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Partial versus radical nephrectomy for T1b renal cell carcinoma: A comparison of efficacy and prognostic factors based on the Surveillance, Epidemiology, and End Results database

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Abstract

Objectives: This study compared the long-term efficacy and prognostic factors of partial nephrectomy (PN) and radical nephrectomy (RN) for T1bN0M0 renal cell carcinoma (RCC) using data from the Surveillance, Epidemiology, and End Results database.

Materials and methods: We retrospectively analyzed the clinical data of 12,471 patients diagnosed with T1bN0M0 RCC from the Surveillance, Epidemiology, and End Results database between 2010 and 2019. Patients were divided into the PN and RN groups, and propensity score matching was conducted to balance the differences between the groups. We compared overall survival (OS), RCC cancer–specific mortality (CSM), and noncancer-specific mortality (NCSM) between the 2 groups. The risk factors for all-cause and RCC-related mortality were analyzed.

Results: After propensity score matching, there were 3817 patients in each group. After matching, OS and NCSM were significantly longer in the PN group ($p < 0.001$); however, there was no significant between-group difference in the RCC-CSM. The hazard ratio (HR) for all-cause mortality was significantly lower in the PN group (HR, 0.671; 95% confidence interval [CI], 0.579–0.778, $p < 0.001$), but PN was not associated with lower RCC-related mortality. Subgroup analysis showed that PN reduced the HR of all-cause mortality by 35% (HR, 0.647; 95% CI, 0.536–0.781; $p < 0.001$) in patients with 4.0- to 5.5-cm tumors compared with RN and by 29% (HR, 0.709; 95% CI, 0.559–0.899; $p = 0.004$) in those with larger tumors (5.6–7.0 cm). Multifactorial analysis showed that PN was an independent predictor of OS (HR, 0.671; 95% CI, 0.579–0.778; $p < 0.001$). In addition, multivariate analysis validated that age at diagnosis, sex, pathological grade, and tumor size were associated with outcomes.

Conclusions: In patients with T1b RCC, PN resulted in better OS and NCSM outcomes than RN. The benefit of PN in all-cause mortality was pronounced in patients with 4.0–5.5 cm tumor loads. Therefore, individualized treatment schemes should prioritize PN, when technically feasible.

Keywords: T1b renal cell carcinoma; Partial nephrectomy; Radical nephrectomy; Survival prognosis

1. Introduction

Renal cell carcinoma (RCC) accounts for 2%–3% of all adult malignancies and is most common in people aged 50–70 years, with a higher prevalence in men than in women.[1] In recent years, improving health awareness and broad applications of imaging examinations have increased the proportion of small RCCs.[2] Traditionally, RCC is not sensitive to radiotherapy or chemotherapy.[3] Many novel drugs have emerged for the treatment of RCC, including targeted therapies and immunotherapy-related drugs; however, they are only used in patients with locally advanced or metastatic RCC.[4] The standard treatment for localized RCC (T1–2N0M0) is primary tumor resection. Therefore, the choice of the surgical approach is of clinical significance. Partial nephrectomy (PN) and radical nephrectomy (RN) are effective methods for treating localized RCC. With the improvement of surgical instruments, the accumulation of surgical experience, and the emergence of various biomarker-free techniques, such as the use of Hem-o-lok clips or the suture of the renal parenchyma with barb wires.[5] In addition to recently emerged techniques, Avitan et al.[6] demonstrated that the use of tissue sealant during tumor bed reconstruction is associated with reduced devascularized parenchymal mass loss. These techniques have significantly shortened the surgical time, resulting in a gradual increase in the rate of PN application in RCC.[7] Preserving kidney function and reducing postoperative noncancer-specific mortality (NCSM) (including chronic kidney disease and cardiovascular diseases) are some of the most beneficial advantages of PN,[8] making it the standard procedure for treating T1a RCC.[9] Currently, the optimal surgical approach for T1b (4–7 cm) remains controversial. Some studies have shown no significant differences in survival, prognosis, and oncological outcomes in patients with T1b RCC who received PN or RN.[10]

