

Ureteric injury after laparoscopic hysterectomy: a report of 3 cases and brief literature review

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ABSTRACT

Objectives: The application of minimally invasive laparoscopic techniques in gynecologic surgery gained popularity due to quicker recovery, shorter hospital stays as well as lower risk of complications. Ureteric injuries at laparoscopic hysterectomies are incidental and occur in less than 1% of cases. They can be identified intra-operatively but most of them are undetected. In most cases, the symptoms of an injury are non-specifically manifested after several days or even months following surgery.

Case reports: We described different clinical symptoms suggesting ureteric injury based on 3 laparoscopic hysterectomies. Methods of diagnosis and repair techniques were also presented.

Conclusions: All complications following laparoscopic hysterectomy should be analyzed meticulously and ureteral injury must be considered as one of the possible causes of abnormal patient recovery.

Key words: ureteric injury; laparoscopic hysterectomy; gynecologic surgery; ureteric damage

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INTRODUCTION

The use of minimally invasive laparoscopic procedures in gynecologic surgery gained popularity due to quicker recovery, shorter hospital stays as well as lower risk of peri- and post-operative complications. While there is an increasing number of procedures including laparoscopic hysterectomy (LH) [1], there is still a risk of complications related to the technique applied. One of the most intriguing is ureteric injury with a reported incidence of less than 1% worldwide [2]. From 2018 until 2020, we performed 487 laparoscopic hysterectomies (total and supracervical) and ureteral injuries were diagnosed in three cases reported herein. The complication rate was 0.61%, which is in the middle average in relation to the data reported worldwide. The risk diminishes significantly with increased surgeon experience, and it is estimated that 30 LHs is a safety threshold for this procedure [3, 4]. Indications for LH and anatomic pelvic conditions greatly influence ureteric injury. The highest rates are linked to operations for gynecological malignancies, being also connected with difficult surgical conditions [5, 6]. Ureteral dam-

age in open surgery is usually caused by ligation, crushing by forceps, partial or complete incision, excision of a segment, or even secondary ischemic wall necrosis due to ischemia. Endoscopy with the extensive use of energy-generating instruments could be linked to thermal injury, while all of the above-mentioned damage mechanisms are also possible. Ureteral injuries can be identified intra-operatively but most of them are undetected. In most cases, the symptoms of an injury are non-specifically manifested after several days or even months following surgery [7].

Our study aimed to describe the clinical symptoms suggesting urinary tract injuries based on 3 cases of laparoscopic hysterectomy. Methods of their diagnosis and repair techniques were also presented.

MATERIAL AND METHODS

Case 1

A 54-year-old woman with negative history of previous pelvic surgery was admitted due to metrorrhagia, atypical endometrial hyperplasia, and left ovarian cyst.

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Table 1. Case 1. Results of laboratory tests

WBC [$\times 10^9/L$]	NEU [$\times 10^9/L$]	RBC [$\times 10^{12}/L$]	HGB [g/dL]	HCT [%]	PLT [$\times 10^9/L$]	D-Dimer [ng/dL]	CRP [mg/L]	Creatinine [mg/dL]	PCT [ng/mL]	Blood culture
15.88	14.85	4.23	13.2	40.7	314	1995	92.97	1.2	0.15	negative

WBC — white blood cells; NEU — neutrophils; RBC — red blood cells; HGB — hemoglobin; HCT — hematocrit; PLT — thrombocytes; CRP C Reactive Protein, PCT — procalcitonin

Imaging studies did not reveal pelvic abnormalities. Total laparoscopic hysterectomy (TLH) with left adnexectomy and right salpingectomy was performed. At surgery, moderate pelvic peritoneal adhesions were released. Perioperative and early postoperative periods were uneventful. The patient was discharged in a good condition on the third postoperative day. On the 15th postoperative day, the patient was readmitted with significant lower left quadrant abdominal pain, elevated body temperature, and chills. At admission, her body temperature was 37.4°C, systemic blood pressure 135/90, heart rate 95 beats/ per minute and the results of laboratory tests suggested the likelihood of the infection (Tab. 1). The abdominal X-ray in the standing position showed no signs of gut perforation or intestinal obstruction. Transvaginal ultrasound examination revealed a small volume of fluid in the pouch of Douglas. On the next day, the patient reported an outflow of a great amount of clear and odorless fluid from the vagina. Antibiotics were administered (metronidazole, cefuroxime) and intravenous urography was performed (Fig. 1). The examination revealed leakage of the contrast from the left ureter, which has been consistent with the presence of a ureterovaginal fistula. Further management consisted of the placement of a double-J stent into the left ureter with subsequent confirmation of its position by abdominal X-ray. The urinary bladder was catheterized. A day after the procedures, the patient reported complete resolution of the symptoms. She was discharged on the third day with scheduled follow-ups in Week 2 to confirm the right placement of the DJ-catheter and a week later to remove it. The repeated intravenous urography showed no abnormalities in the left ureter and the other segments of the urinary tract.

