Transplantation

Ureteral Injury in Gynecologic Surgery: A 5-Year Review in A Community Hospital

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Purpose: We reviewed the cases of ureteral injury during gynecologic surgeries in a community hospital and attempted to find possible options for alleviating these distressing situations.

Materials and Methods: A total of 2,927 patients underwent gynecologic surgeries in the last 5 years at our hospital. We retrospectively analyzed the cases, particularly the possible risk factors and management according to the time of detection of the injury. Thirty-five cases (1.2%) were identified with ureteral injury in a total of 2,927 gynecologic surgeries. Risk factors included endometriosis, pelvic inflammatory disease, previous pelvic surgery, history of pelvic radiation, and congenital anomalies. Among 2,927 patients, 522 had predisposing factors for ureteral injuries.

Results: The incidence of ureteral injury in laparoscopic cases was 1.1%, similar to the cases of laparotomy (1.2%). The rate of ureteral injury was significantly higher in the group with risk factors (2.7%) than in the group without risk factors (0.9%; p=0.002). Prophylactic ureteral stenting was performed in 101 of 522 patients with risk factors according to the gynecologic surgeon's preference. The injury rate (1.0%) in the stenting group was lower than that in the non-stenting group (3.1%; p=0.324). Management of ureteral injuries was successful in all cases. Of the patients with postoperatively diagnosed injuries, two patients were managed with secondary procedures, such as retrograde balloon dilatation or ureteroneocystostomy.

Conclusions: The incidence of ureteral injury was significantly higher in cases having risk factors than in cases without risk factors. Surgeons should be cautious to avoid ureteral injury during gynecologic surgery, especially in patients with risk factors.

Key Words: *Gynecologic surgical procedures; Laparotomy; Stents; Ureter; Wounds and injuries*

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INTRODUCTION

Ureteral injury is one of the most problematic complications with significant postoperative morbidity in pelvic and abdominal surgical procedures. Unrecognized ureteral injury can cause prolonged postoperative morbidity leading to fistula formation, sepsis, or renal functional loss [1,2]. According to the literature, more than 50% of all iatrogenic injuries occur during gynecologic surgery [3]. Many studies assessing the incidence of ureteral injuries in gynecologic procedures detail ureteral injury rates ranging from 0.1 to 2.5% [4-7].

Although ureteral injury can be recognized intraoperatively and managed appropriately without any sequelae, it can also present during the postoperative period [8,9]. Some studies report that over 80% of ureteral injuries are diagnosed postoperatively [10]. Unfortunately, patients with undiagnosed injuries can have a highly variable course that causes diagnostic delay, resulting in additional hospitalization that is associated with substantial morbidity and commonly results in medicolegal litigations [8,9].

The purpose of this study was to review the cases of ure-

teral injury during gynecologic surgeries in relation to possible predisposing factors and patient management according to the time of detection of the injury in our hospital from March 2006 to February 2011. We also attempted to identify possible options to resolve these distressing situations.

MATERIALS AND METHODS

The records of 35 patients (1.2%) with 38 iatrogenic ureteral injuries sustained in a total of 2,927 gynecologic surgeries carried out from March 2006 to February 2011 in the Department of Obstetrics and Gynecology in our hospital were retrospectively reviewed. Ureteral injuries were recognized intraoperatively in 20 patients and 1 to 28 days after the surgery in 15 patients. For the 35 patients with diagnosed iatrogenic ureteral injuries, gynecologic surgeries had been performed for malignant (n=27) or benign (n=8) pelvic disease. Laparoscopic surgery and laparotomy cases numbered 11 and 24 patients, respectively (Table 1). Among the total 2,927 patients, 522 had predisposing factors for ureteral injuries, such as endometriosis, pelvic inflammatory disease, previous pelvic surgery, history of pelvic radiation, or congenital anomalies.

In the presence of suspected ureteral injuries during the gynecologic operation, the urologist confirmed ureteral intactness. The damaged suspicious lesion was confirmed by direct inspection or cystoscopic evaluation of urinary efflux. Twenty patients showed impaired urinary flow or ureteral patency, and defects were promptly repaired with proper procedures.

The signs and symptoms in patients with postoperatively recognized ureteral injury included urinary leakage, flank pain, azotemia, anuria, and fever. Ureteral intactness was evaluated by intravenous pyelography (IVP), retrograde pyelography (RGP), and contrast computerized tomography (CT).

