp., Armonk, NY, USA) were used for the statistical analysis. The Student's *t*-test was used to compare groups, and Fisher's test was used to examine differences. Differences in the average annual rate of change in the eGFR between the groups were assessed using the Wilcoxon-Mann-Whitney test. The Kaplan-Meier method was used to estimate CSS and OS. Cox regression models were used to perform the univariate and multivariate survival analyses. In the univariate analysis, characteristics with a P value of less than 0.2 were considered potentially influential and were therefore included in the multivariate analysis. All the statistics were two-sided, and a P value <0.05 was considered statistically significant.

Results

Demographic, clinical, and pathological features

The demographic, clinical, and pathological characteristics of the 1,030 patients are presented in *Table 1*. Overall, the median age of the patients was 55.85±11.01 years, and 68.1% were male; no significant differences were found between the two surgical groups in terms of these characteristics. In terms of histopathology, 949 patients (92.1%) had clear cell carcinoma, 33 (3.2%) had chromophobe cell carcinoma, 34 (3.3%) had papillary RCC, and 14 (1.4%) had other histological types or unclassified types. Compared to the patients in the PN group, those in the RN group had higher tumor grades (P<0.001); 19.5% were classified as G3/4 patients in the RN group, while 10.2% were classified as G3/4 patients in the PN group. The RN group also had a more advanced pathological stage (P<0.001) and a larger tumor size (4.12±1.26 *vs.* 2.61±1.02 cm, P<0.001) than the PN group. In terms of the surgical approach, only 19 patients underwent open surgery (including three patients in the PN group: one due to lumbar spine disease preventing lateral decubitus positioning and two due to multiple tumors, later confirmed to be Von Hippel-Lindau syndrome). The remaining surgeries were performed using traditional laparoscopy. Of the patients, 403 (39.1%) had preoperative hypertension, 150 (14.6%) had diabetes, and 67 (6.5%) had coronary artery disease; however, no significant differences were observed between the two surgical groups in terms of these pre-existing conditions. In terms of renal function, the preoperative mean eGFR was 97.59±20.55 mL/min/1.73 m^2, and no significant difference was observed between the groups. Compared to the PN group, the RN group had a significantly lower eGFR on the first postoperative day (60.74±14.95 *vs.* 84.01±21.35 mL/min/1.73 m^2, P<0.001) and at the final follow-up (64.27±16.75 *vs.* 88.57±20.74 mL/min/1.73 m^2, P<0.001).

Outcomes

After a median follow-up of 57 months (range, 24–110 months), a total of 34 patients died, including 27 in the RN group and seven in the PN group (P<0.001; *Figure 2*). Among these, 15 patients experienced cancer-specific mortality, including 13 in the RN group and two in the PN group (P=0.003). Additionally, eight patients died due to cardiovascular diseases (five in the RN group and three in the PN group); two patients died from cerebrovascular diseases (both in the PN group); two patients died from other tumors that diagnosed after kidney surgery (one from lung cancer and the other from melanoma); and the cause of death was unknown for seven other patients. In the T1a subgroup, 18 patients died, including 12 in the RN group and six in the PN group (P=0.02). Of these, five cases were cancer-specific deaths, including three in the RN group and two in the PN group (P=0.27).

In the univariate analysis, age, tumor grade, tumor stage, and surgical approach were identified as risk factors for both CSS and OS (*Table 2*). In the multivariate analysis, age [hazard ratio (HR), 2.664; 95% confidence interval (CI): 1.147–6.192; P=0.02], tumor grade (HR, 2.247; 95% CI: 1.050–4.810; P=0.04), and surgical approach (HR, 2.585; 95% CI: 1.056–6.325; P=0.04) were identified as independent risk factors for OS. While age (HR, 4.603; 95% CI: 1.035–20.471; P=0.045) and tumor grade (HR, 4.972; 95% CI: 1.752–14.111; P=0.003) were identified as independent risk factors for CSS (*Table 3*).

