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Urological Injuries during Gynecologic Surgery at Songklanagarind Hospital

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ABSTRACT

Objectives: To determine the incidence of urological injuries during gynecologic surgeries, and identify the risk factors associated with urological injuries, management and outcome after repair of urological injuries.

Materials and Methods: A retrospective case-control study of women who underwent gynecologic surgeries at Songklanagarind hospital from January 2006 to December 2020. The cases with urological injury were identified and analyzed for incidence, risk factors, management and outcome after repair of urological injuries. Demographic and clinical parameters were analyzed using multiple conditional logistic regression to clarify the determinate. A p value of < 0.05 was considered statistically significant.

Results: There were 125 cases (0.66%) of urological injuries, from a total of 19,003 gynecological surgery cases. The incidence of bladder, ureteric and combined bladder and ureteric injuries were 0.42%, 0.19% and 0.04%, respectively. A total of 117 cases with complete data was analyzed. Previous myomectomy, level of surgeon, the presence of dense pelvic adhesion, and large tumor size were significant risk factors for urological injuries ($p < 0.05$). The management of urological injuries was successful in 116 patients (99.1%).

Conclusion: Bladder injury was the most common urinary tract injury during gynecologic surgery. Previous myomectomy, level of surgeon, the presence of dense pelvic adhesion, and large tumor size were significant risk factors.

Keywords: bladder injury, ureteric injury, urologic complication, gynecologic surgery, risk factor.

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การบาดเจ็บต่อระบบทางเดินปัสสาวะจากการผ่าตัดทางนรีเวชที่โรงพยาบาลสงขลานครินทร์

อรุณลักษณ์ ชูสม, ศิวัชญา คนึงกิจก้อง, ธนพันธ์ ชูบุญ

บทคัดย่อ

วัตถุประสงค์: *เพื่อศึกษาอุบัติการณ์การบาดเจ็บต่อระบบทางเดินปัสสาวะจากการผ่าตัดทางนรีเวชที่โรงพยาบาลสงขลานครินทร์ ระบุปัจจัยเสี่ยงที่มีความสัมพันธ์ต่อการเกิดการบาดเจ็บต่อระบบทางเดินปัสสาวะ และศึกษาวิธีการรักษาและผลของการรักษาต่อการบาดเจ็บที่เกิดขึ้นกับระบบทางเดินปัสสาวะ*

วัสดุและวิธีการ: *การศึกษาวิจัยแบบย้อนหลัง โดยเก็บข้อมูลจากเวชระเบียนของสตรีที่ได้รับการผ่าตัดทางนรีเวชที่โรงพยาบาลสงขลานครินทร์ ตั้งแต่เดือนมกราคม พ.ศ. 2549 ถึงธันวาคม พ.ศ. 2563 เพื่อระบุอุบัติการณ์ของการบาดเจ็บต่อระบบทางเดินปัสสาวะ วิเคราะห์ข้อมูลเพื่อระบุปัจจัยเสี่ยงที่มีความสัมพันธ์ต่อการเกิดการบาดเจ็บต่อระบบทางเดินปัสสาวะ และศึกษาวิธีการรักษาและผลของการรักษาต่อการบาดเจ็บที่เกิดขึ้นกับระบบทางเดินปัสสาวะ โดยกำหนดค่า p value < 0.05 ถือว่ามีนัยสำคัญทางสถิติ*

