Gynecology; *and Gynecological Oncology*

Urinary Tract Injury at Gynecological Surgery: Results from a Tertiary-Care Institution

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ABSTRACT

OBJECTIVE: To identify clinical features of urinary tract injuries detected during or after gynecologic surgeries, with a specific focus on incidence and role of surgeon and surgical route on urinary injury.

STUDY DESIGN: The institutional database from January 2009 to January 2017 was reviewed with respect to gynecologic (non-obstetric) surgeries and urinary injuries.

RESULTS: A total of 8719 gynecologic surgeries were identified. Of these, 46 (0.52%) were found to be complicated with a bladder (n=34, 0.38%), ureteral (n=11, 0.12%) and/or urethral injury (n=1, 0.01%). Bladder injuries occurred mostly at the superior part of the bladder, while ureteric injuries at the most distal part of the ureter. Ureteric injuries were mostly delayed (81.8% vs. 5.9%, p<0.001) and were more related to thermal injury than bladder injuries (45.5% vs. 8.8%, p=0.029). Among all surgical procedures, radical hysterectomy had the highest incidence for the ureteric injury (8.53%), while Burch colposuspension via minimally invasive route had the highest incidence for the bladder injury (16.6%). Cumulative incidence of urinary injury significantly differed according to the surgical route preferred (p=0.032), with the vaginal surgeries were associated with the highest incidence (0.96%). However, there was no such a difference in injury rates between the low-volume (0.55%) and high-volume (0.52%) surgeons (p=0.328)

CONCLUSION: Overall incidence of lower urinary tract injury at gynecologic surgeries is low, does not differ according to annual number of surgeries performed, but increases with the vaginal surgeries.

Keywords: Gynecologic surgery, Urinary injury, Incidence

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Introduction

Lower urinary tract injuries are one of the most common surgical complications of gynecologic procedures, which are mainly due to the anatomic proximity between the female reproductive organs and urinary compartment. Distorted anatomy related to pelvic inflammatory disease, endometriosis or malignancy increases the risk of injury. It is estimated that 52-82% of all iatrogenic urinary tract injuries occur during gynecologic surgeries, and the risk of such injuries may be as high as 3% after laparoscopic hysterectomy (1).

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Surgical complications have a significant negative impact on patient outcomes as well as health care costs (2,3). A failed identification and repair of urinary injuries can result in more complicated consequences beyond the site of the injury, involving the loss of the kidney or fistula formation (4). Hence, the detection of risk factors for complications is crucial in the prevention of surgical morbidity and mortality. In this study, we sought to identify clinical features of urinary tract injuries detected during or after gynecologic surgeries at our institution, with a specific focus on incidence and role of surgeon and surgical route on urinary injury.

Material and Method

The institutional database from January 2009 to January 2017 was reviewed with respect to gynecologic (non-obstetric) surgeries as well as lower urinary tract injuries, using institutional web-based data automation software (Sarus®, EES, Ankara, Turkey). Searched terms used included the key words ‘‘hysterectomy (total or subtotal)’’, ‘‘radical hysterectomy’’, ‘‘salpingo-oophorectomy (unilateral or bilateral)’’, ‘‘myomectomy’’, ‘‘Burch colposuspension’’, ‘‘sacrocolpopexy’’, ‘‘trans-obturator tape’’, ‘‘bladder’’, ‘‘ureter’’, ‘‘urethra’’, ‘‘ureteroneocystostomy’’, ‘‘ureteroureterostomy’’, ‘‘nephrostomy’’, ‘‘cystotomy’’, and ‘‘vesico-vaginal fistula’’.

Relatively low-risk surgeries for urinary tract injury including salpingectomy, salpingostomy, tubal ligation, ovarian cystectomy, cyst aspiration or drilling, diagnostic laparoscopy and/or hysteroscopy, or cervical conization were excluded.

A total of 8719 gynecologic surgeries were identified. Of these, 46 (0.52%) were found to be complicated with a bladder, ureteral and/or urethral injury at the time of surgery. The clinical records of 46 patients regarding the age at surgery, prior pelvic surgery, history of pelvic radiotherapy, indication of surgery, surgeon of the patient, surgical approach (open vs. vaginal vs. minimally invasive), surgical procedure, presence of endometriosis, pelvic abscess, malignancy or adhesions, site of urinary injury, type of injury (thermal vs. non-thermal), time of diagnosis of injury (intraoperatively vs. postoperatively), management of injury, and length of hospital stay were extracted from the patient charts and electronic database following the local ethics committee approval.

The study was performed in accordance with the ethical standards described in an appropriate version of the 1975 Declaration of Helsinki, as revised in 2013. A written informed consent was not required for this type of retrospective review.

