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Approach to prevention and preventive measures of urinary tract injury in gynecological surgery

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نهج الوقاية والتدابير الوقائية لإصابات المسالك البولية في جراحة أمراض النساء

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Abstract:
Background: Operative injuries to the urinary tract are not uncommon in gynecological surgery due to the proximity of the urogenital organ systems. Urinary tract injury constitutes an estimated 0.2–1% of all gynecologic procedures and pelvic operations. Urinary tract injuries due to obstetric and gynecologic surgery are classified into two categories: Acute complications, such as bladder or ureteric injury that can be identified and repaired immediately during the operation, and chronic complications such as vesicovaginal fistula (VVF), ureterovaginal fistula (UVF) which can discover days to months after primary surgery. Aim of the study: to evaluate the most common iatrogenic injury to urinary tract following gynecological surgery in order to prevent life threating and troublesome complications that impact patients' quality of life and to make a guideline and preventive measures and protocol that reduce the rate of serious complications. Patients and methods: a prospective study from January 2011 to December 2021, the total number of patients included in the study was 37 with genitourinary injuries following obstetric and gynecologic surgery. Result: the mean age of patients was 32 years. Out of 37 patients, acute complications seen in 31 patients (83.7%) while chronic complications seen only in 6 patients (16.2%). the urinary bladder was the most frequently injured (20 patients) followed by ureter (13 patients) while the least injured structure was the urethra (one patient). most iatrogenic urinary tract injuries occur during abdominal hysterectomy and noted in 22 patients while cesarean section was the case of injury in 15 patients.

Key words: Urinary Bladder, Ureteric Injury, Caesarian Section, Hysterectomy.

الملخص:
الخلفية: تُعدّ إصابات المسالك البولية أثناء العمليات الجراحية شائعة في جراحة أمراض النساء نظرًا لقرب الجهاز البولي التناسلي. تُقدّر نسبة إصابات المسالك البولية بنحو 0.2-1% من جميع العمليات النسائية وعمليات الحوض. تُصنّف إصابات المسالك البولية الناتجة عن جراحة التوليد وأمراض النساء إلى فئتين: المضاعفات الحادة، مثل إصابات المثانة أو الحالب التي يُمكن تشخيصها وإصلاحها فورًا أثناء العملية، والمضاعفات المزمنة، مثل الناسور المثاني المهبلي والناسور الحالبي المهبلي، والتي قد تُكتشف بعد أيام إلى شهور من الجراحة الأولية. هدف الدراسة: تقييم أكثر إصابات المسالك البولية شيوعًا الناتجة عن العمليات الجراحية النسائية، وذلك للوقاية من المضاعفات الخطيرة والمُزعجة التي تُؤثر على جودة حياة المريضات، ووضع دليل إرشادي وتدابير وقائية وبروتوكول يُقلّل من معدل حدوث المضاعفات الخطيرة. الخلفية: المرضى والأساليب: دراسة استباقية أُجريت في الفترة من يناير 2011 إلى ديسمبر 2021، شملت 37 مريضًا يعانون من إصابات في الجهاز البولي التناسلي بعد جراحات التوليد وأمراض النساء. النتائج: كان متوسط عمر المرضى 32 عامًا. من بين

37 مريضًا، لوحظت مضاعفات حادة لدى 31 مريضًا (83.7%)، بينما لوحظت مضاعفات مزمنة لدى 6 مرضى فقط (16.2%). كانت المثانة البولية أكثر الأعضاء إصابةً (20 مريضًا)، تليها الحالب (13 مريضًا)، بينما كان الإحليل أقلها إصابةً (مريض واحد). تحدث معظم إصابات المسالك البولية العرضية أثناء استئصال الرحم عن طريق البطن، حيث سُجلت لدى 22 مريضًا، بينما كانت الولادة القيصرية هي سبب الإصابة لدى 15 مريضًا.

الكلمات المفتاحية: المثانة البولية، إصابة الحالب، الولادة القيصرية، استئصال الرحم.

