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Original Research

Clavien System Classification of Complications Developed following Laparoscopic Urological Operations Applied in our Clinic

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Abstract

Objectives: We analyzed the complications of laparoscopic surgery using Clavien system classification on 396 urological procedures performed at our institution between 2005-2009.

Methods: A retrospective analysis was performed, focusing on complications associated with 396 laparoscopic surgeries performed between 2005 and 2009, which included radical and simple nephrectomy (n=188), partial nephrectomy (n=29), pyeloplasty (n=78), sacrocolpopexy (n=16) and radical prostatectomy (n=85). Complication data were tabulated according to the case number, procedure type, patient age, the American Society of Anesthesiologists score (ASA), Clavien classification system and annual complication rate during this study. Statistical analysis was performed with Fisher's exact and chi-square tests.

Results: A total of 75 patients had complications during the study period. Thus, the total postoperative complication rate was 18.9%. When sub-stratified to various surgical procedures, complication rates were: laparoscopic radical and simple nephrectomy (11.1%), laparoscopic partial nephrectomy (37.9%), laparoscopic pyeloplasty (15.3%), laparoscopic sacrocolpopexy (18.7%) and laparoscopic radical prostatectomy (32.9%). When the complications were classified according to Clavien Classification System stage 1, 2, 3, 4, 5, complication rate was observed in 11.6%, 13.8%, 1.2%, 1%, and 0% of patients, respectively. A correlation was not identified between ASA score and complication rate (p=0.02).

Conclusion: The data presented here would enable us to compare our complication rates objectively with world literature.

Keywords: Clavien system classification; complication; laparoscopy, urology.

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Laparoscopic surgery has been increasingly used in both academic and private centers since the early 1990s, the time when laparoscopic surgery entered urology practice. Nowadays, with the increasing experience in laparoscopic surgery, more complicated laparoscopic procedures have been started to be routinely applied. Complications encountered with increasing number and frequency of complex laparoscopic procedures may become a problem. Postoperative complications lead to a longer hospital stay and increased the cost.[1–3]

Complications encountered in urological laparoscopic procedures, and their rates have been published in various studies.[1, 2] The use of a single and standardized complication classification system allows both the comparison of the complications of different surgical centers and the comparative evaluation of the results of different surgical

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techniques in terms of complications.[4] Clavien et al.[5, 6] developed a complication classification method which can be used in general surgical practice in 1992, and this system was changed in 2004 by the same group and validated.

This study aimed to evaluate the complications seen after laparoscopic procedures according to the Clavien system, which is a standardized classification system.

Methods

Laparoscopic urological operations performed in our clinic between 2005 and 2009 were evaluated retrospectively for complications after obtaining the ethical approval from the relevant ethics committee. Necessary information was obtained from patient files. Age, gender, previous operations, American Society of Anesthesiologists (ASA) scores, operations, and their dates were recorded in the database created for this study. Complications developed within the first 30 days after surgery were examined and listed according to the surgical operation performed. Complications were evaluated according to the Clavien System.

Clavien System

Grade 1 complications, according to the Clavien System, include abnormal changes within the postoperative period that do not require pharmacological, endoscopic or surgical interventions. Drugs that can be used in Grade 1 are diuretics, antiemetics, antipyretics, anti-inflammatory drugs and electrolytes. Grade 2 complications require the use of other medical drugs. For example, total parenteral nutrition (TPN) products, blood transfusion or other antihypertensive drugs are included in this group. Grade 3 complications include situations where medical treatment is inadequate and requires surgical or endoscopic intervention. There are 2 subclasses of Grade 3. Grade 3A complications are intervened under local anesthesia and Grade 3B includes conditions intervened under general anesthesia. Grade 4 complications include organ disorders. Grade 4A refers to single organ disorder and Grade 4B refers to multiple organ disorder. Grade 5 is the loss of the patient. Clavien grading system is summarized in Table 1.[6]

Table 1. Clavien classification system[6]

Clavien classification system	
Grade 1	Normal postoperative changes that do not require pharmacologic treatment or surgical, endoscopic and radiological interventions. (Drugs allowed include antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy)
Grade 2	Conditions that require the use of drugs apart from those included in Grade 1). (blood transfusions, total parenteral nutrition, antihypertensives etc...)
Grade 3	
Grade 3A	Interventions which do not require general anesthesia
Grade 3B	Interventions performed under general anesthesia
Grade 4	
Grade 4A	Single organ dysfunction (Dialysis)
Grade4B	Multiorgan dysfunction
Grade 5	Death of the patient

Preoperative preparation of the patient

Preoperatively blood count, serum urea, and creatinine values, bleeding and coagulation profile, serological tests (HBV, HCV, HIV) and urine culture were evaluated. All patients who underwent transperitoneal intervention received preoperative bowel cleansing with 45 cc oral laxatives (monobasic sodium phosphate 2.4 g/5 ml, dibasic sodium phosphate 0.9 g/5 ml). For prophylaxis of deep vein thrombosis, all patients had worn knee varicose stockings, and 0.4 cc subcutaneous administration of low molecular weight heparin was started 12 hours before the operation and continued during the postoperative period every 24 hours. Generally, treatment was continued until the patient was fully mobilized. A first, -generation cephalosporin was used as antibiotic prophylaxis.