The primary outcome of the study was the incidence of lower urinary tract injuries with respect to surgical procedures, and the secondary outcomes were the determination of the roles of the surgeon (low-volume vs. high volume) and the surgical route on the incidence of urinary injuries. Surgeons were defined as low-volume surgeon or high-volume surgeon, according to their annual number of gynecologic surgeries: <50 vs. ≥51.

The statistical analysis was performed using SPSS Statistics 18.0 (SPSS Inc, Chicago, IL, USA) software. The normal distributions of continuous variables were assessed using the Kolmogorov-Smirnov test. The continuous variables were reported as median and range, while the binary variables were reported as counts and percentages. Analyses between two independent groups were conducted with the Student's t-test for parametric data and the Mann–Whitney U test for non-parametric data. Two-sided p values <0.05 were considered to be significant.

Results

Table 1 presents the characteristics of 46 patients with lower urinary tract injury. Median age at surgery was 46.5 years. Of the patients, 56.5% had a history of prior pelvic surgery and 23.9% had a gynecologic malignancy. Pelvic adhesions were identified in 36.9% of patients while endometriosis and/or pelvic abscess in 19.5%. Twenty-nine of 46 urinary injuries occurred at open surgeries, 4 injuries at vaginal surgeries, 12 injuries at laparoscopic surgeries, and one injury at robotic surgery. The distribution of surgical procedures complicated with a urinary injury was as follows: extrafascial hysterectomy, 25 patients; radical hysterectomy, 10 patients; Burch colposuspension, 7 patients; trans-obturator tape, 3 patients; and salpingo-oophorectomy, 1 patient.

The bladder was the most common organ injured with 34 events (73.9%), followed by ureter with 11 (23.9%), and urethra with one (2.1%). The bladder injuries occurred mostly at the superior part of the bladder, while the ureteric injuries at the most distal part of the ureter involving the segments located within the ureteric tunnel and bladder wall. All the ureteric injuries were unilateral (Table 1).

Table 1: Characteristics of 46 patients with a lower urinary tract injury

Variables	Values
Age, median (range), years	46.5 (28-75)
Prior pelvic surgery, n (%)	26 (56.5)
Gynecologic malignancy	11 (23.9)
Pelvic adhesions, n (%)	17 (36.9)
Endometriosis and/or abscess, n (%)	9 (19.5)
Blood loss requiring transfusion, n (%)	9 (19.5)
Surgical approach, n (%)	
Abdominal-open	29 (63.0)
Vaginal	4 (8.7)
Laparoscopic	12 (26.1)
Robotic	1 (2.2)
Surgical procedure, n (%)	
Radical hysterectomy	10 (21.7)
Extrafascial hysterectomy	25 (54.3)
Adnexal surgery (unilateral/bilateral salpingo-oophorectomy)	1 (2.2)
Burch colposuspension	7 (15.2)
Trans-obturator tape	3 (6.5)
Site of urinary injury, n (%)	
Bladder	34 (73.9)
Superior	28/34 (82.3)
Base	4/34 (11.8)
Neck	2/34 (5.9)
Ureter	11 (23.9)
Below the infundibulopelvic ligament	4/11 (36.3)
Lateral parametrium (paracervix)	1/11 (9.1)
Anterior parametrium including ureteric tunnel	3/11 (27.3)
Intramural segment	3/11 (27.3)
Urethra	1 (2.2)
Length of hospital stay, median (interquartile range), days	6.5 (8)

Table 2 summarizes the comparison of bladder and ureteric injuries with respect to time to diagnosis, type of injury and repair of injury. Of the 34 bladder injuries, 32 (94.1%) were recognized immediately during the surgery and repaired by primary suture. Two delayed diagnoses of bladder injuries were identified as vesicovaginal fistula postoperatively. Both cases were initially managed conservatively with bladder catheters: one healed spontaneously 3 weeks after the primary surgery, whereas the other one required resection of fistula and closure of the defect on postoperative day 90.

In contrast, ureteric injuries were mostly delayed (81.8% vs. 5.9%, p <0.001), ranging from one week to one month, and were more related to thermal injury than bladder injuries (45.5% vs. 8.8%, p=0.029). Only 2 of 11 ureteric injuries were recognized during the surgery, which were immediately managed by insertion of double-j stent and ureteroureterostomy. Of the 9 delayed diagnosed patients, 6 underwent ureteroneocystostomy within 2 weeks after the primary surgery. The remaining 3 patients were initially managed with nephrostomy catheters for 6 weeks, and then treated with ureteroureterostomy. In all cases, the repair of the ureteric injuries was supported with double-j stents for a period of one month (Table 2).