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Thompson et al.[11] studied 1159 patients with T1b RCC and compared the efficacy of PN and RN, showing no significant difference in overall survival (OS) ($p > 0.05$). The only randomized controlled trial included 541 patients randomized to the PN or RN group; the average long-term follow-up of 9.3 years showed a 10-year OS rate of 81.1% in the RN group and 75.7% in the PN group.[12] The study concluded that the OS rate was lower in the PN group than in the RN group. Notably, 39 of the 268 patients (14.6%) randomly assigned to PN eventually received RN, and the study enrolled only 541 patients, which is short of the original target of 1300. However, several studies have reached different conclusions. A systematic review and meta-analysis by Zhang et al.[13] comprising 13 retrospective cohort studies showed that PN could better protect renal function and was superior in terms of RCC-related mortality, all-cause mortality, and oncological outcomes. However, most studies have limitations such as small sample size, short follow-up time, and selection bias. At present, numerous cases of patients with T1b RCC receiving PN have been reported; therefore, it is necessary to discuss whether PN is superior to RN. This study aimed to compare the OS, RCC cancer–specific mortality (RCC-CSM), and NCSM of PN and RN in patients with T1b RCC using the Surveillance, Epidemiology, and End Results (SEER) database. These results will help nephron-sparing surgeries dominate this debate and provide evidence-based medical evidence for recent surgical decisions.

2. Materials and methods

2.1. Ethics statement

The data published in the SEER database are anonymous and do not require informed patient consent; therefore, this study did not require an ethics statement.

2.2. Study population

We obtained data from T1bN0M0 RCC patients diagnosed between 2010 and 2019 from 17 registries of the SEER database, according to the surgical procedure, and divided them into PN and RN groups. Data were downloaded from SEER*STAT software (v8.4.1; National Cancer Institute, Bethesda, MD) in February 2023.

2.3. Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) diagnosed between 2010 and 2019; (2) histologically confirmed RCC (ICD-O-3 site code C64.9), and (3) pathological diagnosis of T1bN0M0. The exclusion criteria were as follows: (1) surgery other than PN or RN; (2) important information unknown such as pathological grade, tumor size, and diagnosis; (3) rare pathological types (such as collecting duct carcinoma, renal medullary carcinoma, and cystic RCC); (4) bilateral tumors; (5) adjuvant therapy (patients with T1b RCC are not sensitive to adjuvant therapy); and (6) combination of other tumors.

2.4. Observed indicators

Observations included sex, age, tumor partiality, pathological grade, pathological type, tumor size, and surgical approach. The primary outcomes were OS, RCC-CSM, and NCSM. The secondary study outcomes were risk factors affecting all-cause and RCC-related mortality.

2.5. Statistical analysis

All statistical analyses were performed using R version 4.0.3 (R Core Team, Auckland, New Zealand). All data were categorical variables, and the χ^2 test was used to compare groups. Propensity score matching matched patients to the PN or RN group in a 1:1 ratio with a caliber of 0.05. Kaplan-Meier survival analysis was used to compare OS, and log-rank tests were used to determine the significance of the differences. The cumulative incidence function was used to compare the RCC-CSM and NCSM, and the Fine and Gray test was used to determine the significance of the differences. Multivariate Cox proportional hazards regression analyses were used to analyze the risk factors for all-cause mortality, and competing risk proportional hazards regressions were used to analyze the risk factors for RCC-related mortality. Tumor size was grouped for subgroup analysis to compare the risk factors affecting survival.

3. Results

3.1. Study population characteristics

After screening procedure, 12,471 T1bN0M0 RCC cases were identified (Fig. 1). Before matching, 3940 (31.6%) and 8531 (68.4%) patients underwent PN and RN, respectively. Significant differences were observed between the PN and RN groups in sex, age, tumor location, tumor size, pathological grade, and pathological type. Compared with patients receiving RN, those receiving PN had a smaller tumor size, lower pathological grade, lower percentage of clear cell carcinoma, and higher percentage of patients younger than 65 years. After propensity score matching using 1:1 nearest neighbor matching (caliber = 0.05), all statistically significant covariates achieved a good balance among the matched groups with 3817 patients in both the PN and RN groups (Table 1). From the data in the SEER database, RN remained the primary surgery for patients with T1bN0M0 RCC between 2010 and 2019; however, PN showed an overall increasing trend, from 22.6% in 2010 to 34.8% in 2019 (Fig. 2).

