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Original article

Patient factors associated with 30-day complications after partial nephrectomy: A contemporary update

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Abstract

Introduction: Patient-level factors associated with perioperative complications after partial nephrectomy (PN) have not been well described in a contemporary series.

Methods: Single-institution retrospective study evaluating patients undergoing open, laparoscopic, and robotic PN between 2001 and 2012. Univariable and multivariable logistic regression models were evaluated to assess factors associated with complications within 30 days of surgery.

Results: We identified 1,763 patients who underwent 1,773 PNs between 2001 and 2012. From 2001 to 2006, 766 PNs were performed (85% open, 15% laparoscopic, and <1% robotic); in contrast, from 2007 to 2012, 1,007 PNs were performed (75% open, 8% laparoscopic, and 17% robotic); $P < 0.001$. Overall, 241 (14%) PNs resulted in an early surgical complication. Patients undergoing a minimally invasive approach had smaller tumors ($P < 0.001$), were less likely to have a solitary kidney ($P < 0.001$), and had a lower Charlson score ($P = 0.004$). On multivariable analysis, factors independently associated with an increased risk of any complication included male sex (odds ratio [OR] = 1.40), solitary kidney (OR = 1.71), estimated glomerular filtration rate (OR = 2.89 for estimated glomerular filtration rate <30), Charlson score (OR = 1.97 for Charlson score ≥3), and tumor size (OR = 1.12 for each 1-cm increase in tumor size); meanwhile, laparoscopic and robotic approaches were associated with a lower risk for complication (OR = 0.017 and 0.016, respectively), all $P < 0.05$.

Conclusion: Several patient-level factors are associated with 30-day complications after PN, regardless of surgical approach. These data may inform counseling before PN, including potential identification and selection of high-risk surgical candidates for percutaneous ablative approaches.

Keywords: Complication; Laparoscopic; Partial nephrectomy; Percutaneous ablation; Robotic; Outcomes

1. Introduction

Radical nephrectomy has historically been the treatment of choice for localized renal cell carcinoma. However, nephron-sparing surgery including open partial nephrectomy (OPN), laparoscopic partial nephrectomy (LPN), and robotic partial nephrectomy (RPN) are now favored for the management of T1 masses. Indeed, American Urological Association (AUA) and European Association of Urology (EAU) guidelines encourage nephron preservation when technically feasible [1,2]. These recommendations are based partly on mounting evidence that partial nephrectomy (PN), compared with radical nephrectomy, may decrease the risk of chronic kidney disease [3]. Although PN still remains the treatment of choice in healthier patients [2], percutaneous ablation and surveillance may be selected in certain patients with competing comorbidities [4].

However, PN is often technically more challenging than radical nephrectomy and remains underused in the community despite perceived benefits [5,6]. Over the past 2 decades, practice patterns have also changed, with

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progressive shift from OPN to minimally invasive approaches [7]. The advent of robotics, furthermore, has augmented laparoscopy to make minimally invasive PN more technically accessible to practicing urologists [8].

As treatment patterns continue to change, comprehensive comparative data comparing OPN with minimally invasive PN are lacking [9]. Furthermore, although minimally invasive approaches have been demonstrated to be safe [7], few studies have documented patient-level risk factors influencing outcomes in those undergoing PN, adjusting for surgical approach. Indeed, a better understanding of these risk factors could potentially inform preoperative counseling and help identify patients who may be candidates for surveillance or percutaneous ablative approaches.

Herein, we describe our institutional experience with PN from 2001 to 2012, a contemporary cohort, to comprehensively evaluate patient-level factors associated with 30-day perioperative morbidity.

2. Patients and methods

2.1. Patient selection

After institutional review board approval, we queried the Mayo Clinic Nephrectomy Registry to identify 1,763 patients who underwent 1,773 PNs for solid renal masses between 2001 and 2012. Patients with bilateral synchronous disease, von Hippel-Lindau syndrome, or tuberous sclerosis syndrome, were excluded.

2.2. Clinical, surgical, and pathologic features

Clinical features included year of surgery, age at surgery, sex, estimated glomerular filtration rate (eGFR) at diagnosis calculated using the Chronic Kidney Disease Epidemiology Collaboration formula, Eastern Cooperative Oncology Group (ECOG) performance status at surgery, Charlson score at surgery, and obesity (defined as body mass index ≥ 30).

Surgical features included approach to PN (open—OPN, laparoscopic—LPN, or robotic—RPN), surgical margin status, estimated blood loss, transfusion rates, length of hospital stay, and complications within 30 days of surgery including death, hemorrhage (defined as bleeding resulting in an intervention such as reoperation or angioembolization, or a hematoma confirmed on imaging), deep vein thrombosis, pulmonary embolism, myocardial infarction, wound infection or dehiscence (defined as infection requiring antibiotics or drainage, or a separation of the layers of the surgical wound requiring intervention), abscess (defined as abscess requiring antibiotics or drainage), urine leak, sepsis (defined as bacteremia that resulted in hypotension or admission to the intensive care unit), acute renal failure, loss of kidney, need for an additional surgical procedure, and pneumothorax. Pathologic features included tumor size and histologic subtype (renal cell carcinoma or benign).

2.3. Statistical methods

Continuous features were summarized with medians and interquartile ranges; categorical features were summarized with frequency counts and percentages. We compared features between an early cohort (2001–2006) and a later cohort (2007–2012) to assess temporal trends in practice patterns using Wilcoxon rank-sum, chi-square, and Fisher exact tests, where appropriate. Associations with any early surgical complication were evaluated using logistic regression models and summarized with odds ratios (ORs) and 95% CIs. A multivariable model was developed using stepwise selection with the P value for a feature to enter or leave the model set to 0.05. Statistical analyses were performed using version 9.3 of the SAS software package (SAS Institute, Cary, NC). All tests were two-sided and $P < 0.05$ were considered statistically significant.

3. Results

A comparison of clinical, surgical, and pathologic features by year of surgery (2001–2006 vs. 2007–2012) is shown in Table 1. As can be seen, patients undergoing PN between 2007 and 2012 tended to be younger with higher eGFRs, have lower Charlson and ECOG scores, and present less frequently with tumors in a solitary kidney (all $P < 0.05$).

Between 2001 and 2006, 766 PNs were performed (85% open, 15% laparoscopic, and $<1\%$ robotic); in contrast, between 2007 and 2012, 1,007 PNs were performed (75% open, 8% laparoscopic, and 17% robotic); $P < 0.001$. When compared with OPN, patients undergoing a minimally invasive approach had smaller tumors (2.2 vs. 3.2 cm; $P < 0.001$), were less likely to have a solitary kidney (3% vs. 9%; $P < 0.001$), and had lower Charlson scores (0 vs. 1; $P = 0.004$).

A full list of early complications is included in Table 2. No patient died intraoperatively. There were 241 (14%) PNs that resulted in an early surgical complication, with a similar rate regardless of period ($P = 0.94$). Overall, 119 (7%) PNs experienced a Clavien grade 3, 4, or 5 complication, which was similar between 2001–2006 and 2007–2012 (6% vs. 7%, $P = 0.38$).

With the exception of hemorrhage (2% vs. 5%; $P = 0.009$) and wound infection or dehiscence (3% vs. 1%, $P = 0.044$), other complications were similar between 2001–2006 and 2007–2012. To better evaluate these bleeding complications, hemorrhage events were stratified by surgical approach and were similar between OPN ($n = 54$, 4%) and minimally invasive PN ($n = 11$, 3%), $P = 0.48$. Furthermore, wound dehiscence occurred only in