Renal function analysis

All patients underwent renal function assessments preoperatively and on the first postoperative day. No significant difference was found between the RN and PN groups in terms of baseline renal function (95.13±19.99

Table 1 Demographic and clinical features of 1,030 kidney cancer patients

Variables	Total (n=1,030)	RN (n=489)	PN (n=541)	P value
Age (years)	55.85±11.01	57.23±10.68	54.60±11.16	0.16
Gender		489 (47.5)	541 (52.5)	0.38
Male	701 (68.1)	330 (67.5)	371 (68.6)	
Female	329 (31.9)	159 (32.5)	170 (31.4)	
Cell type				0.24
Clear cell	949 (92.1)	458 (93.7)	491 (90.8)	
Chromophobe cell	33 (3.2)	15 (3.1)	18 (3.3)	
Papillary renal cell	34 (3.3)	11 (2.2)	23 (4.3)	
Other type	14 (1.4)	5 (1.0)	9 (1.6)	
Grade				<0.001*
G1	209 (20.3)	68 (13.9)	141 (26.1)	
G2	608 (59.0)	302 (61.8)	306 (56.6)	
G3	126 (12.2)	77 (15.7)	49 (9.1)	
G4	15 (1.5)	13 (2.7)	2 (0.4)	
Other	72 (7.0)	29 (5.9)	43 (7.9)	
Tumor diameter (cm)	3.33±1.36	4.12±1.26	2.61±1.02	<0.001*
pT stage				<0.001*
pT1a	766 (74.4)	268 (54.8)	498 (92.1)	
pT1b	264 (25.6)	221 (45.2)	43 (7.9)	
Surgical method				<0.001*
Open surgery	19 (1.8)	16 (3.3)	3 (0.6)	
Laparoscopic surgery	1,011 (98.2)	473 (96.7)	538 (99.4)	
Preoperative complications				
Hypertension	403 (39.1)	201 (41.1)	202 (37.3)	0.22
Diabetes	150 (14.6)	64 (13.1)	86 (15.9)	0.20
Coronary heart disease	67 (6.5)	37 (7.6)	30 (5.5)	0.19
eGFR (mL/min/1.73 m^2)				
Preoperative	97.59±20.55	95.13±19.99	99.82±20.82	0.26
First day after surgery	72.90±21.90	60.74±14.95	84.01±21.35	<0.001*
Last follow-up	77.24±22.51	64.27±16.75	88.57±20.74	<0.001*

Data are presented as mean ± SD or n (%). *, statistically significant. eGFR, estimated glomerular filtration rate; PN, partial nephrectomy; RN, radical nephrectomy; SD, standard deviation.

vs. 99.82±20.82 mL/min/1.73 m^2, P=0.26). On the first postoperative day, the eGFR of the RN group was significantly lower than that of the PN group, with a difference of 26.45 mL/min/1.73 m^2 (60.74±14.95 *vs*. 84.01±21.35 mL/min/1.73 m^2, P<0.001). Similarly, at both the first year of the follow-up and the last follow-up, the eGFR of the RN group remained significantly lower than that of the PN group (first year: 62.93±16.14