3.2. Survival analysis

After matching, the median follow-up durations were 49 (95% confidence interval [CI], 47–50) months and 54 (95% CI, 52–56) months for the PN and RN groups, respectively. There were 745 (9.8%) deaths during the follow-up period, with 451 and 294 deaths in the RN and PN groups, accounting for 60.5% and 39.5% of the total deaths, respectively. Among them, 251 deaths from RCC accounted for 33.7% of the total deaths, 141 and 110 deaths from RN and PN accounted for 56.2% and 43.8% of RCC-related mortality, respectively. Cardiovascular disease accounted for 22% of the total deaths in 164 patients, compared with 106 (79%) in the RN group and 58 (21%) in the PN group. After matching, the RN group had significantly higher all-cause mortality, RCC-related mortality, and cardiovascular disease–related deaths than the PN group. Both before and after matching, the OS of the PN group was significantly higher than that of the RN group ($p < 0.001$). After matching, the 5- and 9-year OS rates in the RN group were 86.8% and 76.2%, while the 5- and 9-year OS rates in the PN group were higher than those in the RN group (90.9% and 82.8%, respectively) (Fig. 3).

Death from RCC was an outcome event, whereas death from other noncancer diseases was a competing event. In both the PN and RN groups, the cumulative incidence of RCC-CSM over time was much lower than that of NCSM. The cumulative incidences of RCC-CSM and NCSM in the PN group were lower than those in the RN group. After matching, the RN group's 5- and 9-year incidence of NCSM was 8.9% and 16.9%, respectively. In contrast, the 5- and 9-year cumulative incidences in the PN group was lower than in the RN group (5.8% and 11.1%, respectively; $p < 0.001$). The cumulative incidence of RCC-CSM in the PN group was lower than in the RN group after matching; however, the difference was not statistically significant ($p = 0.162$) (Fig. 4).

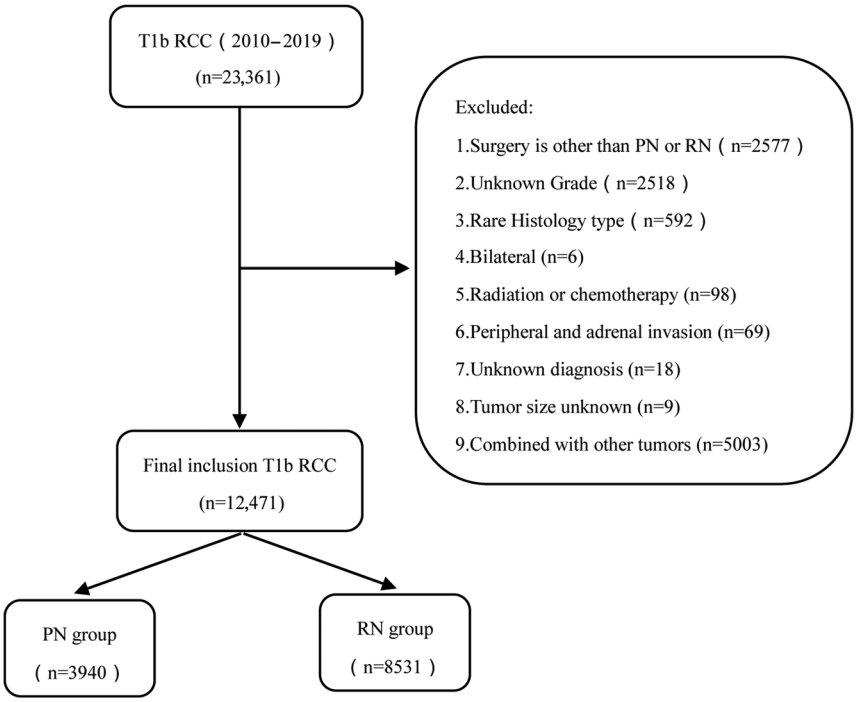

Figure 1. Flow chart of data inclusion and exclusion for patients with T1bN0M0 RCC. PN = partial nephrectomy; RCC = renal cell carcinoma; RN = radical nephrectomy.

After matching, the all-cause mortality risk of PN for T1b RCC patients is lower than that in RN (HR, 0.671; 95% CI, 0.579–0.778; $p < 0.001$). There was no significant difference in the risk of RCC-related mortality between the 2 groups (HR, 0.799; 95% CI, 0.621–1.03; $p = 0.082$). The multivariable Cox proportional hazards regressions suggested that age >65 years (HR, 2.946; 95% CI, 2.548–3.407; $p < 0.001$), male sex (HR, 1.192; 95% CI, 1.017–1.395; $p = 0.029$), Grade IV (HR, 2.505; 95% CI, 1.705–3.681; $p < 0.001$), tumor size 5.6–7.0 cm (HR, 1.268; 95% CI, 1.093–1.471; $p = 0.002$), RN (HR, 0.671; 95%

Table 1

Clinical characteristics of patients with T1bN0M0 RCC.

