National Trends in the Utilization of Partial Nephrectomy Before and After the Establishment of AUA Guidelines for the Management of Renal Masses

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OBJECTIVE To assess the impact of the American Urological Association (AUA) guidelines advocating partial nephrectomy for T1 tumors guidelines on the likelihood of undergoing partial nephrectomy.

MATERIALS AND METHODS We analyzed the Nationwide Inpatient Sample (NIS), a dataset encompassing 20% of all United States inpatient hospitalizations, from 2007 through 2010. Our dependent variable was receipt of radical vs partial nephrectomy (55.50, 55.51, 55.52, and 55.54 vs 55.4) for a renal mass (International Classification of Disease, 9th Revision [ICD-9] code 189.0). The independent variable of interest was time of surgery (before or after the establishment of AUA guidelines); covariates included a diagnosis of chronic kidney disease (CKD), overall comorbidity, age, race, gender, geographic region, income, and hospital characteristics. Bivariate and multivariable adjusted logistic regression was used to determine the association between receipt of partial nephrectomy and time of guideline establishment.

RESULTS We identified 26,165 patients with renal tumors who underwent surgery. Before the guidelines, 4031 patients (27%) underwent partial nephrectomy compared to 3559 (32%) after. On multivariable analysis, undergoing surgery after the establishment of guidelines (odds ratio [OR] 1.20, 95% confidence interval [CI] 1.08-1.32, $P < .01$) was an independent predictor of partial nephrectomy. Other factors associated with partial nephrectomy were urban location, surgery at a teaching hospital, large hospital bed size, Northeast location, and Black race. Female gender and CKD were not associated with partial nephrectomy.

CONCLUSION Although adoption of partial nephrectomy increased after establishment of new guidelines on renal masses, partial nephrectomy remains an underutilized procedure. Future research must focus on barriers to adoption of partial nephrectomy and how to overcome them. UROLOGY 82: 1283–1290, 2013. © 2013 Elsevier Inc.

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The incidence and surgical treatment of renal masses has increased significantly over the last several decades.[1,2] Partial nephrectomy has become increasingly recognized as an oncologically effective treatment for small renal masses, with numerous suggested long-term advantages compared to radical nephrectomy. Specifically, partial nephrectomy is associated with better postoperative renal function,[3] reduced incidence of chronic kidney disease (CKD),[4] decreased incidence of cardiovascular events,[5] and improved overall survival.[6] In spite of these potential benefits, population-based data suggest that the adoption of partial nephrectomy has been slow.[7,8] Partial nephrectomy represented just under 25% of all kidney cancer surgeries in 2008,[8] perhaps because of the technical challenge of surgery on complex tumors, the fear of complications in frail patients,

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as well as other characteristics of both hospitals and surgeons.[9,10] For many patients with kidney cancer, access to partial nephrectomy seems to depend more on their surgeon's practice style than on tumor characteristics.[11]

In response to data demonstrating the benefits of partial nephrectomy, the American Urological Association (AUA) established new guidelines for the management of clinical T1 renal masses.[12,13] Specifically, the AUA guidelines advocate counseling patients about the potential advantages of partial nephrectomy to treat T1 renal tumors and establishes partial nephrectomy as the standard of care both for patients with normal renal function and for those with CKD, who may derive greater benefit from nephron preservation. However, it is unknown whether the new guidelines have increased the adoption of partial nephrectomy in either population.

The primary objective of this analysis was to determine whether there was an association between the introduction of AUA guidelines and the likelihood of partial nephrectomy. Our secondary aims were to determine whether patients with CKD were more or less likely than their peers to undergo partial nephrectomy and whether this changed after introduction of the AUA guidelines. We hypothesized that the AUA guidelines increased the likelihood of partial nephrectomy among all patients undergoing surgery for renal malignancy, with an even higher likelihood among those with CKD. If utilization of partial nephrectomy increased significantly after guideline establishment, it would suggest that future practice might be guided by guideline development and dissemination. If rates of partial nephrectomy remained unchanged or decreased, future efforts might focus on identifying barriers to partial nephrectomy before investing in an intervention to encourage its adoption. Results of this study may help direct future AUA guideline initiatives and may play a role in promoting partial nephrectomy.

