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Original Article

The incidence, causes, and management of lower urinary tract injury during total laparoscopic hysterectomy



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ABSTRACT

Objectives. – Determining the incidence and causes of lower urinary tract injury in patients undergoing total laparoscopic hysterectomy and examining the procedures applied for management.

Methods. – Patients who underwent total laparoscopic hysterectomy in a large referral center between 1 January 2015 and 31 October 2017 for benign gynecological reasons were included in the study. Patients who underwent laparoscopic supracervical hysterectomy, laparoscopy-assisted vaginal hysterectomy and robot-assisted laparoscopic hysterectomy were not included in this study. The hospital records of all patients included in the study were examined and the incidence, causes and management of lower urinary tract injuries were reviewed.

Results. – Total lower urinary tract injury rate was found as 2.01%, and these injuries were evaluated separately as bladder and ureter injuries. All the bladder injuries had occurred on the posterior wall of the bladder during vesicouterine dissection; six cases were intraoperatively detected and one case was detected on the first postoperative day. Most of ureteral injury cases were detected in the early postoperative period (75%). The rates of previous cesarean section and endometriosis were significantly higher in patients with injury to the bladder and ureter than in the control group ($p < 0,001$). There was no significant difference between the patients with lower urinary tract injury and the control group regarding uterine weight, estimated blood loss, bilateral salpingo-oophorectomy, the presence and location of fibroids, and laparoscopic or vaginal closure of the vaginal cuff.

Conclusion. – Laparoscopic hysterectomy may be a good option in appropriate patients, but in case of previous cesarean section and endometriosis cases, patients should be informed about the possible complications in detail before the operation and care should be taken during dissection.

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Introduction

Hysterectomy, for which the abdominal route is often preferred, remains the most frequently performed gynecological surgery albeit with reduced frequency [1]. The indications for hysterectomy often include benign causes such as leiomyomas, menorrhagia unresponsive to medical therapy, chronic pelvic pain, and pelvic organ prolapse. Numerous factors influence the choice of appropriate surgical method for hysterectomy, including uterine size, previous pelvic surgery and endometriosis causing pelvic adhesions, vaginal stenosis, surgeon's experience, technical capabilities of the operating room, timing of surgery, and patient's

preference [2]. In hysterectomy, the advantages of minimally invasive procedures are known and these methods are primarily recommended [3]. The study conducted by Einarsson et al. revealed that surgeons prefer minimally invasive procedures less often because of technical difficulties, surgical experience of staff, the timing of surgery, and potential complications [4]. Despite its advantages, including less blood loss, shorter length of hospital stay, and faster return to daily activities, the probability of an injury to the urinary tract is higher with laparoscopic hysterectomy than with surgery via the abdominal route [5]. Owing to the anatomical and embryological proximity of pelvic genital organs and organs of the urinary tract, the ureter and bladder are susceptible to injury in gynecological surgeries [6]. Lower urinary tract injuries lead to not only prolonged operative time, infections, and fistulas but also serious medico-legal problems due to renal failure and organ loss. The incidence of lower urinary tract injury has been determined as 0.30% for all gynecological surgeries, 0.33%

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for gynecological laparoscopy, and 1.3% for laparoscopic hysterectomy [7–9]. This study aimed to determine the type and frequency of urinary tract injuries during laparoscopic hysterectomy performed for benign gynecological causes in our hospital and to establish the factors that cause these injuries.

Patients and methods

A total of 762 patients who underwent total laparoscopic hysterectomy at Tepecik Training and Research Hospital between January 2015 and October 2017 for benign gynecological reasons were enrolled after searching the hospital information system with the Ministry of Health interventional procedures operation code (620740) and obtaining the approval of Tepecik Training and Research Hospital Ethics Committee. Patients who underwent laparoscopic supracervical hysterectomy, laparoscopy-assisted vaginal hysterectomy and robot-assisted laparoscopic hysterectomy were not included in this study. After excluding 58 patients who were operated on due to malign causes, 23 patients whose post-operative pathology findings were reported as malignant, 69 who underwent additional urogynecological procedures, and 65 who were not followed up at our hospital after surgery, 547 whose uterus was totally removed laparoscopically and who underwent suturing of the vaginal cuff laparoscopically or via the vaginal route were included in the present study. All laparoscopic hysterectomies had been performed by experienced surgeons.

In our clinic, total laparoscopic hysterectomy begins with the administration of antibiotic prophylaxis in all patients after anesthesia induction. All operations are performed in the dorsal lithotomy position under general anesthesia following epidural catheter insertion. After ureteral catheterization with a Foley catheter, a Clermont Ferrand or RUMI II manipulator is used for uterine manipulation depending on the surgeon's choice. After performing AAGL type IVe laparoscopic hysterectomy [10], the vaginal cuff is closed with vaginal or intracorporeal technique depending as per the surgeon's preference.