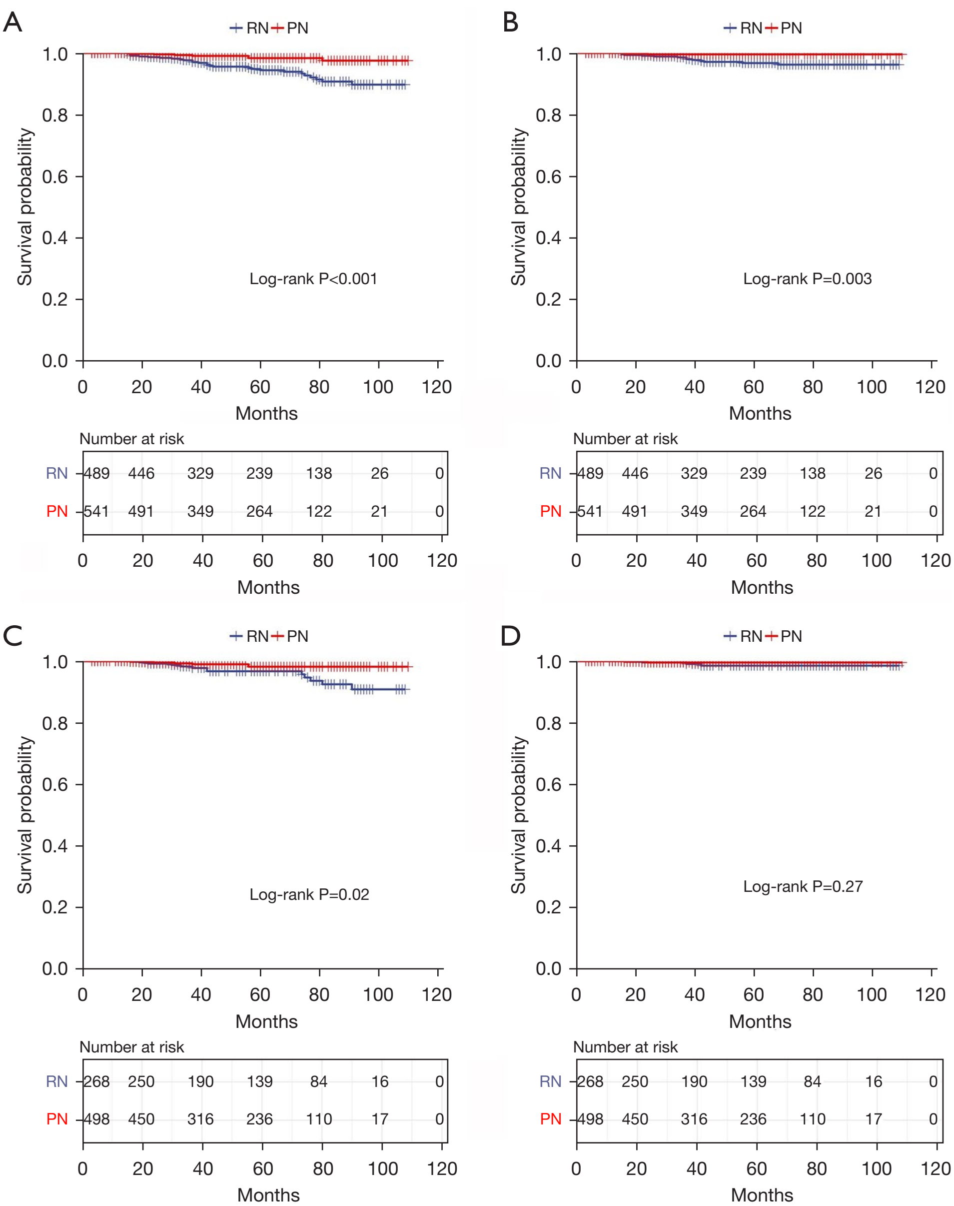

Figure 2 Impact of different surgical approaches on the prognosis of patients with T1 stage RCC. OS (A) and CSS (B) Kaplan-Meier curves by surgical approach (RN or PN) for the whole population. OS (C) and CSS (D) Kaplan-Meier curves by surgical approach (RN or PN) for the pT1a subgroup. CSS, cancer-specific survival; OS, overall survival; PN, partial nephrectomy; RCC, renal cell carcinoma; RN, radical nephrectomy.

vs. 88.77±21.61 mL/min/1.73 m^2, P<0.001; last follow-up: 64.27±16.75 *vs.* 88.57±20.74 mL/min/1.73 m^2, P<0.001). The mean annual eGFR values for each treatment arm during follow-up are summarized in *Figure 3* for both the overall cohort, and the preoperative hypertension, coronary artery disease, and diabetes subgroups. In the overall population, the median subject-specific annual eGFR rate was 1.02 (first quartile: −0.162; third quartile: +2.98) in the RN group, showing a slow upward trend, compared to 0.06 (first quartile: −3.157; third quartile: +2.777) in the PN group, which exhibited no significant change (P=0.001).