MATERIAL AND METHODS

Study Design

A retrospective cohort study was performed to determine the association between the establishment of AUA guidelines for the management of a renal mass and the likelihood of partial nephrectomy use among patients undergoing surgery for renal parenchymal tumors. This study was determined to be exempt from review by our institutional review board.

Data Source

We analyzed the Nationwide Inpatient Sample (NIS), the largest all-payer in-patient care database, for the years 2007 through 2010. The NIS is assembled through the Agency for Healthcare Research and Quality-sponsored Healthcare Cost and Utilization Project. The NIS dataset contains a survey of approximately 20% of all U.S. community hospitals chosen randomly each year.[14] The 2007 data set included hospitals from 40 states, which progressively increased to 45 states in 2010.

Study Cohort

The 2007 to 2010 databases were queried for patients older than 18 years with the diagnosis of renal neoplasm (International Classification of Disease, 9th Revision [ICD-9] code 1890, n = 66,371). Patients with the diagnosis of urothelial carcinoma (n = 37), end-stage renal disease (n = 2936), or metastatic disease (n = 679) were excluded from the analysis as they are not traditionally considered candidates for partial nephrectomy. Those patients whose data did not identify the date of surgery were also excluded from analysis (n = 4). Data submitted to the NIS from the state of Florida do not identify the date of surgery and were therefore excluded (n = 2301), leaving a final analytic cohort of 26,165 patients.

Creation of Variables

Our dependent variable of interest was type of renal surgery, radical nephrectomy vs partial nephrectomy (ICD-9 codes 55.50, 55.51, 55.52, and 55.54 vs 55.4) by any approach. Our independent variable of interest was time period of surgery: before or after the AUA guidelines for T1 renal masses, which were announced on April 28, 2009.

We examined a broad range of covariates potentially influencing the association between the establishment of guidelines and the adoption of partial nephrectomy. These covariates included: CKD (Appendix 1),[15] age (<45, 45-64, 65-74, and ≥75 years), race (white, black, other), gender, Elixhauser comorbidity score (0, 1-2, ≥3),[16] median income for patient's zip code (<$39K, $39K-$47,999, $48K-$62,999, and ≥$63K), and type of insurance (public vs private). The Elixhauser comorbidity score is a measurement tool that defines 30 comorbid conditions using ICD-9 codes. This instrument has been applied and validated in large administrative data sets predicting patient outcomes.[16] We adjusted for year as a continuous variable to account for the increasing adoption of partial nephrectomy over our study period. In addition to these patient-level and demographic covariates, we also analyzed hospital attributes and geographic-level covariates, including location (urban, rural), teaching status, hospital bed number (small, medium, large),[17] region (Northeast, Midwest, South, West), and year of admission.

Statistical Analysis

We proceeded with analysis in 3 steps. First, a bivariate analysis using chi-square tests were performed to examine whether the distribution of each independent variable differed significantly between patients who received partial nephrectomy and those who received radical nephrectomy. Then, all statistically significant variables from this exploration (plus gender, which was deemed clinically significant) were included as independent variables in a multivariate logistic regression model to estimate the likelihood of undergoing partial nephrectomy (dependent variable = dummy for receipt of partial nephrectomy, with 1 observation per patient). Insurance status was excluded from multivariable analysis as this variable is highly correlated with age. Finally, to consider the differential impact of AUA guidelines on patients with vs without CKD, we added an interaction term between time period of surgery (pre- vs post-guidelines) and diagnosis of CKD.

Statistical analysis was performed using SAS version 9.3 (Cary, NC). All P values were two-sided with statistical significance determined at the $\alpha = 0.05$ level.

RESULTS

We found 18,575 radical nephrectomies (71%) and 7590 partial nephrectomies (29%) during the study period. A