Complications of 2,775 Urological Laparoscopic Procedures: 1993 to 2005

Sompol Permpongkosol,* Richard E. Link,* Li-Ming Su,* Frederico R. Romero,* Herman S. Bagga,* Christian P. Pavlovich,* Thomas W. Jarrett† and Louis R. Kavoussi‡,§

From the Department of Urology, The James Buchanan Brady Urological Institute, Johns Hopkins Medical Institutions, Baltimore, Maryland (SP, LMS, FRR, HSB, CPP, TWJ), Scott Department of Urology, Baylor College of Medicine, Houston, Texas (SP, REL) and Institute for Urology, North Shore-Long Island Jewish Health System, Long Island, New York, New York (LRK)

Purpose: We assessed the complications associated with urological laparoscopic surgery at a single high volume center during a 12-year period.

Materials and Methods: A retrospective chart analysis was performed, focusing on complications associated with 2,775 laparoscopic surgeries occurring between 1993 and 2005. These included radical nephrectomy (549), partial nephrectomy (345), donor nephrectomy (553), simple nephrectomy (186), pyeloplasty (301), nephroureterectomy (105), retroperitoneal lymph node dissection (86), renal ablation (81), adrenalectomy (106) and radical prostatectomy (463). Complication data were tabulated according to case number, procedure type, patient age, the American Society of Anesthesiologists score, conversion status, length of hospitalization, Clavien classification system and annual complication rate during the study. Statistical analysis was performed with Fisher's exact and chi-square tests.

Results: A total of 614 complications (22.1%) occurred within each group, broken down into laparoscopic radical nephrectomy (20%), laparoscopic partial nephrectomy (28%), laparoscopic donor nephrectomy (28%), laparoscopic simple nephrectomy (15%), laparoscopic pyeloplasty (13.3%), laparoscopic nephroureterectomy (40.9%), laparoscopic retroperitoneal lymph node dissection (26.7%), laparoscopic renal tumor ablation (18.6%), laparoscopic adrenalectomy (25.4%) and laparoscopic radical prostatectomy (15%). Total intraoperative and postoperative complication rates were 4.7% and 17.5%, respectively. Vascular injuries were the most common intraoperative complications. Annual complication rates plateaued in the year 2000 and were not significantly different during the ensuing 4 years ($p > 0.05$). Complications correlated with a greater American Society of Anesthesiologists score as well as a longer hospital stay ($p < 0.05$).

Conclusions: The data presented here help define the complication rates for laparoscopic urological procedures in experienced hands at a high volume institution.

Key Words: urologic surgical procedures, laparoscopy, intraoperative complications, classification

Since its introduction in the early 1990s urological laparoscopy has been used increasingly by practicing urologists in the academic arena and in private practice. As a result of increased experience, more complex laparoscopic procedures are being performed routinely today. Whether this increase in complexity translates into a significantly higher rate of surgical complications remains an open question. More than 5 years ago a series of studies reviewed rates of complications during urological laparoscopy.[1–3] Given the change in case mixture in the last 5 years it seems appropriate to revisit this issue and update these results to better reflect the more complex procedures performed today.

Uniform reporting and grading of surgical complications via a standardized classification system may permit more meaningful comparisons among different medical centers and varying surgical techniques.[4] Postoperative complications have traditionally been categorized by LOS, reflecting the practical consequences of a complication.[5] However, the duration of hospital stay can no longer be used as a criterion to grade complications because median hospital stays may vary greatly among institutions.[6] A useful classification of general surgical complications was proposed by Clavien et al in 1992,[7] and recently revised and validated by the same group in 2004.[6] This classification offers a convenient and reproducible metric with which to evaluate postoperative complications. Using this system we analyzed the complications of laparoscopic surgery for 2,775 urological procedures performed at our institution during a 12-year period.

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§ Correspondence: Institute for Urology, North Shore-Long Island Jewish Health System, 300 Community Drive, 9 Tower, Manhasset, New York 11030 (telephone: 718-470-7220; e-mail: kavoussi@nshs.edu).

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MATERIALS AND METHODS

We first acquired the records of various urological laparoscopic procedures performed from 1993 through March 2005 at Johns Hopkins Hospital. The data collected included patient age, ASA score, LOS, procedure type and operative date. Complications within the first 30 days after surgery were identified and listed according to surgical procedure. This study was retrospective and approved by The Johns Hopkins University School of Medicine Institutional Review Board.

