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Original article

Can partial nephrectomy provide equal oncological efficiency and safety compared with radical nephrectomy in patients with renal cell carcinoma (≥4 cm)? A propensity score–matched study

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Abstract

Objective: Although partial nephrectomy (PN) is the standard treatment for localized clinical T1a renal cell carcinoma (RCC), treatment of larger renal tumors is controversial. We evaluated the oncological outcomes and perioperative complications after radical and PN for RCC ≥4 cm.

Patients and methods: We retrospectively analyzed the data of 2,373 patients surgically treated for nonmetastatic RCC with clinical T1b or T2 (≥4 cm). The propensity scores for surgery type were calculated, and the partial group was matched to the radical group in a 1:3 ratio. The oncological outcomes were compared using Kaplan-Meier analysis and multivariate Cox regression models were used to identify the independent predictors of progression-free, cancer-specific, and overall survival.

Results: All differences in preoperative clinical characteristics disappeared after matching. There were no significant differences in progression-free, cancer-specific, or overall survival between the partial and radical groups in the matched cohort. The patients' age, tumor size, cellular grade, and pathologic stage were independent predictors for all 3 survival outcomes. However, early complications (<30 d postoperative) were significantly more common in the partial group ($P < 0.001$). In a subgroup analysis of the patients with clinical T2 stage, there were no significant differences in all 3 survival outcomes.

Conclusions: The partial and radical nephrectomy groups had equivalent oncological outcomes. Although the early complication rate was significantly higher after PN, it should be considered as a valuable treatment option even in patients with clinical T1b or higher RCC.

Keywords: Partial nephrectomy; Renal cell carcinoma; RCC; Survival; Clinical stage

1. Introduction

Owing to advanced imaging modalities, more than 300,000 patients have been diagnosed with renal cell carcinoma (RCC) worldwide [1]. Although incidental detection of renal tumors has resulted in an overall downward stage migration, a significant proportion (25%–30%) of patients is discovered to have an advanced or metastatic disease at the time of initial diagnosis [2]. The current major guidelines in urology recommend that patients with small renal tumors should be treated with nephron-saving surgery rather than radical nephrectomy (RN) if technologically feasible [3,4]. The guidelines from the National Comprehensive Cancer Network recommend that partial nephrectomy (PN) can be performed in patients

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with clinical T1a and selected T1b and T2a tumors [3]. On the other hand, the American Association of Urology states that RN is the standard of care for T1b renal tumors, and PN can be performed as an alternative standard therapy when there is a need to preserve renal function [4].

Even though both guidelines recommend PN as the standard of care for T1b renal tumors, the evidence supporting this recommendation is insufficient. The available clinical evidence is mainly from case series or unmatched retrospective studies with a small number of subjects; however, there are no randomized controlled trials. A prospective randomized controlled trial from the European Organization for Research and Treatment of Cancer intergroup compared RN and PN in patients with renal tumors ($\leq$5 cm), but there were no subgroup analyses reporting results for clinical T1b tumors separately [5].

Therefore, we aimed to compare the oncological and long-term survival outcomes and perioperative complications between patients treated with RN and PN in our relatively large cohort. We attempted to eliminate any influence of differences in preoperative characteristics, which have a significant effect on the patients' survival, by performing propensity score matching.

2. Materials and methods

After receiving approval from both the institutional Ethical Review Boards, we retrospectively analyzed the data of 2,492 patients treated with RN or PN for localized renal tumors ($\geq$4 cm) from October 1994 to December 2014 in 2 tertiary centers of South Korea. As we aimed to evaluate the surgical outcomes of patients with clinical T1b and T2 RCC, the patients who had renal vein invasions or caval thrombosis were regarded to be clinical T3a or higher and werenot included in this study. After additional exclusion of 119 patients (other malignancy [$n = 52$], benign pathology [$n = 29$], and incomplete information [$n = 38$]), we analyzed the data obtained from a total of 2,373 patients. The clinical and pathological information was acquired from prospectively managed databases.

The preoperative evaluation at each institution included computed tomography of the abdomen, a bone scan, and chest computed tomography (or simple radiography). The pathological analysis of disease stage, cellular grade, and histologic subtype were performed as previously described [6]. Progression of disease was defined when there was evidence of recurrence, distant metastasis, or mortality from RCC. The information about mortality and cause of death were acquired from the national database of the Korean National Statistical Office and through review of our medical records. The postoperative follow-up protocols slightly varied according to each institution and surgeon, but were usually performed at 3- to 6-month intervals during the initial 2 years and yearly thereafter.

Because the patients had significant differences in preoperative clinical characteristics, we performed propensity score matching according to the propensity to receive PN. The propensity scores were calculated by using nonparsimonious and multivariate logistic regression based on preoperative characteristics such as patients' age, body mass index (BMI), sex, surgery type (open vs. laparoscopic and robotic surgery), American Society of Anesthesiologists score, history of diabetes mellitus and hypertension, and tumor size. As postoperative outcomes cannot influence the preoperative decision, the postoperative pathological outcomes were excluded from the propensity score matching. Except for 1 subject without an appropriate pair, 317 patients with PN were successfully matched to 841 patients with RN in a 1:3 ratio using the nearest neighbor matching method with 0.02 caliber. Our propensity score models were well calibrated and discriminating, showing all minimal mean standardized differences less than 0.05 (Table 1).

To compare the clinical and pathological characteristics between the RN and PN groups, independent *t*-tests and chi-square tests were performed. Kaplan-Meier analyses were performed to compare the survival outcomes among the subgroups. Multivariate Cox proportional regression models were used to identify the independent predictors for progression-free, cancer-specific, and overall survival (OS). All of the statistical analyses were performed by using the SPSS software package (Version 19.0, Chicago, IL) and all *P* values were 2-sided. $P < 0.05$ was considered statistically significant.

3. Results

The overall clinical and pathological parameters of all patients and by subgroups according to surgery type are described in Table 1. For all 2,373 patients, the median age was 55.9 years (interquartile range [IQR]: 47.0–65.0), median tumor diameter was 6.9 cm (IQR: 4.5–8.0), and median follow-up time was 43.5 months (IQR: 20–77) including 346 patients with follow-up loss. There were 2,055 patients with RN and 318 patients with PN. When we analyzed the percentage of PN according to the time periods, the use of PN increased over time from 0% in the late 1990s (1994–2000) to 47.4% in the early 2010s (2011–2015) (Fig. 1). The RN group was significantly older ($P = 0.001$), had a lower BMI ($P = 0.007$), had more patients with a history of hypertension ($P = 0.032$), and had significantly larger tumors ($P < 0.001$) than the PN group. The RN group showed worse postoperative pathological outcomes than the PN group with a significantly higher pathological stage ($P < 0.001$) and cellular grade ($P < 0.001$). The proportion of patients with clear cell–type histology was significantly higher in the RN group compared with the PN group.