ผลการศึกษา: *ผู้ป่วยที่เข้ารับการผ่าตัดทางนรีเวชทั้งหมด 19,003 คน เกิดการบาดเจ็บต่อระบบทางเดินปัสสาวะ 125 คน (ร้อยละ 0.66) โดยอัตราการบาดเจ็บต่อกระเพาะปัสสาวะพบร้อยละ 0.42 อัตราการบาดเจ็บต่อท่อปัสสาวะพบร้อยละ 0.19 และอัตราการบาดเจ็บต่อกระเพาะปัสสาวะร่วมกับท่อปัสสาวะพบร้อยละ 0.04 สามารถเก็บข้อมูลจากเวชระเบียนได้ครบจำนวน 117 คน เพื่อนำมาวิเคราะห์ข้อมูล พบว่าปัจจัยเสี่ยงที่มีนัยสำคัญต่อการบาดเจ็บของระบบทางเดินปัสสาวะ ได้แก่ เคยผ่าตัดเนื้องอกมดลูก ความเชี่ยวชาญของแพทย์ผ่าตัด ภาวะพังผืดในอุ้งเชิงกราน และขนาดของเนื้องอก ผลการผ่าตัดแก้ไขพบว่าประสบความสำเร็จจำนวน 116 คน (ร้อยละ 99.1)*

สรุป: *กระเพาะปัสสาวะเป็นอวัยวะในระบบทางเดินปัสสาวะที่พบการบาดเจ็บได้บ่อยที่สุดจากการผ่าตัดทางนรีเวช โดยปัจจัยเสี่ยงที่มีนัยสำคัญต่อการบาดเจ็บของระบบทางเดินปัสสาวะ ได้แก่ เคยผ่าตัดเนื้องอกมดลูก ความเชี่ยวชาญของแพทย์ผ่าตัด ภาวะพังผืดในอุ้งเชิงกราน และขนาดของเนื้องอก*

คำสำคัญ: *การบาดเจ็บของกระเพาะปัสสาวะ, การบาดเจ็บของท่อไต, ภาวะแทรกซ้อนระบบปัสสาวะ, การผ่าตัดทางนรีเวช, ปัจจัยเสี่ยง*

Introduction

Female genital organs and urinary tracts are anatomically as well as embryogenic related. Therefore, gynecological surgeries can sometimes create an injury to the organs in the urinary system. Worldwide studies have shown that urological injuries, from gynecological surgery, range from 0.2% to 1.34%[1-5]. A previous study in Thailand reported the incidence of urinary tract injuries from gynecological procedure as being 0.3%[6]. The bladder was the most common site of injured organ at 0.18%, followed by the ureter at 0.083%, and the last was combined bladder and ureter injuries at 0.014%[2, 6, 7]. In addition of most common site of injury, bladder injuries are easier to detect during operation than ureteral injuries. Hence, it is possible to treat the injury in a concurrent procedure, leading to a successful outcome after primary repair. A previous study demonstrated a high success rate up to 88% of concurrent surgical repair of the urinary tract injuries caused by gynecological and obstetric procedure that were intraoperatively detected[2]. A small percentage of patients experienced complications after treatment such as sepsis and death at 8% and 4%, respectively[2]. Injuries to the ureters are more complicated and might involve late detection. Patients may present with symptoms of fever, back pain, vaginal discharge or non-specific symptoms[2]. Long-term consequences: such as, urogenital fistula, ureteric stenosis, or renal function loss can lead to difficult and complication in management; requiring longer hospital stays and also increasing the hospitals expenses[6-8].

There are different types of gynecological surgeries, which include abdominal, vaginal, and laparoscopic surgeries. Among these route, abdominal hysterectomy, whether benign or malignancy, are the most common that lead to urinary tract injuries[3,9]. Recent studies have found that the risk factors which increase urinary tract injuries were from ovarian cancer operations, patients with history of pelvic surgeries, excessive blood loss during operation, pelvic adhesions, endometriosis and large uterine size[2, 6, 10, 11].

There are abundant gynecological surgeries each year at Songklanagarind hospital, which is a tertiary and referral-based hospital in Southern, Thailand. Some gynecological surgeries were found to have intraoperative complications, including injury to the urinary system, gastrointestinal tracts, or vascular system. However, the precise incidence of urinary tract injures were difficult to ascertain from the literature, as they are dependent on many factors, such as the setting, different types of procedures, and the complexity of gynecological conditions. Furthermore, there was a lack of the data, including factors contributing to urologic injuries and outcome after treatment in our setting. Hence, we aimed to study the incidence of urinary tract injuries from gynecological procedures, to identify risk factors related to urinary tract injuries. Moreover, management after injury and outcomes were collected for providing information to counsel patients. In addition, the findings may help gynecologists to complete preoperative evaluations and help in the early detection of urinary tract complications.

