

Complications of 411 laparoscopic urological procedures: A single surgeon experience

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Abstract

Objectives: The aim of this study is to review the complications of laparoscopic urological procedures performed using a single surgeon during a 12-year period.

Materials and Methods: From June 2004 to May 2017, a total of 411 abdominal urological procedures were performed using the author. They included 250 varicocele ligations, 94 nephrectomies (simple, partial, radical, and nephroureterectomy), 34 adrenalectomies, 22 renal cyst ablation, and 11 pelvic lymph node dissections. Operative and postoperative complications were reviewed and analyzed. The results were analyzed using Chi-squared tests for statistical analysis.

Results: A total of 55 complications out of 411 procedures occurred in 26 patients with a total complication rate of 13.4%, 19 were major (4.6%), and 36 were minor (8.8%). Mortality occurred in two patients (0.5%). Conversion to open surgery was done in 5 patients (1.2%) to manage uncontrolled bleeding. Major intraoperative complications included vascular injuries (2.2%), injuries to the diaphragm (0.5%), bowel (0.7%), and pancreas (0.5%). Major postoperative complications included urine leak (0.2%) and pelvic lymphocele (0.2%). Minor intraoperative complications included bleeding during trocar access (4.4%) and subcutaneous emphysema (0.7%), whereas minor postoperative complications included atelectasis (1.2%) and ileus (2.2%).

Conclusions: Even though the complications rate in this series was comparable to those of other studies in the literature, yet it remains higher than that of open surgery. The continuing advances in laparoscopic techniques will reduce the complication rate and will pave the way for laparoscopy to replace most currently practiced open surgical urological procedures.

Keywords: Complication of urological laparoscopy, laparoscopy in urology, management of laparoscopic complication in urology

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INTRODUCTION

The first report on a laparoscopic urological procedure involved pelvic lymph node dissection for prostate cancer in 1991.^[1] This was followed by a rapid increase in laparoscopic procedures for the treatment of various

urologic diseases as a substitute to conventional open surgery.^[2] However, laparoscopy is a complex procedure that can be accompanied by a wide range of complications, and that requires a steep learning curve.^[3] The high complication rate has been attributed to the progression of inexperienced individual surgeons through the learning

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curve as well as the use of more sophisticated laparoscopic procedures.^[4]

Complications of laparoscopy were published following single center,^[5] and multi-institutional studies.^[6] This study included the complications of laparoscopic urological procedures from a single surgeon experience. The Clavien classification system offers a convenient and objective metric for the evaluation of general surgical complications.^[7,8] This classification was used in this study to analyze the complications of laparoscopic surgery for 411 urological procedures during an 11-year period.

MATERIALS AND METHODS

A total of 411 laparoscopic urological procedures were performed from June 2004 to May 2017 by a single surgeon. Data collected for each patient included patient age, the American Society of Anesthesiologists (ASA) score, length of stay (LOS) in the hospital, type of procedure, and operative data. Complications during and after laparoscopy were identified and recorded. This study was retrospective and was approved by the Review Board of the Institution and performed by one surgeon (KAO) after informed consent from the patient. All laparoscopic procedures in this study were performed transperitoneally as previously described.^[9] The laparoscopic procedures performed in the order of frequency were varicose ligation: LVL (250), radical nephrectomy: LRN (50), adrenalectomy: LA (34), simple nephrectomy: LSN (30), renal cyst resection: LRRCR (22), pelvic lymph node dissection: LPND (11), partial nephrectomy: LPN (8) and nephroureterectomy: LNU (6).

The European scoring system (ESS)^[10] for classification of the complexity of the laparoscopic procedures was used in this study. It included easy procedures (varicose ligation), difficult procedures (renal cyst resection and pelvic lymph node dissection) and very difficult procedures (nephrectomy, nephroureterectomy, and adrenalectomy). All intraoperative and postoperative complications were

classified as minor and major and were categorized according to the Clavien-Dindo classification.^[8] Differences between complication rates were analyzed using Chi-square tests in which $P < 0.05$ was considered to be statistically significant.