Introduction:

In gynecological surgery, the risk of urinary tract injury is significant due to the anatomical proximity of the urinary and genital organs. Urinary tract injuries are reported to occur in approximately 0.2–1% of gynecologic and pelvic surgical procedures [1]. These injuries associated with obstetric and gynecologic interventions are generally categorized into two main groups: immediate (acute) complications, including bladder or ureteral trauma detected and managed during surgery, and delayed (chronic) complications such as vesicovaginal fistula (VVF) and ureterovaginal fistula (UVF), which may develop days or even months following the initial operation.

The incidence of clinically recognized ureteral injury varies between approximately 0.2% and 2.5% in standard gynecologic pelvic surgeries, while the risk increases significantly to about 10–30% in extensive radical operations performed for malignant diseases [2]. Although genitourinary fistulas are uncommon in developed countries, they remain a persistent health concern among women in low-resource settings. In many developing regions, nearly 90% of such fistulas are associated with prolonged and obstructed labor that has not been adequately managed [3]. Advances in minimally invasive techniques, including endoscopic and laparoscopic approaches, have led to their increasing use by urologists in the management of these complications.

The present study aimed to identify the underlying causes and therapeutic approaches for urological complications associated with obstetric and gynecologic procedures, in an effort to minimize their recurrence.

Material and method:

Over a ten-year period extending from January 2011 to December 2021, thirty-seven patients who developed genitourinary injuries after obstetric and gynecological surgeries received treatment in the Obstetrics and Urology departments. Each referred patient underwent detailed history taking and complete clinical assessment as part of the urological consultation for chronic postoperative complications.

In the course of data analysis, we assessed the anatomical site of injury, the etiological factors involved, the therapeutic approach implemented, as well as the effectiveness of the management strategy.

For the purposes of this study, urologic complications encompassed structural damage to the genitourinary tract, such as laceration, transection, rupture, or unintended ligation—detected during surgery, in addition to postoperative complications including hydronephrosis or leakage of contrast agent outside the urinary tract. A successful therapeutic outcome was defined by the achievement of effective repair.

Patients were followed-up in the outpatient clinic at 1, 3, and 6 months with detailed history, physical examination, complete urinalyses, and urine cultures at each visit. Serum creatinine was done at 3 months follow-up. Patients with positive urine cultures received appropriate antibiotic therapy. Follow-up cystogram was performed 2 to 3 weeks after surgery and intravenous urography was performed 3 months after treatment.

Result: Mean age of the patients was 32 years (range: 19–58 years).

Thirty-one out of 37 patients (83.78%) treated by us had acute complications of bladder and ureter while delayed complications like fistulas occurred in 6 patients (16.21%).

Table (1): Types of complication

Number of patients	Type of complication	Percentage
31	Acute complication	83.78%
6	Delayed complication	16.21%

The most common type of injured organ was the urinary bladder, occurring in 20 patients (54.05%), followed by ureter in 13 patients (35.13%), then bladder along with ureter in 3 patients (8.10%) and least was the urethra;1 patient (2.7%).

Table (2): Sites of injury

Number of patients	Site of injury	Percentage
20	Urinary bladder	54.05%
13	Ureter	35.13%
3	Combined urinary bladder & ureteric injury	8.10%
1	Urethra	2.7%

Out of 20 patients of bladder injury, 19 patients (95%) diagnosed as acute bladder laceration and only 1 patient (5%) was diagnosed as VVF. In our series, 20 patients had urinary bladder injury, treated with open procedures. Acute complications noted and diagnosed intraoperatively in 19 cases of bladder injury and were repaired using transabdominal repair and Foley's catheter drainage for a period of 7-10 days with 100% success rate.

And one case of delayed complication [VVF] was diagnosed by cystogram and cystoscopy after the patient complains of continuous leak of urine, and then managed by vaginal route with martius flap with bladder drainage using Foley's catheter and the use of anticholinergic therapy along with local estrogen cream with 100 % success rate.

Table (3): Types of urinary bladder injuries

Number of patients	Type of urinary bladder injury	Percentage
19	Acute bladder laceration	95%
1	VVF	5%

Out of 13 cases of ureteric injury, acute ureteric injury noted in 9 patients (69.23%), UVF occurred in 3 patients (23.07%), and ureteric stricture in 1 patient (7.69%). Nine patients had left ureteric injury and 4 had a right ureteric injury.

