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Original article

Health status and use of partial nephrectomy in older adults with early-stage kidney cancer

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Abstract

Introduction: The long-term benefits of nephron-sparing surgery for kidney cancer depend on patient health. Accordingly, we examined whether receipt of partial nephrectomy varied with baseline comorbidity or functionality among older adults with stage I kidney cancer.

Materials and methods: Using Surveillance, Epidemiology, and End Results (SEER)-Medicare data from 2000 to 2009, we identified patients treated with partial or radical nephrectomy for stage I kidney cancer. We examined treatment trends according to baseline comorbidity, function, and relevant health conditions. We then estimated the probability of partial nephrectomy using multivariable, mixed-effects models adjusting for patient, surgeon, and hospital characteristics.

Results: Overall, 2,956 of 11,678 patients (25.3%) underwent treatment with partial nephrectomy. Receipt of partial nephrectomy was associated with younger age, male sex, higher socioeconomic position, smaller tumor size, and treatment by a high-volume provider, cancer center, or academic institution ($P < 0.001$). During the study period, utilization increased significantly ($P < 0.001$) but did not differ according to comorbidity or patient function. Adjusting for patient, surgeon, and hospital characteristics, the probability of partial nephrectomy by comorbidity and function categories remained within a narrow range from 19.6% to 22.8%. Only preexisting kidney disease appeared to be linked to partial nephrectomy usage (odds ratio = 1.49, 95% CI: 1.33–1.66).

Conclusion: With the exception of kidney disease, the increasing use of partial nephrectomy did not vary with respect to health status. As the potential benefits of partial nephrectomy differ according to a patient's underlying health, selection tools and algorithms that match treatment to patient comorbidity or function may be needed to optimize kidney cancer care in the United States.

Keywords: Kidney neoplasm; Nephrectomy; Comorbidity; Health status

1. Introduction

Kidney cancer incidence has steadily increased over the past two decades. Now the seventh most common solid tumor in the United States, kidney cancer accounts for 63,920 new cases and 13,860 corresponding deaths annually [1,2]. Small tumors compose most of this growth with the incidence of stage I disease raising from 3.7 to 7.0 per

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100,000 US adults in the past decade [3]. Though surveillance and ablative strategies have emerged, surgical intervention remains the established standard for stage I kidney cancer [4].

For surgical candidates, partial nephrectomy (PN)—when feasible—has become the preferred approach to cancer removal. Compared with radical nephrectomy (RN), PN provides comparable oncologic efficacy while better maintaining long-term renal function [5,6]. Several observational studies have further identified reductions in renal and cardiac morbidity as well as potential gains in long-term survival, largely attributed to renal preservation [7–9]. Nonetheless, EORTC 30904, a randomized control trial, found paradoxically better survival in patients treated with RN [10]. These conflicting findings have rekindled interest in the differential effects of nephron-sparing surgery based on patient phenotype. Recent investigations suggest a more pronounced survival benefit in those with worse baseline comorbidity, particularly preexisting kidney disease [9,11]. Patient performance and function also appear to be clinically important modulators of long-term survival among patients with stage I cancer [12,13].

Collectively, these findings suggest that the decision between PN and RN may be based, in part, on patient health status. However, the extent to which such purposeful selection occurs remains poorly understood. Accordingly, we investigated whether receipt of PN for stage I kidney cancer varied with baseline comorbidity, patient function, and pertinent health conditions. In understanding these practice trends, we can further optimize care for patients with early-stage kidney cancer.

2. Materials and methods

2.1. Data source and cohort identification

Using linked Surveillance, Epidemiology, and End Results (SEER)-Medicare data, we identified subjects ≥ 65 years old diagnosed with primary, non–urothelial kidney cancer from 2000 through 2009. SEER is a population-based cancer registry that maintains data regarding incidence, treatment, and mortality representative of the US population. The Medicare program provides primary health insurance for 97% of the US population aged 65 years or older. Successful linkage with Medicare claims is achieved for more than 90% of covered patients whose cancer information are tracked by SEER [14].

We identified a preliminary cohort of 30,158 subjects after excluding those enrolled in a Medicare managed care plan or without continuous enrollment from 12 months before 6 months following surgery (or death). Next, we narrowed our sample to patients with stage I kidney cancer (i.e., T1N0M0), leaving 15,871 patients. We further excluded those with multiple tumors ($n = 358$) and bilateral disease ($n = 11$) to create an initial cohort of 15,502 subjects.

2.2. Treatment identification

We applied a validated, claims-based algorithm to characterize the surgical procedure for each subject based on inpatient hospital and physician claims using International Classification of Diseases, ninth revision, Clinical Modification (ICD-9) and Current Procedural Terminology codes [15]. Given recent practice trends, this algorithm has been updated to further recognize robotic surgery (ICD-9 codes: 17.4X) and distinguish those receiving ablative therapies. For patients with claims indicating multiple treatments for kidney cancer, we assigned patients to the earliest treatment. In total, we identified 11,678 subjects who underwent PN or RN, forming our primary outcome variable. We also created an indicator variable for receipt of minimally invasive surgery based on this claims-based algorithm.

2.3. Measures of health status

As proxies for patient health, we used the following 2 indices for our primary exposure variables: (1) Charlson comorbidity index (CCI) and (2) function-related indicators (FRI). The CCI—derived from inpatient and outpatient claims submitted during the 12 months before diagnosis—is a commonly used measure of health and predicts 10-year mortality [16]. More recently, FRIs have been developed to gauge functional status, which predicts long-term mortality independent of comorbidity [13,17]. This measure is derived from Medicare claims indicative of disability or dysfunction (e.g., mobility-assist device, previous blood transfusion, nutritional supplementation, falls, fractures, pressure ulcers, and dementia) that correlate with patient-reported performance status and mortality [17,18].

Additionally, we identified the presence of the following 4 specific health conditions relevant to kidney surgery: (1) hypertension, (2) diabetes mellitus, (3) heart disease, and (4) kidney disease. Based on the published literature, we identified specific ICD-9 codes (i.e., hypertension: 401–405; diabetes mellitus: 250; heart disease: 410–414, 420–429; kidney disease: 581–583, 585–587, 250.40–43, 403–404, 274.10, 440.1, and 442.1) in both hospital and physician claims within 1 (i.e., hypertension, diabetes mellitus, and heart disease) or 2 (i.e., kidney disease) years of cancer diagnosis. Validation studies demonstrate high specificity for each condition and good sensitivity for hypertension, diabetes mellitus, and heart disease [19–22].

2.4. Patient, surgeon, and hospital covariates

We used SEER data to extract patient demographics and cancer information such as age, sex, marital status, race, year of treatment, and tumor size (i.e., 4–7 vs. <4 cm). We