A total of 2,775 patients underwent urological laparoscopic procedures, including 549 LRN, 345 LPN, 553 LDN, 186 LSN, 301 LP, 105 LNU, 86 LRPLND, 81 LRA, 106 LA, and 463 LRP. All procedures could be classified as difficult procedures as defined by both the European Scoring System for laparoscopic operations in urology[8] and Cadeddu et al.[1]

Mean patient age was 50 ± 15.9 years (range 1 to 90), 75.5% of patients had an ASA score of 1 or 2 and 24.5% had a score of 3 or 4. We classified all complications into categories of operative (directly attributable to the technical execution of the procedure and identified at surgery) and postoperative (directly or not directly attributable to the technical execution of the procedure and identified after surgery). In these studies we also used a uniform reporting and grading scale for surgical complications (the Clavien classification system[6]). There are 7 grades, including 2 subgroups of grade III and IV. Grade I complications are classified as any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological intervention. Grade II complications require pharmacological treatment with drugs other than those allowed for grade I complications. Blood transfusion and total parenteral nutrition are also included. Grade III complications require surgical, endoscopic and radiological intervention. Grade III is subdivided into grade IIIa and IIIb depending on the need for general anesthesia. Life threatening complications requiring intensive care unit management are classified as grade IVa—single organ dysfunction or IVb—multiple organ dysfunction. Death resulting from complications is classified as grade V. To enhance our study we also divided our complications into major and minor categories. A major complication results in enough morbidity to require significant additional treatments and at least 2 more days of hospitalization. A minor complication requires little if any additional treatment and does not result in hospitalization extended beyond 2 days.

Fisher's exact tests and chi-square tests were performed to analyze the correlation of LOS and ASA scores with complications. Relative risk and 95% CI were applied between complications following various operative procedures, and 95% CIs were also applied when percentages were reported. Differences between complication rates were analyzed by chi-square tests in which $p < 0.05$ was considered statistically significant. The correlations between the complication grades and length of hospital stay were analyzed using the bivariate Spearman rank correlation test.

RESULTS

Among 2,775 laparoscopic procedures 614 complications were noted in 525 patients for a total complication rate of 22.1%. Broken down by procedure, complications occurred in 20% of LRN, 28% of LPN, 28% of LPN, 28% of LDN, 15% of LSN, 13.3% of LP, 40.9% of LNU, 26.7% of LRPLND, 18.6% of LRA, 25.4% of LA and 15% of LRP (table 1). Open conversion was performed in 74 patients (2.67%), and blood transfusion treatment was given in 117 (4.2%) of patients. The complication rate was 18.9% for patients with ASA score 1 or 2, and 32.1% for those with ASA 3 or 4. The median LOS for patients with a complication was 4 days (range 1 to 84) compared to only 2 days (range 1 to 14) for those without complications. Complications correlated with a greater ASA score (3 or 4, $p = 0.03$) and longer hospital stay ($p < 0.01$). The majority were identified in the postoperative period (485 of 614, 79%) and were classified as minor (442 of 614, 72%).

Median LOS (6 days) increased by a factor of 3 in patients experiencing a major complication. Even a minor complication led to a 50% increase in median hospital stay (3 days). Complications were shown to significantly prolong hospital stay in multiple comparisons among all groups (none, minor only, and major complication, $p < 0.0001$). The relative complication risk for LNU compared to that of other laparoscopic procedures was 1.9 (95% CI 1.5, 2.4), for LDN was 1.4 (95% CI 1.2, 1.6) and for LPN was 1.3 (95% CI 1.1, 1.6). In this series LNU carried the highest risk of complications.

The 4 complications most commonly identified were vascular injuries (19.8 per 1,000), postoperative bleeding requiring blood transfusion (17.6 per 1,000), ileus that prolonged LOS more than 48 hours (16.2 per 1,000) and wound infection (10.5 per 1,000, table 2). As expected, each individual procedure had its own characteristic profile of complications. In LRN the most common complications were related to injury of adjacent organs (2.37%) or the diaphragm (0.73%). In LPN the most common complications were ileus (3.48%) and vascular injury that was not hemorrhage from the partial nephrectomy bed (2.9%). In LDN vascular injuries, postoperative bleeding requiring blood transfusion, and wound infection were the most common complications (2.35%). The relative risks for vascular injury and wound infection with LDN, compared with other procedures, were 1.2 (95% CI 0.7, 2.3) and 1.5 (95% CI 0.8–2.7), respectively. Not surprisingly, complications of testicular infarction or ischemia, orchialgia, and epididymitis were also relatively more common in LDN (21.7 per 1,000). In LP postoperative complications were usually related to urinary leaks (2.33%). In LNU the most common complication was postoperative bleeding requiring blood transfusion (5.71%). In LA electrolyte imbalance (3.7%) was more common, reflecting the underlying metabolic consequences of adrenal pathology. In LRP postoperative ileus (2.38%) was the most frequent complication, and this was often associated with a urinary anastomotic leak (in 45% of cases). Anastomotic leakage was defined as persistent urine in the suction drain for more than 6 days following LRP.[9] In addition, note that for RPLND results for surgery before and after were not substratified in this data set. The 4 most common complications for each procedure are listed in table 3.

Overall, postoperative complications were classified by the Clavien classification system in tables 2 and 4. Grade I complications were recorded in 7.53%, grade II in 6.85%, grade IIIa in 0.83%, grade IIIb in 1.59%, grade IVa in 0.6% and grade IVb in 0.04% of patients. The mortality rate (grade V complications) for the entire series was 0.07%. Median hospital stays for patients with complications were 3 days (range 1 to 18) when grade I complications developed,