In all cases of acute ureteric injury [9 cases], the diagnosis was made intra operative; ligation of ureter was noted in 5 cases which were managed by de-ligation only in 4 cases, and one case managed by de-ligation and primary repair using vicryl 3-0 with DJ stenting.

The other 4 cases of acute ureteric injury; three cases diagnosed as laceration of the ureter and managed successfully with primary repair plus DJ stenting, and one case had complete transection of the ureter which was repaired using open ureteroneocystostomy and DJ stenting.

Table (4): Types of ureteric injuries

Number of patients	Type of ureteric injury	Percentage
9	Acute ureteric injury	69.23%
3	UVF	23.07%
1	Ureteral stricture	7.69%

All 3 cases of UVF, the diagnosis was made in first post-operative week, as the 3 patients were complaining of vaginal leak of urine and confirmed by IVU and CTU and were repaired by transabdominal ureteroneocystostomy.

One case of ureteric injury was diagnosed as ureteral stricture after 6 months of performing an abdominal hysterectomy as the patient start to complain of an abdominal pain, the diagnosis was highly suspected by an ipsilateral hydro-ureter nephrosis and confirmed by an IVU study and was managed with primary uretero-ureterostomy [end to end spatulated, water tight, tension free and stented anastomosis].

Of 3 patients had a combined acute ureteric & bladder injury, one had laceration of distal ureter at its entry to the urinary bladder along with laceration of urinary bladder which was managed successfully with primary repair plus DJ stenting. Two patients had complete transactions which were repaired successfully with open primary bladder repair and ureteroneocystostomy. One case of urethra vaginal fistula was managed using the vaginal route with martius flap.

Abdominal hysterectomy was the cause of urological injury in 22 patients (59.45%) and 15 patients (40.54%) had obstetrical causes.

Of 22 patients [where abdominal hysterectomy is the cause of urological injury]; 15 patients had a history of surgery in the form of caesarean section in the past. In follow-up, all patients were asymptomatic and with normal radiological findings.

Table (5): Total numbers of injries

Type of gynecological surgery	Number of injured patients	Percentage
Abdominal hysterectomy	22	59.45%
Cesarean section	15	40.54%

Discussion:

The close anatomical relationship between the female reproductive organs and the lower urinary tract increases the risk of iatrogenic injury during obstetric and gynecological procedures. In the present series, the types of surgical procedures performed, along with their association with the site of injury and the management approach, are summarized in Tables 6 and 7:

Table (6): type of gynecological surgery performed in patients & the site of urinary tract injury:

Type of surgery	Total number of injuries	Site of injury	Number of cases
Transabdominal hysterectomy	22	Bladder Ureter Bladder & ureter	9 10 3
Obstetric causes	15	Bladder Ureter Bladder & ureter Urethra	11 3 0 1

In this study, transabdominal hysterectomy demonstrated the greatest incidence of urologic complications. Of the 22 patients subjected to this operation, bladder injury occurred in 9 cases, ureteric injury in 10 cases, and combined bladder and ureteric injury in 3 cases. Conversely, other obstetric surgeries accounted for 15 injury cases, involving the bladder, ureter, and urethra in 11, 3, and 1 patient, respectively.

Table (7): type of surgical repair

Site of injury	Type of management/repair	Number of cases
Urinary bladder /acute laceration	Primary repair	19
Urinary bladder/ VVF	Transvaginal repair	1
Ureter	Deligature only Deligature & primary repair with DJ stent Primary repair with DJ stent Open Ureteroneocystostomy with DJ stent	4 1 3 1
UVF	Open repair & uretero-neocystostomy	3
Ureteric stricture	Primary uretero-ureterostomy	1
Combined bladder & ureteric injury	Primary bladder repair with DJ stenting Open urinary bladder repair with uretero-neocystostomy	1 2
Urethra [Urethro-vaginal fistula]	Transvaginal repair	1

The urinary bladder was identified as the most frequently affected organ, accounting for injuries in 20 patients (54.05%). Intraoperative bladder laceration was observed in nine patients (24.32%) during transabdominal hysterectomy and was successfully managed with immediate primary repair. Additionally, ten cases of bladder injury (29.72%) were recognized during obstetric procedures and treated with open primary bladder repair. Only one patient developed a vesicovaginal fistula (VVF), which became clinically evident four weeks after obstetric surgery and was subsequently managed four months later using a transvaginal approach with a Martius flap. There remains no universal agreement regarding the optimal timing or surgical method for fistula repair [4]; however, the traditional recommendation is to postpone surgical correction for approximately 3–6 months to allow adequate resolution of inflammation.