After repair of the ureteral injury was complete, success was defined on the basis of IVP or contrast CT.

Statistical analysis was performed by chi-square and Fisher's exact tests with $p < 0.05$ considered as significant.

RESULTS

The incidences of ureteral injury with laparoscopic surgery and laparotomy were 1.1% and 1.2%, respectively. The postoperative detection rate of ureteral injury was higher in laparoscopic surgery cases (73%) than in laparotomy cases (29%; p=0.027) (Table 2).

Management of the intraoperatively detected ureteral injuries showed satisfactory outcomes in all cases. Of the patients with postoperatively diagnosed ureteral injuries, only two were managed with a secondary procedure, such as retrograde balloon dilatation or ureteroneocystostomy (Table 3).

1. Patients with intraoperatively diagnosed ureteral injuries

All 20 cases of intraoperatively diagnosed ureteral injuries were unilateral injuries.

In 6 of the 20 cases, the ureteral injury was a mucosa-sparing injury and was managed with primary closure.

TABLE 1. Patients' characteristics

Characteristic	Intraoperative diagnosis (n=20)	Postoperative diagnosis (n=15)
Age (yr)	50.9	47.7
Follow-up, mean (range), (mo)	12.9 (1-40)	15.5 (1-48)
Surgical indications (n)		
Malignant disease		
Cervical cancer	8	9
Ovarian cancer	3	2
Endometrial cancer	3	1
Ovarian metastasis	1	0
Benign disease		
Uterine myoma	4	3
Ovarian cyst	1	0
Gynecological surgeries (n)		
Laparoscopy		
Laparoscopic radical hysterectomy	1	4
Laparoscopic assisted vaginal hysterectomy	0	3
Laparoscopic total hysterectomy	1	1
Laparoscopic ovarian cyst excision	1	0
Laparotomy		
Total abdominal hysterectomy	8	0
Radical hysterectomy	3	4
Modified radical hysterectomy	3	1
Secondary cytoreductive surgery for ovarian cancer	3	2

TABLE 2. Incidence and detection rate of ureteral injury according to surgery

Gynecologic surgery	Incidence	Injuries detected intraoperatively		Injuries detected postoperatively	
	% (total injuries/total surgeries)	No.	Detection rate (%)	No.[a]	Detection rate (%)
Laparoscopy	1.1 (11/994)	3	27	8	73
Laparotomy	1.2 (24/1,933)	17	71	7	29
Total	1.2 (35/2,927)	20	57	15	43

[a]: $p=0.027$.

TABLE 3. Management of ureteral injuries

Management (n)
Intraoperative diagnosis
Unilateral injury (20)
Ureteroureterostomy (11)
Primary closure (6)
Ureteroneocystostomy (2)
Clip removal and retrograde ureteral stenting (1)
Postoperative diagnosis
Unilateral injury (12)
Retrograde ureteral stenting (5)
Percutaneous nephrostomy and antegrade stenting
(3)-failure in two patients
→ Ureteroneocystostomy with Boari flap (1)
Retrograde balloon dilatation (1)
Ureteroureterostomy (2)
Ureteroneocystostomy (2)
Bilateral injury (3)
Retrograde ureteral stenting (R)+ureteroneocystostomy
(L) (1)
Ureteroneocystostomy (R)+ureteroureterostomy (L) (1)
Ureteroureterostomy (R)+retrograde ureteral stenting (L)
(1)

Another 5 patients with partial transected injury were managed through excision of the compromised segment followed by ureteroureterostomy.

Among another eight cases presenting with complete transection of the ureter, six cases were managed by ureteroureterostomy. Two patients were managed by ureteroneocystostomy because of ureteral transection within 2 to 3 cm of the bladder.

In the last case among the 20 cases, the ureter was clamped by a metal clip. After the clip was removed, the ureter returned to its normal peristaltic activity and color. Retrograde ureteral stent insertion was carried out and removed after 6 weeks.

Serious complications requiring additional intervention were not observed during the follow-up visit and the urinary tract patency was not compromised at the follow-up IVP, contrast CT, or sonogram.

2. Patients with postoperatively diagnosed ureteral injuries

Between postoperative day 1 and 28, patients in whom ureteral injury was suspected underwent RGP and IVP, showing non-visualized kidney, hydronephrosis, or contrast leakage into the pelvic cavity. Contrast CT depicted urinoma formation or ureteral obstruction in some patients.

Retrograde ureteral stenting with a Double-J stent was attempted in all patients; if successful, the ureteral stent was preserved for 2 to 3 months.