	Before propensity score matching			After propensity score matching		
Characteristics	**RN (n = 8531)**	**PN (n = 3940)**	***p***	**RN (n = 3817)**	**PN (n = 3817)**	***p***
Sex, n (%)			<0.001			1.000
Male	5186 (60.8)	2632 (66.8)		2513 (65.8)	2514 (65.9)	
Female	3345 (39.2)	1308 (33.2)		1304 (34.2)	1303 (34.1)	
Age, n (%)			<0.001			0.882
≤65 yrs	5485 (64.3)	2703 (68.6)		2624 (68.7)	2631 (68.9)	
>65 yrs	3046 (35.7)	1237 (31.4)		1193 (31.3)	1186 (31.1)	
Laterality, n (%)			0.027			0.749
Left	4330 (50.8)	1915 (48.6)		1874 (49.1)	1889 (49.5)	
Right	4201 (49.2)	2025 (51.4)		1943 (50.9)	1928 (50.5)	
Tumor size, n (%)			<0.001			1.000
40–55 mm	4358 (51.1)	2723 (69.1)		2599 (68.1)	2600 (68.1)	
56–70 mm	4173 (48.9)	1217 (30.9)		1218 (31.9)	1217 (31.9)	
Grade, n (%)			<0.001			0.842
Grade I	781 (9.2)	435 (11.0)		424 (11.1)	423 (11.1)	
Grade II	4791 (56.2)	2270 (57.6)		2177 (57.0)	2177 (57.0)	
Grade III	2569 (30.1)	1118 (28.4)		1112 (29.1)	1100 (28.8)	
Grade IV	390 (4.6)	117 (3.0)		104 (2.7)	117 (3.1)	
Histology type, n (%)			<0.001			0.879
Clear-cell	6309 (74.0)	2576 (65.4)		2601 (68.1)	2576 (67.5)	
Papillary	849 (10.0)	770 (19.5)		648 (17.0)	650 (17.0)	
Chromophobe	391 (4.6)	205 (5.2)		199 (5.2)	202 (5.3)	
Renal-cell	982 (11.5)	389 (9.9)		369 (9.7)	389 (10.2)	

PN = partial nephrectomy; RCC = renal cell carcinoma; RN = radical nephrectomy.

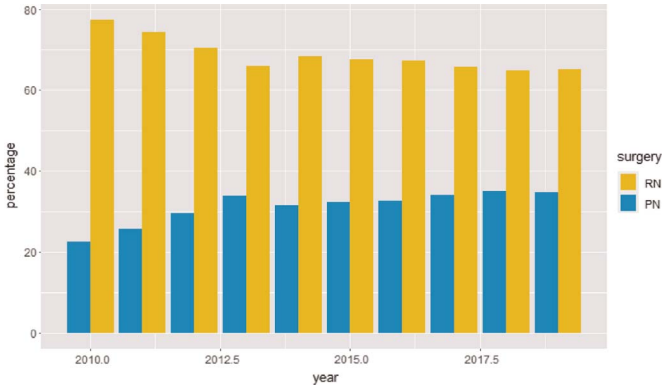

Figure 2. The proportion of treatment with the year at diagnosis in patients with T1bN0M0 RCC. PN = partial nephrectomy; RCC = renal cell carcinoma; RN = radical nephrectomy.

CI, 0.579–0.778; $p < 0.001$) were independent risk factors for all-cause mortality. The competing risk proportional hazards regressions suggested that age >65 years (HR, 2.507; 95% CI, 1.942–3.23; $p < 0.001$), Grade III (HR, 3.251; 95% CI, 1.727–6.12; $p < 0.001$), Grade IV (HR, 10.74; 95% CI, 5.288–21.81; $p < 0.001$), and tumor size 5.6–7.0 cm (HR, 1.674; 95% CI, 1.301–2.15; $p < 0.001$) were independent risk factors for RCC-related mortality (Table 2).

