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Original Article

Standardized analysis of laparoscopic and robotic-assisted partial nephrectomy complications with Clavien classification

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Abstract

Background: Laparoscopic partial nephrectomy (LPN) and robotic-assisted partial nephrectomy (RPN) are accepted as alternatives of open partial nephrectomy for managing renal tumors. However, LPN and RPN are technically challenging procedures. This report analyzed, according to the Clavien classification, the complications after LPN and RPN.

Methods: We analyzed consecutive LPN ($n = 85$) and RPN ($n = 93$) cases at our institution between April 1994 and December 2012. The data were retrospectively reviewed from a prospectively collected database. All complications that occurred within 3 months postoperatively were recorded and classified according to the modified Clavien classification system.

Results: The mean tumor size was 3.90 ± 1.77 cm. The mean operative time was 255.0 ± 83.5 minutes, and the mean warm ischemia time was 31.6 ± 22.0 minutes. The overall complication rate was 18.5%. Clavien Grades I, II, IIIa, and IIIb complications accounted for 3.93%, 11.2%, 2.81%, and 1.69% of patients, respectively. The most common complication was perioperative hemorrhage that required blood transfusion. Delayed bleeding occurred in seven patients, and four patients underwent angiographic embolization. The proportions of intermediate and high PADUA (Preoperative Aspects and Dimensions Used for an Anatomical) score (≥8) and RENAL (Radius/Exophytic/Nearness to collecting system/Anterior/Location) score (≥7) were 70.8% and 74.2%, respectively. A higher PADUA or RENAL score was associated with a significantly greater complication rate ($p = 0.024$ and $p = 0.02$, respectively).

Conclusion: The overall complication rate in the present study was comparable to that reported in previous studies, although our patients had a larger mean tumor size and higher-complexity procedures.

Keywords: complications; laparoscopy; nephron-sparing surgery; renal tumors; robotics

1. Introduction

Open partial nephrectomy provides excellent long-term oncologic and renal functional outcomes and is currently the standard therapy for managing selected small renal tumors.[1,2] Since the first reports on laparoscopic partial nephrectomy (LPN) by Winfield et al[3] and McDougall et al,[4] this minimally invasive procedure has been broadly accepted and gradually developed. However, the relatively longer learning curve associated with laparoscopic suturing has deterred many urologists from performing LPN. Robotic-assisted partial nephrectomy (RPN) was introduced in 2004, offering advantages such as a magnified three-dimensional view and decreased technical difficulty in intracorporeal suturing, and it has already become a viable alternative to open partial

Conflicts of interest: The authors declare that there are no conflicts of interest related to the subject matter or materials discussed in this article.

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nephrectomy and LPN.[5] However, LPN and RPN are still technically challenging procedures associated with different types of complications.[6–8] In this study, we present the results of our experience with minimally invasive surgery and the method of standardizing complications according to the modified Clavien classification system.

2. Methods

We analyzed 178 consecutive patients who had undergone LPN or RPN at our institution between April 1994 and December 2012. We prospectively collected preoperative baseline demographic data and perioperative data. Information regarding age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, tumor characteristics [tumor size, Preoperative Aspects and Dimensions Used for an Anatomical (PADUA) score, Radius/Exophytic/Nearness to collecting system/Anterior/Location (RENAL) nephrometry score], operative time, estimated blood loss (EBL), and transfusion data were documented. Complications were recorded prospectively and graded according to the modified Clavien classification system (I, II, IIIa, IIIb, IVa, IVb, or V).[9] As several previous studies had shown an association between increasing PADUA and RENAL scores and increasing complication rates,[10–14] a subset analysis was performed to compare complications for simple and complex tumors by using these parameters as objective measures of complexity. All patients underwent preoperative contrast-enhanced computed tomography with three-dimensional volume reconstruction for the evaluation of vascular anatomy, tumor location, depth of invasion, and proximity to the renal sinus or hilum. Maximal tumor diameter (Max T) was calculated using the preoperative computed tomography images.

This study was conducted according to the provisions of the Declaration of Helsinki.

2.1. LPN

A total of 85 patients underwent LPN. Eighty-four procedures were performed via the transperitoneal approach using Veress needle or Hasson access. Only one patient underwent LPN using the retroperitoneal approach because of a history of left hemicolectomy for descending colon cancer 11 years before the operation. The procedure for LPN has been described elsewhere; however, we offer here a brief description, as follows[15]: the hilar vessels and the kidney were dissected from the surrounding tissues, and the perirenal fat covering the tumor was preserved. If it was difficult to clearly identify the tumor invasion area, intraoperative ultrasonography was performed. The hilar vessels were then clamped with laparoscopic bulldog clamps if needed. The renal arteries were clamped first, and the renal veins were clamped based on the surgeon's preference. Subsequently, the tumor was excised using cold scissors and ensuring an adequate safe margin. The frozen section was not routinely examined but only checked in cases of uncertainty. The opened collecting system was repaired using sutures. Hemostasis was achieved by applying energy via electrocautery or an argon beam coagulation and bolster suture. Tissue sealants and thrombogenic agents were used according to the surgeon's decision. Renorrhaphy was performed with traditional tied suture closures with the assistance of Hem-o-locks.

2.2. RPN

RPN was performed in 93 patients using the da Vinci Si Surgical System, and all procedures were performed using the transperitoneal approach with 30° down optics. The procedures were performed with a technique similar to that used for LPN, differing slightly in the subtle variation of renorrhaphy using a sliding-clip method, which has been described previously.[16] Bolster was not routinely used in RPN.

2.3. Definition of complication

Intraoperative hemorrhage was defined as bleeding that required blood transfusion perioperatively. Postoperative bleeding was defined as hematoma confirmed on cross-section imaging or bleeding that required interventions such as reoperation or angioembolization. Urine leakage was defined as urine extravasation, which required prolonged drain maintenance, drain reinsertion, or ureteral stent insertion. Ileus was defined as intestine hypomobility, requiring prolonged hospitalization or nasogastric tube insertion. All complications that occurred perioperatively or within 3 months postoperatively were recorded.

2.4. Statistical analysis

We used SPSS version 18.0 (SPSS Inc., Chicago, IL, USA) for all statistical analyses. The baseline characteristics of the patients are presented as mean ± standard deviation for continuous variables and n (%) for categorical variables. The Mann–Whitney U test was used to compare the numerical variables and Fisher's exact test or Pearson's Chi-square test was used to compare the categorical values. For all statistical analyses, $p < 0.05$ was considered significant. The 95% confidence interval (CI) for the odds ratio (OR) was calculated.

3. Results

Baseline patient demographics and tumor characteristics are listed in Table 1. The mean tumor size on preoperative imaging was 3.90 ± 1.77 (range, 1.40–10.7) cm. The tumor was on the right side in 102 patients (57.0%). Pathological analysis indicated carcinoma in 119 (66.9%), angiomyolipoma in 48 patients (27.0%), oncocytoma in five patients (2.81%), and benign/other in six patients (3.37%). The mean operative time was 255.0 ± 83.5 (range, 100–620) minutes, and the mean warm ischemia time was 31.6 ± 22.0 (range, 0–100) minutes. A total of 33 patients (18.5%) had at least one complication. In 32 patients, complications occurred within 30 days postoperatively, and one patient experienced delayed bleeding requiring angiographic embolization on