Materials and Methods

This was a retrospective case control study. The study was approved by the ethics committee of the institutional research board (IRB) of the Faculty of Medicine, Prince of Songkla University (REC 63-142-12-4).

The medical records of all women who underwent gynecologic surgeries from January 2006 to December 2020, in Songklanagarind hospital were reviewed. The cases were identified as patients who were diagnosed with urological injuries, including bladder, ureteric or combined bladder and ureteric injuries, detected intraoperatively or postoperatively. All charts of cases were reviewed, except charts with inadequate data. The control group was recruited from the hospital's computerized database by matching the same surgical procedure, indication and surgical date at a 1:4 of case-to-control ratio and performed by a computer-generated matching program. Demographic data regarding patient's age, body mass index, co-morbidities, previous pelvic surgeries, previous pelvic irradiation, pelvic infection, and diagnosis were obtained. Procedure related data: including indication for surgery, type of

operation, level of primary surgeon, tumor size, presence of pelvic adhesions, duration of procedure, intra-operative blood loss, intra-operative and post-operative urological injuries, and length of hospital stay were reviewed from the patient' charts. In the case group, the type of urological injuries, types of surgical repair and results after surgical repair was reviewed thoroughly.

Statistical analysis was performed using R-version 4.0.3. Descriptive data was expressed as number, percentages, median and inter quartile range (IQR; Q1, Q3) for continuous variables. Student's t-test and Wilcoxon rank-sum test were used to analyze the difference in continuous variables. Pearson's chi-squared test and Fisher's exact test were used to analyze categorical variables. Multiple conditional logistic regression analysis was used to determine the association of potential risk factors with secondary outcome variables, and to estimate adjusted odds ratio (OR) along with their 95% confidence interval (CI). Univariate analysis was first performed to identify any potential predictor variables. Variables with a p value < 0.2, according to univariate analysis and those considered to be clinically relevant were included in the multiple conditional logistic regression analysis to determine any independent predictors of the secondary outcome variables. All variables included in the final model had a variance inflation factor (VIF) of less than 2. A p value of < 0.05 was considered statistically significant.

Results

During the period of study, 2006 to 2020, there were 19,003 patients who underwent gynecologic surgeries, with the incidence of overall urologic injuries being 0.66% (125 patients). The incidence of bladder injury, ureteric injury and combined bladder and ureteric injuries were 0.42%, 0.19% and 0.04%, respectively. There were 8 cases for which the data had incomplete records; therefore, a total of 117 patients were eligible and analyzed in this study. Of the 117 patients, 72 patients (61%) had bladder injury, followed by ureteric injury in 37 patients (32%) and combined ureter and bladder injuries in 8 patients (7%).

Demographic data of urological injury cases and the control group are shown in Table 1. The median (IQR) age of cases was 48 years. Body mass index was found to be of significant difference between the groups, which was higher in the control group.

Table 1. Demographic data of cases with and without urological injuries.

Characteristics	Cases (n = 117)	Control (n = 468)	p value
Age (years)	48 (42, 56)	49 (44, 58)	0.073
Body mass index (kg/m^2)	23.3 (20.8, 26.1)	24.4 (21.6, 27.5)	0.012
Previous pelvic surgery	58 (49.6)	187 (39.9)	0.075
History of pelvic inflammatory disease	0 (0)	5 (1.1)	0.589
Previous pelvic radiation	1 (0.9)	6 (1.3)	1

Data are presented as median (interquartile range) or n(%).

Among type of surgery performed in patients with urological injuries, open abdominal surgery was still the most common route of gynecologic surgeries. Total abdominal hysterectomy with bilateral salpingo-oophrorectomy was the most common procedure, causing urological injuries in 69 patients (59%). Other surgeries included: total abdominal hysterectomy in 18 patients (15.4%), followed by adnexal operation in 11 patients (9.4%), radical hysterectomy in 9 patients (7.7%) and interval debulking surgery for ovarian cancer in 3 patients (2.6%). Laparoscopic surgery and vaginal surgery were the minority among the gynecologic surgeries as shown in Table 2.

