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Original article

A comparison of overall survival and perioperative outcomes between partial and radical nephrectomy for cT1b and cT2 renal cell carcinoma—Analysis of a national cancer registry

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Abstract

Objectives: Partial nephrectomy (PN) is the standard management of cT1a renal cell carcinoma (RCC), and there is a basis for expanding its indications to larger tumors (cT1b and cT2). We analyzed a large population-based cancer registry to compare the overall survival (OS) and perioperative outcomes in patients with cT1b and cT2 RCC undergoing PN with those undergoing radical nephrectomy (RN).

Materials and methods: Patients with cT1bN0M0 and cT2N0M0 RCC were identified from the National Cancer Database (2004–2013). Patients were classified by the surgery performed and 1:1 propensity matched based on the likelihood of receiving PN. They were then compared for OS, 30-day readmission rates and 30- and 90-day mortality.

Results: A total of 6,072 patients underwent PN. PN was associated with better OS in cT1b tumors on multivariate analyses (OR = 0.8; 95% CI: 0.72–0.89; $P < 0.001$). For cT2 tumors, PN was associated with better OS, however this was not statistically significant (OR = 0.8; 95% CI: 0.62–1.04; $P = 0.092$). Unplanned readmission at 30 days was significantly more common in patients undergoing PN (4.2%) vs. RN (2.9%) but there was no difference in 30- and 90-day mortality between the 2 groups.

Conclusions: PN was associated with a significantly better OS than RN for cT1b but not cT2 RCC. PN had a higher 30-day readmission rate than RN in these tumors and appropriate patient selection is crucial. These results require further validation, ideally via randomized trials.

Keywords: Partial nephrectomy; Radical nephrectomy; Overall survival; cT1b and cT2; Perioperative outcomes

1. Introduction

Over the past 2 decades, partial nephrectomy (PN) has supplanted radical nephrectomy (RN) as the treatment of choice for patients with cT1a renal cell carcinoma (RCC). This was based on retrospective studies and database analyses showing equivalent oncological efficacy with better preservation of renal function in patients undergoing PN for T1a tumors [1–4]. Based on these results, the indications for PN began expanding with many experts and guidelines recommending its use in cT1b, as well as anatomically favorable cT2 tumors [5]. However, the only randomized trial comparing PN vs. RN (EORTC 30904) showed a reduced overall survival (OS) in patients undergoing PN for tumors ≤5 cm [6]. This trial was subsequently criticized for its crossover rate and slow and incomplete accrual, but the seeds of doubt about the true benefit of PN had been sown. With this in mind we decided to perform an analysis from a large population-based database to compare OS in patients undergoing PN and RN for cT1b and cT2 tumors. However, PN is a technically challenging procedure with a potential for complications, especially in the setting of larger tumors. Therefore, we also studied readmission

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rates, and 30- and 90-day mortality for PN and RN in this group of patients.

2. Patients and methods

2.1. Data source

The National Cancer Data Base (NCDB) is an oncology registry in the United States that compiles approximately 70% of all national cancer cases each year, receiving cases from over 1,400 healthcare centers. For quality assurance purposes, cases that do not meet standardized requirements are returned to their respective facilities. Data on patient socio-demographics, tumor characteristics, staging details, surgical and adjuvant treatments, and outcomes are all reported, while simultaneously ensuring both hospital and patient anonymity [7].

Using NCDB registry data from 2004 to 2013, we identified 142,208 patients who were diagnosed with RCC. All histological variants were included for the study. We selected patients with clinical stage cT1b-T2N0M0 and divided them into 2 arms—those undergoing PN or RN. We excluded patients diagnosed at death or autopsy and those with missing or unknown data for clinical TNM stage. The final cohort was limited to patients with known survival, 30- and 90-day mortality and unplanned readmission data, resulting in 33,394 patients for analysis. These patients then underwent propensity matching for the likelihood of receiving PN and were subjected to complete further analysis.

2.2. Outcomes and variables

The primary outcome of the study was OS. Secondary outcomes of the study were unplanned readmission within 30 days and 30- and 90-day mortality. All outcome measurements were binary variables. Mortality was defined as whether the patient died within a given number of days after undergoing PN or RN for RCC. Clinical T-stage and surgery performed were the primary predictive variables.

Socio-demographic variables included age at diagnosis (years), sex, and race (white and black), Hispanic ethnicity, primary payor. Clinical variables included AJCC clinical T-stage and comorbidity (yes and no). Facility was categorized as academic or nonacademic.

2.3. Statistical analysis

Patient characteristics (age, sex, and race), tumor characteristics such as AJCC tumor stage, and facility type were summarized using descriptive statistics for the overall sample as well as by clinical T-stage. Frequencies and percentages were obtained for categorical variables, while mean, standard deviation, and median with 25th and 75th percentiles were used for continuous variables.

A nearest-neighbor propensity score matching for the likelihood of receiving a PN was carried out by calculating propensity scores for each patient based upon the available preoperative variables of age, race, gender, Hispanic ethnicity, AJCC clinical stage, facility type, primary payor, and comorbidity. This was performed in order to reduce selection bias and balance variables that could impact the association between treatment type and survival. Patients who received PN were matched 1:1 to patients treated with RN by patients' propensity scores derived from the multivariable logistic regression model. Nearest-neighbor propensity score 1:1 matching between patients with PN and RN started the matching process from a difference of propensity scores in the magnitude of $<10^{-8}$, and then $<10^{-7}$, and so on until the difference was <0.1. If the patient was not matched in a given propensity score difference, then the patient was moved to the next score difference to find the match until the match is found.

Univariate and multivariable logistic regression models were fitted to each complication outcome. These models included type of surgery (PN or RN) as the primary predictor variable, where RN was considered the reference group in regression models. Age in years, sex, race, comorbidity, academic program, primary payor, and pathological T were also included in the models as co-variables to adjust for differences in patient socio-demographic and clinical characteristics. This allowed for identification of whether surgery type was considered as a risk factor for OS. Crude and adjusted odds ratios (OR) and 95% confidence intervals (95% CI) were calculated.

All statistical analyses were performed using SAS v9.4 statistical software for Windows (SAS Institute Inc., Cary, NC, USA).

3. Results

Out of the 142,208 patients with RCC in the NCDB from 2004 to 2013, 33,394 patients were eligible for inclusion in our study. A total of 6,072 cases underwent PN and 27,322 underwent RN (Supplementary Table S1). Among the PN, 5,534 (91.1%) were for cT1b tumors and 538 (8.9%) for cT2 tumors. The majority of patients were male (62.4%), white (88.9%), without comorbidity (68.2%), treated at a nonacademic institution (63.8%) and on average 62 years old. We performed 1:1 propensity score matching for the likelihood of receiving PN resulting in 6,072 patients in each arm for further statistical analysis and the baseline variables can be seen in Table 1. The median follow-up was 35.6 months (range: 22.2;54.1) for the PN arm and 45.1 months (range: 26.2;65.7) for the matched RN cohort.

Table 2 shows multivariate logistic regression analysis for OS for propensity-matched cT1b and cT2 patients. PN was associated with better OS in cT1b tumors on multivariate analyses (HR = 0.8; 95% CI: 0.72–0.89; $P < 0.001$). For cT2 tumors, PN was associated with better OS however this was not statistically significant on