Laparoscopic radical nephrectomy was performed in 102, nephrectomy for benign disease in 86, radical prostatectomy in 85, pyeloplasty in 78, partial nephrectomy in 29 and sacrocolpopexy in 16 patients. Laparoscopic procedures were performed retroperitoneally in nine patients who underwent radical prostatectomy, pyeloplasty and partial nephrectomy, and all other procedures were performed transperitoneally.

Technique

The operations were performed by five different surgeons. Although there were some different personal preferences among surgeons, the techniques applied were essentially the same.

Laparoscopic renal procedures: Two different techniques, namely retroperitoneal and transperitoneal, were used. Transperitoneal renal procedures were performed using 3 - 5 trocar accesses while the patient was in the 45-60 degree lateral decubitus position. To generate pneumoperitonium, access with a Veress needle was generally preferred. A 14 Fr nasogastric tube, a drain, and a 16 Fr urethral catheter were used for all patients. Retroperitoneal laparoscopic renal interventions were performed using 3 or 4 trocars while the

patient was in 90-degree lateral decubitus position. Hasson technique and balloon dilatation were used to create the first trocar entry and extraperitoneal cavity

Laparoscopic radical prostatectomy: The patient underwent 5 trocar techniques in the supine position with arms extended and the table flexed. In extraperitoneal laparoscopic radical prostatectomy, the Hasson technique was used to create the first trocar entry and extraperitoneal cavity. In transperitoneal laparoscopic prostatectomy, Veress access needle was used to generate pneumoperitonium. Laparoscopic radical prostatectomy was performed using two different, namely ascending and descending techniques. Van Velthoven technique was used in vesicourethral anastomosis.[7] A 14 Fr nasogastric tube was implanted in all patients during the procedure and a drain was placed during the postoperative period. An 18 Fr silicone catheter was used for urethral catheterization.

Laparoscopic pyeloplasty was performed with 3-4 trocars while the patient in 45 degree- lateral decubitus position. To generate pneumoperitonium, the entry with a Veress needle was preferred. After the colon was mobilized medially, ureter and pelvic dissection exposed complete ureteropelvic junction, ureter, pelvis and renal vascular system. Foley Y-V pyeloplasty or Fenger pyeloplasty technique was performed in patients with crossed vessels and large renal pelvis in patients with dismembered pyeloplasty, high ureteral access, short segment ureteral stenosis and small renal pelvis. For all patients, 6 Fr JJ catheter, 18 Fr urethral catheter and a drain were used.

Laparoscopic partial nephrectomy was performed through transperitoneal route using 4-5 trocars when the patient was in 45-60 degree lateral decubitus position. The colon was mobilized medially. Renal artery and vein were released by renal hilus dissection. Gerota fascia was opened, and renal mass was reached, and the boundary of the mass circumference with normal renal parenchyma was determined by protecting the fat tissue on the mass. Renal artery was clamped with bulldog clamp, and warm ischemia was achieved. Renal mass was removed using cold scissors. The collecting system and bleeding areas were sutured with polyglactin sutures. Surgicell (Johnson & Johnson, Ethicon, NJ, USA) cushions were placed on the base and closed with polyglactin sutures and renal parenchymal sutures. A drain, 14 Fr nasogastric tube, and 18 Fr urethral catheter were inserted in all patients.

Laparoscopic sacrocolpopexy was performed with the patient in low lithotomy position through the transperitoneal route with five trocar technique. A dilator was placed intravaginally to release the vaginal apex. The peritoneum over the vagina was dissected with care not to damage the anterior wall of the bladder and posterior rectum, and the anterior and posterior part of the vagina was released by dissection. The peritoneal incision behind the vagina was extended to the sacral promontory by paying attention to the lateral ureter. The sacral promontorium was released by dissection up to the periosteum. Anterior and posterior walls of the vagina were fixed with 2/0 polyglactin tension-free sutures to the sacral promontory using polypropylene mesh (Ethicon, Smorville, NJ). The separated peritoneal layers were closed, and polypropylene mesh was completely retroperitonealized. A drain and a vaginal tampon were used for all patients. An 18 Fr foley catheter was used for urethral catheterization.

Results

Complications were detected in 75 (18.9%) of 396 patients who underwent laparoscopic surgery. Total complications were Clavien Grades 1 in 46 (61%), 2 in 50 (66.6%), 3 in 5 (6.6%), 4 in 4 (5.3%) patients. Clavien Grade 5 complications were not encountered.

