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Original Article UROLOGY

Management of urological injuries following gynecologic and obstetric surgery: A retrospective multicenter study

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ABSTRACT

OBJECTIVE: Urinary system injuries may occur iatrogenically during some surgical procedures especially gynecological and obstetrical surgeries. Unfortunately, these injuries can lead to serious complications in patients. In this multicentric study, we aimed to review and report our experiences and results of urinary tract injuries identified during gynecological and obstetrical surgery.

METHODS: We included women with urinary tract injuries during gynecological and obstetrical surgeries between January 2018 and October 2023 at four centers. Detailed data collected include patient demographics, surgical details, injury characteristics, diagnostic and treatment methods, timing of injury diagnosis and management reports of the patients. The incidence of bladder and ureter injuries was evaluated and the rate of intraoperative urological consultations was recorded.

RESULTS: In a total of 328 patients with a median age of 47 years (24-90), urinary tract injuries were diagnosed, including 227 (69.2%) iatrogenic bladder injuries (IBI) and 101 (30.8%) iatrogenic ureteral injuries (IUI). These injuries were diagnosed in 299 patients (91.2%) during surgery and in 29 patients (8.8%) after the surgical procedure. We observed intraoperative detection rates of 71.9% for IBI and 28.1% for IUI. IBI (71.9%) was diagnosed significantly more frequently than IUI (28.1%) (p=0.001). Cesarean section resulted in significantly more frequent IBI, whereas tumor debulking surgeries resulted in more IUI (n=52, 56.5%) than the other types of procedures (p<0.001).

CONCLUSION: Our study provides a comprehensive overview of iatrogenic urological injuries during gynecological and obstetrical surgeries. Although the bladder is the most frequently injured organ during gynecological and obstetric surgeries, early diagnosis and urological intervention are mandatory to prevent delayed complications. Surgeons must have a thorough understanding of the pelvic anatomy and appropriate surgical techniques to prevent iatrogenic injuries during surgery and ensure timely diagnosis and treatment of urinary tract injuries.

Keywords: Iatrogenic injury; gynecological and obstetrical surgeries; urinary system.

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Iatrogenic ureteral and bladder injury (IUI/IBI) remains a challenge in gynecologic surgery, despite advancements in surgical techniques. The female pelvis has an intricate anatomy, with urinary structures close to reproductive organs, making gynecologic procedures responsible for up to 75% of all iatrogenic urinary tract injuries [1]. IUI occurs in 0.5–1% of pelvic and abdominal surgeries, with IBI potentially even more prevalent [2]. These injuries manifest in a spectrum of forms, such as ureterovaginal fistulas, ureteral ligation/laceration, bladder tears, and vesicovaginal fistulas. Obstetric and gynecological procedures may result in IUI/IBI due to various factors, including procedure type, adhesions resulting from prior surgeries, altered pelvic anatomy caused by deep infiltrating endometriosis, pelvic inflammatory diseases, malignancies, radiotherapy, and myomas [3, 4].

Timely detection of urinary tract injuries is critical to improve treatment outcomes. Most IBI cases are identified during surgery, whereas IUI is usually detected postoperatively. Management strategies for ureteral injuries depend on the cause, location, and timing of diagnosis [5, 6]. Stenting alone may help manage smaller lesions from electrocoagulation for 4–6 weeks, whereas more extensive injuries necessitate reconstructive procedures. Specific techniques, such as neo-implantation, Boari flap, and transureteroureterostomy, are considered based on the location and length of the injury and additional factors [5, 7]. This multicenter study investigated the management and outcomes of IUI/IBI encountered during gynecologic and obstetric surgery between 2018 and 2023.

Highlight key points

- Gynecological and obstetrical surgeries are responsible for up to 75% of all iatrogenic urinary tract injuries.
- While bladder injuries are often detected during surgery, ureter injuries can often be detected after surgery.
- The most recommended thing to prevent these injuries is to increase knowledge of pelvic anatomy.

MATERIALS AND METHODS

Study Design and Setting

This multicenter retrospective study examined urologic complications arising from obstetric and gynecologic procedures. Researchers reviewed medical records from the obstetrics and gynecology departments of tertiary hospitals between January 2018 and October 2023. The study specifically focused on patients who developed urinary tract injuries and were subsequently referred and managed by the urology departments within the same hospitals.