In the subgroup analyses, no significant differences in the median annual eGFR rates were observed between the RN and PN groups, when comparing the hypertension (P=0.93)

Table 2 Univariate Cox regression analysis of the correlation between different characteristics, and the CSS and OS of patients with T1 stage RCC

Characteristics	CSS		OS	
	HR (95% CI)	P value	HR (95% CI)	P value
Age (<55 *vs*. ≥55 years)	5.102 (1.151–22.617)	0.03*	3.078 (1.340–7.071)	0.008*
Gender (male *vs*. female)	0.543 (0.153–1.925)	0.34	0.878 (0.420–1.837)	0.73
Cell type (clear cell *vs*. other type)	0.044 (0.000–150.192)	0.45	0.334 (0.046–2.445)	0.28
Grade (G1–2 *vs*. G3–4)	7.285 (2.636–20.133)	<0.001*	2.977 (1.419–6.246)	0.004*
pT stage (pT1a *vs*. pT1b)	5.889 (2.013–17.229)	0.001*	2.602 (1.327–5.103)	0.005*
Hypertension (yes *vs*. no)	0.817 (0.279–2.390)	0.71	1.307 (0.664–2.572)	0.44
Diabetes (yes *vs*. no)	1.479 (0.417–5.242)	0.54	1.522 (0.663–3.495)	0.32
Coronary heart disease (yes *vs*. no)	1.058 (0.139–8.047)	0.96	1.872 (0.659–5.316)	0.24
Preoperative eGFR (≥90 *vs*. <90 mL/min/1.73 m^2)	0.421 (0.875–4.153)	0.632	1.769 (0.875–3.578)	0.112
Surgical approach (RN *vs*. PN)	7.167 (1.617–31.759)	0.01*	4.000 (1.741–9.190)	0.001*

*, statistically significant. CI, confidence interval; CSS, cancer-specific survival; eGFR, estimated glomerular filtration rate; HR, hazard ratio; OS, overall survival; PN, partial nephrectomy; RCC, renal cell carcinoma; RN, radical nephrectomy.

Table 3 Multivariate analysis of the CSS and OS of patients with T1 stage RCC

Variables	CSS		OS	
	HR (95% CI)	P value	HR (95% CI)	P value
Age (<55 *vs*. ≥55 years)	4.603 (1.035–20.471)	0.045*	2.664 (1.147–6.192)	0.02*
pT stage (pT1a *vs*. pT1b)	3.024 (0.938–9.749)	0.06	1.638 (0.79–3.396)	0.18
Grade (G1–2 *vs*. G3–4)	4.972 (1.752–14.111)	0.003*	2.247 (1.050–4.810)	0.04*
Preoperative eGFR (≥90 *vs*. <90 mL/min/1.73 m^2)	–	–	1.244 (0.605–2.558)	0.55
Surgical approach (RN *vs*. PN)	3.033 (0.601–15.304)	0.19	2.585 (1.056–6.325)	0.04*

*, statistically significant. CI, confidence interval; CSS, cancer-specific survival; eGFR, estimated glomerular filtration rate; HR, hazard ratio; OS, overall survival; PN, partial nephrectomy; RCC, renal cell carcinoma; RN, radical nephrectomy.

and coronary artery disease (P>0.99) subgroups. However, in the diabetes subgroup, the decrease in the eGFR was greater in the RN group than the PN group. The median annual eGFR rate of the RN group was −3.566 (first quartile: −4.878; third quartile: −1.109), while that of the PN group was −0.187 (first quartile: −2.636; third quartile: 1.396) (P=0.03).

Discussion

Early-stage RCC is a malignant disease with a favorable prognosis, and has a cure rate exceeding 90% following surgical treatment (2). In this study, the patients, all of whom were from a Chinese population, had an OS rate of 96.6% and a CSS rate of 98.5% over a median follow-up period of 57 months, which is consistent with previous findings on the prognostic outcomes of patients from various regions.