Case 2

A 50-year-old patient was admitted due to CIN3 and abnormal uterine bleedings. She was scheduled for a total laparoscopic hysterectomy with bilateral salpingectomy. The early postoperative period was uncomplicated, and the patient was discharged on the second postoperative day in a good condition.

On the 19th postoperative day, the patient was readmitted with vaginal bleeding and enlargement of the abdominal girth. Physical examination did not reveal abdominal tenderness, guarding, or abdominal masses. Transvaginal



Figure 1. Urography — left-sided ureterovaginal fistula

ultrasound examination showed a large volume of fluid in the Douglas pouch and the upper right abdominal quadrant. Laboratory tests showed an increased serum level of CRP with normal leucocyte counts (Tab. 2).

Since the reason for the collection of fluid was unknown, the patient underwent diagnostic laparoscopy. Intraoperative meticulous inspection excluded abdominal bleeding or gastrointestinal damage. A large amount of a clear and yellowish fluid was found. Findings on the laparoscopy suggested injury of the urinary tract. A sample of abdominal fluid was analyzed which enabled us to confirm the presence of the urine. The next step was intravenous urography that demonstrated contrast outflow from the right ureter (Fig. 2).

The uretero-abdominal fistula was diagnosed. Attempt to place a DJ stent into the right ureter was unsuccessful due to its stenosis related likely to thermal injury. The next day, the patient reported leakage of a copious amount of clear fluid from the vagina. Since right-sided mild hydronephrosis developed, there was a plan to establish percutaneous nephrostomy. However, the first attempt on Day 6 failed but another procedure scheduled two days later was successful. During the hospital stay, all parameters of renal function normalized. After another unsuccessful attempt to place the

Table 2. Case 2. Results of laboratory tests

	WBC [$\times 10^9/L$]	NEU [$\times 10^9/L$]	RBC [$\times 10^{12}/L$]	HGB [g/dL]	HCT [%]	PLT [$\times 10^9/L$]	D-Dimer [ng/dL]	CRP [mg/L]	Creatinine [mg/dL]	PCT [ng/mL]
Day 1	7.25	5.44	3.9	11.5	34.6	444	—	227.26	0.9	—
Day 9	7.54	5.18	3.83	11.1	34.5	453	—	—	—	—
Day 11	5.58	3.4	3.43	9.7	31.0	431	—	56.78	0.8	—
Day 16	—	—	—	—	—	—	—	—	—	0.07

WBC — white blood cells; NEU — neutrophils; RBC — red blood cells; HGB — hemoglobin; HCT — hematocrit; PLT — thrombocytes; CRP C Reactive Protein, PCT — procalcitonin

**Figure 2.** Urography. Right ureteric injury

ureteral stent, the patient was discharged in good clinical condition with a functioning nephrostomy tube. Four weeks later, the DJ stent was inserted into the right ureter, and the nephrostomy was removed. The repeated intravenous urography showed no abnormalities in the right ureter and other segments of the urinary tract.

Case 3

A 40-year-old patient was hospitalized with symptomatic uterine leiomyoma and abnormal uterine bleeding. Laparoscopic supracervical hysterectomy with bilateral salpingectomy was performed without intraoperative complications. The subsequent postoperative course was uneventful, and the patient was discharged on Day 2.

Three weeks later, the patient was readmitted with abdominal pain and flatulence. The woman had occasional vomiting, micturition was normal, body temperature was

37.2°C and peritoneal signs were negative. Results of blood tests suggested intra-abdominal infection (Tab. 3). Transvaginal ultrasound showed a small amount of fluid in the Douglas pouch. The abdominal X-ray in the standing position revealed several air-fluid levels in the lower right abdominal quadrant but with no suspicion of intestinal perforation. Abdominal ultrasonography showed thickened and swollen intestinal walls with decreased motility and a moderate amount of intra-abdominal fluid. CT abdominal scan confirmed the presence of fluid in the abdominal cavity especially around the liver and the Douglas pouch. On the 30th postoperative day (day 8 of re-admission), the patient was scheduled for reoperation. Diagnostic laparoscopy revealed solid adhesions of the fibrin, bowel, and parietal perineum and around 1500 mL of a clear fluid in the cavity. The adhesions were partially released. Due to technical difficulties, the surgeon decided to convert to laparotomy. After complete adhesiolysis, fluid and tissue samples were collected for further analysis. Two drainage tubes were placed in the abdominal cavity.