Eligibility criteria

Study participants were women over 18 years of age who had experienced IUI/IBI after obstetric or gynecologic surgery. Surgical procedures performed on both benign and malignant women were included in this study. Patients with prophylactic ureteral stent placement but no urinary tract injury, as well as those with concurrent bowel injury, urinary incontinence history, and elevated creatinine levels, were excluded.

Data Collection and Athical considerations

A comprehensive dataset was collected, including:

- Patient demographics (age)
- Surgical procedure performed
- Specific type of urinary tract injury (IUI or IBI)
- Diagnostic procedures employed
- Treatment methods implemented
- Repair time for injuries
- Duration of urinary catheterization
- Size and location of bladder tears (if applicable)
- Timing of injury diagnosis and management

This study focused on the early intraoperative and late postoperative injuries. Early injuries encompassed lacerations, ruptures, and ligations, whereas late injuries included hydronephrosis, contrast material leakage, or fistulas. Diagnosis utilized physical and gynecological examinations alongside radiological imaging.

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics version 25.0 for Windows. Categorical data are presented as frequencies and percentages, while numerical data are expressed as median, minimum, and maximum values. The chi-square test was employed to compare categorical variables, with a significance level of $p<0.05$.

Ethical Considerations

Ethical approval for this study was formally obtained from the Istanbul Medeniyet University Goztepe Training and Research Hospital Clinical Research Ethics Committee (date: 20.09.2023, number: 2023/0602). before commencing the research. All procedures adhered to the established ethical principles outlined in the Declaration of Helsinki and its subsequent amendments.

RESULTS

This study includes 328 patients who experienced urological complications. The median patient age was 47 years (range 24–90 years). Bladder injuries were the most prevalent complication (n=227, 69.2%), followed by ureteral injuries (n=101, 30.8%). Surgery resulting in urological injury most commonly occurred during abdominal hysterectomy (48.5%), debulking surgery (28%), cesarean section (18.3%), and urogynecological procedures, such as tension-free vaginal tape/Burch colposuspension (4.9%). The follow-up period ranged between 10 and 18 months, with a mean follow-up time of 10.4 months. The baseline characteristics, surgical indications, localization of injury, and management are summarized in Table 1.

During the surgeries, diagnoses were made in 300 patients (91.5%), while for 28 (8.5%) patients, the diagnoses were made post-surgery. Direct visualization was the primary diagnostic modality (91.5%). Notably, bladder injuries were significantly more likely to be diagnosed during surgery than ureteral injuries were (72% vs. 28%, p=0.001). Cesarean sections demonstrated a considerably higher prevalence of bladder injuries (96.7%), while debulking procedures were more frequently associated with ureteral injuries (56.5% vs. 43.5% for other procedures, p<0.001).

The median size of bladder tears was 3 cm, with a range of 1 to 10 cm. Larger tears (>3 cm) constituted 62.1% of all bladder injuries, while smaller tears (<3 cm) comprised 37.9%. The two-layer suture technique was the predominant method of bladder injury repair, employed in 97.8% of cases. The median duration of urinary catheterization following bladder injury repair was 14.6 days (range 1–60 days). Long-term consequences of these injuries, including fistula rate, were explored. A total of six women (7.4%) developed fistulas. One (16.7%) of these developed in women with bladder injuries, while five (83.3%) developed in women with ureter injuries.

A total of 84 of the 101 ureteric injuries were identified during the surgery, with immediate management involving the insertion of a double-J stent (56; 66.0%) and ureteroneocystostomy (28; 33.3%). Of the 17 delayed diagnoses, 12 underwent ureteroureterostomy within two weeks of the primary surgery. The remaining three patients were initially managed with nephrostomy catheters for six weeks, with subsequent treatment involving ureteroureterostomy. In all cases, the repair of the ureteric injuries was supported with double-J stents for a period of one month.