Laparoscopic radical and simple nephrectomy: The median age of the 188 patients who underwent laparoscopic radical and simple nephrectomy was 52.4 (6-78) years, and the mean ASA score was 1.9.[1–3] Complications were found in 21 (11.1%) of 188 patients who underwent laparoscopic nephrectomy. In the patient group who underwent laparoscopic nephrectomy, fever requiring antipyretic and antibiotic treatment developed in 12 (6.3%) patients as Grade 1 complication and wound infection were detected in eight (4.2%) patients. Postoperative blood transfusion was performed in 18 (9.5%) patients as Grade 2 complications.

Total parenteral nutritional therapy was administered in four (2.1%) patients whose oral intake was restricted due to metastatic kidney tumor, and seven (3.7%) patients with ileus that developed after surgery and improved with conservative treatment. As a Grade 3b complication, one (0.5%) patient whose organ bag was forgotten inside during laparoscopic radical nephrectomy was removed with open operation under general anesthesia on the first postoperative day. As a Grade 4a complication, 1 patient (0.5%) with normal preoperative serum creatinine level had elevated postoperative creatinine level secondary to postrenal acute renal failure. As a Grade 4b complication, antibiotic and total parenteral nutritional therapy were applied in the intensive care unit due to sepsis and multiple organ dysfunction in two (1%) patients.

Laparoscopic radical prostatectomy: The median age of the patients who underwent laparoscopic radical prostatectomy was 61.2 (53-72) years, and the median ASA score

was 1.8. A total of 28 patients (32.9%) had complications. Fever requiring antipyretic treatment was detected in 14 (16.4%) patients as Grade 1 complication in this patient group. As Grade 2 complications, bleeding requiring transfusion in patients who underwent (n=4 (4.7%), and did not undergo (n=2: 2.3%) nerve-sparing laparoscopic prostatectomy, ileus which developed due to prolonged urine leakage in 2 (2.3%) patients which regressed with conservative treatment, urinary tract infection requiring antibiotic treatment in two (2.3%) patients and wound infection in one patient (1.1%) were detected. As a Grade 3b complication, two (2.3%) patients had prolonged urinary leakage so bilateral open-ended ureter catheter was placed endoscopically under general anesthesia, and in the other patient anastomosis was repaired using open surgery Multiple organ dysfunction due to sepsis was detected in one (1.1%) patient as Grade 4b complication. There were no grade 5 complications in the patient group who underwent laparoscopic radical prostatectomy.

Laparoscopic pyeloplasty: The median age of the patients who underwent laparoscopic pyeloplasty was 37.2 (5-61) years, and the median ASA score was 1.4.[1–3] Complications were detected in 12 (15.3%) patients in the laparoscopic pyeloplasty group. As a Grade 1 complication, urinary tract infection requiring antibiotic and antipyretic therapy was confirmed in seven (8.9%) patients with urine cultures. Grade 2 complications included bleeding requiring transfusion in two (2.5%) patients and ileus and electrolyte imbalance (hypopotasemia) due to prolonged urinary leakage in one patient (1.2%). As a Grade 3a complication, one (1.2%) patient had prolonged urinary leakage and the urinary system X-ray (KUB) showed that the double-j (JJ) catheter was not in place and JJ catheter was replaced under local anesthesia. As a Grade 3b complication, the lower end of the JJ catheter was found to be in the ureter in plain urography performed due to prolonged urinary leakage in one (1.2%) patient and the JJ catheter of the patient was replaced under general anesthesia. There were no Grade 4 and Grade 5 complications in patients who underwent laparoscopic pyeloplasty.

Laparoscopic partial nephrectomy: The median age of the 29 patients who underwent laparoscopic partial nephrectomy was 52 (44-65) years, and the median ASA score was 1.4.[1–3] Complications were detected in 11 (37.9%) patients who underwent laparoscopic partial nephrectomy. In the laparoscopic partial nephrectomy group, urinary tract infection and fever requiring antibiotic and antipyretic treatment were detected in three (10.3%) patients as Grade 1 complications. As a Grade 2 complication, ileus and deteriorated electrolyte balance were detected in six (20.6%) patients. While conservative treatment improved in four patients and ileus regressed with a high-level enema in two patients. Blood transfusion was required in 10 (34.4%) patients postoperatively. There were no Grade 3, 4 or 5 complications in the patient group who underwent laparoscopic partial nephrectomy.

Laparoscopic sacrocolpopexy: The median age of the 16 patients who underwent laparoscopic sacrocolpopexy was 57 (39-70) years, and the median ASA score was 1.2.[1–3] Complications were detected in three (18.7%) patients in the patient group who underwent laparoscopic sacrocolpopexy. As Grade 1 complication fever requiring antipyretic treatment was detected in two (12.5%) patients and the Grade 2 complication was related to mesh which could not be fully retroperitonealized. One patient (6.2%) had prolonged ileus, which regressed with conservative treatment. In laparoscopic sacrocolpopexy group, there were no complications except Grade 1 and Grade 2 complications.