In relation to the surgical approach, the RN group had worse OS than the PN group in the overall cohort. Age, tumor grade, and surgical approach were identified as independent risk factors affecting OS. Several factors may have contributed to this outcome. First, the RN group had a significantly higher proportion of T1b tumors than the PN group (45.2% *vs*. 7.9%), which could have significantly affected the oncological outcomes and was likely the primary reason. However, in the multivariate analysis, even after adjusting for pT stage and other factors,

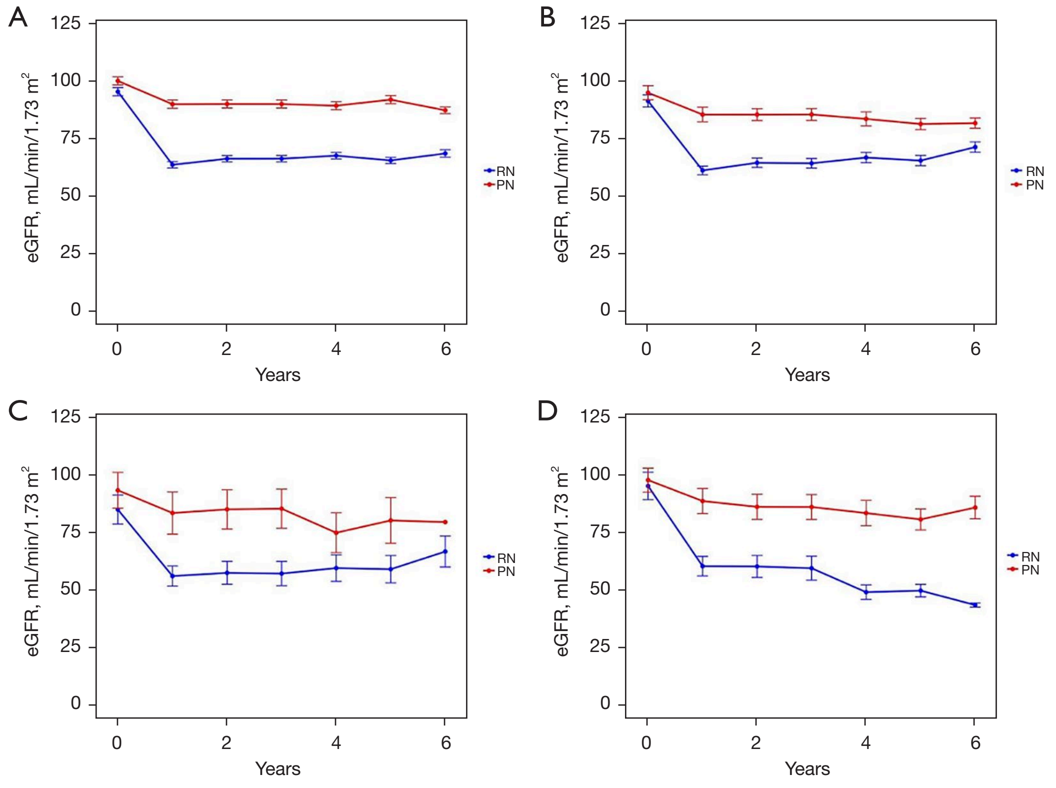

Figure 3 The mean annual eGFR values for each treatment arm during the follow-up in the overall cohort (A), preoperative existed hypertension (B), coronary artery disease (C), and diabetes (D) subgroups. eGFR, estimated glomerular filtration rate; PN, partial nephrectomy; RN, radical nephrectomy.

RN remained an independent poor prognostic factor for OS. The selection bias inherent in the retrospective study might explain this finding. Specifically, surgeons may favor RN for patients with poorer overall conditions or higher perioperative risks, as RN is associated with fewer perioperative complications, such as bleeding, urinary fistula, and thrombosis disease associated with prolonged bed rest, than PN, making it relatively safer (15).

However, our study found that there was no significant difference in the cancer-specific mortality between RN and PN in the T1a patients, suggesting that the oncological outcomes of PN and RN are similar. Additionally, only a few patients experienced postoperative metastasis instead of local recurrence, which further confirmed the reliability of PN in achieving effective local control.

In relation to renal function, there was no significant difference in the baseline eGFRs between the PN and RN groups, suggesting that preoperative renal function does not impact the surgical approach decision-making. However, a constant decline in the postoperative eGFR was observed in both groups, and the eGFR of the RN group consistently remained significantly lower than that of the PN group. The subgroup analyses revealed that the patients with diabetes experienced a continuous decline in the postoperative eGFR in the RN group. These findings suggest that for patients with preoperative comorbidities, RN may further exacerbate long-term renal dysfunction.