The incidence of bladder, ureter, urethra and overall lower urinary tract injury were 0.38%, 0.12%, 0.01%, and 0.52%, respectively. Among all surgical procedures, radical hysterectomy had the highest incidence rate for the ureteric injury (8.53%), while Burch colposuspension via minimally invasive route had the highest incidence rate both for the bladder injury (16.6%) and for the overall lower urinary tract injury (16.6%). During the study period, 3445 extrafascial hysterectomies were performed, of which 3074 were abdominal hysterectomy. Alternate surgical approaches were utilized less frequently: laparoscopic hysterectomy, 316; robotic hysterectomy, 29; and vaginal hysterectomy, 26. Among women undergoing hysterectomy, the overall incidence of lower urinary tract injury was least common with abdominal hysterectomy (0.55%). The incidence of bladder injury was highest with the minimally invasive approach including laparoscopic and robotic hysterectomies (1.73%), whereas the incidence of ureter injury was highest with the vaginal hysterectomy (3.84%), (Table 3).

Table 2: Comparison of bladder and ureteric injuries with respect to time to diagnosis, type of injury and repair of injury

Variables	Bladder injuries n = 34	Ureteric injuries n = 11	*p*
Time to diagnosis for injury, n (%)			
Immediately (intraoperatively)	32 (94.1)	2 (18.2)	<0.001
Delayed (postoperatively)	2 (5.9)	9 (81.8)	
Type of injury, n (%)			
Thermal	3 (8.8)	5 (45.5)	0.029
Non-thermal	31 (91.2)	6 (54.5)	
Repair of injury, n (%)			N/A
Primary suture	32 (94.1)	–	
Resection of fistula	1 (2.9)	–	
Conservative management	1 (2.9)	–	
Ureteroureterostomy	–	5 (45.5)	
Ureteroneocystostomy	–	6 (54.5)	
Length of hospital stay, median (IQR), days	5.5 (7)	12 (25)	<0.001

N/A denotes not applied; IQR, interquartile range

Table 3: The incidences of lower urinary tract injuries according to surgical procedures

	No. of procedures	No. of events	Incidence according to site of injury			Overall incidence, %
			Bladder, events (%)	Ureter, events (%)	Urethra, events (%)	
Radical hysterectomy	82	10	3 (3.65)	7 (8.53)	–	12.2
Extrafascial hysterectomy	3445	25	23 (0.66)	2 (0.05)	–	0.72
Abdominal-open	3074	17	17 (0.55)	–	–	0.55
Vaginal	26	1	–	1 (3.84)	–	3.84
MIS	345	7	6 (1.73)	1 (0.28)	–	2.02
Adnexal surgery	3630	1	1 (0.02)	–	–	0.02
Abdominal-open	1318	1	1 (0.07)	–	–	0.07
MIS	2312	–	–	–	–	–
Burch colposuspension	1172	7	5 (0.42)	2 (0.17)	–	0.59
Abdominal-open	1142	2	–	2 (0.18)	–	0.17
MIS	30	5	5 (16.6)	–	–	16.6
Trans-obturator tape	390	3	2 (0.51)	–	1 (0.25)	0.76
Total	8719	46	34 (0.38)	11 (0.12)	1 (0.01)	0.52

MIS: Minimally invasive surgery including laparoscopic and/or robotic approaches

The cumulative incidence of lower urinary tract injury significantly differed according to the surgical route preferred (p = 0.032), with the vaginal surgeries were associated with the highest overall injury incidence (0.96%). However, there was no such a significant difference in injury rates between the low-volume (0.55%) and high-volume (0.52%) surgeons (p= 0.328), (Table 4).

Table 4: Effect of surgeon and surgical route on lower urinary tract injury

Variables	Events/No. of procedures	Incidence	*p*
Surgeon			
Low-volume	8/1453	0.55	0.328
High-volume	38/7266	0.52	
Surgical route			
Open-abdominal	30/5616	0.53	0.032
MIS	12/2687	0.45	
Vaginal[a]	4/416	0.96	

MIS: Minimally invasive surgery including laparoscopic and/or robotic approaches, a: Vaginal route included cases of trans-obturator tape and vaginal hysterectomy

Discussion

This study investigates the incidence of lower urinary tract injury, and impact of surgeon and surgical approach on the incidence in selected gynecologic procedures. The study provides evidence that the overall incidence of lower urinary tract injury at gynecologic surgeries is low (5.2 per 1000 women), does not differ according to annual number of surgeries performed, but increases with the vaginal surgeries.

Iatrogenic lower urinary tract injury is traditionally associated with the gynecologic surgery, of which the overall incidence reported in the literature varies from 0.2 to 15 per 1000 procedures (1). It has been reported that up to 50% of all ureteric injuries are caused by gynecologic surgeries (5). Other risk factors reported for urinary injury include malignancy, history of prior pelvic surgery, adhesions, body mass index, large uterine size, long operative time, inexperience of surgeon, and increased blood loss during surgery (6-8). Consistent with the previous studies, patients in our study population had at least one of these factors.

