Original Article

Predictors and potential risk factors of iatrogenic ureteral injury following common obstetric and gynecological surgeries: A single-center retrospective study

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Abstract

Objectives: As iatrogenic ureteral injury carries a high burden and is associated with increased postoperative morbidity and mortality, the purpose of this study is to determine the incidence and potential risk factors of iatrogenic ureteral injury following common obstetric and gynecological surgeries in King Abdulaziz Medical City.

Methods: This was a single-center retrospective cohort study based on data extracted from an electronic hospital information system conducted in King Abdulaziz Medical City, Riyadh, Saudi Arabia. Three thousand four hundred and sixty-four cases of cesarean section (C-section) and hysterectomy from January 1, 2021, to December 31, 2022, were reviewed. All cases of C-section and hysterectomy in which the urology department was consulted for suspected iatrogenic ureteric injuries were included in the study. All cases other than C-sections and hysterectomy in which the urology department was consulted for suspected iatrogenic ureteric injuries were excluded from the study.

Results: A total of 45 patients for whom urology was consulted for suspected ureteral injury were included in this study. Approximately (35.6%) one-third of the patients had positive findings of ureteral injury following common obstetric and gynecological surgeries. About 41.2% of these patients had previous gynecological surgeries. Other potential risk factors were tested such as age and body mass index. Older patients were slightly at higher risk of iatrogenic ureteral injury ($P < 0.05$).

Conclusion: Ureteral injury in obstetric and gynecological surgeries is rare yet serious complication. The findings of this study suggest that the incidence of iatrogenic ureteral injury was relatively associated with older age.

Keywords: Abdominal hysterectomy, cesarean section, iatrogenic ureteric injury

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INTRODUCTION

Ureteric injury is one of the most serious complications following gynecological operations. Unidentified injuries, in particular, can prolong postoperative morbidity and lead to fistula formation, or even kidney loss.[1] Ureteric injury incidence appears to be relatively low, and in most series, varies between 0.1% and 1.5%.[2-5] Most ureteric injuries are iatrogenic. Many studies show the causes of iatrogenic ureteric injuries include gynecologic procedures such as abdominal hysterectomy, vaginal hysterectomy, anterior colporrhaphy, laparoscopic hysterectomy, and emergency cesarean section (C-section).[6]

Ureteric injury can be unilateral or bilateral. One study showed that the injuries were on the left side in 60.6%, the right side in 36%, bilateral in 3.4%,[7] and the upper, middle, and lower thirds of the ureter in 2%, 7%, and 91% of cases, respectively.[8] Ureteral injury is detected intraoperatively in as low as 8.6% of cases, compared to up to 70% in the postoperative period.[9] There are several types of ureteric injuries, intraoperatively, there may be ligation or kinking by a ligature, crushing by a clamp, division, complete or partial transection, devascularization, or diathermy-related injury.

The incidence of different forms of injury is complete transection, 61%; excision, 29%; ligation, 7%; and partial transection, 3%. In the postoperative period, avascular necrosis may occur following extensive dissection of periureteric tissue with impairment of the anastomotic blood supply. Another mechanism of injury is the kinking and subsequent obstruction over a hematoma or lymphocele.[10]

Management of iatrogenic ureteral injury depends on the nature, type of ureteric injury, time of diagnosis, severity, and location of the trauma. General principles of ureteric repair include (1) tension-free anastomosis by ureteric mobilization, (2) ureteric dissection preserving adventitial sheath and its blood supply, (3) minimal use of fine absorbable suture to attain watertight closure, (4) use of peritoneum or omentum to surround the anastomosis, (5) drain the anastomotic site with a passive drain to prevent urine accumulation, (6) stent with a ureteric catheter, and (7) proximal diversion.[10,11]

As iatrogenic ureteral injury carries a high burden and is associated with increased postoperative morbidity and mortality, the purpose of this study is to determine the incidence, threshold, and approaches of iatrogenic ureteral injury following obstetric surgeries in King Abdulaziz Medical City.

