

# Delayed diagnosis of ureteral injuries following gynecological laparoscopic surgery: three case reports and review

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## Summary

*Purpose of investigation:* The clinical manifestations, causes, and methods for the treatment and prevention of ureteral injuries presenting late after gynecological laparoscopic surgeries were investigated. *Materials and Methods:* The medical records of patients who experienced delayed recognition of ureteral injuries after gynecological laparoscopic surgeries in the present hospital between 2008 and 2012 were reviewed retrospectively. *Results:* There are three cases of ureteral injuries which are diagnose-delayed, The incidence of the malignant tumor groups was 0.99%, and for malignant patients undergoing laparoscopic lymphadenectomy it was 1.3%. *Conclusion:* The main way to prevent delayed ureteral injuries is to avoid adhesion between the ureter and surrounding tissues as well as eliminate electrothermal trauma during laparoscopic operations. Surgical repair is effective for such patients.

*Key words:* Laparoscopic surgeries; Ureter; Iatrogenic injuries.

## Introduction

Ureteral injury is a severe complication that can occur during or after gynecological surgery. Since the female ureters are closely associated with the female genital organs, the ureters are likely to be injured during pelvic surgeries, especially during complex procedures [1]. Ureteral injury may cause urinary fistula, infection, renal failure, and even death [2]. In recent years, the incidence of perioperative iatrogenic ureteral injuries has increased as more gynecological laparoscopic procedures are being performed [3]. The incidence of iatrogenic ureteral injury is reported to be 0.14%, and the average time between the procedure and recognition of injuries is 3.1 days [3]. The ureteral injury cases reported in the literature mainly occurred during the perioperative period [4]. In some cases, four months elapsed between surgery and the presentation of ureteral stricture injury [5]. Here the authors present a retrospective study of ureteral injuries with delayed diagnosed.

## Materials and Methods

The medical records of 3,922 patients were reviewed, who underwent laparoscopic surgery in the Department of Gynecology and Obstetrics, Beijing Chaoyang Hospital between January 1<sup>st</sup>, 2008 and January 1<sup>st</sup>, 2013. These were reviewed and summarized retrospectively, including the following information: data regarding the time from laparoscopic surgery to the onset of ureteral injury, manifestations of the disease, causes, sites of occurrence, treatment methods, and prognosis.

## Results

A total of 3,922 patients received laparoscopic surgery, between January 1<sup>st</sup>, 2008 and January 1<sup>st</sup>, 2013. Among them, 302 patients received laparoscopic surgery for the treatment of malignant tumors, and 153 underwent laparoscopic lymphadenectomy. Six cases of postoperative ureteral injuries occurred in patients after gynecological laparoscopic surgery in the present hospital and the incidence of ureteral injury was 0.14%. Three patients with ureteral injuries were delayed diagnosed. All of these cases were patients with gynecological malignant tumors; two patients underwent lymphadenectomy. The incidence of delayed ureteral injury in patients who underwent laparoscopic surgery for the treatment of gynecological malignant tumors was 0.99%; in particular, the incidence in patients who underwent lymphadenectomy was 1.3%.

### *Demographic data and surgical information*

The three patients who presented with ureteral injuries had an average age of 47.7 years (41, 42, and 60 years old, respectively); they were diagnosed with Stage Ia1 squamous cell carcinoma (SCC) of the uterine cervix, Stage Ib1 SCC of the uterine cervix, and Stage IA endometrial carcinoma, respectively (Table 1). None of the patients had a history of pelvic surgery or endometriosis. Furthermore, none of them presented with severe pelvic adhesion intraoperatively. The surgical protocols for these three patients were laparoscopic-assisted extrafascial hysterectomy, laparoscopic radical hysterectomy with pelvic lymphadenec-

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Table 1. — *Clinical data of the patients with delayed ureteral injuries.*

Case	Age (years)	Primary disease	Laparoscopic surgery	Duration of postoperative in-hospital observation	Time to the occurrence of urinary fistula	Diagnostic methods	Cause of injury
1	41	Stage Ia1 SCC of cervix	Laparoscopic-assisted extrafascial hysterectomy	4 days	16 days postoperatively	Intravenous pyelography + cystoscopic retrograde catheterization	Adhesion to surrounding tissues
2	42	Stage Ib1 SCC of cervix	Laparoscopic radical hysterectomy with pelvic lymphadenectomy	19 days	63 days postoperatively	Intravenous pyelography + cystoscopic retrograde catheterization	Adhesion in obturator foramen
3	6	Stage Ia endometrial carcinoma	Laparoscopic extrafascial hysterectomy with pelvic lymphadenectomy	17 days	10 days postoperatively	Intravenous pyelography + cystoscopic retrograde catheterization	Adhesion to iliac vessel



Figure 1. — An intravenous pyelogram showing injury to the right ureter.

tomy, and laparoscopic extrafascial hysterectomy with pelvic lymphadenectomy, respectively. All surgical procedures were performed successfully without the occurrence of severe intraoperative pelvic adhesion. The surgeries were all performed by veteran chief gynecologists who were qualified and had experience performing laparoscopic surgeries. Abdominal drainage was placed postoperatively in the two patients who underwent laparoscopic lymphadenectomy.

