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Original article

Toward greater adoption of minimally invasive and nephron-sparing surgical techniques for renal cell cancer in the United States

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Abstract

Purpose: To examine national, population-based utilization trends of nephron-sparing and minimally invasive techniques for the surgical management of patients with adult renal cell cancer (RCC) in the United States.

Methods: Linked data from the National Cancer Institute's Patterns of Care studies and the Area Health Resource File were used to evaluate trends of nephron-sparing and minimally invasive techniques in a sample of 1,110 patients newly diagnosed with American Joint Committee on Cancer stages I-II RCC, in 2004 and 2009, who underwent surgery. Descriptive statistics were used to assess patterns of surgery between 2004 and 2009. Multivariable logistic regression analyses were used to evaluate the associations between demographic, clinical, hospital, and area-level health care characteristics with surgery utilization, stratified by the subset of patients who were potentially eligible for partial nephrectomy (PN) vs. radical nephrectomy (RN) and laparoscopic RN (LRN) vs. open RN, respectively.

Results: Between 2004 and 2009, PN use among stage I patients with tumors $\leq$7 cm increased from 29% to 41%, respectively ($P = 0.22$). Among patients with stage I tumors $\leq$ 4 cm, use of PN significantly increased from 43% in 2004 to 55% in 2009 ($P \leq 0.05$). Among patients with stage I tumors >4 to 7 cm, laparoscopic partial nephrectomy increased from 8% to 15%, whereas LRN increased from 38% to 69%, between 2004 and 2009 ($P = 0.07$). Significant increases in LRN use were observed for both stage I (from 43% in 2004 to 58% in 2009; $P \leq 0.05$) and stage II patients (from 16% in 2004 to 47% in 2009; $P \leq 0.01$). Patients diagnosed at an older age, with larger tumors, non–clear cell RCC and who did not receive treatment in a hospital with residency training were significantly less likely to receive PN vs. RN; whereas, those diagnosed in 2009 with stage I disease were significantly more likely to receive LRN vs. open RN.

Conclusions: This study highlights a significant shift toward increased use of nephron-sparing and minimally invasive surgical techniques to treat patients with RCC in the United States. Our findings are among the first population-based reports in which most eligible patients with RCC received PN over RN. In light of the long-standing evidence on the improved patient outcomes, future investigation is warranted to identify the barriers to increased adoption of these nephron-sparing and minimally invasive approaches.

Keywords: Renal cell cancer; Patterns of care; Partial nephrectomy; Radical nephrectomy; Open radical nephrectomy; Laparoscopic radical nephrectomy; Nephron-sparing surgery

1. Introduction

Renal cell cancer (RCC) represents approximately 4% of all new cancer cases in the United States, with 61,560 estimated new cases in 2015 [1]. Over the past few decades, incidence rates of RCC in the United States have been rising, with a general shift toward diagnosis of stage I (localized), smaller sized tumors ($\leq$4 cm) [2] that are

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detected because of widespread abdominal imaging (>50% detected incidentally) [3]. Alongside the increase in early stage RCC, nephron-sparing and minimally invasive surgical techniques such as partial nephrectomy (PN) and laparoscopic radical nephrectomy (LRN), respectively, have evolved as viable options to open radical nephrectomy (ORN) for management of these patients. Moreover, a growing body of evidence points to demonstrated benefits of PN and LRN compared with ORN, including improved postoperative morbidity while achieving equal oncological outcomes. Since 2009, guidelines from the American Urologic Association, National Comprehensive Cancer Network, and European Association of Urology recommend PN as the preferred standard of care for T1 tumors (≤7 cm). RN is an alternative standard of care for T1 tumors not amenable to PN or not technically feasible as determined by the urologic surgeon and thermal ablation or active surveillance are other options [4–6]. The European Association of Urology lists LRN as the recommended standard of care for patients with T2 tumors and smaller renal masses not suitable for nephron-sparing surgery, with ORN as an optional standard of care, whereas the National Comprehensive Cancer Network and American Urologic Association cite similar oncological outcomes between the laparoscopic and open approaches [4–6].