On the 1st postoperative day, 200 mL of the yellowish fluid was collected from the drainage tubes. A high concentration of urea and creatinine in this fluid raised suspicion of uretero-abdominal fistula. The URO-CT showed right-sided hydronephrosis with contrast leakage from the ureter into the abdominal cavity located on the level of the uterine cervix (Fig. 3). An attempt to insert a DJ catheter into the right ureter failed but percutaneous nephrostomy was successfully performed. The patient was in a stable condition and was discharged with an indication for a follow-up visit after 4 weeks to remove the catheter. On the 39th postoperative day, the nephrostomy tube was removed. The follow-up renal blood test and URO-CT confirmed normal kidney function.

DISCUSSION

The diagnosis of ureteric injury may be made intra- or postoperatively but approximately 70% of ureteric injuries are diagnosed after surgery [8–10]. The most common symptoms of ureteric injury are fever and abdominal flank pain. The patient may present hematuria, oliguria, anuria, and retroperitoneal urinoma with the risk of abdominal

Table 3. Case 3. Results of laboratory tests										
	WBC [$\times 10^9/L$]	NEU [$\times 10^9/L$]	RBC [$\times 10^{12}/L$]	HGB [g/dL]	HCT [%]	PLT [$\times 10^9/L$]	D-Dimer [ng/dL]	CRP [mg/L]	Creatinine [mg/dL]	PCT [ng/mL]
Day 1	10.8	7.16	3.9	11.8	35.9	510	881	71	0.8	< 0.10
Day 5	11.91	7.91	4.32	12.8	39.9	557	—	79	0.8	—
Day 7		—	—	—	—	—	1535	70	0.8	—
Day 8	13.8	11.28	3.85	11.5	35.2	418	—		—	—
Day 9	11.57	9.25	3.57	10.6	33.0	389	—	289	0.4	0.13
Day 10	9.08	6.86	3.16	9.5	28.5	357	—	273	0.4	—
Day 11	5.96	3.72	2.96	9.1	26.4	376	—	b.d.	0.4	< 0.10
Day 13	—	—	—	—	—	—	—	52.96	—	—
Day 14	—	—	—	—	—	—	2279	39.61	—	—
Day 19	9.47	5.98	3.83	11.3	35.9	505	—	20.92	—	—
Day 22	8.42	5.48	3.84	11.6	35.8	487	—	12.98	—	—
Day 28	6.14	3.0	3.77	11.2	34.7	307	—	9.74	0.6	—
Day 34	—	—	—	—	—	—	445	2.05	—	—
Day 35	7.28	3.57	4.23	12.6	38.7	278	447	2.38	—	—

WBC — white blood cells; NEU — neutrophils; RBC — red blood cells; HGB — hemoglobin; HCT — hematocrit; PLT — thrombocytes; CRP C Reactive Protein, PCT — procalcitonin

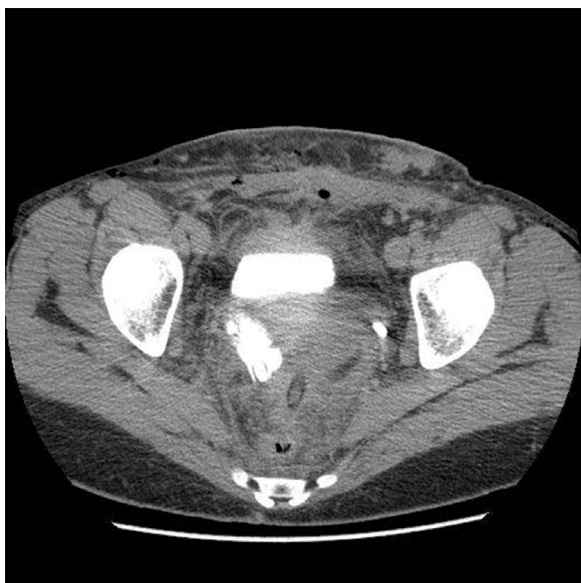


Figure 3. URO-CT showing right ureteric injury

or even retroperitoneal abscess formation. The presence of vaginal or cervical urine leakage is an important clue in the diagnostic procedure. Unfortunately, in approximately 50% of cases, the symptoms are not specific, and the first manifestation of ureteric injury may be hypertension caused by obstructive uropathy.