#### *Delayed diagnosis of ureteral injuries*

The three patients were in good condition during the perioperative period; they had normal temperature, a well-balanced daily water intake and excretion, gradually reduced

drainage, no urinary fistula, and urination restored after urinary catheter removal. The average course of postoperative in-hospital observation was 13.3 days. The three patients presented with urinary fistulae on days 10, 16, and 63 after undergoing surgery, respectively; the average time from surgery to onset of injury was 29.7 days. All three patients had large amount of vaginal discharge. Vaginal speculum examination revealed visible discharge of pale yellow fluids from the vagina but no obvious fistula in the vaginal orifice. The laboratory assay results showed that the urea nitrogen content in the intra-vaginal fluid was similar to that in urine, suggesting the occurrence of a urinary fistula. The negative results on bladder methylene blue tests obtained from all three patients on admission led to the elimination of the occurrence of vesicovaginal fistula and suggested ureterovaginal fistula. Ultrasonographic scans performed after the patients' admission revealed right ureteral dilation and hydronephrosis. Intravenous pyelography (IVP) findings suggested the presence of lower ureteral stricture in the right ureter (Figure 1). Cystoscopy showed no urine spouting from the right ureteral meatus in the contracted bladder. Retrograde catheterization of the right ureter was performed under the guidance of cystoscopy; however, the catheter was unable to be inserted into the right ureter in all three patients. In one patient, the inserted ureteral catheter returned to the vagina via the ureterovaginal fistula during catheterization. In the three patients, urinary fistula occurred for at least ten days after surgery.

#### *Treatment*

All three patients underwent exploratory laparotomy on the ureters via an open and extraperitoneal approach. Through these exploratory surgeries, the lesions were all localized on the areas near the right ureterovesical junction, showing fistulae on the lateral wall at these injured locations. The injured ureters were closely adherent to the surrounding tissues. In the two patients who underwent lymphadenectomy, the injured ureter was adhered to the right iliac vessel; in one of them, the adhesion even ex-

tended to the obturator foramen. The ureteral tension in the adhered site was increased, which generated a traction force that caused trauma, resulting in the fistula. All three patients underwent ureteroneocystostomy, which aimed to re-implant the upper end of a transected ureter into the bladder. Double-J stents (D-J) were placed into the re-implanted ureters. After ureteroneocystostomy, none of the patients presented urinary fistula. The D-J catheters were removed three months later. The patients' renal function returned to normal levels after surgery. Furthermore, the ureters exhibited normal morphology on ultrasonographic scans, indicating excellent prognosis.

## Discussion

### *Incidence and time of onset of ureteral injuries following laparoscopic surgery*

The reported incidence of ureteral injuries after gynecological laparoscopic surgery in the literature is < 1–2%; the leading cause of such injuries is reported to be laparoscopy-assisted vaginal hysterectomy (LAVH) [5]. A previous study [3] reports the incidence of ureteral injuries among patients who underwent gynecological laparoscopic surgery at the Peking Union Medical College Hospital to be 0.14% and an average time from operation to onset of injury of 3.1 days. A case report suggests the onset of ureteral stricture injury may occur as late as four months after gynecological laparoscopic surgery [6]. In the past five years, six cases of postoperative ureteral injuries occurred in patients after gynecological laparoscopic surgery in the present hospital. Two of these patients had ureteral injuries recognized intraoperatively, one was recognized within 24 hours, and three were recognized at least ten days after surgery. Therefore, the incidence of ureteral injury was 0.14%. In the present study, all the delayed injuries occurred in patients who underwent laparoscopic surgeries for the treatment of gynecological malignant tumors, especially in patients who underwent lymphadenectomy.

### *Causes of delayed ureteral injuries after laparoscopic surgery*

The locations with the highest risks for laparoscopic surgery-associated ureteral injury include the pars pelvina of the ureter, areas near the uterine artery, the sacral ligament, and the ureterovesical junction [7]. The intraoperative injuries during laparoscopy-assisted surgery were mainly associated with the abnormal or disease-induced anatomic disruption of the ureteral course in the pelvis, including pelvic adhesion caused by endometriosis. The variations in the anatomic position of the ureter may affect surgical operations and result in ureteral injury. Intraoperative ureteral injuries normally occur earlier, and patients are likely to present certain situations that may cause operational difficulties, such as intraoperative adhesion and enlarged uterus. In some cases, dila-

tion or rupture of the ureter was discovered intraoperatively. Moreover, some patients may present with some perioperative manifestations, such as increased drainage, reduced urine, and lower back pain. In contrast, delayed postoperative ureteral injuries are more prevalent among patients who have undergone gynecological laparoscopic surgery for the treatment of malignant tumors, especially among those who have undergone lymphadenectomy. Patients with delayed injury usually have successful laparoscopic surgeries producing satisfactory outcome. No obvious adhesion is found intraoperatively, drainage and urination after surgery are normal, and the patients are likely to pass their perioperative period smoothly. The most common manifestation of delayed ureteral injury is urinary fistula taking place several days after surgery. Severe adhesion between the ureter and its surrounding tissues can be revealed by exploratory surgery. The adhesion imposes traction on the ureter, on which the fistula forms because of the increased tension.