When the complications developed during the operations were evaluated and divided into two groups as those occurring between 2005-2007 and 2007-2009; the overall complication rate (15.1%) developed as a result of laparoscopic operations performed between 2007 and 2009 was found to be lower (10.1%) when compared with 2005-2007 period (chi-square test $p<0.01$).

The relationship between ASA scores and the development of complications was investigated, and no statistically significant relationship was found ($p=0.02$ Fisher's exact test). Our postoperative complication rates are shown in Table 2.

Table 2. Postoperative laparoscopic urologic complications

Surgery	Number of patients	Grade 1, n (%)	Grade 2, n (%)	Grade 3, n (%)	Grade 4, n (%)	Grade 5, n (%)
Prostatectomy	85	14 (16.4)	6 (7)	2 (2.3)	1 (1.1)	-
Nephrectomy	188	20 (10.5)	29 (15.3)	1 (0.5)	3 (1.5)	-
Partial nephrectomy	29	3 (10.3)	16 (55)	-	-	-
Sacrocolpopexy	16	2 (12.5)	1 (6.2)	-	-	-
Pyeloplasty	78	7 (8.9)	3 (3.7)	2 (2.4)	-	-
Total	396	46 (11.6)	55 (13.8)	5 (1.2)	4 (1)	-

Discussion

In the last 15 years, the frequency and use of laparoscopy in genitourinary surgery have increased. Nowadays, laparoscopic radical nephrectomy has become the gold standard treatment option in centers experienced in the treatment of clinical stage T1 kidney tumors.[8] Laparoscopic prostatectomy, laparoscopic partial nephrectomy, and laparoscopic pyeloplasty are used with increasing interest and frequency with their minimally invasive features.

Complications developed after laparoscopic surgery differs between surgical centers and surgeons.[2] A standard definition for the developing complications in the surgical literature is not available yet. A single classification system and the characteristics of the described complications are not considered sufficient.[9] In this study, we aimed to classify laparoscopic procedures performed in our clinic with a standardized and proven complication system, to compare our complications with other those of centers and to evaluate our surgical technique with an objective and critical eye.

In 1996, Gomella et al.[10] found out that the rate of total complications in laparoscopic urological procedures was 7.9%. In a subsequent multicenter German study, the total complication rate in laparoscopic urologic procedures was found to be approximately 4.4%.[11] These studies are presenting the results of the basic laparoscopic urological procedures (such as laparoscopic radical nephrectomy, simple nephrectomy and pyeloplasty) performed by experienced surgeons, which we use as standard today. In the last decade, in parallel to the widespread use of laparoscopy in more complicated urological procedures, the complication rates after laparoscopic urologic procedures have increased. In two separate studies conducted in 2001 and 2007, the complication rates were 13.2% and 17%, respectively.[1, 12]

Kavoussi et al.[12] reported the mortality rate (Clavien Grade 5) in 2700 laparoscopic procedures performed within 12 years as 0.07 percent. The total complication rate in this series was slightly lower than the other series and complication rates were 22.1% in the early 1990s, but decreased to 17% in 2004 with increasing experience. When the complications developed in the operations performed between 2005-2007 and 2007-2009 in our clinic were evaluated; the overall complication rate (15.1%) developed as a result of laparoscopic operations performed between 2007 and 2009 was found to be lower (10.1%) than the operations performed between 2005-2007.

We think that this lower complication rate detected between 2007 and 2009 was related to increased experience. In the study of Kavoussi et al.,[12] the rate of major complications (Clavien Grade >3) was 3.8% in the early 1990s and 3.5% in 2004. The complication rate has remained constant over the past 15 years which can be explained as follows. The increasing experience has led to a decrease in complication rates in standard operations; however, laparoscopic interventions were performed in more complicated cases, so relatively higher complication rates were observed in some operations.[12] In our study, the total complication rate was 18.9%, and the major complication rate (Clavien >3) was 10.8% among a limited number of patients and within a shorter period of experience. Although our total complication rates seem to be consistent with the literature, the rate of major complications encountered (Clavien Grades 3, 4, and 5) appears to be much lower (2.2%). The reason why our major complication rates are lower than the literature may be that our study included selected, patients at the beginning of the learning curve of more than one surgeon and that laparoscopy was less frequently applied for complex urologic cases.

Laparoscopic nephrectomy: After laparoscopic simple nephrectomy performed by Clayman et al.[13] in 1991, the frequency of use of laparoscopy in renal surgery has increased worldwide, and nowadays, it has become the standard surgical approach for nephrectomies. In the meta-analysis, in which complications developed as a result of laparoscopic renal procedures were published, complications were encountered in 2046 patients in laparoscopic simple and radical nephrectomy operations, and the major and minor complication rates in general laparoscopic renal procedures were reported as 9.5% and 1.9%, respectively.[14] In our study, major and minor complication rates were 25.8% and 2%, respectively.

