Original Article

Characteristics and management of iatrogenic urinary tract injuries in teaching hospital: A single-centered study

Syah Mirsya Warli[1,2], Ryan Ramon[3], Ramlan Nasution[1], Dhirajaya Dharma Kadar[1], Kharisma Prasetya Adhyatma[1], Mohd. Rhiza Z. Tala[4]

[1]Division of Urology, Department of Surgery, Faculty of Medicine, Universitas Sumatera Utara, Adam Malik Hospital, [2]Department of Urology, Universitas Sumatera Utara, Universitas Sumatera Utara Hospital, [3]Department of Urology, Faculty of Medicine, Universitas Indonesia-Adam Malik Hospital, [4]Department of Obstetric and Gynaecology, Medical Faculty, Universitas Sumatera Utara, Adam Malik Hospital, Medan, Indonesia

Abstract

Context and Aims: Despite its rarity, iatrogenic urinary tract injury can cause severe morbidity and mortality. The purpose of this study was to determine the frequency of urinary tract injuries caused by medical treatment in a hospital in Medan, Indonesia.

Settings and Design: This retrospective descriptive study was conducted at H. Adam Malik General Hospital and Universitas Sumatera Utara Hospital in Medan from March to August 2022.

Subjects and Methods: Medical data of individuals who had iatrogenic urinary tract injuries in a Medan teaching hospital from 2018 to 2022 were obtained using total sampling. SPSS version 25 was utilized to analyze patient characteristics, the type of surgery, urinary tract injuries, and urologic procedures.

Results: There were 11 ureteral injuries and 23 bladder injuries in 32 iatrogenic urinary tract injuries. The average age of the patients was 40.5 ± 13.3. Patients who received obstetrical care had the highest rate of iatrogenic urinary tract injury (56.3%), followed by patients who received gynecological care (21.9%) and surgical care (21.9%). The procedure most likely to cause iatrogenic urinary tract injury was hysterectomy (40.6%). Bladder rupture (65.5%) and ureteral transection (28.1%) were common types of iatrogenic bladder and ureteral injuries. Majority of iatrogenic urinary tract injuries were treated with bladder repair (68.8%).

Conclusions: Obstetrical and gynecologic procedures, especially hysterectomy, were the most common causes of iatrogenic urinary tract injury; bladder repair was the most common treatment. Iatrogenic urinary tract injury is best managed by knowing the anatomical position of the urinary tract inside the operative field.

Keywords: Hysterectomy, iatrogenic disease, urinary bladder diseases

Address for correspondence: Prof. Dr. Syah Mirsya Warli, Jl. Dr. Mansyur No. 66, Medan 20154, Indonesia.
E-mail: warli@usu.ac.id
Received: 26.06.2023, **Revised:** 01.03.2024, **Accepted:** 11.03.2024, **Published:** 10.06.2024.

INTRODUCTION

Iatrogenic injury to the urinary tract, which includes the kidneys, ureters, bladder, and urethra, can occur due to surgical procedures performed in the abdominal area behind the peritoneum or the region around the pelvis.[1,2] Such procedures, which are often performed by urologic surgeons, obstetricians, gynecologists, and general surgeons, have typically been responsible for the majority

Access this article online	
Quick Response Code:	Website: www.urologyannals.com
	DOI: 10.4103/ua.ua_68_23

How to cite this article: Warli SM, Ramon R, Nasution R, Kadar DD, Adhyatma KP, Tala MR. Characteristics and management of iatrogenic urinary tract injuries in teaching hospital: A single-centered study. Urol Ann 2024;16:197-202.

of iatrogenic injuries in this area. Thus, awareness of such injuries is of utmost importance for these specialists. Indeed, lack of recognition at the time of injury precludes immediate repair, and additional procedures are often required at later intervals to address the complications of missed iatrogenic injuries.[3] These procedures are associated with their morbidities and run the risk of loss of renal function or, worse, of the renal unit. Thus, prompt investigation and treatment of suspected iatrogenic injury are crucial to lessen the occurrence of subsequent complications.[3]

Lower urinary tract injuries can take place during obstetrics or gynecology procedures. Obstetric procedures are commonly associated with iatrogenic bladder injuries. The frequencies ranged from 0.2 to 19.6/1000 surgeries, commuting to 2.6/1000 on average.[4] During the cesarean section (CS), the injuries can be divided into two categories which are bladder injuries and ureteral injuries. The rate of bladder injuries during CS was between 0.13% and 0.44%, and in ureteral injuries, which were rare, the rates were between 0.01% and 0.08%.[5]