Previous studies have shown that PN offers a clear advantage over RN in preserving renal function, which might help mitigate the risk of long-term cardiovascular adverse events (7,19). This is also one of the reasons that surgeons opt for PN. However, in the only randomized controlled trial conducted to date, nearly 10 years of follow-up revealed no significant difference in cardiovascular mortality between the RN and PN groups, despite persistent disparities in the eGFR values and prevalence of CKD between the two groups (5,16). It may be that pre-existing medical conditions, such as diabetes, hypertension, and coronary artery disease, inherently elevate the postoperative cardiovascular risk which are not solely caused by surgery-induced renal function impairment (20). In support of this viewpoint, some studies have found that surgically induced CKD carries a lower long-term risk than medically induced CKD (20,21). Additionally, studies have indicated that PN is more beneficial for patients with lower baseline CKD levels (22,23). In this study, overall, the RN group had much lower eGFR values than the PN group, and this persisted over time. Similarly, the proportions of patients with preoperative hypertension, diabetes, and coronary artery disease were consistent with those reported in previous studies (20,21). In the subgroup analysis, among patients with diabetes, those who underwent RN experienced a progressively greater decline in eGFR compared to those who underwent PN, with the gap widening over time. A recent study suggests that postoperative immunonutritional status significantly impacts renal function recovery after RN (24). In patients with preoperative diabetes and potentially underlying metabolic syndrome, a heightened inflammatory state and significant nutritional risk may contribute to poorer postoperative renal function recovery after RN, which could be one of the reasons for the inferior renal outcomes observed in this subgroup in our study. This suggests that PN might be more beneficial for these patient subgroups.

There are several limitations in this study. First, as a retrospective analysis, it is inherently susceptible to selection bias. Surgical decisions for many early-stage patients might have been influenced by surgeons' subjective judgments based on the patients' overall condition and perceived risks of perioperative complications. Second, there is a lack of postoperative renal function data for a significant proportion of patients, resulting in potential data attrition and diminishing the robustness of the findings. Third, there is missing data on postoperative complications and other several comorbidities such as chronic obstructive pulmonary disease and heart failure for both surgical approaches. Finally, during our follow-up, the causes of non-cancer-related deaths in some patients were not clearly documented. Future prospective controlled studies need to be conducted to confirm and further validate these results.

Conclusions

Patients with early-stage renal cancer generally have a favorable prognosis with surgery. In T1 patients, age, tumor grade, and undergoing RN surgery were independent adverse prognostic factors for OS, while age and tumor grade were risk factors for CSS. Thus, PN is an oncologically safe option for the treatment of such patients. In terms of renal function, the patients who underwent PN showed a sustained benefit in terms of the eGFR compared to those who underwent RN, and this difference remained consistent across the overall population. Notably, the patients with pre-existing diabetes who underwent RN showed a more pronounced decline in long-term renal function, which suggests that PN is a more advantageous choice for such patients.

Acknowledgments

None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-2025-136/rc

Data Sharing Statement: Available at https://tau.amegroups.com/article/view/10.21037/tau-2025-136/dss

Peer Review File: Available at https://tau.amegroups.com/article/view/10.21037/tau-2025-136/prf

Funding: This research was supported by the Beijing Hospitals Authority Innovation Studio of Young Staff Funding Support (No. 202325) and the Beijing Hospitals Authority's Ascent Plan (No. DFL20241101).

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-2025-136/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Peking University Cancer Hospital & Institute (No. 2024YJZ127) and informed consent was taken from all the patients.

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(English Language Editor: L. Huleatt)

Cite this article as: Cao Y, Cui Y, Li R, Tang X, Lin C, Yang X, Liu J, Zhao Q, Ma J, de Oliveira Paludo A, Schmeusser BN, Wang S, Du P. Comparing the long-term prognosis and renal function changes of partial nephrectomy (PN) and radical nephrectomy (RN) in T1 stage renal cell carcinoma patients. Transl Androl Urol 2025;14(3):740-750. doi: 10.21037/tau-2025-136

