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Original article

Contemporary, age-based trends in the incidence and management of patients with early-stage kidney cancer

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Abstract

Purpose: Although kidney cancer incidence and nephrectomy rates have risen in tandem, clinical advances have generated new uncertainty regarding the optimal management of patients with small renal tumors, especially the elderly. To clarify existing practice patterns, we assessed contemporary trends in the incidence and management of patients with early-stage kidney cancer.

Materials and methods: Using Surveillance, Epidemiology, and End Results data, we identified adult patients diagnosed with T1aN0M0 kidney cancer from 2000 to 2010. We determined age-adjusted and age-specific incidence and management rates (i.e., nonoperative, ablation, partial nephrectomy [PN], and radical nephrectomy) per 100,000 adults and determined the average annual percent change (AAPC). Finally, we compared management groups using multinomial logistic regression accounting for patient characteristics, cancer information, and county-level measures for health.

Results: From 2000 to 2010, we identified 41,645 adults diagnosed with T1aN0M0 kidney cancer. Overall incidence increased from 3.7 to 7.0 per 100,000 adults (AAPC $= 7.0\%$, $P < 0.001$). Over the study interval, rates of PN (AAPC $= 13.1\%$, $P < 0.001$) increased substantially, becoming the most used treatment by 2010. Among the elderly, rates of nonoperative management and ablation approached nephrectomy rates for those aged 75 to 84 years and became the predominant strategy for patients older than 84 years. Adjusting for clinical, oncological, and environmental factors, older patients less frequently underwent PN and more often received ablative or nonoperative management ($P < 0.001$).

Conclusions: As the incidence of early-stage kidney cancer rises, patients are increasingly treated with nonoperative and nephron-sparing strategies, especially among the most elderly. The broader array of treatment options suggests opportunities to better personalize kidney cancer care for seniors. Published by Elsevier Inc.

Keywords: Kidney neoplasm; Epidemiology; Nephrectomy; Aged

1. Introduction

The incidence of kidney cancer has continued to rise, increasing by 50% in the past decade [1–3]. Among the 10 most common malignancies in the United States, kidney cancer is projected to grow at an accelerated rate, both in terms of prevalence and cost [2]. Driven primarily by the increased diagnosis of small renal masses [1], these trends are most pressing among older adults (i.e., age 65 y and older) who already bear high rates of diagnosis [3]. Given the aging population and rising expenses [2,4], kidney cancer represents an emerging focus within geriatric cancer care.

Despite the frequent use of aggressive therapy, mortality rates among elderly patients with kidney cancer have remained stagnant over the past quarter century [1,5,6]. Moreover, emerging evidence suggests that the comparative advantage between partial and radical nephrectomy (RN) and the overall benefit for any treatment may be limited for patients ≥75 years of age [5–9]. Surgery itself carries considerable risk from postoperative complications and long-term renal or cardiovascular health consequences [10–12]. For older patients, such events can be particularly

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burdensome because of the physiologic process of aging; prevalence of comorbid conditions including chronic kidney disease; and predisposition to frailty, cognitive decline, malnourishment, and loss of independence [13–15]. Given these considerations, the Institute of Medicine has called for a more patient-centered, geriatric approach to cancer care [4]. In line with these sentiments, some kidney cancer experts have recommended less morbid management options (e.g., surveillance and ablative therapies) for certain older adults. Although these management modalities have increased in use [6,16], age-specific trends—as they pertain to treatment—remain less well characterized.

In this context, there is an immediate need to clarify existing trends in the management of patients with early-stage kidney cancer (i.e., T1aN0M0—tumors $\leq$4 cm in greatest dimension without nodal involvement or metastases) as they relate to age. In doing so, we highlight opportunities to optimize treatment selection so that the overall burden of kidney cancer can be lessened, especially for the growing segment of older adults at risk for this disease.

2. Materials and methods

2.1. Data source and study cohort

We used data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program to identify patients diagnosed with T1aN0M0 kidney cancer in the United States from 2000 through 2010. SEER is a population-based cancer registry that collects nationally representative data regarding incidence, treatment, and mortality [17]. Since 2000, the SEER program incorporates data from 18 registries, encompassing approximately 26% of the US population.

Limiting our sample to primary, nonurothelial kidney tumors, we identified 117,001 patients with kidney cancer based on International Classification of Diseases for Oncology, third edition, site code C64.9 and International Classification of Diseases, ninth revision, Clinical Modification code 189.0. Next, we excluded 1,630 patients identified using death certificates or autopsy alone, leaving 115,371 cases. Using SEER staging information, we excluded those with metastatic disease, nodal involvement, and tumors larger than 4 cm and further limited our sample to adults 20 years old and older to create an analytic cohort of 41,645 patients.

2.2. Identification of management strategy

Using SEER treatment data, we assigned each patient to 1 of 4 management categories: nonoperative, ablation, partial nephrectomy (PN), and RN. A small number of patients (n = 250, 0.6% of the sample) could not be classified. These patients were included in our estimation of tumor incidence but excluded from treatment-specific analyses.

2.3. Patient-level and county-level covariates

We used SEER data to determine age, gender, race/ethnicity, marital status, registry, and diagnosis year for each patient. Tumor burden was characterized in terms of size (i.e., 0–2 cm vs. 2–4 cm) and laterality. As tumor histology and grade are often not available before management selection, we did not consider these histopathologic indicators in our analyses.

Because SEER does not include conventional measures for socioeconomic status and comorbidity, we used data from the Area Health Resource File. These data contain county-level measures of health services access, resource utilization, socioeconomic indicators, and health status [18], which we linked to kidney cancer cases in SEER through Federal Information Processing Standards county codes. For each patient, we identified the rural/urban status, median household income, and extent of non–high school education of his or her area of residence. We further characterized the local care environment in terms of the density of urologists; total physicians; kidney cancer cases; hospital beds; and rates of death due to heart disease, diabetes mellitus, chronic obstructive pulmonary disease, liver disease, and cancer per county population with each covariate divided into equally sized quartiles. The number of cancer hospitals for each county was also identified.

2.4. Statistical analysis

We determined age-adjusted incidence and management rates per 100,000 adults standardized to 2010 US Census data by the direct method. We then calculated age-specific rates for the following age groups: 20 to 44, 45 to 54, 55 to 64, 65 to 74, 75 to 84, and $\geq$85 years. For each rate, we calculated the average annual percentage change and 95% CI using Joinpoint regression and permutation testing made available through SEER (Joinpoint Regression Program, version 4.0.4, May 2013) [19].

Next, we evaluated the association between management and patient demographics, cancer burden, and county-level characteristics using the chi-square test. We measured the association between age and management using multinomial logistic regression adjusting for clinical, oncologic, and environmental factors. Because of the correlated nature of the data, we accounted for county-level clustering of patients. Finally, we determined the model-adjusted probability for each management strategy according to age-strata and used bootstrapping with replacement for 1,000 replications to obtain 95% CIs.

2.5. Specification tests and sensitivity analysis

To assess the robustness of our findings, we performed several specification tests and sensitivity analyses. First, we performed likelihood ratio tests comparing models with and without our county-level data to ensure that these measures