Demographic information such as age, parity, body mass index (BMI), comorbid systemic diseases, menopausal status, indications for surgery, and previous surgeries were obtained from the patients' files. The patients' preoperative and postoperative hemoglobin levels, perioperative or postoperative blood transfusions, preoperative and postoperative endometrial pathology reports, smear findings, operative time, perioperative complications and their managements, the insertion of peritoneal drainage catheter, the type and method of vaginal cuff suturation, and urinary catheterization time were recorded. Preoperative imaging reports were reviewed and the size and location of fibroids and the presence of adnexal masses were noted and they were confirmed with postoperative pathology reports.

Surgery notes of the patients with lower urinary tract injury, consultation reports, and urology consultation notes in postoperative follow-ups were recorded. Second surgery reports and follow-ups of these patients were reviewed and noted, if any. Postoperative six-month control visits of patients with urinary tract injury were reviewed in the hospital information system and noted.

Statistics

Statistical analysis was performed using the IBM SPSS 22.0 for Windows (SPSS Inc, Chicago, IL) program. *p* values of ≤ 0.05 were considered statistically significant. Normality tests were used for determining the distribution pattern of the data. One-way ANOVA test was used for the data showing parametric distribution and the data were presented as mean \pm standard deviation (std). Kruskal–

Wallis test was used for non-parametric data and the results were presented as median (minimum, maximum). The categorical variables were presented as percentage and frequency and chi-square or Fisher's exact test was used depending on the number of patients.

Results

A total of 547 patients included in the study between January 2015 and November 2017 were divided into two groups as 11 patients with lower urinary tract injury and 536 patients without lower urinary tract injury. The indications for surgery in these patients are summarized in Table 1. The most frequent cause of surgery in both groups was symptomatic uterine fibroids, whereas the second-most frequent cause was menorrhagia refractory to medical treatment.

Lower urinary tract injuries were separately evaluated as ureter injuries and bladder injuries. Demographic data are summarized in Table 2. The total rate of lower urinary tract injury was 2.01% (11/547). All the bladder injuries had occurred on the posterior wall of the bladder during vesicouterine dissection; six cases were intraoperatively detected and one case was detected on the first postoperative day. One of the ureter injuries was detected in the perioperative period and the other three cases were detected in the early postoperative period. The rates of previous cesarean section and endometriosis were significantly higher in patients with injury to the bladder and ureter than in the control group ($p < 0.001$ and $p < 0.001$, respectively).

Owing to suspected thermal injury to the right ureter at the level of uterine artery during hysterectomy, a consultation with an urologist had been conducted for one patient in whom ureteral injury was perioperatively detected, and a Double-J (D-J) ureteral stenting had been preoperatively performed. The other three patients with ureteral injury were detected at postoperative days 1, 3, and 4, respectively. These three patients had full-thickness laceration, and the patient whose injury was detected at postoperative day 1 underwent ureteroureterostomy via laparotomy, while the other patients first underwent nephrostomy and then underwent ureteroneocystostomy at three months; 75% of the ureteral injuries occurred on the right side and all reportedly occurred at the level of the uterine artery at approximately 3 cm from the point of entrance to the bladder. In two out of three patients with full-thickness ureteral laceration, endometriosis and associated endometriotic foci in the pouch of Douglas and uterosacral endometriotic foci had been indicated in the surgery reports. One out of the 547 patients had been hospitalized at day 28 after surgery after being diagnosed with ureterovaginal fistula. This patient was treated by removing the fistula tract, and a D-J ureteral stenting was performed following extravasical ureteroneocystostomy (Lich–Gregoire method). The patient showed normal findings at the six-month control visit after removal of D-J catheter at three months.

The relationship between the operative outcomes of the patients and the lower urinary tract injury is summarized in

Table 1
Indications for surgery.

Indications for surgery	The group with lower urinary tract injury (n = 11)	Control group (n = 536)
Symptomatic fibroids	7 (63.6%)	180 (33.5%)
Menorrhagia	2 (18.1%)	145 (27%)
Endometrial hyperplasia	1 (9%)	86 (16%)
Pelvic mass	1 (9%)	61 (11.3%)
Chronic pelvic pain	0	38 (7%)
Cervical dysplasia	0	26 (4.8%)

Table 2
Demographic patient data.