Prior CS is a risk factor for urinary tract damage during surgery, as is the case with placenta accreta and placenta previa. In a study, patients who had previously experienced CS and a full placenta previa and/or accreta that required a hemostatic hysterectomy had a higher risk of bladder and ureter injury.[5] There is a connection between iatrogenic injury to the urinary tract and the placenta accreta spectrum (PAS), the most commonly reported factor in the literature to cause urological injuries following cesarean delivery. Placenta previa and bladder invasion are two conditions that are often associated with PAS.[5]

Gynecologic procedures such as abdominal hysterectomies also account for bladder and ureteral injuries. The incidence ranged from 0.1% to 1.8%. More radical surgeries pose a greater risk for a ureteral injury, which reaches up to 30%.[6] A laparoscopic approach is believed to contribute to urinary tract injuries during gynecologic surgery.[6] According to research conducted in 2011, the rate of bladder injury in abdominal, vaginal, and laparoscopic hysterectomies was 0.9%, 0.6%, and 1%, respectively. On the other hand, research from 2011 found that the rate of ureteric injury in abdominal, vaginal, and laparoscopic hysterectomies was 0.3%, 0.04%, and 0.3%, respectively.[7-9]

Digestive surgery can also contribute to urinary tract injuries, with ureteral injuries being more common than bladder injuries. Bladder/ureteral injury incidence rates during gastrointestinal surgery were around 0.21%. Iatrogenic urinary tract injuries also happen during colorectal surgeries, and the incidence was found to be 0.18%.[10]

Advances in surgical techniques and approaches, particularly the shift toward minimally invasive applications such as robotic and laparoscopic surgery, have expanded the potential for iatrogenic injury. The use of energy-based devices on tissue near the urinary tract may cause an iatrogenic injury to appear later. It is worth mentioning that the way iatrogenic injuries are treated has changed in recent times to focus on conservative, noninvasive, or minimally invasive methods. In addition to early recognition and awareness, this shift has laid the groundwork for minimizing morbidity and loss of renal function associated with such injuries. Evidence suggests that delayed diagnosis of the iatrogenic injury significantly influences a patient's outcome.[10,11]

Despite its rarity, urologists need to understand the iatrogenic injury. Urinary tract iatrogenic injury in abdominal or pelvic surgery may cause morbidity, mortality, or even medico-legal aspects. Several adverse outcomes may occur due to ureteral injuries, including more extended hospital stays, the need for additional medical procedures, longer surgeries, reduced kidney function, and reduced quality of life for the patient. Trauma investigation and management, both in acute and delayed conditions, are essential to decrease the effects of possible complications. Distal ureteral injuries are best managed with ureteroneocystostomy with or without a vesico-psoas hitch. In some cases, mid-ureteral and proximal ureteral injuries can be treated with ureteroneocystostomy. If the distal segment is unsuitable for anastomosis, several options are available, such as using a Boari tubularized bladder flap, performing a transureteroureterostomy, or performing renal autotransplantation. In rare instances, it may be necessary to perform renal autotransplantation or use gastrointestinal segments for ureteral substitution to restore the continuity of the urinary tract. Laparoscopic and minimally invasive techniques have been employed to remedy iatrogenic ureteral injuries.[12]

The majority of intraperitoneal injuries require immediate operative repair to prevent the development of sepsis. Intraperitoneal injuries that do not result in sepsis or ileus may be managed conservatively without surgical intervention. These injuries are typically repaired using a two-layer closure technique, using absorbable suture material for the mucosa. In contrast, extraperitoneal injuries are often treated with a conservative approach, using a Foley catheter for bladder decompression and

observation.[4] The management of iatrogenic trauma surgeries in Indonesian teaching hospitals, especially in North Sumatra, has not been reported. Thus, the author was interested in conducting this research.

SUBJECTS AND METHODS

This retrospective descriptive study was carried out in the Urology Division of the Department of Surgery at H. Adam Malik General Hospital and Universitas Sumatera Utara Hospital in Medan from March to August 2022. The study protocol is compliant with ethical standards and approved by the local ethical committee (no: 905/KEPK/USU/2022). We included all patients with iatrogenic urinary tract injuries from surgery procedures in a teaching hospital in Medan (i.e., H. Adam Malik General Hospital and Universitas Sumatera Utara Hospital) by employing total sampling. The inclusion criteria for research participants were patients who experienced iatrogenic urinary tract injuries from surgery procedures in a teaching hospital in Medan. We then excluded patients who had surgery procedures at private hospitals. For this study, we obtained data from the medical records of patients who sustained iatrogenic urinary tract injuries due to surgical procedures at a teaching hospital in Medan from 2018 to 2022, and all the patients have given their consent to their inclusion in this study. Variables included patients' characteristics, type of surgery procedure, urinary tract trauma, and urologic procedures. The analysis was performed using SPSS version 25 (SPSS Inc., IBM Corp., Armonk, NY, USA). Data were then presented in Table 1 and tabulations.