Postoperative symptoms in the above-mentioned cases were blurred and non-specific. Hysterectomized patient (Case 1) had mainly gastrointestinal symptoms *e.g.*, difficulty to pass a stool that made diagnosis more difficult by mimicking postoperative ileus. Another patient (Case 2)

reported vaginal bleeding and distension of the abdomen that raised suspicion of abdominal bleeding. Finally, the main complaint reported by the woman after LASH (Case 3) was abdominal pain. She was also feverish, which initially suggested intra-abdominal organ infection, visceral injury, or even peritonitis.

Diagnostic methods of ureteral damage depend on the time of diagnosis. Perhaps the best strategy is to verify the ureter's course with the reservation that the observed peristalsis does not prove the ureter's viability. Another intraoperative strategy is intravenous injection of dye followed by cystoscopy, which reveals dye-stained urine (negative test) or bubbles, eventually blood-tinged urine (positive test). Unfortunately, intraoperative methods of ureteral damage assessment were not applied thereafter, because the likelihood of urinary injury was deemed by the surgeon as low. Moreover, there have been no definitive guidelines regarding the role of cystoscopy at the time of benign hysterectomy so far. American Association of Gynecologic Laparoscopists (AAGL) recommended that routine cystoscopy should be performed after all laparoscopic hysterectomies, whereas ACOG limited the indication to prolapse and incontinence procedures [11, 12]. The research of Barber et al. [13] highlighted the limitations of cystoscopy in the prevention of delayed lower genitourinary tract injury. They showed a significant 27% increase in the risk of urinary tract infections after they performed cystoscopy. In conclusion, they encourage the use of other strategies, beyond cystoscopy, to improve surgical quality and decrease the rate of delayed urinary tract injury in women undergoing benign hysterectomy [13].

There are few methods of imaging in suspected ureteral damage but the cheapest and most readily available is intravenous urography. This method was applied in two cases and proved sufficient to make the correct diagnosis. However, in patient three, we used URO-CT to assess the urine outflow tract. It allowed to precisely diagnose the ureteral damage.

Laboratory tests (Tab. 1–3) must be evaluated in every case of suspected ureteral injury. All (except case 2) patients had leukocytosis and significantly elevated levels of CRP but both markers are not specific for urinary tract injury. Of note is the lack of increase of creatinine level. It is likely that transient early postoperative elevation of blood creatinine went unnoticed and renal function was well compensated at the time of hospital re-admission.

Once diagnosis is made, medical intervention should be immediate. The first line of treatment is usually stent placement especially in the partial transection or subtotal obstruction of the ureter. Complications such as abscess, urinoma, urinary tract infection, sepsis, or even renal failure must be treated with a combination of surgery, antibiotics, and supportive care.

Intraoperative identification of the ureters could reduce the risk of their injury especially when normal anatomy is severely distorted [14]. Obviously, this crucial surgical step was not taken in the cases described above, but it is worth noting that anatomy was normal except uterine with leiomyomas. The cadaver study highlights a few steps of protecting the ureter during laparoscopic extra-fascial hysterectomy [15]. They recommend combined lateralization and elevation of the uterus, sectioning the ascending branch of the uterine artery, and dissecting it along the uterosacral ligaments. Moreover, Feng et al. [16] reported that ureteral catheterization before surgery should be recommended for complicated gynecological surgical interventions or unskilled surgeons to prevent iatrogenic ureter injuries. However, routine stent placement before gynecological laparoscopy remains controversial and is not recommended. The use of trans-illuminating stents has also been suggested to identify the ureter during laparoscopy; however, this application is limited by costs, as well as by the additional equipment required [16].

Most likely, the mechanisms described above were thermal destruction that highlight the value of a proper application of electro-surgery at laparoscopy. The anatomical proximity of the ureter which passes with an average distance of 2.3 ± 0.8 cm or is as close as 0.5 cm to the cervix makes the area of uterine artery-ureter crossing especially vulnerable [17]. Indeed, all described ureteric injuries were located on that level and lateral to the cervix. The penetration of heat from bipolar forceps used in the sealing of uterine vessels is the most likely underlying cause of this injury. The risk may

be reduced by the employment of advanced electro-surgery devices that are able to limit the power settings. However, all described safety managements to prevent laparoscopic electro-surgical ureteric injuries are of utmost importance.

CONCLUSIONS

All complications following laparoscopic uterine surgery should be analyzed meticulously and ureteral injury must to be considered as one of the possible causes of abnormal patient recovery. This is of paramount importance in preventing ureteric damage-related morbidity.

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Conflict of interest

The authors have no conflict of interest relevant to this article.

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