	Bladder injury (n=7, 1.3%)	Ureteral injury (n=4, 0.7%)	Control (n=536, 97.9%)	p
Age	44.7 ± 2.81	45.25 ± 4.03	49.02 ± 7.03	0.282
Parity	3 ± 1.15	3.25 ± 2.21	2.84 ± 1.55	0.206
BMI	26.6 ± 1.07	25.4 ± 2.24	25.9 ± 2.19	0.766
Post-menopause	/	1 (25%)	140 (26.3%)	0.292
HT	1 (14.2%)	/	132 (24.4%)	0.434
DM	/	/	60 (11.1%)	0.501
Prior C/S	3 (42.9%)	3 (75%)	51 (9.5%)	<0.001
Prior L/T	/	/	29 (5.4%)	0.730
Prior L/S	1 (14.2%)	/	13 (2.4%)	0.110
Endometriosis	3 (42.9%)	2 (50%)	16 (2.9%)	<0.001

Statistically significant results are written in bold.

Table 3. The duration of surgery in the group of patients with bladder injury was significantly higher than that in the control group, whereas there was no significant difference in patients with ureteral injury ($p < 0.001$ and $p = 0.208$, respectively). There was no significant difference between the patients with lower urinary tract injury and the control group regarding uterine weight, estimated blood loss, bilateral salpingo-oophorectomy, the presence and location of fibroids, and laparoscopic or vaginal closure of the vaginal cuff. The rate of conversion to laparotomy was significantly higher in the group with bladder injury than in the control group ($p < 0.001$), whereas no conversion to laparotomy was reported in patients with ureteral injury. Urinary catheterization time and postoperative length of hospital stay were significantly higher in the groups with bladder and ureteral injuries compared with those in the control group ($p < 0.001$ and $p < 0.001$, respectively, $p = 0.004$ and $p < 0.001$, respectively).

Discussion

In patients in whom hysterectomy is indicated, laparoscopic hysterectomy is a better option than abdominal hysterectomy because of faster return to daily activities, shorter hospital stay, and fewer wound infections [5]. However, complications that remain unrecognized during laparoscopic hysterectomy and thus require a secondary surgery are stress factors for both the patient and the physician. Urinary tract injuries, particularly ureteral injuries, present a good example. Late recognized injuries may cause various morbidities including infection, fistula formation, and organ loss, whereas the repair of perioperatively detected injuries in the same session reduces morbidity [11]. In this study, the total rate of lower urinary tract injury was 2.01%, and consistent with the literature, the majority of bladder injuries were

perioperatively detected (85.7%), while 75% of the ureteral injuries were detected during the postoperative period [8,12]. Accordingly, because of the perioperative repair of the injury, operative times in patients with bladder injuries were significantly higher compared with those both in the ureteral injury and control groups ($p < 0.001$). In a study comparing laparoscopic hysterectomy with abdominal and vaginal hysterectomy, Garry et al. [13] reported a rate of 3% for urinary tract injuries during laparoscopic hysterectomy, which was similar to the rate of 2.01% in the present study. In other large studies in the literature, the rate of urinary tract injury was reported to be between 0.33% and 0.73% [8,14].

In terms of hysterectomy indications in our study, the two most frequently occurring indications both in patients with lower urinary tract injury and in the control group were symptomatic uterine fibroids and menometrorrhagia in respective order, and this was consistent with the data in the literature [15]. Reportedly, the presence of uterine fibroids and the greater size of the uterus, especially at 12–16 weeks, are risk factors for lower urinary tract injury during hysterectomy [16,17]. In this study, uterine fibroids, whether symptomatic or not, were divided into the following two groups in statistical analysis: (a) uterine fibroids of any size and location and (b) fibroids of any size located in the lower uterine segment. When these two groups were examined in terms of lower urinary tract injury, there was no statistical significance noted in terms of the presence or location of fibroids in patients with bladder or ureteral injury. A large mass located in the lower uterine segment may cause ureteral injury, especially by resulting in a more lateral ligation of the uterine artery. This region is where the ureteral injury often occurs during laparoscopy [18]. Koh maneuver may provide lateralization of the ureter in this region, but this maneuver may not be sufficient in cases with endometriosis, where dense adhesions may be present [19]. Lower uterine fibroids

Table 3
Relation of lower urinary tract injuries with operative results.

	Bladder injury (n=7)	Ureteral injury (n=4)	Control (n=536)	p ^a	p ^b
Duration of surgery (min)	180 ± 70	141 ± 53.2	113 ± 42.6	<0.001	0.208
Uterus weight (g)	232 (86–660)	163 (98–210)	178 (26–780)	0.462	0.890
Estimated blood loss (mL) median (min–max)	130 (90–250)	110 (60–240)	125 (20–1500)	0.124	0.223
Blood transfusion (U)	/	/	12 (2.3%)	NA	NA
Presence of fibroids	4 (57.1%)	2 (50%)	270 (50.4%)	0.724	0.327
Lower uterine segment fibroid	2 (28.5%)	1 (25%)	117 (21.8%)	0.670	0.877
BSO	5 (71.4%)	3 (75%)	437 (81.5%)	0.495	0.739
Peritoneal drain	7 (100%)	4 (100%)	507 (94.5%)	0.531	0.636
Vaginal cuff suturation					
Laparoscopic	3 (42.9%)	2 (50%)	294 (54.9%)	0.805	0.804
Vaginal	4 (57.1%)	2 (50%)	242 (45.1%)	0.633	0.889
Conversion to L/T	2 (28.5%)	/	4 (0.74%)	<0.001	NA
Urinary catheterization time (day)	3.6 ± 4.1	4.5 ± 6.5	1 ± 0.7	<0.001	<0.001
Postop hospital stay (day)	3.78 ± 1.36	4.25 ± 2.69	2.55 ± 1.01	0.004	<0.001

BSO, bilateral salpingo-oophorectomy. Statistically significant results are written in bold.