RESULTS

Thirty-five incidents of iatrogenic urinary tract injuries were found in a teaching hospital in Medan from 2018 to 2022; 31 injuries (88.6%) occurred in female patients, whereas four injuries (11.4%) occurred in males. The iatrogenic urinary tract injury case was dominated by female patients, consisting of 10 (28.57%) patients with iatrogenic ureter injury, 22 (62.86%) patients with iatrogenic bladder injury, and three patients had both iatrogenic ureter and bladder injury (8.57%). The mean age of the patients included in this study was 40.43 years, with the youngest being 15 years, whereas the oldest was 79 years. Regarding the case, we obtained those patients with an obstetrical case had the most iatrogenic urinary tract injuries (54.3%), accounting for three cases (8.6%) and 17 cases (48.6%) in ureteral and bladder injury, respectively. Of 19 obstetrical patients, we obtained that 15 of them had PAS disorder (78.95%). Of the remaining nonobstetrical cases, five patients with gynecological cases (14.3%) and five with digestive cases (14.3%) had ureteral injuries. Meanwhile, five patients with gynecological cases (14.3%) and three with digestive cases (8.6%) had bladder injuries. In this study, the iatrogenic ureteral injury was most commonly found in those patients who underwent a hysterectomy procedure (22.9%), as well as in the iatrogenic bladder injury, which was primarily reported in those patients who underwent a hysterectomy procedure (28.6%). Of 22 patients who underwent a hysterectomy, data regarding computed tomography scan examination were only found in one patient (4.55%).

Regarding the urological diagnosis, the most common type of iatrogenic trauma was bladder rupture, found in 22 (62.9%) patients. Ureteral transection was the most common type of iatrogenic ureteral injury, with 10 (28.6%) cases. In addition, three patients had bladder rupture and ureteral transection (6.3%). This study found that patients with bladder ruptures underwent bladder repair (62.9%). Six patients with iatrogenic ureteral injury underwent ureteral reimplantation (17.1%), whereas others underwent ureteroureterostomy and Double J-Stent insertion (11.4%).

DISCUSSION

Regardless of the surgical approach, urinary tract injury can occur during abdominopelvic surgery, particularly obstetrical or gynecological procedures. Previous studies have reported different incidences of iatrogenic urinary tract injury; nevertheless, the vast majority of the studies reported that gynecological issues were the most prevalent cause of iatrogenic urinary tract injury. In a previous investigation conducted at a single center in Indonesia, gynecological procedures were identified as the leading cause of iatrogenic urinary tract injury.[11] Similarly, the current study discovered that gynecological procedures, notably hysterectomy, were commonly reported as the cause of urinary tract injury. The results of the current study align with the findings of Chianakwana *et al*.,[13] who discovered that transabdominal hysterectomy was the most common cause of iatrogenic urinary tract injury in Nigeria. Cordon *et al*. also noted that these injuries could occur during abdominal and vaginal hysterectomy procedures.[14]

In this study, the average age of incidence for iatrogenic urinary tract injury was 40.43 years. In addition, it was found that bladder injury was more common than ureteral injury. An earlier meta-analysis by Xu *et al*. discovered that patients at high risk of iatrogenic bladder injuries include those undergoing emergency surgeries and those having previous pelvic surgeries, resulting in adhesion

Table 1: Characteristics of patients according to the types of iatrogenic urinary tract injury