METHODS

This was a single-center retrospective cohort study based on data extracted from an electronic hospital information system conducted in King Abdulaziz Medical City, Riyadh, Saudi Arabia. A total of 3464 cases of C-section and hysterectomy (from January 1, 2021, to December 31, 2022) were reviewed. All cases of C-section and hysterectomy in which the urology department was consulted for suspected iatrogenic ureteric injuries were included in the study. All cases other than C-section and hysterectomy in which the urology department was consulted for suspected iatrogenic ureteric injuries were excluded from the study. An institutional review board-supported investigation was performed on data tentatively gathered from patients' electronic records through the BESTcare2.0 system. A full history was collected, which included patient information, such as age, type of surgery (elective, emergency), body mass index (BMI), comorbidities, history of previous gynecological surgeries, time of injury, location of injury, and number of pregnancies.

Data were analyzed using the Statistical Packages for the Software Sciences (SPSS) version 26 Armonk, New York, USA. IBM Corporation. Categorical variables were elaborated as counts and proportions (%), whereas continuous variables were described as mean and standard deviation whenever appropriate. The relationship between the incidence of ureteric injury in terms of the demographic and clinical characteristics of the patients has been performed using the Fischer's exact test and independent sample *t*-test. $P \leq 0.05$ was considered statistically significant.

RESULTS

The study included all intraoperative consultations for a suspected iatrogenic ureteric injury from January 1, 2021, to December 31, 2022. A total of 45 patients were included in the study. Seventeen out of 45 (37.8%) patients had a ureteric injury following common obstetric and gynecological surgeries [Figure 1]. Table 1 demonstrates the characteristics of patient demographics. Of 45 patients who had a suspected uretic injury, 55.6% were aged <40 years old and 62.2% were obese with BMI higher or equal to 30. Regarding comorbidities, diabetes was found in 20% of patients, whereas hypertension and dyslipidemia were found in 15.6%, respectively. Among 45 patients, 31.1% had at least one abortion.

As shown in Table 2, the prevalence of patients with a suspected ureteric injury and who had a previous history

Table 1: Patient's demographic characteristics (*n*=45)

Study variables	*n* (%)
Age (years), mean±SD	
<40	25 (55.6)
≥40	20 (44.4)
BMI (kg/m^2), mean±SD	31.9±6.29
Normal (18.5–24.9)	8 (17.8)
Overweight (25–29.9)	9 (20.0)
Obese (≥30)	28 (62.2)
Hypertension	
Yes	7 (15.6)
No	38 (84.4)
Diabetes	
Yes	9 (20.0)
No	36 (80.0)
Dyslipidemia	
Yes	7 (15.6)
No	38 (84.4)
Other comorbidities	
Morbid obesity	5 (11.1)
Hypothyroidism	5 (11.1)
Asthma	2 (04.4)
Other	6 (13.3)
Number of abortions	
None	28 (62.2)
One	14 (31.1)
Two	2 (04.4)
Three	1 (02.2)
Gravida (mean±SD)	4.51±3.16
Parity (mean±SD)	3.80±2.86

BMI: Body mass index, SD: Standard deviation

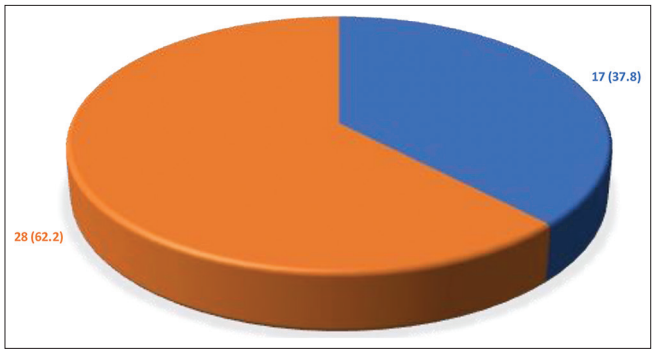

Figure 1: Shows that the incidence of ureteric injury was 37.8%, whereas the rest were normal

of obstetric or gynecological surgery was 33.3%. Of them, the most common previous history of obstetric or gynecological surgery was C-section (80%).

The prevalence of patients with a suspected ureteric injury and who had a previous history of abdominal surgery was only 11.1% and the most common type of surgery was laparoscopic cholecystectomy (80%).