Tumor size was divided into a 4.0- to 5.5-cm group and a 5.6- to 7.0-cm group. In the group with small tumor size (4.0–5.5 cm), PN reduced the all-cause mortality risk by 35% compared with RN (HR, 0.647; 95% CI, 0.536–0.781, $p < 0.001$), in the group with larger tumor size (5.6–7.0 cm), PN reduced the all-cause mortality by 29% compared with RN (HR, 0.709; 95% CI, 0.559–0.899; $p = 0.004$). Regardless of tumor size, there was no significant difference in RCC-related mortality between the two surgical approaches (Tables 3, 4).

4. Discussion

In this study, we found that in patients with T1b RCC, both PN and RN achieved an extended prolonged survival, indicating that surgical treatment of T1b RCC has a good prognosis. The shortest follow-up was 1 month, and the longest follow-up was 11.9 years. A superior outcome of PN over RN was observed before matching. After matching, the 5- and 9-year OS rates were significantly higher in the PN group than those in the RN group. Cai et al.[14] retrospectively analyzed 199 patients with T1 RCC and obtained similar survival outcomes. We can observe from the Kaplan-Meier survival curves that the gap between the 2 curves is increasing, with far more deaths in the RN group than in the PN group over time. Multifactorial Cox regression analysis revealed that PN was an independent predictor of OS. Weight et al.[15] also found that PN was an independent predictor of OS in a retrospective analysis of 510 patients with T1b RCC (HR, 0.30). In this study, we observed that 28.9% of those >65 years of age received PN and 33% of those ≤65 years of age received PN, which may be related to the poor tolerance of surgery by patients with more combined underlying base diseases in older generations. Among patients with a tumor size of 4.0–5.5 cm, 36.9% underwent PN; among patients with 5.6–7.0 cm, 21.4% underwent PN. Larger tumors increase the difficulty of performing PN because of the tumor location (such as endogenous renal cancer) and short postoperative residual nephrons, which limit the use of PN. The multifactorial Cox proportional risk model suggested that age >65 years, male sex, Grade IV disease, tumor size of 5.6–7.0 cm, and RN were risk factors for all-cause mortality, similar to the conclusion reached by Lee et al.[16] that age, tumor size, pathological grade, and pathological stage were independent predictors of all-cause mortality.

The graph of the cumulative incidence showed that the incidence of NCSM was higher than that of RCC-CSM over time after surgery in both the PN and RN groups. After matching, the 5- and 9-year RCC-CSM rates in patients receiving PN were 3.3% and 6.1%, respectively, whereas the NCSM rates were 5.8% and 11.1%, respectively. The 5- and 9-year cumulative incidence rates

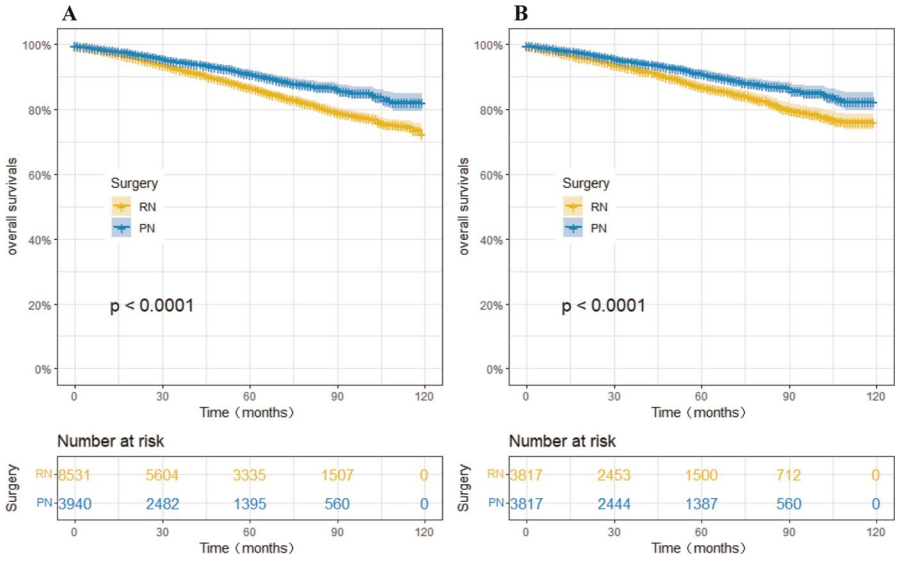

Figure 3. Kaplan-Meier survival curves demonstrating patients "overall survivals according to patients" nephrectomy modalities (partial vs. radical), log-rank test to calculate the p value; the number of people at risk at different times; before propensity score matching (A), after propensity score matching (B). PN = partial nephrectomy; RN = radical nephrectomy.