Variables	Total (*n*=35), *n* (%)	Case of ureter injury, *n* (%)	Case of bladder injury, *n* (%)
Age (years)			
Mean±SD	40.43±13.02		
Median (IQR)	37 (17)		
Sex			
Female	31 (88.6)	10 (28.6)	24 (68.6)
Male	4 (11.4)	3 (8.6)	1 (2.9)
Case			
Obstetric	19 (54.3)	3 (8.6)	17 (48.6)
Gynecologic	8 (22.9)	5 (14.3)	5 (14.3)
Digestive	8 (22.9)	5 (14.3)	3 (8.6)
Procedures			
Hysterectomy	15 (42.9)	8 (22.9)	10 (28.6)
Cesarean section	4 (11.4)	-	4 (11.4)
Cesarean + hysterectomy	7 (20.0)	-	7 (20.0)
Colon resection	4 (11.4)	3 (8.6)	1 (2.9)
Others	5 (14.3)	2 (5.7)	3 (8.6)
CT scan examination of hysterectomy			
Yes	1 (4.55)		
No	21 (95.45)		
Urological diagnosis			
Bladder rupture	22 (62.9)	-	22 (62.9)
Ureteral transection	10 (28.6)	10 (28.6)	-
Bladder rupture + ureteral transection	3 (8.6)	3 (8.6)	3 (8.6)
Urological procedures			
Bladder repair	22 (62.9)	-	22 (62.9)
Ureteral reimplantation	6 (17.1)	6 (17.1)	-
Ureteroureterostomy	4 (11.4)	4 (11.4)	-
Bladder repair + ureteral reimplantation	3 (8.6)	3 (8.6)	3 (8.6)

SD: Standard deviation, IQR: Interquartile range, CT: Computed tomography

formation or distortion of pelvic anatomy.[15] Furthermore, the surgeon's experience was also identified as crucial.[16] As a note, the present study was conducted in teaching hospitals where residents mainly gain surgical experiences by getting involved in operative and postoperative care. However, it is necessary for attending surgeons to provide supervision, while inexperienced residents should not be permitted to perform complex procedures. By adhering to these guidelines, the risk of iatrogenic injury caused by resident involvement in surgery at teaching hospitals can be avoided.

Bladder injury can occur at several points in gynecologic surgery. The bladder is in danger during lysis of adhesions, bladder dissection in all routes of hysterectomy, or entry into the anterior *cul-de-sac* in vaginal hysterectomy. However, Glaser and Milad suggest utilizing sharp dissection, backfilling the bladder, and implementing cephalad traction on a uterine manipulator to mobilize the bladder away from the uterine arteries, as opposed to using blunt dissection, which can offer the most effective injury prevention method.[17] This approach avoids distortion of anatomic planes and facilitates safe ligation. In addition, retrograde bladder filling with normal saline during a laparoscopic or vaginal hysterectomy can delineate the bladder's borders more clearly.

The bladder is the urinary system organ most frequently damaged during medical procedures.[18] According to a prior study, external bladder injuries result most frequently during obstetric and gynecological procedures and less frequently from general surgery; meanwhile, internal bladder injuries are the result of endourological operations.[19] Hematuria and any urination disorders (dysuria, incomplete or inadequate emptying, anuria, or urinary retention) are among the clinical manifestations of iatrogenic bladder injury. In addition, soreness, overflowing bladder, and signs of urinary peritonitis required further objective evaluation.[19] Among other iatrogenic injuries, the current study found that bladder rupture was the most prevalent type of iatrogenic urinary tract injury reported following an abdominopelvic surgery. This injury can develop when the bladder is released caudally in the ureterovesical region, as there is typically fibrosis between the bladder base and pubovesical fascia.[11] Regarding the diagnosis, intraoperative identification of bladder perforation with external damage can be suspected with extravasation of the urine and visible urethral catheter, whereas in case of internal damage, paravesical fatty tissue, abdominal cavity, or intestine are visualized.[20,21] Cystography has been the golden standard for diagnosing bladder injury, as it can help to determine perforation, fistula formation, and ureteral reflux.

In addition to bladder injury, the current study identified ureteral injury as a type of iatrogenic urinary injury. Compared to bladder injury, the incidence of ureteral injury was lower because only a third of all iatrogenic ureteral injuries were recognized and reported since ureteral injuries were asymptomatic and did not present any sign or symptom until renal function declined.[22] The ureters are susceptible to injury during gynecological procedures due to their proximity to the uterine arteries and the cervix. In certain circumstances, such as deformed pelvic anatomy, extensive adhesions, or significant hemorrhage, injuries may be nearly inevitable. The leading causes of iatrogenic ureteral injuries differ according to the mechanism of occurrence: direct ligation of the ureter or the formation of a pathological inflection during ligation of adjacent structures, crushing or squeezing with an instrument, partial or complete intersection, thermal damage during coagulation, electrical leakage, denervation, and devascularization.[23,24] In general, surgical, gynecological, and colorectal operations, it is generally observed that the lower third of the ureter segment is more susceptible to severe injury than the middle and upper third.[25] The segment that is difficult to identify is the intersection between the uterine arteries and the bladder. However, it should be noted that most ureteral injuries are covert, and early postoperative diagnostic procedures do not always make it possible to establish a diagnosis.[26] The clinical diagnosis is generally determined by the patient's complaints, typically discovered by flank pain, urinary incontinence, vaginal or urinary leakage, hematuria, fever, azotemia, or urinoma. Such complaints are nonspecific and do not allow for differentiation in the diagnosis, but they should still be considered.[19] In regard to the diagnosis, retrograde or antegrade urography is the golden standard for the confirmation of iatrogenic ureteral injury.[18]