Regarding the type of surgery for which the urology department was consulted, we found that emergency surgery has a higher incidence of a ureteric injury accounting for 62.2%.

Table 2: Patient's surgical intervention and related injuries (*n*=45)

Variables	*n* (%)
History of previous gynecological surgeries	
Yes	14 (33.3)
No	30 (66.7)
Type of gynecological surgery (*n*=15)	
CS	12 (80.0)
Hysteroscopy with D/C	1 (06.7)
Repair of anterior and posterior vaginal compartment	1 (06.7)
Hysterotomy	1 (06.7)
Number of previous gyne surgery	
None	28 (66.7)
One	12 (26.7)
Two	1 (02.2)
Three	2 (04.4)
History of previous abdominal surgeries	
Yes	5 (11.1)
No	22 (48.9)
NA	18 (40.0)
Type of abdominal surgery (*n*=5)	
Laparoscopic chole	4 (80.0)
laparoscopic chole and umbilical hernia repair	1 (20.0)
Type of surgery	
Elective	17 (37.8)
Emergency	28 (62.2)
Date of surgery	
First 6 months of the academic year	20 (44.4)
Last 6 months of the academic year	25 (55.6)
Time of consultation	
Working hours	29 (64.4)
On call time	16 (35.6)
Gynecology surgery which was consulted	
C-section	33 (73.3)
Hysterectomy	12 (26.7)
Side of suspected ureteric injury	
Right ureter	26 (59.1)
Left ureter	18 (40.9)
Bladder injury	
Yes	1 (02.2)
No	44 (97.8)
Location of injury	
Proximal ureter	2 (04.4)
Mid ureter	1 (02.2)
Distal ureter	14 (31.1)
No injury	28 (62.2)
Detection of injury	
Intraoperative	15 (33.3)
>24 h	2 (04.4)
No injury	23 (62.2)
Method of diagnosis	
Cystoscopy and retrograde pyelography	44 (97.8)
CT	1 (02.2)
Complication	
UTI	1 (02.2)
None	44 (97.8)
Length of hospital stay (days), mean±SD	7.71±6.28

CS: Cesarean section, CT: Computed tomography, SD: Standard deviation, UTI: Urinary tract infection, NA: Not available

In the current study, we looked for the rate of incidence of ureteric injury during the academic year and we found that more than half (55.6%) had a suspected injury during the past 6 months of the academic year.

The consultation time was mainly during working hours (64.4%) and C-section was the most consulted (73.3%). For the side of suspected ureteric injury, the right ureter was the most common side (59.1%). We describe her that the most common side of ureteric injury was the righht ureter and among these case, one case had ureteric and bladder injury.

The most common location of ureter injury was the distal part of the ureter (31.1%) which was detected intraoperatively (33.3%). Most ureteric injuries were diagnosed intraoperatively using cystoscopy and retrograde pyelography (97.8%).

When measuring the relationship between the incidence of ureteric injury and patient demographics [Table 3], it was observed that there was no significant relationship between the incidence of ureteric injury and patients' demographic including age, BMI, and comorbidities.

DISCUSSION

The ureter is highly vulnerable to damage during obstetrics or gynecological surgery since it passes close to the female reproductive organs from the pelvic margin to the bladder entry. The most frequent cause of ureteric injury seen in clinical practice is iatrogenic ureteric injury. As far as we are aware, this is one of the biggest studies in the

Table 3: Relationship between incidence of ureteric injury according to the patient's demographic and clinical characteristics of the patients (*n*=45)

