Intraoperative Conversion From Partial to Radical Nephrectomy at a Single Institution From 2003 to 2008

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Abbreviations and Acronyms

ASA = American Society of Anesthesiologists
BMI = body mass index
CKD = chronic kidney disease
eGFR = estimated GFR
GFR = glomerular filtration rate
LPN = laparoscopic PN
OPN = open PN
PN = partial nephrectomy
RN = radical nephrectomy

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Purpose: Little information exists on conversion from partial to radical nephrectomy. We assessed the intraoperative reasons and predictive factors for conversion in a contemporary series of patients undergoing partial nephrectomy.

Materials and Methods: We identified all patients at our institution who underwent open or laparoscopic partial nephrectomy with conversion to radical nephrectomy between 2003 and 2008. Renal function was assessed by the glomerular filtration rate using the modification of diet in renal disease equation. We used logistic regression analysis to determine whether tumor site, tumor size, body mass index, American Society of Anesthesiologists score, age or gender was associated with the conversion risk.

Results: The rate of conversion to radical nephrectomy was 6% (61 of 1,029 patients). In the open partial nephrectomy group 59 of 865 cases (7%, 95% CI 5–9) and in the laparoscopic partial nephrectomy group 2 of 164 (1.2%, 95% CI 0.01–4) were converted. The most common reasons for conversion were invasion of hilar structures, size discrepancy and insufficient residual kidney. Patients with conversion were more likely to have larger tumors (per 1 cm increase OR 1.41, 95% CI 1.24–1.59), a central site (central vs peripheral OR 7.74, 95% CI 3.98–15) and a lower preoperative glomerular filtration rate (per 10 ml/minute/1.73 m^2 OR 0.78, 95% CI 0.67–0.91), and present with symptoms (any vs none OR 2.78, 95% CI 1.54–5.04) than those without conversion. The median postoperative glomerular filtration rate was 46 vs 61 ml/minute/1.73 m^2 in patients with vs without conversion.

Conclusions: Conversion to radical nephrectomy was rare in patients undergoing partial nephrectomy in this series. Increasing tumor size, central site, lower preoperative glomerular filtration rate and symptoms at presentation were associated with an increased risk of conversion, which increases the likelihood of chronic kidney disease postoperatively.

Key Words: kidney; nephrectomy; laparoscopy; surgical procedures, operative; intraoperative complications

Partial nephrectomy is now the surgical standard of care for small renal masses.[1] Compared to RN it provides equivalent oncological control while maximally preserving renal function.[2] There is increasing evidence of an association between RN and CKD, cardiovascular morbidity and overall mortality.[3,4] Indications for PN are increasing as surgeons push the boundaries of what is technically feasible while hoping to avoid the CKD associated with RN.[5] Tumor size and proximity to the renal hilum or vessels are no longer

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contraindications to PN, increasing complexity and the potential for complications. Patients may not be aware of the risks of conversion and the consequences of conversion on future well-being.

In the last 20 years there has been a large increase in the detection of renal masses, most less than 4 cm, and of corresponding renal surgery and yet the cancer specific mortality rate for kidney cancer continues to increase, suggesting that many small renal masses are nonlethal.[6,7] Although renal function is maximally preserved by PN, patients scheduled for PN are at risk for intraoperative conversion to RN, which places them at risk for CKD and its complications. Careful patient selection is required to identify those who will benefit from surgical intervention vs those who can be observed and avoid the risks of surgery.

We assessed the risk of surgical conversion from PN to RN, any preoperative factors predicting conversion and the implications of conversion on renal function. To our knowledge the reasons and predictive factors for conversion have not been studied previously.

METHODS

Using our prospectively maintained nephrectomy database we identified all patients who underwent PN between January 2003 and December 2008 with the approval of our institutional review board. This period covered all laparoscopic cases at our institution and represents a contemporary series of open surgical cases. All patients scheduled for PN who subsequently underwent RN were identified, and their medical and operative records reviewed. All patients were candidates for PN and had a solitary renal mass on preoperative imaging, including computerized tomography or magnetic resonance imaging and preoperative ultrasound, that was amenable to resection. Renal function was assessed by the estimated glomerular filtration rate using the modification of diet in renal disease equation.[8] CKD was defined as eGFR less than 60 ml/minute/1.73 m^2 at last GFR measurement. Precise preoperative tumor size and site were retrieved from imaging reports.

Statistical Methods

Statistical analysis was used to identify predictors associated with conversion from PN to RN. Since open and laparoscopic conversions are different and likely involve different reasons for conversion, we had originally planned to perform all analyses separately by technique. However, conversion was done in only 2 of the 164 patients treated with LPN and, thus, formal analysis in the laparoscopic group was not feasible. Instead we focused our predictive analysis on the 865 patients in the OPN group and describe outcomes in patients with laparoscopy separately. We used logistic regression to determine whether date of surgery, tumor size, tumor site, BMI, ASA score as an indicator of comorbidity, preoperative GFR, symptoms at presentation (local or systemic vs none), age or gender was associated with the risk of conversion.

RESULTS

Between 2003 and 2008 at our institution 1,029 patients underwent PN, including 61 (6%) with conversion to RN. In the OPN group 59 of 865 cases (7%, 95% CI 5–9) and in the LPN group 2 of 164 (1.2%, 95% CI 0.01–4) were converted. The conversion rate in the OPN group decreased significantly during the study period from a high of almost 13% to a low of 3.4% ($p = 0.002$, part *A* of figure).

Table 1 lists the reasons for conversion. The most common reasons for conversion were invasion of hilar structures in 15 patients (25%), size discrepancy (finding a tumor that was larger than expected) in 10 (17%), insufficient residual kidney in 9 (15%) and inability to achieve clear margins in 7 (12%). Although there were significant differences in estimated blood loss between the PN and conversion groups ($p < 0.002$), hemorrhage was an uncommon reason to convert (3 patients or 5.1%).

Table 2 lists the characteristics of patients with LPN, OPN and conversion. Compared to those without conversion patients who underwent conversion were more likely to be male (70% vs 63%), have larger tumors (median size 4.7 vs 3.0 cm) on preoperative imaging and present with local symptoms (32% vs 13%).

Table 3 shows the results of univariate analyses of predictors of conversion from OPN to RN. Formal analysis of LPN cases was not possible due to the few conversions in that group. There was no evidence that age, gender, BMI or ASA score was associated with the risk of conversion to RN. Larger tumor size, lower preoperative eGFR and presentation with symptoms were significantly associated with a higher risk of conversion (table 3). The risk of conversion in a patient with a 3 cm tumor was 5.5% (95% CI 4.0–7.4), which increased to 7.5% (95% CI 5.8%–9.7%) for a 4 cm tumor and to 10.3% (95% CI 7.9%–13.3%) for a 5 cm tumor. Tumor site data were available on 357 OPN cases. Central tumor site was a strong predictor of conversion (central vs peripheral OR 7.74, 95% CI 3.98–15.0, $p < 0.0005$). Tumor size, preoperative eGFR and site remained significant predictors of conversion when they were included in a multivariate model. The increased risk of conversion associated with presenting with symptoms no longer attained statistical significance (table 3).

We also analyzed a randomly selected subset of patients from the conversion and PN groups using the R.E.N.A.L. (radius, exophytic/endophytic, nearness of tumor deepest portion to the collecting system or sinus, anterior/posterior and location relative to the polar line) nephrometry score[9] after selecting 5 patients