The most common major complication of laparoscopic radical nephrectomy is arterial bleeding in 1% and venous bleeding in 1.8% of the cases.[15, 16] In a study in which the Mayo clinic reported laparoscopic nephrectomy experience and complications, the findings indicated that major complications were encountered in16 (5.6%) patients including the patients who required reoperation (n=12) and medical treatment (n=4), but none of the patients exited as a major complication.[17] In the same study, the rate of complications encountered in laparoscopic nephrectomy operations performed between 2001 and 2002 was 5.8%, whereas this rate decreased to 2.5% in operations performed between 2002-2003.[17]

In another study comparing laparoscopic nephrectomy operations in the first 100 and subsequent patients, the complication rate in the first 100 patients was 13.3%, whereas this rate decreased to 3.6% in the subsequent operations.[18] In a similar study by Soulie et al.,[19] the complication rate of the first 100 patients was 9%, while the complication rate

of subsequent 250 patients was reported as 4% (Table 3).[11, 17, 19, 20] In our study, when the complications that developed during the operations were evaluated and divided into two groups as those performed between 2005-2007 and 2007-2009, the overall complication rate as a result of laparoscopic operations performed between 2007 and 2009 was found to be lower (10.1%) than laparoscopic operations carried out between 2005-2007 (15.1%).

When we examined the laparoscopic nephrectomy subgroup, no difference was found between periods of 2005-2007 and 2007-2009 in terms of complications. Over time, the increasing number of surgeons in our clinic has started to perform laparoscopy, because until 2009, the learning curve was not exceeded in the clinic in general. Another possibility is that over time, more complicated nephrectomies could be performed.

Partial nephrectomy: The incidence of localized renal cell cancer has increased by 3.7% per year within the last decade.[21, 22] Majority of the detected renal cell cancers are small asymptomatic renal tumors diagnosed incidentally.

Laparoscopic partial nephrectomy is being performed for elective indications and more frequently for T1a kidney tumors, but partial nephrectomy is recommended in all current T1 renal tumors in current guidelines due to the increased risk of chronic renal disease after radical nephrectomy, and resultant risk of long-term cardiovascular morbidity and mortality.[23] Although laparoscopic partial nephrectomy has the advantage of providing a faster return to normal postoperative life, but because of prolonged warm ischemia time due to lack of a defined standard renal cooling system, and higher postoperative complication rates than open partial nephrectomy it is still not the gold standard surgical treatment.[24, 25] However, the popularity of laparoscopic partial nephrectomy has increased in urology centers thanks to technical improvements and better results obtained within the last 10 years.

Gill et al.[26] who have the most experience in this field divided laparoscopic partial nephrectomy operations they have performed within the last 10 years into three groups, and found out overall complication rates as 25.4, 15.6, and 11.1% between the years 1999-2003, 2004-2006 and 2007–2008, respectively (Table 4). In our study, the overall complication rate was 25.4% between 2005 and 2007, whereas it was 12.5% between 2007 and 2009. Postoperative urologic complication rates decrease significantly as a result of increased experience and improved technical skills. Marszalek et al.[27] compared laparoscopic and open partial nephrectomy in 200 patients and found out that the overall complication rate after laparoscopic partial nephrectomy was detected as 24%. Most of them were Grade 1-3 complications, but grade 3 complications are seen more frequently in laparoscopic partial nephrectomy group due to the development of pneumothorax and highly frequent ureteral stent placement. When the general complications are evaluated, Grade 1-4 complication rates were found to be 5, 8, 8, 2%, respectively, but grade 5 complications were not encountered.[27]

In the literature, overall complication rates after laparoscopic partial nephrectomy vary between 9, and 33%.[28–32]

Bleeding (5%) and urine leakage (4.2%) appear to be the two most common urologic complications encountered in large series (Table 5).[28–35] With the development of tissue hemostasis techniques, a wide range of hemostatic agents can now be used to control bleeding. Gill et al.[36] performed laparoscopic partial nephrectomies with and without using gelatin matrix thrombin (Floseal (R), Baxter, Deerfield, IL), and they detected a significant decrease in overall complication rates (16% vs. 37%) and decrease in hemorrhagic complications (12% vs 3%) in Floseal (R) used group. The early postoperative bleeding complication is monitored, and transfusion is performed in case of need. In more severe cases, selective angioembolization, open or laparoscopic surgery may be required for the control of bleeding.