In this study, all patients identified with iatrogenic bladder injury (25 patients, 71.43%) underwent bladder repair according to the European Association of Urology (EAU) guidelines. Although surgical exploration and repair is the standard treatment for intraperitoneal injuries, conservative management with continuous bladder drainage and antibiotic prophylaxis may be considered in some instances, especially when there is no evidence of peritonitis or ileus.[27] Meanwhile, patients diagnosed with iatrogenic ureteral injury (13 patients, 37.14%) underwent either ureteral reimplantation or ureteroureterostomy procedures per the EAU recommendations.[27] As ureteral injury treatment largely depends on the mechanism of injury, identified or suspected intraoperative damage can be resolved conservatively (by installing a ureteric DJ stent) or removed surgically directly during surgery. Performing a nephrostomy is also possible, but stenting is preferred due to the sewer effect, which produces a gaping lumen, which minimizes the chance of stricture formation.[23] In addition, pelvic ureter injuries are frequently accompanied by a danger of ureter devascularization and denervation; hence, ureteroneocystostomy or urethroplasty with a bladder transplant (Boari method) with or without the psoas hitch technique is regarded as standard treatment.[28,29] Due to the significant risk of stricture recurrence, the antireflux treatment is administered individually. The success rate of pelvic reconstruction procedures ranges from 85% to 98%, but their immediate implementation is not always achievable.[28]

CONCLUSIONS

There were 35 patients with iatrogenic urinary tract injury in the hospital teaching in Medan from 2018 to 2022, consisting of 13 incidences of ureteral injury and 25 incidences of bladder injury. Most patients with iatrogenic urinary tract injuries reported having obstetrical diagnoses, and hysterectomy was the most commonly reported procedure. Bladder repair was the most frequently performed procedure for patients with iatrogenic urinary tract injuries. Although these injuries are rare, they can have severe morbidity. Understanding the anatomical position of the urinary tract within the surgical field is the most effective way to prevent and manage iatrogenic urinary tract injuries. Besides, the risk of injury should be anticipated in patients with associated risk factors, and necessary precautions significantly reduce the risk. Of equal importance is for the surgeon to be alert and able to identify injury intraoperatively to facilitate immediate repair and achieve the best outcome to decrease morbidity and prevent long-term complications.

Acknowledgment

The authors would like to thank everyone who supported this study. Special thanks are given to Adam Malik General Hospital and Universitas Sumatera Utara Hospital, which fully supported the authors during the writing period.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Ricard AS. Leo R. Upper urinary tract trauma. In: Campbell-Walsh Urology. 10th ed. Amsterdam: Elsevier Sauders Inc.; 2012.
2. El-Tabey NA, Ali-El-Dein B, Shaaban AA, El-Kappany HA, Mokhtar AA, El-Azab M, *et al*. Urological trauma after gynecological