RESULTS

Patient mean age was 48 years (range 14–78). The total number of procedures was 411, and the total number of complications was 55 (13.4%). The complications were major in 4.6% ($n = 19$) and minor in 8.8% ($n = 36$) of cases [Table 1]. Thirty-seven of the complications (9%) were intraoperative, and 18 (4.4%) were postoperative. Complications based on the procedure are summarized in Table 1. None of the LVL procedures had major complications and 4.8% had minor complications. The incidence of major and minor complications for other procedures were 1.2% and 1% for LRN, 0.7% and 0.7% for LA, 1.2% and 0.7% for LSN, 0.5% and 0.5% for LRRCR, 0.2% and 0.7% for LPND, 0.5% and 1.2% for LPN, and 0.2% and 1% for LNU, respectively. The procedure with the highest incidence of complications was LNU (2/6 LNU procedures: 33.3%). According to the ESS, the number of complications was 19/296 (4.6%) among easy procedures, 14/89 (3.4%) among difficult procedures and 22/26 (5.3%) among very difficult procedures [Tables 2 and 3]. Three laparoscopic procedures (0.7%) were converted to open surgery for control of intra-operative bleeding during LA ($n = 2$) and LRN ($n = 1$) [Table 3].

Patients who were otherwise healthy with no systemic disease (ASA1) had a complication rate of 14.1% ($n = 46/327$). Patients with mild systemic disease (ASA2) had a complication rate of 9.5% ($n = 7/74$), and those with a significant systemic disease (ASA3) had a complication rate of 20.0% ($n = 2/10$). The median LOS in the hospital was 2 days in the absence of complications and increased to 5 days when complications were present [Table 4]. Thirty-seven complications (9.0%) were

Table 1: Laparoscopic procedures and complications

Procedure	No. (%)	Complications No. (%)	
		Major	Minor
Laparoscopic varicocele ligation (LVL)	250 (60.8)	-	12 (4.8)
Laparoscopic radical nephrectomy (LRN)	50 (12.2)	5 (1.2)	4 (1.0)
Laparoscopic adrenalectomy (LA)	34 (8.3)	3 (0.7)	3 (0.7)
Laparoscopic simple nephrectomy (LSN)	30 (7.3)	5 (1.2)	3 (0.7)
Laparoscopic renal cyst resection (LRRCR)	22 (5.4)	2 (0.5)	2 (0.5)
Laparoscopic pelvic lymph node dissection (LPND)	11 (2.7)	1 (0.2)	3 (0.7)
Laparoscopic partial nephrectomy (LPN)	8 (1.9)	2 (0.5)	5 (1.2)
Laparoscopic nephroureterectomy (LNU)	6 (1.5)	1 (0.2)	4 (1.0)
Total	411 (100)	19/411 (4.6)	36/411 (8.8)
			55/411 (13.4)

intraoperative and 18 (4.3%) were postoperative. The incidence of complications during different phases of the study was evaluated. The number of complications during period A (June 2004–May 2008) was 21/106 procedures (19.8%). Complications occurred in 18/124 procedures (14.5%) during period B (June 2008–May 2012) and in 16/181 procedure (8.8%) during period C (June 2012–May 2016) [Figure 1].

The most common intraoperative complication was vascular injury. It was frequently observed irrespective of the procedure done. Bleeding at the time of access ($n = 18$; 4.4%) was controlled during the procedure. Intraoperative bleeding from vascular injury occurred in 8 procedures during LA ($n = 3$), LSN ($n = 1$), LNU ($n = 2$), LRCR ($n = 1$), and LRN ($n = 1$), and occurred in a single incident during the immediate postoperative period after LSN [Tables 3 and 5]. Bleeding necessitated blood transfusion in 11 procedures (2.7%) intraoperatively and in 6 (1.5%) postoperatively. Diaphragmatic injury occurred during LSN ($n = 1$) and LPN ($n = 1$), ileal injury during LRN ($n = 2$), duodenal injury during LSN ($n = 1$), and pancreatic injury during LA ($n = 1$) and LRN ($n = 1$). In 1 subcutaneous emphysema ($n = 4$), atelectasis ($n = 5$) and ileus ($n = 9$) were minor complications that were resolved conservatively during the postoperative period [Table 3].