Table 1. Characteristics of cases reviewed

Variables	n	%
Primary surgery that resulted in the urological injury		
Hysterectomy (abdominal)	159	48.5
Caesarean section	61	18.6
Debulking surgery	92	28
Incontinence surgery	16	4.9
Length and location of injury		
Bladder		
Bladder<3 cm	86	37.9
Bladder >3 cm	141	62.1
Ureter		
Distal	58	17.7
Middle	26	7.9
Proximal	17	5.2
Recognition		
Intraoperative	300	91.5
Postoperative	28	8.5
Diagnostic techniques		
Direct visualization	300	91.5
Imaging	28	8.5
Primary management of bladder injuries		
Primary Repair	225	99.2
Other	2	0.8
Primary management of ureteral injuries		
Ureteroneocystostomy	30	29.7
Ureteroureterostomy	15	14.9
Ureteral stent indwelling	56	55.4
Type of ureteral injury		
Partial transection	41	40.6
Complete transection	24	23.8
Other (ligation, thermal injury)	36	35.6
Nephrostomy		
Absent	201	93.5
Present	14	6.5
Pelvic adhesions		
Absent	101	30.8
Present	227	69.2
Repair time		
Early	300	91.5
Delayed	28	8.5
Age (years), Median (Min–Max)	47 (4–90)	
Catheterization time (day), Median (Min–Max)	14 (1–60)	
Size of the bladder tear (cm), Median (Min–Max)	3 (1–10)	

Min: Minimum; Max: Maximum.

Table 2. Comparison of bladder and ureteral injuries with respect to time to diagnosis, type of injury, and primary management

Primary surgery that resulted in the urological injury	Bladder injury (n=227) (%)	Ureter injury (n=101) (%)	Total n	Chi-square value	p
Hysterectomy (abdominal)	71.7	28.3	159	53.222	<0.001*
Caesarean section	96.7	3.3	61		
Debulking surgery	43.5	56.5	92		
Incontinence surgery	87.5	12.5	16		
Recognition				11.560	0.001*
Intraoperative	72	28	300		
Postoperative	39.3	60.7	28		
Diagnostic techniques				7.454	0.006*
Direct visualization	71.3	28.7	300		
Imaging	46.4	53.6	28		
Pelvic adhesions				265.595	<0.001*
Absent	6.9	93.1	101		
Present	96.9	3.1	227		
Time to treatment for injury				11.560	0.001
Early	71.3	28.1	300		
Delayed	46.4	58.6	28		

Table 3. Surgical procedure with respect to the size and location of urinary injuries

Surgical procedure	Bladder tear <3 cm		Bladder tear >3 cm		Distal ureter injury		Mid-ureter injury		Proksimal ureter injury		Chi-square value	p
	n	%	n	%	n	%	n	%	n	%		
Hysterectomy (abdominal)	39	24.5	75	47.2	37	23.3	8	5	0	0		
Caesarean section	25	41	34	55.7	2	3.3	0	0	0	0	89.741	<**0.001***
Debulking surgery	13	14.1	27	29.3	18	19.6	17	18.5	17	18.5		
Incontinence surgery	9	56.3	5	31.3	1	6.3	1	6.3	0	0		

Mean hospitalization was 3.3 days (95% CI 1.5–4.8) in women with a bladder injury and 2.9 days (95% CI 0.5–5.3) in women with a ureteral injury.

Table 2 compares bladder and ureteral injuries based on repair time, type of injury, and primary management. Notably, bladder injuries were diagnosed significantly more frequently during surgery (72%) compared to ureteral injuries (28%) (p=0.001). Bladder injuries were also more common in cesarean section cases (n=59, 96.7%), while ureteral injuries were significantly more prevalent in debulking procedures (n=52, 56.5%) compared to other procedures (n=40, 43.5%) (p<0.001). Additionally, pelvic adhesions were observed in 96.9% of patients with bladder injuries and only 3.1% of patients with ureteral injuries (p<0.001).

Table 3 illustrates the distribution of surgical procedures performed according to the type of urinary tract injury. Cesarean section resulted in significantly more

frequent bladder injuries, whereas debulking surgeries resulted in more ureteral injuries (n=52, 56.5%) than the other types of procedures (p<0.001).

DISCUSSION

Our findings suggest a potential for reducing the recommended duration of urinary catheterization following bladder injury repair. Traditionally, the recommended duration for catheterization to facilitate healing has been 2–3 weeks [5]. However, recent studies suggest that even in complex cases, exceeding seven days may not be necessary for optimal outcomes [8, 9]. These findings warrant further investigation into the potential adequacy of a two-week catheterization period, or potentially even a shorter duration, for sufficient bladder injury healing.