There may be several causes of delayed ureteral injuries: First, the ureter can adhere to its surrounding body structures after laparoscopic surgery. Surgery for the dissection of malignant tumors requires the dissociation of the ureter, which affects a large area. In particular, lymphadenectomy involves the removal of a blend of soft tissues and lymph nodes between the ureter and pelvic vessels, resulting in an increased tendency of adhesion between the ureter and iliac vessels; such adhesion may even extend to the obturator foramen. Long-term adhesion-related traction increases the tension exerted on the ureter, leading to ureteral injuries. Second, thermal damage may occur during laparoscopic surgery [8]. During some laparoscopic surgeries, the techniques of electrocoagulation and electroincision may be applied to the uterine vessels and ligaments. For gynecological laparoscopic surgeries, especially lymphadenectomies, monopolar electrical techniques are usually employed to dissociate the ureter. The current monopolar electrocoagulation and electroincision techniques produce thermal effects that can be transmitted at a distance of two cm. Such thermal transmission may alter the blood supply peripheral to the ureter, resulting in local ischemic necrosis of the ureter. Such indirect injuries to the ureter may not have significant manifestations during the perioperative period, but the consequences (e.g., urinary fistula) could manifest sometime after the surgery, thus resulting in delayed ureteral injuries. The third possible cause of delayed ureteral injury is technical operations. During the course of gynecological laparoscopic surgery, the surgery is performed under a two-dimensional view. The surgeon usually performs the procedure on the patient's left side. Therefore, compared to the operation performed on the left side, procedures on the patient's right side (e.g., uterine vessel processing and ureter dissociation) are more difficult, increasing the risk of thermal damage to the right ureter. The three patients with delayed ureteral injury all had lesions on the right ureter.

### Diagnosis and treatment of delayed ureteral injuries

Ureteral injuries usually manifest as ureterostomia and ureterostenosis. Clinical symptoms include vaginal discharge (i.e., ureterovaginal fistula), backache, fever, and oliguria. Since symptoms of delayed ureteral injuries usually occur late, patients may be already discharged, signifying that symptoms of fistula may occur outside the hospital [9]. The diagnosis of ureteral injury can be confirmed on the basis of the following findings: (1) determination of creatinine and urea nitrogen levels in the fluids discharged from the vagina; if the contents have similar levels to that of urine, urinary fistula is suggested; (2) bladder methylene blue test positive results suggest bladder injury; otherwise, ureteral injury is more likely; (3) ultrasonographic examination of the dilation/stricture of the ureter; (4) IVP, which can be used to localize the lesion of the ureteral injury and estimate the severity of ureteral dilation/stricture; and (5) cystoscopy-guided retrograde ureteral catheterization. If the surgery is successful, the injury is expected to heal spontaneously; otherwise (i.e., catheterization failure), ipsilateral ureteral injury is suspicious and exploratory surgery is recommended.

Regarding the treatment of delayed ureteral injuries, if delayed ureteral injury occurs, the patient should be treated immediately to improve her quality of life. At present, surgical procedures are the primary therapy. The majority of patients undergo cystoscopy-guided retrograde ureteral catheterization, through which a D-J stent can be placed in the patient's body for three months, allowing spontaneous healing of the fistula. However, as delayed ureteral injuries are often complicated with ureteral adhesion, stricture, or obstruction, retrograde catheterization is difficult. Hence, exploratory surgeries are often performed. The recommended procedure includes exploratory surgery on the ureter via an open and extraperitoneal approach, which should be performed by a veteran urologist. During the operation, ureteroneocystostomy (i.e., re-implantation of the ureter) can be conducted after the adhered ureter is carefully dissociated from the peripheral tissues. A D-J stent is subsequently placed ureterovesically for three months; the stent can be removed after three months via a cystoscopic approach. Early diagnosis and management of delayed ureteral injury can have excellent prognosis.

### Prevention of delayed ureteral injury

Considering the specific causes of delayed ureteral injury, the following steps should be performed to prevent ureteral injuries. First, anti-adhesion measures should be taken after the ureter dissociates from the surrounding tissues. Application of anti-adhesion films to the surrounding areas is considered an effective measure for preventing adhesion. Second, the use of mono- or dipolar electrocoagulation and electrocision should be reduced in order to

process the peripheral tissues in a "cold-management" manner. Some specially designed metal or plastic clamps can be used to process the peripheral tissues, reducing the thermal damage to the ureter during laparoscopic surgery. Finally, since gynecological surgery is the leading cause of iatrogenic ureteral injuries, surgeons may consider placing a D-J stent preoperatively for patients receiving a complex surgical protocol, which requires a large operation area, or in those with have a higher risk of postoperative adhesion at the preoperative assessment.

### Conclusion

Ureteral injury is a severe complication that can occur during or after gynecological surgery, even two months later. The main way to prevent ureteral injuries is to avoid adhesion between the ureter and surrounding tissues, as well as to eliminate electrothermal trauma during laparoscopic operations. Surgical repair is effective for such patients.

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