



# Overall survival and renal function after partial and radical nephrectomy among older patients with localised renal cell carcinoma: A propensity-matched multicentre study



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Received 6 October 2014; received in revised form 1 December 2014; accepted 14 December 2014

Available online 6 January 2015

## KEYWORDS

Renal cell carcinoma  
Survival  
Nephrectomy  
Renal insufficiency  
Propensity score

**Abstract Background:** This study aimed to evaluate the overall survival (OS) rate and renal function after radical nephrectomy (RN) and partial nephrectomy (PN) in patients aged  $\geq 65$  years.

**Methods:** Patients who underwent RN ( $n = 622$ ) or PN ( $n = 622$ ) for renal cell carcinoma (pT1N0M0) between 1999 and 2011 were propensity-score matched in our multicentre database. To investigate the relative effect of PN on OS according to age, we divided the patients into two age subgroups ( $<65$  and  $\geq 65$  years). The 5-year OS rates and probabilities of freedom from chronic kidney disease (CKD III or IV) were estimated using the Kaplan–Meier method and separate Cox proportional hazards models.

**Results:** The 5-year OS rates after surgery were 94.7% for PN and 91.9% for RN in the older patients ( $P = 0.698$ ). The corresponding rates in the younger patients were 99.7% for PN and 96.3% for RN ( $P = 0.015$ ). In separate Cox hazards models for OS, the older patients who

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underwent PN were not significantly different from their RN-treated counterparts (hazard ratio (HR): 0.960; 95% confidence interval (CI): 0.277–2.321,  $P = 0.797$ ). Kidney function was significantly better preserved after PN than after RN at all ages. However, stage IV CKD in the older patients did not occur more frequently in the RN arm than in the PN arm. **Conclusions:** Although PN was associated with improved renal function compared with RN, it did not confer a benefit of higher survival rate in elderly patients ( $\geq 65$  years old).

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## 1. Introduction

Although radical nephrectomy (RN) was considered the standard treatment for renal cell carcinoma (RCC), there has been a recent shift in this paradigm [1–3]. Partial nephrectomy (PN) is now the recommended treatment for RCC, when technically feasible [4–6]. RCC patients undergoing RN have an increased risk of chronic kidney disease (CKD), which increases the probability of cardiovascular events and contributes to higher rates of non-cancer-related deaths [7–9].

The proposed superiority of PN over RN in terms of overall survival (OS) is still controversial [10–12]. Thus, a recent comparison suggested that OS and renal function are similar for the two surgical approaches [13]. Additionally, in a recent large-cohort study, kidney donors showed no excess risk of kidney failure or death compared with a matched general population during a 30-year follow-up [14]. Surgically-induced CKD, unlike medically-induced CKD, does not substantially affect OS [15,16]. It is important to know whether all patients will benefit from PN. Furthermore, it remains unclear if the above findings are applicable to elderly patients with limited life expectancy. In this study, we compared OS and renal function after RN and PN in patients aged  $\geq 65$  years.

## 2. Patients and methods

### 2.1. Patient population

This study was approved by the Institutional Review Boards of all the participating centres. Data from 3567 RCC patients who had undergone RN or PN between 1999 and 2011 were collected from five institutions in Korea. Patients with solitary kidney, bilateral RCC, stage pT2 or greater cancer, lymph node or distant metastases, preoperative hemodialysis, or preexisting stage IV CKD (estimated glomerular filtration rate [eGFR]  $< 30$  mL/min/1.73 m<sup>2</sup>) were excluded. To investigate the relative effectiveness of PN in terms of OS according to age, we divided the RCC patients (pT1N0M0) who underwent RN or PN into two subgroups: older ( $\geq 65$  years old) and younger ( $< 65$  years old).

Demographic information included age, sex, body mass index (BMI), tumour size, comorbidities (diabetes and hypertension), Eastern Cooperative Oncology

Group (ECOG) performance status, preoperative nutritional status (albumin and haemoglobin levels), histological differentiation, pathological staging, and kidney function assessment (preoperative eGFR). Pathological staging was performed based on the 7th edition of the American Joint Committee on Cancer classification system, and histological differentiation was graded according to the Fuhrman nuclear grading system [17,18]. Follow-up eGFR was calculated using the Modification of Diet in Renal Disease equation [19]. Information on deaths and their causes ('cancer-related death' or 'non-cancer-related death') was updated by reviewing medical records and through the office for Korean National Statistics. Follow-up duration was calculated from the date of surgery to the date of death or the last follow-up. Primary outcomes were OS and cancer-specific survival (CSS). The secondary outcome was postoperative new onset of stage III or IV CKD.

### 2.2. Statistical analysis

Baseline patient characteristics were analysed using descriptive statistics. Continuous and categorical variables were analysed using the independent  $t$ -test and  $\chi^2$ -test, respectively. To account for inherent differences among patients undergoing RN and PN, such as baseline characteristics or uneven patient distribution between the two groups, we used 1:1 propensity score matching to adjust for age, sex, BMI, tumour size, Fuhrman grade, comorbidities (diabetes, hypertension), ECOG performance status and preoperative nutritional status (albumin and haemoglobin levels), and kidney function (preoperative eGFR). Propensity scores were calculated using multivariate logistic regression. Kaplan–Meier survival plots were obtained for OS, CSS and recurrence-free survival (RFS) rates within the post-propensity-matched cohort. In the descriptive analyses of renal function, mean eGFR in each group was evaluated separately and plotted against each follow-up point. Probabilities of freedom from new onset of stage IV CKD after surgery were also compared using Kaplan–Meier plots. Only patients with preoperative eGFR  $> 60$  mL/min/1.73 m<sup>2</sup> were included in the analyses of new onset of stage IV CKD. Separate Cox proportional hazards regression models were used to detect associations of nephrectomy type with survival rate or new onset of stage III CKD (eGFR  $< 60$  mL/min/1.73 m<sup>2</sup>). Associations

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