

The Effect of Age on the Morbidity of Kidney Surgery

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Purpose: Previous reports of the morbidity of renal surgery have been primarily from academic tertiary referral centers and, thus, they may not reflect general clinical practice. We determined the effect of age and comorbidity on in-hospital surgical morbidity for radical and partial nephrectomy on a population level.

Materials and Methods: Data were obtained from a Canadian national discharge abstract database. From April 1998 to March 2008 information was available on 20,286 radical and 4,292 partial nephrectomies. Complications were identified using specific ICD-9 and 10 diagnosis and procedure codes. Complication rates were estimated by procedure type and by various explanatory variables, including patient age and Charlson comorbidity score. Multivariate logistic regressions were constructed for radical and partial nephrectomy to determine associations between explanatory variables and complications.

Results: Overall complications developed in 34.1% of radical and 34.3% of partial nephrectomy cases. Patients were more likely to have cardiac, respiratory, vascular and surgical complications after radical nephrectomy while they were more likely to experience genitourinary and nephrectomy specific complications after partial nephrectomy. On multivariate logistic regression after radical and partial nephrectomy complications increased with age and Charlson score. After adjusting for other covariates patients with a Charlson score of greater than 2 were approximately 6 times more likely to experience a complication than patients with a Charlson score of 0 for radical and partial nephrectomy (OR 6.22, 95% CI 5.18–7.48 and OR 5.68, 95% CI 3.72–8.66, respectively).

Conclusions: In our population based study radical nephrectomy and partial nephrectomy were associated with higher morbidity than previously reported, particularly in the elderly population and in patients with comorbidity.

Key Words: kidney; carcinoma, renal cell; nephrectomy; postoperative complications; morbidity

In the last 3 decades there has been an increase in the incidence of RCC in North America, paralleled by an increase in renal surgery during a similar period.¹ Although published data on disease outcomes are common, data on the morbidity of surgery tend to come from academic tertiary referral centers.^{2–4} Thus, they may not ad-

equately reflect the true morbidity of renal surgery in general clinical practice.

Only 1 previous group has assessed the morbidity of renal surgery using a large administrative data set.⁵ However, the number and types of complications captured as well as the number of patient and provider variables

Abbreviations and Acronyms

CIHI = Canadian Institute for Health Information

PN = partial nephrectomy

RCC = renal cell carcinoma

RN = radical nephrectomy

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Study received University of Toronto ethics approval.

Supplementary material for this article can be obtained at http://casemed.case.edu/dept/urology/RCC_Complications_JUrology_2011.

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available for analysis were limited. Also, studies of kidney surgery in the elderly population have failed to show an increased complication rate with advanced age.^{6–10} These studies have largely been single institution case series and, thus, subject to selection bias. Better assessment of surgical morbidity, particularly in those at highest risk, ie elderly patients, would allow better preoperative counseling and may suggest the need for less invasive therapy in these groups, eg active surveillance or ablative therapy.

We determined the effect of age and comorbidity on the in-hospital surgical morbidity of RN and PN on a population level. We hypothesized that in-hospital procedure related complications may be higher than previously reported, particularly in the elderly population and in patients with comorbidity.

METHODS

Study Design and Data Source

We performed a population based, national, retrospective, observational study using administrative data obtained from the CIHI Discharge Abstract Database on patients treated between April 1, 1998 and March 31, 2008. This comprehensive database contains information on all acute care hospitalizations in 9 of the 10 Canadian provinces.¹¹ Extensive data quality monitoring is continuously performed by CIHI.¹²

Study Sample

We initially identified 35,038 patients using specific procedure codes for RN and PN, as previously described.¹³ Pediatric patients, ie the 534 younger than 18 years, and the 9,926 treated for anything other than a solid or cystic renal mass based on diagnosis codes, eg a chronically infected or nonfunctioning kidney, were excluded from study, leaving 24,578 available for analysis.

Variables

Demographic variables were available for all patients. Income quintiles were created by linking median individual income estimates from Canada 2006 Census data to postal codes.¹⁴ To facilitate analysis we created provincial groupings for Atlantic (New Brunswick, Nova Scotia, Newfoundland and Prince Edward Island) and Prairie (Alberta, Saskatchewan and Manitoba) provinces while British Columbia and Ontario were analyzed independently. Surgeon and hospital volume quartiles were also created using the total number of kidney procedures performed during the 10-year observation period.

ICD-9 and 10 diagnosis codes were used to identify comorbid conditions during hospitalization in the CIHI database. For study purposes comorbidity was adjusted using the Charlson-Deyo index adaptation by Deyo et al,¹⁵ a commonly used comorbidity measure for administrative data.

Complications were identified using specific ICD-9 and 10 diagnostic and procedure codes in a manner analogous to that in prostate cancer surgery studies.^{16–18} These complications were well described in large, observational RCC studies.^{2–4} We performed a comprehensive literature

search to identify all studies of short-term complications after RCC surgery. To ensure completeness a panel of expert clinicians, including 2 uro-oncologists and an internist/hospitalist, reviewed the complication list. This is identical to the procedure in a prior study of prostate cancer surgery.¹⁸ Complications were grouped into major organ systems (cardiac, pulmonary, vascular, wound/bleeding, genitourinary, miscellaneous medical, miscellaneous surgical and nephrectomy specific) according to a previous study.¹⁸ Validation studies suggest that there is excellent capture of in-hospital surgical complications using administrative data.¹⁹ Ethics approval was obtained from the University of Toronto.

Statistical Analysis

The overall complication rate and complication rates by organ system category were estimated by procedure type, ie RN and PN. Complication rates were also tabulated by various explanatory variables, ie patient age, Charlson score, fiscal year, gender and provincial region, and compared using the chi-square test. For each treatment multivariate logistic regressions were constructed to determine the association of age, Charlson score and the probability of any complication with adjustment for covariates.

RESULTS

A total of 24,579 patients were treated surgically for a renal mass between April 1, 1998 and March 31, 2008, including 20,286 (82.5%) treated with RN and 4,292 (17.5%) treated with PN. **Table 1** lists the baseline characteristics of the patients in the data set. There were no missing data on fiscal year, age, gender or Charlson category. Provincial region and income quintiles were not available for 2 ($8.2 \times 10^{-5}\%$) and 285 patients (1.2%), respectively.

The overall complication rate for kidney surgery in our study was 34.2%, representing an overall complication rate of 34.1% for RN and 34.3% for PN. When complications were examined by explanatory variables, only procedure type and income quintile were not associated with the overall complication rate. As expected, complications increased with patient age and comorbidity. Patients 80 years old or older had a 16.6% higher complication rate than those younger than 50 years. Although the effect of age was significant for all complication categories, it was most dramatic for medical complications (**table 2**). For example, after RN cardiac complications developed in only 1.1% of patients younger than 50 years compared with 14.1% of those 80 years old or older. Similarly patients with a Charlson score of 3 or greater experienced a complication almost three-quarters of the time and had a 44% higher complication rate than patients with a Charlson score of 0. Complications appeared to decrease with time, women had fewer complications than men and we noted regional differences in the complication rate. The observed

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