Table 3. Complications of laparoscopic nephrectomy

Studies	Number of the patients	Rates of complications (%)
Siquiera et al.[20]	213	7.5
Soulie et al.[19]	350	13
Fahlenkamp et al.[11]	351	8.2
Mayo clinic[17]	285	5.6
Cerrahpaşa	188	11.1

Table 4. Complications of partial nephrectomy in large series

	Number of patients	Overall complication rates, n (%)	Medical complications n (%)
Ramani et al.[28]	200	66 (33)	24 (12)
Simmons et al.[29]	200	38 (19)	18 (9)
Wright et al.[30]	49	7 (14.3)	4 (8.2)
Venkatesh et al.[31]	123	26 (21.1)	10 (8.1)
Schiff et al.[32]	66	6 (9)	2 (3)
Link et al.[33]	217	27 (12.4)	15 (6.9)
Bollens et al.[34]	39	12 (30.7)	8 (20.5)
Abukora et al.[35]	78	23 (29.5)	10 (12.8)
Porpiglia et al.[25]	90	22 (24.4)	11 (12.2)
Total	1062	227 (21.4)	102 (9.6)
Cerrahpaşa	29	11 (37.9)	11 (37.9)

Table 5. Complications of laparoscopic partial nephrectomy

	Gill et al.[26]	Simmons et al.[29]	Ramani et al.[28]	Link et al.[33]	Cerrahpaşa
Bleeding (%)	2.1	4.5	6	1.8	10.2
Urine leakage (%)	1.7	2	4.5	1.4	-
Urologic (%)	3.8	8	13.5	4.6	21.6
Non-urologic (%)	12.7	11	14	7.8	16.3
Blood transfusion (%)	14.1	8	5.5	6.9	34.4

After laparoscopic partial nephrectomies performed in 29 patients, in our clinic, blood transfusion was performed in 10 (34.4%) patients. When compared with the literature, the rate of a bleeding complication in our series seems to be high. This may be due to the non-use of tissue hemostatic agents (because it is difficult and costly to obtain these agents in our country's conditions), and the difficulty in suturing early in the learning curve. The indication for transfusion may also vary significantly between centers and physicians. The indication for transfusion in surgeries performed in our clinic is almost always put by the anesthesiologist.

Urinary leakage is the second most frequently encountered urologic complication in partial nephrectomy due to the opening of the collecting system during tumor excision. The risk of its incidence increases after excision of large and deeply seated tumors. When closing the collecting system with sutures, damage to the vascular structures should be absolutely avoided. Damage to the vascular structures may lead to the development of arteriovenous fistula or formation of pseudoaneurysms. Urinary leakage can be monitored postoperatively by providing optimal drainage with ureteral stents. Urine leakage has varied between 1.4% and 10.6% in studies performed with a large number of patients (31.33). In our limited series of patients who underwent laparoscopic partial nephrectomy, we did not encounter urine leakage. This may be due to patient selection. In general, the selection of peripheral and minor cases may have prevented injury of the collecting system and related complications.

Since perirenal surgical adhesions may occur, laparoscopic partial nephrectomy is a relative contraindication in patients with a history of previous surgery. Turna et al.[37] reported postoperative complications at a rate of 12% in 25 patients who underwent laparoscopic partial nephrectomy with a history of previous renal surgery. Complications were recorded as bleeding requiring blood transfusion (n=1), epistaxis (n=1) and compartment syndrome requiring fasciotomy (n=1).[37] Twenty-nine laparoscopic partial nephrectomy cases performed in our clinic did not have a history of previous surgical operation.

Laparoscopic radical prostatectomy: Postoperative bleeding rates vary between 1-7.6% in various published series of laparoscopic radical prostatectomy.[38, 39] Stolzenburg et al.[40] classified the results of 1800 laparoscopic radical prostatectomies using the Clavien system and reported postoperative bleeding rate as 1.1 percent. In our patient group, we detected a postoperative bleeding rate of 7 percent. Although not statistically significant postoperative blood transfusion rates were found to be higher in patients who underwent laparoscopic radical prostatectomies. In the same study, the patients had Grade 1 (n=60:3.4%) Grade 2 (n=, 27:1.56%), Grade 3 (n=75:4.1%) , and Grade 4 (n=1:0.06%) complications; however, Grade 5 complications were not observed (Tables 6, 7).[40]

The risk of ileus after transperitoneal laparoscopic radical prostatectomy varies between 1.1-2.5 percent.[41, 42] The risk of ileus after extraperitoneal laparoscopic radical prostatectomy was reported to be quite high (0.6%) in the study of Ruiz et al. in contrast to other publications.[43–47] In none of these studies, ileus requiring surgical operation was detected, and ileus was regressed with conservative treatment in all patients. In our patient group, ileus developed due to prolonged urinary leakage regressed at a rate of 2.3% with conservative treatment.

Obturator nerve injury during laparoscopic radical prostatectomy is a rare complication caused by the equipment used for coagulation or the clips used during pelvic lymphadenectomy. Transient nerve damage during coagulation regresses within six weeks with medical treatment and physiotherapy. Obturator nerve injury rates in laparoscopic radical prostatectomy publications range from 0 to 0.3 percent.[48] Since laparoscopic radical prostatectomy in our clinic did not include patients that requireed pelvic lymphadenectomy, we did not encounter obturator nerve injury as a complication. After laparoscopic radical prostatectomy, leakage from the site of vesicourethral anastomosis can be seen up to a frequency of 13.5 percent.[38, 41–46]

Stolzenburg et al.[44] detected minor and major anastomotic leakage in 42 (2.4%) of 1800 patients who had undergone laparoscopic radical prostatectomy. Laparoscopic re-anastomosis was achieved in three of 42 patients with