Nine patients (24.24%) sustained acute ureteric injuries, eight of which occurred during transabdominal hysterectomy and one during obstetric surgery. These injuries were identified intraoperatively and managed immediately as follows: four patients required deligation only, one patient underwent deligation.

Combined with primary repair, three patients received primary ureteric repair with insertion of a double-J (DJ) stent, and one patient underwent ureteroneocystostomy with DJ stenting. In addition, three patients developed delayed ureteric injury in the form of ureterovaginal fistula (UVF), including two cases following transabdominal hysterectomy and one case after obstetric surgery. These patients presented between 3 and 8 weeks postoperatively, were diagnosed with UVF, and were subsequently managed by open surgical repair with ureteroneocystostomy.

One case of ureteric injury was diagnosed as ureteral stricture after 6 months of performing an abdominal hysterectomy as the patient start to complain of an abdominal pain, the diagnosis was highly suspected by an ipsilateral hydro-ureteronephrosis and confirmed by an IVU study and was managed with primary uretero-ureterostomy [end to end spatulated, water tight, tension free and stented anastomosis].

Gynecologic pelvic procedures have become a leading cause of iatrogenic ureteric injury in modern surgical practice. Among these procedures, laparoscopic hysterectomy is considered to carry the highest risk of ureteral damage [5]. Traditionally, open surgical reconstruction of the distal ureter has been regarded as the standard approach for treating lower ureteric obstruction. However, despite the technical challenges involved, laparoscopic ureteral reimplantation has emerged as a practical and effective alternative for managing these injuries. The laparoscopic Lich–Gregoir extravesical ureteroneocystostomy technique has demonstrated a reported success rate ranging from 90% to 100% [6].

One case of urethra vaginal fistula was managed using the vaginal route with martius flap with catheter drainage 14 days using local estrogen cream with 100% success rate.

Recommendation regarding the preventive measures:

Patient counseling regarding the potential risk of urinary tract injury should be considered an essential component of the informed consent process prior to performing pelvic surgery **(Informed consent)**.

A comprehensive medical history should be obtained, with particular attention to previous pelvic operations, prior radiation exposure, history of infection, and congenital abnormalities of the urinary tract such as duplicated ureters or pelvic kidney **(Medical history)**.

Radiological assessment is an important part of preoperative evaluation. Contrast-based studies such as CT scanning or urography are useful for demonstrating structural abnormalities of the urinary system [7]. Additionally, MRI can aid in identifying pelvic masses, including cervical fibroids, broad ligament abnormalities, or retroperitoneal cystic lesions, that may predispose patients to urinary tract injury during surgery **(Imaging studies)**.

Approach to prevention:

The prevention of urinary tract injury is a critical objective in pelvic surgical practice. Preventive measures are commonly divided into three levels [8]:

- **Primary prevention:** aims to minimize the occurrence of urinary tract injury and is regarded as the ideal preventive approach. Accurate identification of the bladder and ureters during surgery, along with meticulous operative technique, plays a central role in preventing damage. In addition, comprehensive preoperative evaluation helps determine patients who may require prophylactic ureteral catheterization.
- **Secondary prevention:** emphasizes the early intraoperative detection and immediate correction of injuries when they occur. Rapid recognition and management during surgery can significantly reduce the risk of subsequent complications, including ureteral obstruction and fistula formation such as ureterovaginal or vesicovaginal fistula.
- **Tertiary prevention:** focuses on the postoperative diagnosis and management of urinary tract injuries that become evident after the surgical intervention.

Conclusion:

Statistically urological injuries are rare, but are responsible for significant morbidity. Bladder injuries are more common than ureteric injuries but cause less morbidity due to early detection and repair. Ureteral injuries are, however, less frequent but associated with high morbidity. Early diagnosis and intervention are necessary to prevent the occurrence of life-threatening urological complication in gynecological surgery.

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