Table 2. Type of surgery performed in patients with urological injuries (n = 117).

Type of surgery	Number of cases (%)
Abdominal surgery	
Open	
TAH with BSO	69 (59)
TAH	18 (15.4)
Adnexal operation	11 (9.4)
Radical hysterectomy	9 (7.7)
Interval debulking surgery	3 (2.6)
Laparoscopic	
Total laparoscopic hysterectomy	1 (0.9)
Lysis adhesion	1 (0.9)
Vaginal surgery	
Vaginal hysterectomy	3 (2.6)
V-NOTES hysterectomy	2 (1.7)

TAH: total abdominal hysterectomy, BSO: bilateral salpingo-oophrorectomy, V-NOTES: vaginal natural orifice transluminal endoscopic surgery hysterectomy

The most common indication for surgery in cases of urological injuries was ovarian cancer for 34 patients (29%), followed by endometriosis, benign ovarian tumor in 30 patients (26%) and uterine leiomyoma in 25 patients (21%). In the urologic injury group, there was a significance in greater blood loss, longer operative time and longer length of hospital stay ($p < 0.001$). However, there were no statistically significant differences regarding the surgical indication between the two groups ($p = 0.576$) as shown in Table 3.

Table 3. Risk factors associated with urological injuries.

Risk factors	Cases (n = 117)	Control (n = 468)	p value
Level of surgeon			< 0.001
Staff	106 (90.6)	322 (68.8)	
Fellow/Resident	11 (9.4)	146 (31.2)	
Surgical indication			0.576
Malignant;	57 (48.7)	212 (45.3)	
Ovarian cancer	34 (29.1)	85 (18.2)	
Cervical cancer	11 (9.4)	43 (9.2)	
Uterine cancer	9 (7.7)	75 (16.0)	
Others	3 (2.6)	9 (1.9)	
Benign;	60 (51.3)	256 (54.7)	
Uterine leiomyoma	25 (21.4)	105 (22.4)	
Endometriosis	15 (12.8)	64 (13.7)	
Ovarian tumor	15 (12.8)	60 (12.8)	
Others	5 (4.2)	27 (5.8)	
Pelvic adhesion			< 0.001
No	38 (32.5)	253 (54.1)	
Dense	70 (59.8)	161 (34.4)	
Filmy	9 (7.7)	54 (11.5)	
Mass size (cm)	12 (9, 18)	10 (8, 15)	0.038
Estimated blood loss (mL)	950 (500, 1900)	300 (150, 600)	< 0.001
Operative time (minutes)	280 (240, 325)	195 (154.2, 258)	< 0.001
Length of hospital stay (days)	12 (9, 16)	6 (5, 9)	< 0.001

Data are presented as median (interquartile range) or n (%)

To identify risk factors associated with urological injuries, we found that there were three significant variables, which included: presence of pelvic adhesion ($p < 0.001$), large tumor size ($p = 0.038$) and level of surgeon ($p < 0.001$). The results of multiple conditional logistic regression are shown in Table 4. The statistically significant risk factors were previous myomectomy (OR 9.25, 95%CI 1.93-44.23), level of surgeon (OR 3.44, 95%CI 1.63-7.24), the presence of dense pelvic adhesion (OR 1.99, 95%CI 1.07-3.7) and large tumor size (OR 1.06, 95%CI 1.01-1.1).

Table 4. Multiple conditional logistic regression analysis for risk factors associated with urological injuries.