Of the 12 unilateral injuries, 5 patients presented with ureterovaginal fistula at postoperative days 6, 7, 14, 22, and 28, respectively. The retrograde ureteral stenting failed in only one patient diagnosed on postoperative day 28. This patient was managed with ureteroureterostomy within a few days.

In three cases, the ureter was completely obstructed by a metal clip. Flank pain was observed in two cases, and azotemia and fever were observed in one case. RGP was used to confirm the diagnosis on day 5 or 6 after the operation. Retrograde ureteral stenting was initially attempted in these three patients but was not successful. Subsequent surgical reconstructions were performed within 2 days after the diagnosis. The methods of reconstruction were ureteroureterostomy, ureteroneocystostomy with psoas hitch, and ureteroneocystostomy with Boari flap.

Four patients were identified with ureteral injury with an associated urinary leak into the abdominal cavity by an increasing Jackson-Pratt drain amount between 3 days and 13 days after the operation. Cystoscopic ureteral stent insertion was achieved in only one patient, and the ureteral stent was preserved for 6 weeks. A percutaneous nephrostomy was created through the afflicted kidney in the remaining three patients. Antegrade ureteral stenting to secure patency was undertaken. In one of these patients, the ureteral stent was removed after 2 months and IVP showed a silent kidney. That patient was subsequently managed with ureteral balloon dilatation. Satisfactory urinary drainage was confirmed on follow-up IVP after 1 month. In the second case, the patient suffered from cervical cancer and received postoperative irradiation. The ureteral stent was left in situ for a total of 6 months with a replacement interval of 3 months. The ureteral stent was removed after that period and ureteral distention was confirmed by IVP. This distention was resolved after ureteroneocystostomy with Boari flap. In the one remaining case, the ureteral stent was removed after 2 months and urinary tract patency was restored.

Three cases with bilateral injuries presented with anu-

ria: azotemia in one case and ureterovaginal fistula and flank pain in two cases. The IVP showed bilateral silent kidney in one case and ureterovaginal fistula and hydronephrosis in two cases. Retrograde ureteral stenting was unilaterally achieved in one case. Subsequently, all of these cases were treated by surgical exploration. The patient with bilateral ureterovaginal fistula also suffered from a rectal injury; thus, she was managed with primary rectal repair, ileostomy, and ureteral reconstruction. After 3 months, ileostomy take-down was undertaken.

3. Factors associated with ureteral injury

Among 2,927 patients, 522 had predisposing factors for ureter injuries including endometriosis, pelvic inflammatory disease, previous pelvic surgery, history of pelvic radiation, or congenital anomaly. The rate of ureteral injury was significantly higher in the group with risk factors (2.7%) than in the group without risk factors (0.9%; p=0.002). No predisposing factors were detected in 21 of the total 35 patients (60%) (Table 4).

Preoperative ureteral stenting was performed in 101 of 522 patients having risk factors according to the gynecologic surgeon's preference. The incidence of ureteral injury in the stenting group (1.0%) was lower than in the non-stenting group (3.1%); however, there was no statistically significant difference (p=0.324).

DISCUSSION

Ureteral injuries are reported to occur in approximately 0.1 to 2.5% of gynecologic surgeries [4-7]. Recently, the increasing number of minimally invasive endoscopic procedures being conducted by urologists has led to many cases of ureteral injuries. However, the majority of ureteral injuries during non-urological surgery are recognized postoperatively, whereas injuries during urological surgery are usually identified during the operation [2]. Also, postoperatively detected ureteral injuries are more complicated and require more procedures than do intraoperatively detected ureteral injuries. Most ureteroscopic ureteral injuries can be managed through the insertion of a ureteral stent [3,11].

Laparoscopic surgery has largely replaced laparotomy for gynecologic conditions. In this study, 34% of the surgeries were performed by laparoscopy. Ureteral injury is becoming more common as a result of the increased numbers of laparoscopic pelvic procedures [10,12].

There are controversies about surgical or minimally invasive management. Endoscopic minimally invasive approaches are an option for the management of ureteral injuries and are associated with reduced morbidity and duration of hospitalization [4,5]. On the other hand, Ku et al. [13] concluded that minimally invasive strategies are not always successful in the management of postoperatively detected ureteral injuries. Also, two of three patients treated with percutaneous nephrostomy and antegrade ureteral stenting needed additional procedures in our series. Furthermore, the proximal drainage strategy is inconvenient for some patients and prolongs the recovery period, and surgical intervention is eventually required in patients who are not successfully managed [8]. However, some patients may prefer the minimally invasive approach to avoid the operative repair. When the injury is detected postoperatively, the treatment plan should be discussed with a well-informed patient.