Notwithstanding the benefits and guideline recommendations of PN and LRN for localized RCC, nationwide trends suggest ORN has remained the predominant surgical approach in the United States. Using data from the Surveillance, Epidemiology, and End Results (SEER) program between 1999 and 2006, Dulabon et al. [7], found that 55% of patients with RCC tumors ≤4 cm received ORN rather than LRN. Similarly, based on data from hospital discharges in the National Inpatient Sample, among patients with RCC aged 18 and older who received partial or radical nephrectomy (by open or radical technique) between 2002 and 2008, ORN was the most commonly used approach, from 77% in 2002 to 62% in 2008 [8]. In this population-based study, we used linked multilevel data with information on health insurance, comorbidity, and area-level health care characteristics, to examine more contemporary trends in use of nephron-sparing and minimally invasive techniques for the surgical management of adult patients with RCC in United States community practice between 2004 and 2009, as well as the association of individual- and area-level characteristics with surgical management.

2. Methods

2.1. Data sources

Data for the current study were obtained from the National Cancer Institute (NCI) SEER program, which collects information on all cancer diagnoses in defined US geographic regions, currently covering approximately 28% of the US population [9]. In SEER, patient information is primarily obtained from hospital records, including tumor characteristics, first course of treatment and select demographic characteristics. To collect therapy information that is not well collected by routine SEER activities, NCI annually conducts Patterns of Care (POC) studies on select cancer sites, obtaining information from each treating physician about their patient's cancer treatment [10]. SEER registries obtain approval as required from their institutional review boards before study initiation.

Following centralized training, abstractors from the 14 participating SEER registries (the metropolitan areas of San Francisco/Oakland, Detroit, Seattle, Atlanta, San Jose/Monterey, Los Angeles County, and the states of Connecticut, Iowa, Kentucky, Louisiana, New Jersey, New Mexico, and Utah, and the remainder of California) reabstract the hospital records of sampled patients to verify tumor characteristics and demographic information. To obtain comprehensive treatment information on the care received by these patients, the treating physician is asked to verify therapy provided. The physician is also asked whether any other providers might have treated the patient and supply that provider's contact information. Identification and contact of additional treating physicians is common in POC studies. To ensure quality control of measures in the SEER POC studies, 5% of the abstracted patient records are reabstracted.

The Area Health Resource File (AHRF), maintained by the US Health Resources and Services Administration, collects information on health system resources and socioeconomic indicators that influence health care, according to geographical units. We obtained county-level information on surgeons (including general surgeons and surgeon specialties), Medicaid inpatient discharges and Medicare inpatient discharges, and the 2008 US population. All information used from the AHRF was based on 2008 estimates, which was the most recent year of data available to link with the SEER data included in our analysis of 2004 and 2009 [11]. AHRF data were linked to SEER data using the state and county FIP codes of each patient.

2.2. Study sample

This study included SEER patients diagnosed with renal cell cancer (International Classification of Diseases, Oncology, third revision site code: C64.9, Behavior: 3 (invasive) and Histology: all codes except lymphoma/hematopoietic M-9590-9989) in 2004 and 2009. Patients previously diagnosed with cancer (other than non–melanoma skin cancer), a simultaneous cancer diagnosis (within 60 days), diagnosed at autopsy or on the death certificate only, or who were younger than 20 years were ineligible for the study. Eligible patients were stratified by registry, sex, race/ethnicity and in 2009 stage stratification was included as well, and randomly sampled within strata. Women, non–Hispanic blacks, Asian/Pacific Islanders, Hispanics, American Indians, and Alaskan natives were oversampled to obtain more stable estimates. Sampling fractions were used to calculate weighted percentages that reflect the SEER