Risk factors	Crude OR (95% CI)	Adjusted OR (95%CI)	p value
Age	0.98 (0.96-1)	0.98 (0.95-1)	0.095
Previous pelvic surgery			
No	1	1	
Cesarean section	1.35 (0.77-2.4)	1.34 (0.66-2.72)	0.414
Myomectomy	3.8 (1.14-12.7)	9.25 (1.93-44.23)	0.005
Adnexal operation	4.05 (1.43-11.45)	2.53 (0.6-10.67)	0.207
Others	1.22 (0.7-2.11)	1.39 (0.68-2.84)	0.371
Level of surgeon			
Fellow/resident	1	1	
Staff	5.58 (2.81-11.08)	3.44 (1.63-7.24)	0.001
Pelvic adhesion			
No	1	1	
Dense	3.45 (2.11-5.62)	1.99 (1.07-3.7)	0.03
Filmy	1.2 (0.54-2.66)	1.33 (0.52-3.39)	0.551
Mass size	1.05 (1.01-1.08)	1.06 (1.01-1.1)	0.01
Estimated blood loss	1.0011 (1.0008-1.0014)	1.0009 (1.0006-1.0013)	< 0.001

OR: odds ratio, CI: confidence interval.

Of the 117 patients with urological injuries, most cases (110 patients, 94%) were detected and repaired during the concurrent operation. Most bladder injuries were corrected by primary repair, while ureteric injury was repaired by end-to-end anastomosis, ureteroneocystostomy and ureteral stent indwelling, respectively (Table 5).

Table 5. Multiple conditional logistic regression analysis for risk factors associated with urological injuries.

Site of injury	Management	Number of cases (%)
Bladder	Primary repair	47 (40.2)
	Cystostomy	23 (19.7)
	Primary repair with peritoneal flap	1 (0.8)
	Bladder catheterization	1 (0.8)
Ureter	End-to-end anastomosis	16 (13.7)
	Ureteroneocystostomy	11 (9.4)
	Ureteral stent indwelling	10 (8.6)
Bladder and ureter	Primary repair with end-to-end anastomosis	2 (1.7)
	Primary repair with ureteroneocystostomy	4 (3.4)
	Cystostomy with ureteral stent indwelling	1 (0.8)
	Boari flap with ureteroneocystostomy	1 (0.8)

Of all the primary repairment, 116 (99.1%) were successful. Only one patient who underwent vaginal hysterectomy had a consequence of complicated vesicovaginal fistula at 1 month after the primary repair; this required a secondary repair. Seven patients (6%) were detected post operation. One of them had a bladder injury, and the other had a ureteric injury (Table 6). The presenting symptoms included: abdominal pain, fever, and urine leakage from the vagina.

Table 6. Multiple conditional logistic regression analysis for risk factors associated with urological injuries.

Site of injury	Intraoperative	Postoperative	Total	p value
Bladder	73 (66.4)	1 (14.3)	74 (63.2)	0.01
Ureter	30 (27.3)	6 (85.7)	36 (30.8)	0.003
Bladder and ureter	7 (6.4)	0 (0)	7 (6)	1.000

Data are presented as n(%).

Discussion

Urinary tract injuries have been recognized as a potential complication of gynecologic surgery, with up to 75% of urinary tract injuries being due to gynecologic surgery[1]. The worldwide incidence varies from 0.2% to 1.34%[1-5]. Another study in Thailand reported an incidence of 0.3%[6]. However, the true incidence of urinary tract injures from gynecologic surgery was underestimate, was mostly from a single center, with a small-scale dataset in some centers. From this study, we found that the incidence of overall urologic injuries was 0.66%. This was slightly higher than most previous reports, because this study was conducted at Songklanagarind hospital, which is only university-based hospital in Southern, Thailand, and is involved in resident training programs. Our setting has more complicated benign and malignant gynecological cases referred from other hospitals.

In this study, open pelvic surgery was the majority cause of urological injuries at 94%, especially abdominal hysterectomy, similarly to prior studies[2, 6, 7, 10]. While Desai et al reported the highest incidence in radical hysterectomy[3]. Laparoscopic surgery has gained worldwide popularity since the early 1900s, leading to increasing incidence of ureteral injuries[1, 8, 12]. In contrast, a recent systematic review showed the overall urinary tract injury rate for laparoscopic hysterectomy was 0.73%, with no significant increase in risk[13]. This type of surgery is still the minority in our setting; therefore, the number of urinary tract injuries in this group was few (1.8%). Urinary bladder was the most common site of urological injuries (0.42%), followed by ureteric injury (0.19%) and combined bladder and ureteric injury (0.04%). These findings were similar to previous studies[2, 6, 7, 11].