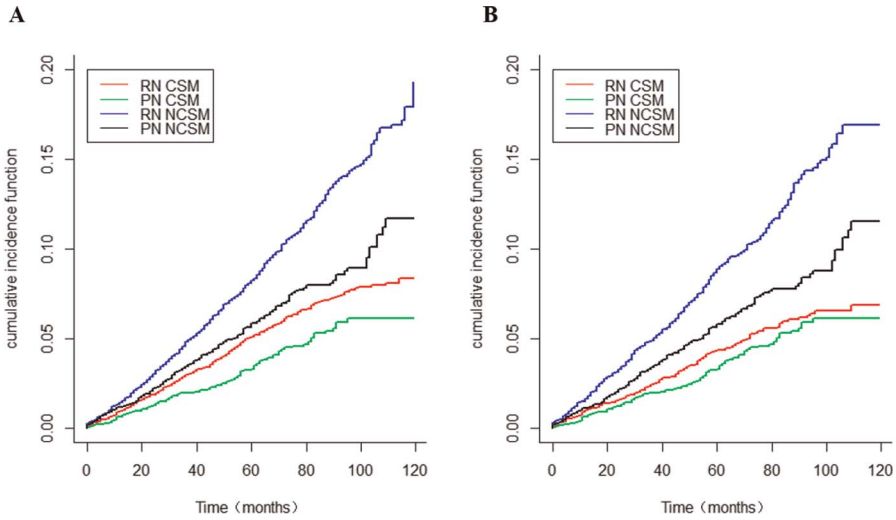

Figure 4. Cumulative incidence function of RCC CSM and NCSM in the T1b RCC PN group versus RN group; before propensity score matching (A), after propensity score matching (B). CSM = cancer-specific mortality; NCSM = noncancer-specific mortality; PN = partial nephrectomy; RCC = renal cell carcinoma; RN = radical nephrectomy.

of RCC-CSM in patients receiving RN were 4.3% and 6.5%, respectively. The cumulative incidences of NCSM were 8.9% and 16.9%, respectively. Renal cell carcinoma-CSM ($p = 0.162$) and NCSM ($p < 0.001$) in the PN group were lower than in the RN group. The competitive risk regression model also showed that PN was an independent predictor of RCC-CSM (HR, 0.787; 95% CI, 0.631–0.981; $p = 0.033$). The most significant proportion of NCSM due to cardiovascular disease was 21.4% (290/1355), indicating that PN reduces the risk of cardiovascular disease–related death, which is also consistent with the findings of Capitanio et al.[17] that the risk of cardiovascular events after renal surgery is reduced if a portion of the affected kidney is preserved.

Subgroup analysis was performed according to the tumor size. The results showed that patients with lower tumor loads benefited more significantly from PN in terms of OS. Regardless of tumor size, there was no significant difference in RCC-CSM. This indicates that there was no significant difference between the 2 surgeries in postoperative tumor recurrence, similar to the conclusion of Zhang et al.,[18] who believed that neither surgery could completely clear the satellite lesion; regardless of whether the surgical margin was positive or negative, the influence on recurrence or metastasis was not significantly different. There may be an underlying satellite lesion; therefore, whether positive surgical margins are a risk factor for RCC recurrence remains controversial.[19]

Partial nephrectomy should not only consider the feasibility of the surgeon's technique but also evaluate whether residual renal function can play a meaningful role in reducing the incidence of chronic kidney disease and cardiovascular mortality.[20–23]

Table 2

Multivariable Cox proportional hazards regressions and competing risk proportional hazards regressions for patients with T1b RCC after PSM.

