# Partial Nephrectomy Versus Radical Nephrectomy in Patients With Small Renal Tumors—Is There a Difference in Mortality and Cardiovascular Outcomes?

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**Purpose:** Compared with partial nephrectomy, radical nephrectomy increases the risk of chronic kidney disease, which is a significant risk factor for cardiovascular events and death. Given equivalent oncological efficacy in patients with small renal tumors, radical nephrectomy may result in overtreatment. We analyzed a population based cohort of patients to determine whether radical nephrectomy is associated with an increase in cardiovascular events and mortality compared with partial nephrectomy.

**Materials and Methods:** Using Surveillance, Epidemiology and End Results cancer registry data linked with Medicare claims we identified 2,991 patients older than 66 years who were treated with radical or partial nephrectomy for renal tumors 4 cm or less between 1995 and 2002. The primary end points of cardiovascular events and overall survival were assessed using Kaplan-Meier survival estimation, Cox proportional hazards regression and negative binomial regression.

**Results:** A total of 2,547 patients (81%) underwent radical nephrectomy and 556 (19%) underwent partial nephrectomy. During a median followup of 4 years 609 patients experienced a cardiovascular event and 892 died. When adjusting for preoperative demographic and comorbid variables, radical nephrectomy was associated with an increased risk of overall mortality (HR 1.38, $p < 0.01$) and a 1.4 times greater number of cardiovascular events after surgery ($p < 0.05$). However, radical nephrectomy was not significantly associated with time to first cardiovascular event (HR 1.21, $p = 0.10$) or with cardiovascular death (HR 0.95, $p = 0.84$).

**Conclusions:** Radical nephrectomy, which is currently the most common treatment for small renal tumors, may be associated with significant, adverse treatment effects compared with partial nephrectomy. Partial nephrectomy should be considered in most patients with small renal tumors.

**Key Words:** kidney, nephrectomy, mortality, postoperative complications, cardiovascular diseases

**Abbreviations and Acronyms**

CKD = chronic kidney disease
CV = cardiovascular
PN = partial nephrectomy
RN = radical nephrectomy
RT = renal tumor
SEER = Surveillance, Epidemiology and End Results

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In 2008 there were approximately 54,400 newly diagnosed cases of RTs in the United States.[1] Although the incidence has been steadily increasing for 2 decades, partially due to the increased use of abdominal imaging for nonrelated medical conditions, there has been downward

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stage migration with small incidental RTs (4 cm or less) now accounting for the largest proportion of newly diagnosed renal masses.[2]

As expected, the increased incidence of RTs has been mirrored by an increase in the number of surgical procedures performed to remove these tumors.[3] However, there is unexpectedly a continuing increase in mortality in these patients following surgery, including those with RTs 4 cm or less.[3] Assuming that complete surgical removal of small localized RTs is generally curative, the mortality rate in patients with small RTs should be decreasing and not increasing.

This seemingly paradoxical trend has drawn attention to the significance of comorbid conditions and competing causes of mortality in patients undergoing surgical treatment for RTs, and it has highlighted a need to reassess the effects of treating these tumors.[3] A mechanism by which surgery may adversely influence nononocological outcomes is through the development of CKD. CKD is associated with not only kidney failure, but also with CV disease and premature death.[4,5]

Although RN is a known risk factor for CKD in patients with RTs,[6] it continues to be the most common procedure performed in patients with small RTs in the United States and abroad.[7,8] Widespread use of RN may result in overtreatment for many of these tumors, contributing to the increasing overall mortality in these patients, particularly individuals with small RTs who are unlikely to die of renal cancer. To investigate this hypothesis we examined a population based cohort of patients with RTs 4 cm or less to determine whether RN is associated with an increased risk of CV events and death compared with PN.

## MATERIALS AND METHODS

### Data

Our sample was obtained from SEER cancer registry data linked with Medicare claims. SEER, a consortium of population based cancer registries sponsored by the National Cancer Institute, currently includes 17 registries covering approximately 26% of the population.[9] For all incident cancers in their coverage areas the SEER registries collect information regarding the site and extent of disease, the first course of treatment and sociodemographic characteristics with active followup on date and cause of death.[9] In patients 65 years old or older who have cancer and reside in SEER areas Medicare claims have been linked to SEER files. Compared with the elderly population in the United States the SEER-Medicare population has a similar age and sex distribution and is more likely to live in urban and affluent areas but has a smaller proportion of nonwhite individuals.[9]

### Patient Selection

In the linked SEER-Medicare database we identified all first primary renal-cortical tumors (ICD-O-2 topography codes C64 and C64.9) diagnosed between 1995 and 2002. The cohort was restricted to patients 66 years old or older in whom the primary tumor was 4 cm or less. We excluded from study patients in whom the diagnosis was made only at the time of death, those in a managed care plan during the treatment course and those who lacked part A or B Medicare coverage.

### Surgery

Although SEER records information on cancer directed surgery, it does not identify procedure dates. Therefore, we defined the type and date of renal surgery based on Medicare claims within the first 6 months after cancer diagnosis. Using CPT codes and ICD-9-CM procedure codes we classified definitive renal surgery as RN (CPT codes 50220, 50225, 50230, 50545 and 50546, and ICD-9-CM codes 5551, 5552, 5553 and 5554) or PN (CPT codes 50240, 50280, 50290 and 50543, and ICD-9-CM codes 553.1 553.9 and 554). When a patient had a claim for RN within 30 days after a claim for PN, the type of surgery was categorized as RN. Patients were excluded from the sample if they had no claim for definitive renal surgery within 6 months of diagnosis, they had a claim for RN more than 30 days after a claim for PN or they had a claim for PN preceded by a claim for RN.

### Outcomes

Primary end points of the analysis were CV events, CV deaths and all cause mortality after renal surgery. Based on claims for inpatient care CV events included myocardial infarction, ischemic stroke, transient ischemic attack, percutaneous coronary intervention, coronary artery bypass graft surgery and hospitalization for a diagnosis of acute angina, congestive heart failure, coronary artery disease or peripheral vascular disease. Diagnosis and procedure codes identifying these events were adapted from a prior study of CV events in patients with CKD.[4]

Date of death was identified from Medicare enrollment records with followup for vital status through December 31, 2004. CV deaths, which were identified from the underlying cause of death reported on the state death certificate, included deaths attributable to diseases of the heart (ICD-9 390-398, 402, 404 and 410 to 429, and ICD-10 I00-I09, I11, I13 and I20 to I51), hypertension without heart disease (ICD-9 400 to 401 and 403, and ICD-10 I10 and I12) or cerebrovascular disease (ICD-9 430 to 438 and ICD-10 I60 to I69).

### Predictors of Surgery

We examined several variables hypothesized to predict the type of surgery and potentially confound the relationship between surgery and the primary end points. Demographic characteristics obtained from SEER and Medicare records included patient age at diagnosis, race, marital status, urban-rural location and area level socioeconomic status.

Comorbidity was defined in 2 ways. In 1 set of analyses we used the Romano modification of the Charlson