and obstetric surgeries. Scand J Urol Nephrol 2006;40:225-31.
3. Thompson JD. Operative Injuries to the Ureter: Prevention, Recognition and Management. Philadelphia: Lippincott Williams and Wilkins; 1997. p. 1135-74.
4. Gomez RG, Ceballos L, Coburn M, Corriere JN Jr., Dixon CM, Lobel B, *et al*. Consensus statement on bladder injuries. BJU Int 2004;94:27-32.
5. Radu VD, Pristavu AI, Vinturache A, Onofrei P, Socolov DG, Carauleanu A, *et al*. Risk factors for urological complications associated with caesarean section-a case-control study. Medicina (Kaunas) 2022;58:123.
6. Başaranoğlu S, Deregözü A, Köroğlu N, Kalkan M, Şahin C, Kadanalı S. Early and late diagnosis of iatrogenic urinary tract injuries during obstetric and gynecological operations. J Clin Exp Invest 2016;7:252-7.
7. Brummer TH, Jalkanen J, Fraser J, Heikkinen AM, Kauko M, Mäkinen J, *et al*. FINHYST, a prospective study of 5279 hysterectomies: Complications and their risk factors. Hum Reprod 2011;26:1741-51.
8. Adelman MR, Bardsley TR, Sharp HT. Urinary tract injuries in laparoscopic hysterectomy: A systematic review. J Minim Invasive Gynecol 2014;21:558-66.
9. Visco AG, Taber KH, Weidner AC, Barber MD, Myers ER. Cost-effectiveness of universal cystoscopy to identify ureteral injury at hysterectomy. Obstet Gynecol 2001;97:685-92.
10. Eswara JR, Raup VT, Potretzke AM, Hunt SR, Brandes SB. Outcomes of iatrogenic genitourinary injuries during colorectal surgery. Urology 2015;86:1228-33.
11. Djufri TR, Warli SM. Iatrogenic urinary tract trauma in obstetrics and gynecologic surgeries at H. Adam Malik general hospital Medan. Indonesian J Urol 2019;16:139.
12. Png JC, Chapple CR. Principles of ureteric reconstruction. Curr Opin Urol 2000;10:207-12.
13. Chianakwana GU, Okafor PI, Ikechebelu JI, Mbonu OO. Urological injuries following gynecological operations – Our experience in a teaching hospital in Nigeria. West Afr J Med 2006;25:153-6.
14. Cordon BH, Fracchia JA, Armenakas NA. Iatrogenic nonendoscopic bladder injuries over 24 years: 127 cases at a single institution. Urology 2014;84:222-6.
15. Xu Y, Wang Q, Wang F. Previous cesarean section and risk of urinary tract injury during laparoscopic hysterectomy: A meta-analysis. Int Urogynecol J 2015;26:1269-75.
16. Hammad FT, AlQaiwani KM, Shirodkar SS. The role of urologists in the management of urological injuries during obstetric and gynaecologic surgery. Int Urogynecol J 2010;21:1237-41.
17. Glaser LM, Milad MP. Bowel and bladder injury repair and follow-up after gynecologic surgery. Obstet Gynecol 2019;133:313-22.
18. Esparaz AM, Pearl JA, Herts BR, LeBlanc J, Kapoor B. Iatrogenic urinary tract injuries: Etiology, diagnosis, and management. Semin Intervent Radiol 2015;32:195-208.
19. Smith TG 3rd, Coburn M. Damage control maneuvers for urologic trauma. Urol Clin North Am 2013;40:343-50.
20. Golan S, Baniel J, Lask D, Livne PM, Yossepowitch O. Transurethral resection of bladder tumour complicated by perforation requiring open surgical repair – Clinical characteristics and oncological outcomes. BJU Int 2011;107:1065-8.
21. Venkatramani V, Panda A, Manojkumar R, Kekre NS. Monopolar versus bipolar transurethral resection of bladder tumors: A single center, parallel arm, randomized, controlled trial. J Urol 2014;191:1703-7.
22. Cirstoiu M, Munteanu O. Strategies of preventing ureteral iatrogenic injuries in obstetrics-gynecology. J Med Life 2012;5:277-9.
23. Hesselman S, Högberg U, Jonsson M. Effect of remote cesarean delivery on complications during hysterectomy: A cohort study. Am J Obstet Gynecol 2017;217:564.e1-8.
24. Matsumura Y, Iemura Y, Fukui S, Kagebayashi Y, Samma S. Iatrogenic injuries of urinary tract: Outcomes of surgical repairs. Hinyokika Kiyo 2018;64:95-9.
25. Lobo N, Kulkarni M, Hughes S, Nair R, Khan MS, Thurairaja R. Urologic complications following pelvic radiotherapy. Urology 2018;122:1-9.
26. Petersen SS, Doe S, Rubinfeld I, Davydova Y, Buekers T, Sangha R. Rate of urologic injury with robotic hysterectomy. J Minim Invasive Gynecol 2018;25:867-71.
27. Summerton DJ, Kitrey ND, Lumen N, Serafetinidis E, Djakovic N, European Association of Urology. EAU guidelines on iatrogenic trauma. Eur Urol 2012;62:628-39.
28. Mundy AR, Andrich DE. Urethral trauma. Part I: Introduction, history, anatomy, pathology, assessment and emergency management. BJU Int 2011;108:310-27.
29. Vorobev V, Beloborodov V, Golub I, Frolov A, Kelchevskaya E, Tsoktoev D, *et al*. Urinary system iatrogenic injuries: Problem review. Urol Int 2021;105:460-9.