	Multivariable Cox proportional hazards regressions			Competing risk proportional hazards regressions		
Variables	**HR**	**95% CI**	***p***	**HR**	**95% CI**	***p***
Sex						
Male (reference: female)	1.192	1.017–1.395	0.029	1.224	0.923–1.62	0.16
Age						
>65 (reference: ≤65)	2.946	2.548–3.407	<0.001	2.507	1.942–3.23	<0.001
Laterality						
Right (reference: left)	0.895	0.775–1.033	0.13	0.822	0.640–1.05	0.12
Tumor size						
56–70 mm (reference: 40–55 mm)	1.268	1.093–1.471	0.002	1.674	1.301–2.15	<0.001
Grade						
Grade II (reference: grade I)	1.015	0.787–1.308	0.911	1.816	0.972–3.39	0.061
Grade III (reference: grade I)	1.242	0.952–1.621	0.11	3.251	1.727–6.12	<0.001
Grade IV (reference: grade I)	2.505	1.705–3.681	<0.001	10.74	5.288–21.81	<0.001
Histology type						
Renal-cell (reference: clear-cell)	1.122	0.89–1.415	0.33	1.211	0.811–1.81	0.35
Chromophobe (reference: clear-cell)	0.765	0.537–1.09	0.138	0.472	0.217–1.03	0.059
Papillary (reference: clear-cell)	1.094	0.91–1.316	0.339	1.086	0.795–1.48	0.61
Nephrectomy type						
PN (reference: RN)	0.671	0.579–0.778	<0.001	0.799	0.621–1.03	0.082

CI = confidence interval; HR = hazard ratio; PN = partial nephrectomy; PSM = propensity score matching; RCC = renal cell carcinoma; RN = radical nephrectomy.
Histology type = renal cell carcinoma without further classification.

Table 3

Multivariable Cox proportional hazards regressions for different tumor sizes.

	4.0–5.5 cm			5.6–7.0 cm		
Variables	**HR**	**95% CI**	***p***	**HR**	**95% CI**	***p***
Sex						
Male (reference: female)	1.168	0.956–1.427	0.128	1.238	0.955–1.6	0.107
Age						
>65 (reference: ≤65)	2.745	2.283–3.3	<0.001	3.308	2.606–4.198	<0.001
Laterality						
Right (reference: left)	0.905	0.754–1.088	0.288	0.869	0.688–1.098	0.24
Grade						
Grade II (reference: grade I)	0.949	0.699–1.287	0.735	1.167	0.735–1.852	0.061
Grade III (reference: grade I)	1.149	0.83–1.59	0.403	1.442	0.898–2.315	0.13
Grade IV (reference: grade I)	2.359	1.4–3.97	0.001	2.79	1.525–5.106	<0.001
Histology type						
Renal-cell (Reference: clear-cell)	1.138	0.847–1.59	0.39	1.123	0.771–1.636	0.546
Chromophobe (reference: clear-cell)	0.653	0.394–1.08	0.097	0.917	0.555–1.515	0.059
Papillary (reference: clear-cell)	1.2	0.948–1.527	0.128	0.955	0.713–1.279	0.757
Nephrectomy type						
PN (reference: RN)	0.647	0.536–0.781	<0.001	0.709	0.559–0.899	0.004

CI = confidence interval; HR = hazard ratio; PN = partial nephrectomy; RN = radical nephrectomy.
Histology type = renal cell carcinoma without further classification.

Therefore, maximizing the preservation of T1b RCC to preserve nephrons to the maximum extent without compromising the postoperative tumor recurrence and OS time of patients while ensuring the effect of tumor control.[24] Postoperative complications are also essential for evaluating surgical efficacy. According to the data in this study, 61.2% and 38.8% of the patients in the RN and PN groups died within 90 days after matching, respectively, suggesting that short-term complications were much higher in the RN group than in the PN group. The incidence of postoperative complications such as bleeding and urinary leakage is often higher when PN is performed for T1b RCC in a complex anatomical position. This also increases the incidence of positive margins.[25] Therefore, strict preoperative screening is required when performing PN for T1b RCC and close follow-up should be performed within 90 days of surgery.

Although several previous studies have investigated the optimal surgical approach for T1b RCC using the SEER database, our study adds value to the existing literature in several ways. We conducted a propensity score–matching analysis, including a larger sample size, and evaluated several endpoints. These unique findings provide additional insights into the optimal surgical approach for patients with T1b RCC.

However, it should be noted that the SEER database has certain limitations, including potential selection bias, missing data, and a lack of granularity in some variables. These limitations could potentially affect the validity and generalizability of our findings. Specifically, the data were retrospective, resulting in inevitable

Table 4

Competing risk proportional hazards regressions for different tumor sizes.