Regarding the indication for surgery, the most common indication that led to causes of urological injuries was ovarian cancer (29%). However, the gynecological condition was not a significant risk factor ($p = 0.576$) in this study compared to prior studies, which indicated that ovarian neoplasms and endometriosis have been recognized as increasing the risk[8,14]. In this current study, we found that there were three significant variables, including presence of pelvic adhesion, large tumor size and level of surgeon, that were significant risk factors for urologic injury ($p < 0.05$). Presence of pelvic adhesion and large tumor size were the influencing factors, these were also demonstrated in other studies[6, 15]. Surprisingly, in our study we found that the level of the primary surgeon was a contributing factor, which has never been reported in previous studies. It may be from complicated and difficult operations that require attending staff as the primary surgeon and causes damage to the urinary tract. Furthermore, we could not identify some variables, such as previous pelvic surgery, chronic pelvic inflammatory disease or previous irradiation as a significant risk factor when compared to the reports in many other studies[5, 6, 8, 14]. Additionally, in the subgroup analyzed by multiple conditional logistic regression, the data

showed that previous myomectomy was consider a significant risk factor, which has never been reported in prior studies. As a consequence of urologic injuries, this group had a significantly greater blood loss, increased operative time and required a longer length of hospital stay ($p < 0.001$) similar to previous reports[6-8].

Most cases of urological injury (94%) were detected and repaired during the concurrent operation, this led to better outcomes, with a high success rate of up to 99.1% in our series. The majority of the bladder injuries were corrected by primary repair, whereas ureteric injuries were repaired by end-to-end anastomosis. The type of procedure was dependent on site, complexities of the injuries and preference of the urologists. Routine preoperative imaging has not been shown to reduce the incidence of lower urinary tract injuries, although cystourethroscopy should be performed if indicated[16]. Prophylactic urethral stenting was recommended in patients with potential risks, such as a history of previous pelvic surgery or pelvic adhesion. This makes the identification of the ureter easier, so as to minimize the injury[8, 17]. However, the result has not shown a statistically significant decrease in the ureteral injury rate[18], and its cost-effectiveness was lower than anticipated[19, 20].

The strength of this study was the design of its case-control, by matching the same surgical procedure, surgical indication and period, with a high ratio at 1:4 of case-to-control. This method may help to minimize the confounding factors. Our study had a limitation, due to it being a retrospective study; therefore, some detailed information may be incomplete or unrecord in the patient' charts.

The current study provided practical information for early detection of urinary tract injuries in patients who had significant risk factors. Patients with significant risk factors should be identified and evaluated thoroughly prior to surgery. In some cases, the urologists should also be counseled prior to the procedure. Gynecologic surgeons must have a thorough understanding of pelvic anatomy. Furthermore, the proper surgical technique should be used. During the operation, urinary tract organs, particularly the ureters, should be identified. If urinary tract injuries occur, they will be detected during the operation and prompt management. However, despite these efforts, the risk of unintended damage to the urinary organs remains. Thus, early recognition and prompt management are critical to reduce morbidity. This study provided evidence in terms of incidence, risk factors, management of urinary tract injuries and surgical outcomes. Counseling and informed consent are fundamental before planning surgery, particularly for patients who are at high risk.

Conclusion

The incidence of urological injury during gynecologic surgery at Songklanagarind hospital was 0.66%, over a 15-year period. Bladder injuries were the most common type of urologic injuries. Previous myomectomy, level of surgeon, the presence of dense pelvic adhesion, and large tumor size were significant risk factors. Eventually, most injuries were detected, and promptly repaired in concurrent procedures, by skillful urologists with successful outcomes.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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