The current study's findings are consistent with reported catheterization durations of 10–14 days for uncomplicated bladder injuries sustained during cesarean delivery [10]. It is important to acknowledge, however, that the prior study involved a population of healthy young women with minimal postoperative complications and no fistulas. Future research is necessary to definitively determine the optimal catheterization duration for patients presenting with more complex urologic injuries. Cesarean section is the most common surgical procedure that results in bladder injury. Our study found that 96.7% of bladder injuries occurred during cesarean section. Recent scientific advancements, along with social and cultural changes, have resulted in a surge in cesarean deliveries [11]. Surgeons performing cesarean sections should have adequate knowledge of bladder healing processes and be able to manage iatrogenic bladder injuries. Additionally, it is crucial to ensure a safe catheterization period after bladder injuries resulting from cesarean section. The optimal length of this period has not yet been determined and the location of the injury may also be a factor to consider.

Bladder injuries are more likely to be detected intraoperatively, while ureteral injuries are more likely to be detected postoperatively, approximately 10–14 days later [12, 13]. In our study, we observed an intraoperative detection rate of 71.9% for bladder injuries and 28.1% for ureteral injuries, which is in line with the findings of Toptas et al. and Yuksel et al. [14, 15]. Bladder injuries are often detected during surgery because of symptoms such as hematuria and urine extravasation, which occur within direct vision. However, ureteric injuries are more difficult to visualize and often present symptoms of urinary obstruction. In addition, it is important to note that thermal injury necrosis may also occur at a later stage, which can contribute to delayed diagnosis of ureteral injury [16]. This discrepancy may be explained by the differences in the symptoms and visibility of the two types of injuries. Early recognition of a urinary tract injury is of great importance and has been associated with a more successful outcome. Delayed recognition and diagnosis can cause increased morbidity such as risk of ureterovaginal and vesicovaginal fistula formation and impact on quality of life [5].

The routine cystoscopy for early detection of lower urinary tract injury is currently a matter of debate. The rationale against routine cystoscopy is its additional cost and moderate predictive values for ureteric injuries. The American College of Obstetricians and Gynecologists (ACOG) recommends the use of cystourethroscopy, particularly for prolapse or incontinence procedures, while the American Association of Gynecologic Laparoscopists (AAGL) recommends routine cystoscopy following laparoscopic hysterectomies [17, 18].

The anatomy of the abdomen and pelvis can help prevent iatrogenic injuries to the bladder and ureter. In addition, it is crucial to consider the preferences and experiences of surgeons to minimize the incidence of such injuries.

This study examined the medical records of patients who experienced urinary tract injuries during obstetric and gynecological surgeries performed in obstetrics and gynecology departments and subsequently treated them in urology departments. However, this study had several strengths. It had a large sample size, a multicenter design, and included all obstetric and gynecological cases, including malignant cases.

This study offers valuable insights into the characteristics, diagnosis, and management of urologic complications following gynecologic procedures. A key strength lies in its large sample size and multicenter design. Analyzing data from multiple institutions with a vast number of patients strengthens the generalizability of the findings to a broader population and reduces the potential for bias specific to a single center. Furthermore, the study's inclusivity is noteworthy, as it encompassed all obstetric and gynecologic cases, including malignant ones. This comprehensive approach provides a more complete picture of urologic complications that may arise following these procedures.

However, it is important to acknowledge some limitations. The retrospective design relies on the accuracy of medical record documentation across various institutions, which may introduce inconsistencies in data collection and coding practices. Additionally, the primary focus was on intraoperative and early postoperative complications. While data on fistula formation, a potential long-term consequence, was collected during the follow-up period, a more comprehensive understanding of long-term sequelae would require a dedicated study with a longer follow-up duration. Future research should aim to prospectively evaluate patients over an extended period to capture the complete spectrum of complications associated with urologic injuries.

Conclusion

In conclusion, this study provides an overview of IUI/IBI management in obstetrics and gynecologic surgery. Although rare, urological complications associated with gynecological surgery can cause significant morbidity. The bladder is the most commonly injured organ; therefore, early diagnosis and urological intervention are imperative to prevent delayed complications. Intraoperatively, the visualization of injuries is critical, and complications can be managed using various techniques. The most widely recommended preventive measure is to enhance anatomical knowledge. Early diagnosis and treatment of complications secondary to urinary tract injuries can eliminate long-term morbidities. To prevent iatrogenic injury during surgery, surgeons must have a thorough knowledge of pelvic anatomy and appropriate surgical techniques.

Ethics Committee Approval: The Istanbul Medeniyet University Goztepe Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 20.09.2023, number: 2023/0602).

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