In the present study, we could not demonstrate a significant difference in the incidence of urinary injury with respect to case volume of surgeons (0.55% vs. 0.52%, p=0.328). However, we also observed that low-volume surgeons of our clinic have performed less complicated procedures as compared to high-volume surgeons. This might have confounded the results since the majority of urinary complications were associated with more complicated surgeries such as radical hysterectomy or Burch colposuspension. To-date, only a limited number of studies has been conducted to specifically examine this relationship at gynecologic surgeries. In a retrospective cohort study of women who underwent hysterectomy, Hanstede et al. (9) reported same urinary injury rates (1.8%) for the low-volume (<10 hysterectomies per year) and high-volume surgeons. In another study evaluating whether the surgical volume has an impact on outcomes of laparoscopic hysterectomy, Tunitsky et al. (10) noted that increasing the surgical volume can reduce the operating time and the risk for conversion to laparotomy, but not the rate of complications. The authors reported urinary injury rates of 1.2% and 1.3%, based on a cutoff of 30 cases per year.

On the other hand, two studies reported a link between the surgical volume and urinary injury. Boyd et al. (11) reported that surgeons who perform an average of 10 hysterectomies per year have a decrease in ureteral injury rates (0.14% vs. 0.09%, p=0.005) when compared with surgeons who perform less than 10 hysterectomies per year. However, such a significant relationship was not evident between the case volume and bladder injury (0.79% vs. 0.78%; p=0.847). In the other study, Wallenstein et al. (12) demonstrated a significant association of low surgical volume with the bladder injury (1.3% vs. 1.0%; p=0.001) as well as with the ureteric injury (0.3% vs. 0.1%; p=0.001).

It has been reported that bladder injuries are up to 15 times more likely to be recognized at the time of surgery than ureteral injuries (13). Similarly, in our study, while 94% of bladder injuries were detected immediately, this rate was only 18% for ureteric injuries. One explanation for this difference may be because bladder injuries often occur under direct vision and lead to hematuria and urine extravasation, which can easily be recognized during the surgery. However, ureteric injuries are difficult to visualize, and mostly associated with late signs of urinary obstruction such as abdominal or back pain of varying intensity. Moreover, the necrosis related to the thermal injury can occur later in the postoperative period, which contributes to the late diagnosis of a ureteric injury (14).

Diagnostic intraoperative cystoscopy has been proposed by some to minimize the delayed diagnoses of urinary injury as well as its related morbidity. In the most recent meta-analysis, Teeluckdharry et al. (15) reported a lower but non-significant postoperative ureteric injury detection rates with the use of routine cystoscopy when compared to no cystoscopy (0.07% vs. 0.16%, p<0.054). The authors concluded that although this meta-analysis used a large pooled data from a total of 79 reports, most of these studies was retrospective and would thus tend to underestimate the actual injury rates.

Today, the use of routine cystoscopy for the early detection of lower urinary tract injury remains controversial. The rationales against routine cystoscopy are its additional cost and moderate predictive values for ureteric injuries. The American College of Obstetricians and Gynecologists (ACOG) recommends a selective use of cystourethroscopy, exclusive to pro-

lapse or incontinence procedures (16), while the American Association of Gynecologic Laparoscopists (AAGL) recommends performance of routine cystoscopy after laparoscopic hysterectomies (1).

In the present study, we found that vaginal surgeries were associated with the highest overall urinary injury incidence (0.96%), and besides, among women undergoing extrafascial hysterectomy, the incidence of ureteral injury was highest with the vaginal hysterectomy (3.84%). The literature data regarding this issue is conflicting. In some studies, the highest incidence has been found with abdominal hysterectomies (17, 18), but others reported a higher incidence with laparoscopic hysterectomies (19,20). In contrast, in a prospective study by Ibeanu et al. (7), the authors reported that the vaginal hysterectomy was associated with more ureteric injuries (2.6%) than abdominal (1.7%) and laparoscopically assisted vaginal hysterectomies (0%), in accordance with our experience. However, drawing a definite conclusion based on our results on this issue is not easy at this stage as given the number of patients undergoing vaginal hysterectomy in our study is quite low (only 26 cases) when compared to abdominal and laparoscopic hysterectomies.

In conclusion, lower urinary tract injury is a rare, but in some instances, an unavoidable complication of gynecological surgery due to the close anatomic relationship of female reproductive organs to the bladder and ureter. Surgeons must have adequate knowledge of pelvic anatomy and proper surgical technique to minimize the risk of an iatrogenic injury and the long term morbidity.

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