^a Evaluation of bladder injury group and control group.

^b Evaluation of ureteral injury group and control group.

or adnexal masses can be manipulated by the surgeon if they do not have adhesions, or they can be removed from the area by excision prior to hysterectomy. In this study, it was determined from the operation notes of the patients with uterine fibroids in the lower uterine segment that the manipulation of the mass allowed a clearer view of the level of uterine artery.

Bladder injuries may occur during the insertion of a suprapubic trocar and Veress needle, particularly in patients with a history of surgery [20,21]. No complications were reported in our study associated with the Veress needle or trocar insertion.

The likelihood of a bladder injury increases with laparoscopic hysterectomy with a previous Cesarean section, especially after two or more Cesarean sections [22]. Similar to the literature, the findings of this study revealed that previous Cesarean section significantly increased the rate of lower urinary tract injury ($p < 0.005$). This damage may occur during sharp or blunt dissection of dense vesicouterine adhesions. In the present study group, bladder injuries of 1.5–4 cm in length occurred and all of them were intraoperatively detected and primarily repaired. Filling the bladder during dissection of the bladder peritoneum may facilitate the procedure by highlighting the bladder borders, reduce complications, and reveal unrecognized injuries [21]. If cystotomy accidentally occurs, the bladder should be sutured once or twice and should be filled with fluid and checked for leaks after the procedure. Especially laparoscopic primary repair was found to be more cost-effective and faster than converting to laparotomy; however, the laparoscopic repair of bladder injury requires advanced surgical skills [21]. In this study, the rate of conversion to laparotomy after bladder injury was found to be significantly higher ($p < 0.001$) when compared with the control group.

Endometriosis is confronted as an important cause of increased risk of lower urinary tract injury by complicating surgical dissection due to loss of surgical planes as a result of thickening in the tissues caused by dense adhesions and inflammation [9,14,20], but it particularly poses a two times higher risk of ureteral injury [8]. Endometriosis was found to be a risk factor for both bladder and ureteral injuries in our study ($p < 0.001$). There are studies suggesting that placement of a prophylactic ureteral catheter in a patient who will undergo laparoscopic hysterectomy reduces the likelihood of ureter injury [23], whereas there are also studies arguing that catheterization does not reduce the likelihood of ureteral injury or shorten the length of postoperative hospital stay [24]. In clinical practice, in deep infiltrative endometriosis, the ureteral catheter manifests as a bulge in the ureteric retroperitoneum when the ureters cannot be seen by direct observation and are difficult to detect with retroperitoneal dissection [24] and thus will allow laparoscopic hysterectomy to be accomplished with fewer complications. One case of ureterovaginal fistula was detected in this study group. The indication for hysterectomy in this case had been recorded as endometriosis and it was also reported in the operation note that extended bipolar coagulation had been performed due to excessive bleeding during ligation of the right uterine artery, a perioperative cystoscopy had been performed and no additional procedures had been employed because the cystoscopy was normal. In this case, thermal damage or devascularization problems was considered to be the possible cause of fistula formation.

The most important limitation of our study is its retrospective design. The strength of our study is that for every patient suspected of having urinary tract injury during total laparoscopic hysterectomy operations in our hospital, a urology specialist is invited as a legal obligation and after involvement in the surgery, urologist states on a separate operation report his/her own findings, procedure performed and recommendations.

Conclusion

Laparoscopic hysterectomy may still be the best choice for eligible patients when performed by experienced surgeons. When the literature is reviewed, the rate of lower urinary tract injuries, which are one of the major operative complications of laparoscopic hysterectomy, have been noted to decrease as a result of technological advances, increased experience of surgeons, and improvements in patient selection criteria.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Contributors' statements

Dr. Inan designed the study, drafted the initial manuscript and approved the final manuscript as submitted.

Dr. Budak carried out the initial analyses, critically reviewed the manuscript and approved the final manuscript as submitted.

Dr. Kanmaz and Dr. Beyan designed the data collection instruments, made statistical analysis and coordinated data collection at hospital information system, critically reviewed the manuscript, and approved the final manuscript as submitted.

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