	4.0–5.5 cm			5.6–7.0 cm		
Variables	**HR**	**95% CI**	***p***	**HR**	**95% CI**	***p***
Sex						
Male (reference: female)	1.146	0.786–1.67	0.48	1.324	0.865–2.03	0.2
Age						
>65 (reference: ≤65)	2.411	1.709–3.4	<0.001	2.642	1.804–3.87	<0.001
Laterality						
Right (reference: left)	0.896	0.638–1.26	0.53	0.735	0.508–1.06	0.1
Grade						
Grade II (reference: grade I)	1.63	0.739–3.59	0.23	2.174	0.777–6.08	0.14
Grade III (reference: grade I)	3.158	1.411–7.07	<0.001	3.52	1.248–9.93	0.017
Grade IV (reference: grade I)	10.745	4.169–27.74	<0.001	11.182	3.697–33.82	<0.001
Histology type						
Renal-cell (reference: clear-cell)	1.16	0.663–2.03	0.6	1.28	0.717–2.28	0.4
Chromophobe (reference: clear-cell)	0.569	0.205–1.58	0.28	0.389	0.119–1.28	0.12
Papillary (reference: clear-cell)	1.226	0.794–1.89	0.36	0.934	0.597–1.46	0.77
Nephrectomy type						
PN (reference: RN)	0.857	0.609–1.21	0.38	0.735	0.506–1.07	0.11

CI = confidence interval; HR = hazard ratio; PN = partial nephrectomy; RN = radical nephrectomy.
Histology type = renal cell carcinoma without further classification.

selection bias. Second, the SEER database lacks critical information on relevant tumors and clinics, which may have biased our results. Preoperative kidney function was unknown, limiting the balance of preoperative kidney function in both the PN and RN groups. Poor kidney function is associated with a high risk of cardiovascular disease and all-cause mortality. Therefore, the role of PN may have been underestimated if there were a high percentage of patients with poor preoperative kidney function in the PN group. The location of the tumor (e.g., endogenous or peripheral) is unknown and is critical for the selection of PN or RN. Blood loss, warm ischemic time, and postoperative complication rates are relatively high when PN is performed for completely endogenous renal tumors. However, the surgical margin status was unknown. If the surgical margins are positive, there is a higher risk of tumor recurrence, which is associated with a poorer prognosis. Patient comorbidities and performance statuses were unknown. Suppose that the patient's preoperative comorbidities, such as diabetes, hypertension, coronary artery disease, and other chronic diseases, are not eliminated. In such cases, this increases the risk of perioperative complications and affects patient prognosis. Whether the surgical technique was open, laparoscopic, or robot-assisted was unknown. This study compared the benefits of PN versus RN for T1bRCC patients with other relatively matched conditions and demonstrated that PN is superior when performed under similar conditions. Therefore, all included patients were diagnosed with pathological stage T1b. However, there are patients with a preoperative clinical stage of T1b and postoperative pathological deficiency upgraded to T3 or distant metastases in the clinic. Therefore, the applicability of the current findings to all patients with clinical stage T1b disease is limited. We acknowledge that several important clinical and pathological variables, including tumor location, surgical technique, and margin status, were not included in our analysis. Future studies that incorporate these variables in the analysis may yield additional insights into the efficacy and prognostic factors of partial and radical nephrectomy in T1b RCC. Despite the limitations of this study, it provides a certain amount of evidence for the application of PN in T1b RCC. These limitations should be addressed in future prospective randomized clinical trials.

5. Conclusions

Patients with T1b RCC can obtain better oncological outcomes and OS with PN than with RN, and the difference was statistically significant. Age >65 years, higher tumor Grade (Grade IV), and tumor size 5.6–7.0 cm were co-independent risk factors for all-cause and RCC-related mortality. The PN of patients with lower tumor loads benefited more significantly from all-cause mortality. Except for complex renal tumors that are difficult to treat, PN is recommended for T1b RCC patients when technically feasible.

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None.

Statement of ethics

The data published in the SEER database are anonymous and do not require informed patient consent; therefore, this study did not require an ethics statement. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of interest statement

JL is an Associate Editor and FW is one member of Editorial Board of Current Urology. This article was accepted after normal external peer review. The other authors have declared no conflict of interest.

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Author contribution

JL, HN, KR: Conceived and designed the study;
JJL, HN, FW, HW, KR: Collected the data and analyzed the data;
KR: Drafted the manuscript;
FW: Reviewed and edited the manuscript and supervised the research;
All authors contributed to the article and approved the submitted version.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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