Table 6. Complications of laparoscopic radical prostatectomy developed within the first postoperative 48 hours[44]

Clavien grades	Number of patients (%)	Cerrahpaşa (%)	Approach
Grade1 High fever	Unknown	14 (16.4)	Conservative
Grade 2 Preperitoneal hematoma	7 (0.4)	6 (7)	Conservative
Grade 2 Transient obturator nerve damage	2 (0.1)	-	Conservative
Grade 2 Transient ileus	-	2 (2.3)	Conservative
Grade 3a Renal failure	3 (0.2)	-	JJ -stent insertion 1
			Nephrostomy Complication tube insertion: 1
			Conservative f: 1
Grade 3b Bleeding	19 (1.1)	-	Endoscopic revision: 13
			Open revision: 6
Grade 3b Gross hematuria	1 (0.06)	-	Transurethral coagulation: 1
Grade 3b Anastomotic leakage	3 (0.2)	-	Laparoscopic anastomosis 3

Table 7. Complications of laparoscopic radical prostatectomy developed within the first postoperative 48 hours-1 month

Clavien Grade	Number of patients (%)	Cerrahpaşa (%)	Approach
Grade 1 Urine retention	28 (1.6)	-	1-4 days of catheterization
Grade 1 Anastomotic leakage	32 (1.8)	-	Prolonged catheterization time
Grade 2 Osteitis pubis	1 (0.06)	-	Antibiotherapy
Grade 2 Deep vein thrombosis	7 (0.4)	-	Conservative
Grade 2 Urinary tract infection	Unknown	2 (2.3)	Conservative
Grade 3a/b Lymphocele	45 (2.5)	-	Percutaneous drainage: 2
Grade 3b Perineal Hematoma	2 (0.1)	-	Percutaneous drainage: 2
Grade 3b Rectourethral fistula	2 (0.1)	-	Colostomy, secondary repair
Grade 3b Anastamotic insufficiency	7 /0.4)	2 (2.3)	Single-j stent: 6
			Perineal reconstruction: 1
Grade 4a Urosepsis	1 (0.06)	1 (1.1)	Conservative (intensive care)

anastomotic leakage, while for the management of anastomotic leakage catheter was held in situ for long periods in 32 patients, mono-J stent was inserted in six patients and perineal reconstruction was performed in one patient.[44] Prolonged urine leakage was detected in two (2.3%) patients who underwent laparoscopic prostatectomy in our clinic. In one patient open-ended catheter was inserted endoscopically into bothureters under general anesthesia, and the other patient underwent open surgery for anastomotic repair. After 20 days of urethral catheterization, complications were successfully treated in both patients.

Laparoscopic pyeloplasty: Ureteropelvic junction stenosis is the most common congenital cause of urinary tract obstruction and leads to progressive dilatation of the upper urinary tract.[49] Open pyeloplasty is the gold standard treatment option for surgical treatment of ureteropelvic junction stenosis with success rates above 90 percent.[50, 51] Schuessler et al.[52] reported the first laparoscopic pyeloplasty operation in 1993, and then, it is being used with increasing frequency in urology practice, and with reported success rates up to 90% it has become the new gold standard treatment approach.

Rates of complications in laparoscopic pyeloplasty in publications on a large number of patients have varied between 12.9% and 15.8%, while this rate increased to 22.5% in series with a low number of patients.[53–55] Rassweiler et al.[56] reported intraoperative complications of laparoscopic pyeloplasty operations using Satava classification and postoperative complications with Clavien classification system. In this study, postoperative Clavien Grade 1 complications were reported in three (0.5-5%) patients, including subcutaneous emphysema (n=1), hematuria (n=1) and neuropathy (n=1). Clavien Grade 2 complication rates ranged from 2.9 to 7.5% and as Grade 2 complications; bleeding requiring a blood transfusion, transient ileus, prolonged urine leakage, port site infection, high fever, urinary tract infection, pneumonia and thrombophlebitis were encountered.

In the same study, the majority of them (9.5%) were Clavien Grade 3 b complications that required interventions under general anesthesia. Clavien grade 3b complications were urinary leakage in 2, bleeding and hematoma in 6, stone

formation in 1 and recurrent ureteropelvic junction stenosis in nine (4.8%) patients. Except for pulmonary embolism, which was a Clavien Grade 4 complication detected in one patient, no Clavien Grade 5 complications were encountered.[56] Similar to Rassweiler, Moon and then Inagaki detected Clavien Grade 3b complication rate as high as 7% in their laparoscopic pyeoplasty series consisting of 170 and 147 patients, respectively. Clavien grade 5 complications were not encountered in either study (Table 8).[54–56]

In our study, unlike the literature, Grade 3 complication rates were lower (2.4%). JJ catheters of the patients undergoing laparoscopic pyeloplasty are removed within 4-6 weeks, and the first scintigraphic evaluation is performed in the 3rd postoperative month. Therefore, it is not appropriate to evaluate recurrent ureteropelvic junction stenosis within 30 days postoperatively. Since we evaluated complications developed within the first postoperative 30 days, recurrent stenosis and its treatment could not be evaluated, which might, of course, underestimate the complication rate.