Certain conditions increase the likelihood of ureteral injuries, particularly conditions that disrupt the normal anatomy and architecture of the ureters. These conditions include endometriosis, retroperitoneal fibrosis, and pelvic inflammatory disease with direct invasion by tumors [14,15]. Other risk factors include previous pelvic surgery, broad ligament fibroids, history of pelvic radiation, and congenital abnormalities such as ureteral duplication, megaureter, or ectopic ureter or kidney [14-17]. In this study, 14 patients (40%) had predisposing factors such as those stated above. Also, 21 patients (60%) had no identifiable risk factors. The results of the present study correspond with data reported earlier showing that most ureteral injuries occur in patients who have no identifiable predisposing factors [14,17]. This study showed that the incidence of ureteral injury in cases having risk factors was significantly higher than in cases without risk factors. Therefore, it is gratifying to find a process by which to prevent ureteral injury during gynecologic surgery, especially in patients with risk factors.

TABLE 4. Factors associated with ureteral injury

Factor	Number of cases	
	Ureteral injury	Prophylactic ureteral stenting
Previous pelvic surgery	5	1
Endometriosis	4	0
Pelvic inflammatory disease	3	0
Previous pelvic surgery and history of pelvic radiation	1	0
Ureteral duplication and previous pelvic surgery	1	0
No identified factor	21	0
Total	35	1

Values are presented as no. of cases.

Prophylactic ureteral stenting during gynecologic surgery has been a controversial issue. Kuno et al. [18] and Chou et al. [19], reported that prophylactic ureteral stenting did not prevent surgical damage to the ureter, but the ureteral stents might predispose to injury by reducing their pliability; furthermore, ureteral stenting itself is not free of complications. However, ureteral stents were helpful when standard attempts to identify the ureter had failed in an area of severe adhesions [20]. The complications of ureteral stenting itself are nowhere near as catastrophic as a ureteral injury. In our study, only 1 of 101 patients who underwent gynecologic surgery with prophylactic ureteral stent insertion suffered from a ureteral injury. The injury rate in the prophylactic ureteral stenting group was lower than in the non-stenting group with risk factors. Although statistically insignificant, this study had a small number of patients and the injury rate of the non-stenting group with risk factors (3.1%) was higher than that in previously reported studies (0.1 to 2.5%). Therefore, it is worth verifying the injury rate of prophylactic catheterized patients having associated risk factors.

In this review, 57% of the ureteral injuries were detected and corrected intraoperatively with an uneventful outcome. It is obvious that the intraoperative diagnosis and repair of ureteral injuries can produce the best results [1,4-7,16]. Although the incidence of ureteral injury with laparoscopy was similar to the incidence of ureteral injury with laparotomy in this study, the postoperative detection rate of ureteral injuries was significantly higher for laparoscopic surgery than for laparotomy. In a report by Ostrzenski et al. [12], intraoperative diagnoses of ureteral injury during laparoscopic gynecologic surgery were made in only 6 (8.6%) of the 70 total cases. Delayed diagnosis seems to be the single controllable factor adversely influencing outcome [5]. In other words, laparotomy may be a better option for the detection of ureteral injury when the surgeon can predict the ureteral injury on the basis of associated risk factors.

The best treatment of ureteral injuries is therefore prevention through careful dissection. Careful surgical technique with surgical exploration of the pelvic side wall is probably the best method by which to prevent ureteral injury [18,19].

The data presented in this study should be viewed with caution because of the retrospective nature and the lack of objective parameters for grading the difficulty of pelvic procedures. Larger, prospective, randomized comparative studies are therefore necessary.

CONCLUSIONS

The incidence of ureteral injury was significantly higher in cases having risk factors than in cases without risk factors. Therefore, surgeons should be cautious to prevent ureteral injury during gynecologic surgery, especially in patients with risk factors. It is necessary to study the optimal method in order to avoid ureteral injury, such as pro-

phylactic ureteral stenting. Laparotomy might be a better option for early detection and intraoperative repair of ureteral injury during gynecologic surgery when the patient has risk factors associated with ureteral injury.

CONFLICTS OF INTEREST
The authors have nothing to disclose.

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