Factor	Incidence of ureteric injury		*P*§
	Yes (*n*=17), *n* (%)	No (*n*=28), *n* (%)	
Age group (years)			
<40	8 (47.1)	17 (60.7)	0.537
≥40	9 (52.9)	11 (39.3)	
BMI level			
Normal	3 (17.6)	5 (17.9)	0.908
Overweight	4 (23.5)	5 (17.9)	
Obese	10 (58.8)	18 (64.3)	
Hypertension			
Yes	4 (23.5)	3 (10.7)	0.399
No	13 (76.5)	25 (89.3)	
Diabetes			
Yes	3 (17.6)	6 (21.4)	1.000
No	14 (82.4)	22 (78.6)	
Dyslipidemia			
Yes	4 (23.5)	3 (10.7)	0.399
No	13 (76.5)	25 (89.3)	
Having abortion			
Yes	8 (47.1)	9 (32.1)	0.357
No	9 (52.9)	19 (67.9)	
History of previous gynecological surgeries			
Yes	6 (35.3)	9 (32.1)	1.000
No	11 (64.7)	19 (67.9)	
Type of surgery			
Elective	9 (52.9)	8 (28.6)	0.124
Emergency	8 (47.1)	20 (71.4)	
Side of the suspected ureter			
Left	9 (52.9)	17 (63.0)	0.545
Right	8 (47.1)	10 (37.0)	
Date of surgery			
First 6 months of the academic year	10 (58.8)	10 (35.7)	0.216
Last 6 months of the academic year	7 (41.2)	18 (64.3)	
Time of consultation			
Working hours	14 (82.4)	15 (53.6)	0.062
On call time	3 (17.6)	13 (46.4)	
Gynecology surgery which was consulted			
CS	10 (58.8)	23 (82.1)	0.086
Hysterectomy	7 (41.2)	5 (17.9)	
Factor	**Incidence of ureteric injury**		***P*‡**
	Yes (*n*=17), mean±SD	**No (*n*=28), mean±SD**	
Gravida	5.06±3.45	4.18±2.98	0.371
Parity	4.18±2.81	3.57±2.91	0.497
Length of hospital stay	9.00±7.84	6.93±5.12	0.289

§*P*-value has been calculated using the Fisher's exact test, ‡*P*-value has been calculated using an independent sample *t*-test. BMI: Body mass index, CS: Cesarean section, SD: Standard deviation

area of iatrogenic ureteric injury following obstetric and gynecological procedures.

Patil *et al*. examined the presentation and the management of posthysterectomy ureteric injuries. Over 2 years, 14 patients experienced 16 iatrogenic ureteric injuries.[12]

Similarly, 6-year retrospective multicentric study conducted in Ghana on iatrogenic ureteric injuries found that 12 patients out of 19 patients had some degree of ureteric injuries.[13] One of the largest studies was conducted by Sakellariou *et al*. which looked at the ureteric injuries during gynecological operations for 10 years. It was found that 76 patients had ureteric injuries following gynecological operations.[1] In the current study, 45 patients were suspected to have ureteric injury. Of 45, 17 patients had an actual iatrogenic ureteric injury.

Regarding type of surgery in which iatrogenic ureteric injury was suspected, we demonstrated that C-section was the most common type of surgery. Our results are in line with the results presented in a study conducted in Nigeria.[6] Conversely, according to Metat *et al*., hysterectomy was the most common cause of ureteric injury, followed by C-section.[4] Furthermore, another two studies reported in Canada and United States with similar finding.[5,7]

Another interesting finding is the side of ureteric injury. We have found that right-sided injury was the most common side accounting for 59.1%. On the other hand, it was reported by Ali *et al*. left-sided ureteric injuries were the most common side.[13] Although it is debatable, it was attributed to the course of the left ureter and the right handiness of the surgeon.[13]

One known risk factor that raises the possibility of ureteric damage is a history of abdominal or pelvic procedures. Most of our patients had undergone one or more abdominal or pelvic surgeries.

It is circuital to diagnose ureteric injury immediately intraoperatively as delaying the diagnosis leads to unfavorable outcome that include peritonitis, sepsis, and the creation of fistulas, among other undesirable consequences. Just three of the 19 cases, according to a study by Metat *et al*., were detected during surgery. The majority of ureteric injuries in this study were identified intraoperatively.

CONCLUSION AND LIMITATION

This is a retrospective study with case selection criteria that may have resulted in the low incidence recorded. Ureteric injuries can cause serious complications if not recognized intraoperatively or early postoperatively. Preoperative intravenous pyelography or placement of prophylactic ureteric stenting or ureteric catheter is not an effective method of avoiding ureteric injury. A solid knowledge of abdominal and pelvic anatomy is most important in the prevention of iatrogenic ureteric injury.

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Conflicts of interest
There are no conflicts of interest.

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