Laparoscopic sacrocolpopexy: Pelvic organ prolapse (POP) is a frequently encountered female health problem, and its incidence increases with increasing age. POP is seen in 50% of women during their lifetime. In the United States, approximately 200.000 women undergo surgical interventions each year, and more than $1 billion is paid annually for surgical interventions.[57, 58] In a large health screening conducted in North America, the risk of prolapse or incontinence surgery was 11% during the lifetime of women, and one-third of these patients required re-operation within four years.[59] There are two main approaches in the treatment of POP namely, abdominal and vaginal repair. Despite the higher cost and morbidity, the abdominal repair is generally recommended because of its better anatomical and functional results.

Among the surgical techniques used in the treatment of POP, the laparoscopic approach was popularized at a later date compared to other methods. Advantages of the laparoscopic approach include magnified and detailed pelvic anatomy, easy access to all pelvic compartments, ease of recto-or vesico-vaginal patch placement, and minimally invasive approach. Despite all these advantages, its technically difficult applicability and the length of the learning curve have been identified as factors limiting the widespread use of this technique.[58]

Sarlos et al.[60] reported a postoperative overall complication rate of 35.6% in 101 patients of a prospective laparoscopic sacrocolpopexy series. The two most common postoperative complications are constipation in 19 (18.8%)

Table 8. Postoperative complications of laparoscopic pyeloplasty

Clavien Grade	Rassweiler et al.[56] (n=189)	Moon et al.[54] (n=170)	Inagaki et al.[55] (n=147)	Cerrahpaşa (n=78)
Grade 1	3 (1.6%)	1 (0.6%)	1 (0.7%)	-
Subcutaneous emphysema	1	-	-	-
Hematuria	2	1	1	-
Grade 2	6 (3.2)	5 (2.9)	6 (4.1)	9 (11.4)
Blood transfusion	1	-	2	2
Anastomotic leakage	1	1	1	-
Port site infection	1	1	-	-
High fever	1	2	-	-
Urinary tract infection	2	1	-	7
Pneumonia	-	-	1	-
Thrombophlebitis	-	-	1	-
Grade 3a	2 (0.1)	1 (0.2)	(0.2)	(1.2)
Urinoma	2	1	1	1
Grade 3b	18 (9.5)	12 (7)	10 (7)	(1.2)
Anastomotic leakage	2	1	1	1
Bleeding/hematoma	6	1	1	1
Colonic lesion	-	1	1	-
Stone formation	1	3	-	-
Recurrent stenosis	9	6	7	-
Grade 4	1 (0.1)	1 (0.1)	1 (0.1)	-
Pulmonary embolism	1	-	-	-
Myocardial infarction	-	1	1	-
Total	30 (15.8%)	22 (%12.9)	19 (%12.9)	11 (14.1%)

and urinary tract infection in 17 (16.8%) patients.[60] Laparoscopic sacrocolpopexy was performed by a single surgeon in our clinic. Complications were detected in three (18.7%) patients in the patient group who underwent laparoscopic sacrocolpopexy. Fever requiring antipyretic treatment was detected in two (12.5%) patients with Grade 1 complication, and as Grade 2 complication prolonged ileus was noted in one (6.2%) patient whose mesh was not fully retroperitonealized which regressed with conservative treatment. There were no Grade 3 complications in the laparoscopic sacrocolpopexy group. In our clinic, the rate of complications of laparoscopic sacrocolpopexies in our clinic may be found to be slightly lower than the cited publications due to their realizations by an experienced single surgeon and a relatively limited number of patient populations in our study.

Although this study included relatively limited number of patients, which is the limitation of this study, the presemt study has a retrospective design and analyzed complications that occurred during the first 30 days postoperatively. In our opinion this study is an insightful and important study because it provides objective data coming from one of the first clinics that performed laparoscopic procedures in our country, Turkey.

Conclusion

In conclusion, in the evaluation of postoperative complications of laparoscopic operations performed in our clinic between 2005 and 2009 using Clavien classification system, the findings showed that minor complications were mainly Clavien Grade 1-2 (91.8%) complications, sand as a Clavien Grade 5 complication, mortality was not seen. Overall, our postoperative complication rate was consistent with the world literature when the minor/major complication rates are analyzed, it is observed that the major complications of our clinic are slightly more severe than the major complications cited in the literature. Our study will help to compare the complications of laparoscopic urologic procedures with those of other centers using the Clavien grading system which is a standardized and objective classification method.

Disclosures

Ethics Committee Approval: The Ethics Committee of Cerrahpasa Faculty of Medicine provided the ethics committee approval for this study (2009/28391).

Peer-review: Externally peer-reviewed.

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