Postoperative complications as classified by the Clavien classification system showed Grade I complications after 9 procedures, Grade II after 5, Grade III after 3, and Grade V after 2 [Table 5]. Postoperative bleeding from vascular injury following 1 LSN procedure was controlled by operative reintervention. In 1 LPN procedure, postoperative urine leak occurred and was managed by angioembolization. One LPND procedure was followed by postoperative pelvic lymphocele that was surgically drained. Two patients (0.5%) died, one of pulmonary embolism

after LRN and the other of intraoperative duodenal perforation complicated by septic shock [Table 5].

DISCUSSION

Together with minimally invasive procedures, laparoscopy is gradually replacing conventional open urological surgeries. Laparoscopic urological procedures have evolved during the last two decades with continuous improvements in technical equipment and technical skills. The laparoscopic practice was initially restricted to academic centers and recently extended to become applicable in the general community practice. However, laparoscopic procedures still face the challenge of having a steep learning curve and a relatively high incidence of complications. This was particularly noticed with procedures that are considered to be technically difficult according to the ESS.^[11]

This study performed by one surgeon started after a 2-year learning period at a large-volume academic training center. The overall complication rate (13.4%) was within accepted international standards that were performed in single or multi-institutional settings.^[4,6,12-15] The increasing experience that developed by a single surgeon in this study showed a significant reduction in the incidence of complications with experience. The complication rate was 19.8% during the first 4 years of the study. It dropped to 14.5% during the following 4 years and became 8.8% during the past 4 years. Increased laparoscopic experience is known to be associated with a decreased risk of complications.^[3] However, when a big number of surgeons are involved in a single study, the overall results do not always show a significant reduction in complications with time.^[4,13] This has been attributed to the variability

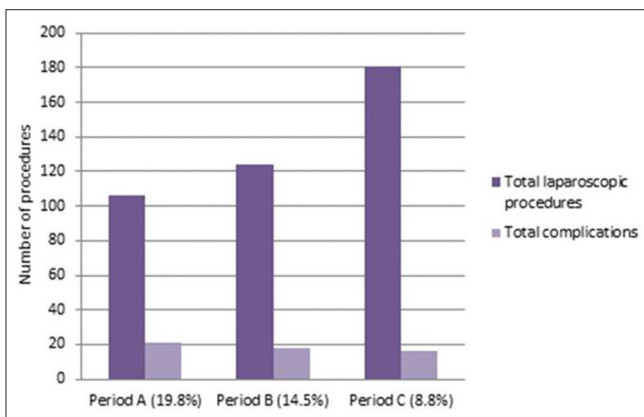


Figure 1: Percentage of complications during different phases of the study period

Table 2: Complications based on complexity of procedure

Classification	Procedures	Complications	Re-intervention
	no.	no. (%)	no. (%)
Easy	296	19 (4.6)	0 (0.0)
Difficult	89	14 (3.4)	1 (0.2)
Very difficult	26	22 (5.3)	2 (0.4)
Total	411	55 (13.4)	3 (0.7)

Table 3: Complications based on ASA and LOS

	ASA Score			Median days LOS	
	ASA1: n (%)	ASA2: n (%)	ASA3: n (%)	Absent	Present
LVL	9/193 (4.7)	3/52 (5.8)	0/5 (0.0)	2	4
LRN	6/38 (15.8)	2/9 (22.2)	1/3 (33.3)	3	5
LA	5/28 (17.9)	1/6 (16.7)	-	2	4
LSN	7/26 (27.0)	0/2 (0.0)	1/4 (25.0)	2	4
LRCR	4/22 (18.2)	-	-	2	4
LPND	3/8 (37.5)	1/3 (33.3)	-	2	4
LPN	7/8 (87.5)	-	-	2	5
LNU	5/6 (83.3)	-	-	3	6
Total	46/327 (14.1)	7/74 (9.5)	2/10 (20.0)	2	5

Table 4: Complications based on the European Scoring System (ESS)

Complications	Procedure	ESS	No.	Management
Major complications				
Intraoperative bleeding	LA	DO	2	Controlled surgically
Intraoperative bleeding	LSN	DO	1	Controlled surgically
Intraoperative bleeding	LRN	DO	1	Controlled surgically
Intraoperative bleeding	LA	DO	1	Controlled laparoscopically
Intraoperative bleeding	LNU	DO	2	Controlled laparoscopically
Intraoperative bleeding	LRCR	EO	1	Controlled laparoscopically
Postoperative bleeding	LSN	EO	1	Controlled surgically
Diaphragmatic injury	LSN	EO	1	Repaired laparoscopically
Diaphragmatic injury	LPN	DO	1	Repaired laparoscopically
Ileal injury	LRN	DO	2	Repaired Laparoscopically
Pancreatic injury	LA	EO	1	Repaired laparoscopically
Pancreatic injury	LRN	DO	1	Repaired laparoscopically
Post-operative urine leak (duplex)	LPN	DO	1	Angio-embolization
Pelvic lymphocele	LPND	EO	1	Drainage
Duodenal injury	LSN	DO	1	Death (septic shock)
Pulmonary embolism	LRN	DO	1	Death
Total			19/411 (4.6%)	
Minor complications				
Access bleeding			18	Controlled during procedure
Subcutaneous emphysema			4	Resolved
Post-operative atelectasis			5	Chest physiotherapy
Post-operative ileus			9	Resolved
Total			36/411 (8.8%)	
Major & minor complications				
Total			55/411 (13.4%)	

DO: difficult operation; EO: easy operation

Table 5: Complications and Clavien classification system for post-operative complications

Complications	Procedures (No.)	Grade	Management
Intra-operative			
Vascular injury	LA (2), LSN (1), LRN (1)		Controlled surgically
Vascular injury	LNU (2), LA (1), LRCR (1)		Controlled laparoscopically
Diaphragmatic Injury	LSN (1), LPN (1)		Repaired laparoscopically
Ileal injury	LRN (2)		Repaired Laparoscopically
Pancreatic Injury	LRN (1), LA (1)		Repaired laparoscopically
Access bleeding	(18)		Controlled during procedure
Subcutaneous emphysema	(4)		Reinsertion of the ports
Post-operative			
Vascular injury	LSN (1)	3	Controlled surgically
Pelvic lymphocele	LPND (1)	3	Drainage
Urine leakage	LPN (1)	3	Angio-embolization
Pulmonary atelectasis	LSN (1), LRN (2), LA (2)	2	Chest physiotherapy
Ileus	LSN (3), LRN (3), LA (2) , LPN (1)	1	conservative
Duodenal injury	LSN (1)	5	Death (septic shock)
Pulmonary embolism	LRN (1)	5	Death
Total	55/411 (13.4%)		

of surgeon experience where a number of the surgeons involved in the study are in the early phases of their learning experience.^[4]

Vascular injuries are the most common complications of laparoscopic urological surgery.^[6,13,15] In the present series, they occurred in 4.4% of cases at the time of access and 2.2% during dissection. Vascular bleeding was encountered with all procedures except LVL and LPND. The only complication of LRCR in this study was a vascular injury in one procedure. Blood transfusion, whether intraoperatively or postoperatively, was required for significant bleeding in 17 procedures (4.1%).

Certain procedures had their own characteristic profile of complications. The most common complications associated with LSN were an injury to the duodenum (0.24%) and the diaphragm (0.24%). LPN also caused diaphragmatic injury (0.24%). The ileal injury occurred with 2 cases of LRN (0.48%). Both LSN and LRN were commonly followed by ileus (0.7% each) and pulmonary atelectasis (0.24%; 0.48%). The only complication encountered in one LPND procedure was pelvic lymphocele (0.24%).

There were two mortalities in the present series (0.48%); one was caused by perforation of the duodenum complicated

by septic shock after LSN, and the other developed pulmonary embolism 8 day after LRN. The mortality rate following urological laparoscopic surgery in the literature ranged from 0.07% to 0.4%.^[4,6,13,14] In one study from Japan done by laparoscopic surgeons who were accredited by an endoscopic surgical skill qualification system, the mortality rate among 2,590 procedures was 0%.^[16]

CONCLUSIONS

The most common complication for laparoscopic procedures in this study was a vascular injury. The complication rates encountered were in accordance with those reported in single or multi-institutional studies. The complication rate was significantly reduced during the 12-year period of this study. The number of minor complications was almost double the number of major complications reflecting an acceptable outcome of results.

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Conflicts of interest

There are no conflicts of interest.

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