Original Article

Abnormal Urine Outflow from the Ureteral Orifice on Cystoscopy Following Vaginal Stump Suture in Total Laparoscopic Hysterectomy

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Abstract

Objectives: Ureteral injuries may occur subsequent to abdominal or laparoscopic hysterectomy. In total laparoscopic hysterectomy (TLH), we usually check for ureteral damage by confirming urinary outflow from the bilateral ureteral orifices by cystoscopy after vaginal stump suture. In this work, we investigated the causes of urine outflow disruption after TLH.

Materials and Methods: We conducted a retrospective review of all TLHs performed for benign diseases at our hospital from February 2012 to March 2016. There were 11 cases with no or poor urine outflow from the ureteral orifice after vaginal stump suture. For these cases, we assessed the treatment to recover urine outflow and examined the cases with intraoperative manipulation. EZR version 1.25 was used for statistical analysis. Correlation coefficients were calculated with Spearman's rank correlation coefficient test.

Results: The abnormality was on the right and left sides in seven and four cases, respectively. In all cases, apart from one, urine outflow was recovered by removing the sutures at the affected side, where the initial suture had included a small amount of the connective tissue near the urinary bladder. It was inferred that ureteral deviation due to vaginal stump sutures that picked up the connective tissue near the ureter caused ureteral peristaltic disorder and abnormal ureteral orifice outflow.

Conclusion: TLH without ureter isolation requires sufficient separation of the bladder from the anterior vaginal wall and careful vaginal stump suture without involving the bladder-side tissue to avoid ureteral injury.

Keywords: Cystoscopy, hysterectomy, laparoscopy, ureter

Introduction

The risk of ureteral injury should always be considered when performing abdominal or laparoscopic hysterectomy. The frequency of ureter injury in laparoscopic hysterectomy was reported to be 0.02%–0.4%.[1] At our hospital, 235 total laparoscopic hysterectomies (TLHs) were performed for benign disease from February 2012 to March 2016, with only one case of bladder injury (0.43%) and no ureteral injuries or postoperative hydronephrosis. However, 11 cases had abnormal urine outflow from the ureteral orifice on cystoscopy following vaginal stump suture. We investigated the causes of abnormal urine outflow and areas for improvement of intraoperative manipulation.

Materials and Methods

We conducted a retroactive database search of hospital records and identified 235 cases, in which TLH was performed for benign disease from February 2012 to March 2016. We further identified 11 cases in which vigorous urine outflow from the ureteral orifice on cystoscopy following vaginal stump

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suture was not confirmed. The data were reviewed for the surgical details, the abnormal side (right or left), postsurgical cystoscopy observation time to confirm urine outflow, and procedures performed to improve urine outflow at the affected or "abnormal" side. Informed consent was obtained from the patients. Urine outflow was judged to be abnormal when the outflow was very low or absent, even when the outflow from the contralateral orifice with normal outflow (the "normal" side) was confirmed twice. Urine outflow causes a surrounding flow of indigo carmine, which can be observed on cystoscopy even when the ureteral orifice is not directly observed. Absent or very low urine outflow was judged to be abnormal, as urine outflow from the ureteral orifice is usually vigorous.

EZR version 1.25 was used for statistical analysis.[2] Correlation coefficients were calculated by Spearman's rank correlation coefficient test. $P = 0.05$ was set as a statistically significant difference.

Written informed consent that the surgical video may be used anonymously for clinical research was obtained preoperatively from the patients. This study was approved by our Institutional Review Board on September 18, 2019 (research approval number 3187).

Total laparoscopic hysterectomy procedure

The standard TLH procedure at our hospital places the patient in a low lithotomy position using a levitator and in a Trendelenburg position of 20°–30°. The surgeon stands on the left side of the patient. An adjusted-size delineator cup (KOH cup™; CooperSurgical, Trumbull, CT) is attached and sewed to the vaginal portion of the uterine cervix. A manipulator with a delineator cup (Rumi II Koh-Efficient®; CooperSurgical) is installed in the uterus. Trocars are positioned in a diamond arrangement, with a trocar of 5-mm diameter and 95-mm length (ENDOPATH Xcel® Optiview® trocar, Ethicon, Somerville, NJ, USA) inserted in the umbilical position using an optical method, in which the trocar is inserted into the navel with a camera attached while confirming that the subcutaneous fat, fascia, subperitoneal fat, and peritoneum are sequentially penetrated using the camera. Three trocars are carefully inserted into the lower abdomen under visualization by the camera to avoid damaging the intestine; a 5-mm in diameter and 70-mm long trocar (EZ TROCAR Smart Insertion; Hakko Co., Ltd., Nagano, Japan) in the left lower abdomen, a 12-mm in diameter and 75-mm long trocar (ENDOPATH Xcel® trocar; Ethicon) in the medial lower abdomen, and a 5-mm in inner diameter trocar (AirSeal® Access Port iAS5; ConMed, Milford, CT) in the right lower abdomen. The electric devices used are the ENDOPATH® Electrosurgery Probe Plus II (Ethicon), ENSEAL® (Ethicon), and bipolar forceps (Olympus, Tokyo, Japan). Insufflation is performed by the AirSeal® System (ConMed). Pneumoperitoneum pressure is maintained at 8–10 mmHg. The camera is 5-mm in diameter with a 30° perspective mirror.

The peritoneum of the vesicouterine pouch is incised, and the bilateral round ligaments are cut. In both sides, the retroperitoneal cavity is opened to identify the ureter and the uterine artery. The uterine artery is isolated to be cut with ENSEAL®, and the ureter is separated when necessary. The upper ligaments (suspensory or proper ligament) are cut, and the broad ligaments are incised along the uterus to the uterine origin of the uterosacral ligament. The urinary bladder is separated from the cervix and the anterior vaginal wall approximately 1 cm beyond the contour of the rim of the delineator cup fitted to the vaginal fornix. The cardinal ligaments are cut with ENSEAL® just beyond the contour of the rim of the delineator cup. The vaginal wall is excised along the contour of the delineator cup rim with a monopolar device (Probe Plus II), and the specimen is recovered from the vagina by morcellation with scissors where necessary. The vaginal stump is sutured in a single knot with 1 PDS® Plus (Ethicon). The interval and depth of stitching are approximately 1 cm. Indigo carmine dilution (20-mg/20-mL) is administered intravenously before the completion of the vaginal stump suturing. As the bladder catheter is being removed, 100-ml of saline is injected into the bladder and urine outflow from the bilateral ureteral orifices is confirmed with a cystoscope (4-mm in diameter with a 30° perspective mirror). The peritoneum is sutured with 2-0 PDS® (Ethicon) to cover the vaginal stump. A Gynecare INTERCEED® absorbable adhesion barrier (Ethicon) and a drain are placed in the abdominal cavity. In the absence of complications, the patients are discharged 3 days after the surgery. Sexual intercourse is prohibited for 3 months postoperatively.

Results

Surgery was suggested for eight, two, and one case of myoma, endometriosis, and pelvic organ prolapse, respectively [Table 1]. The operation time was 213 min on average (188, 297). The bleeding volume was 100-ml on an average (50, 400). The average specimen weight was 235-g (65, 710).

The abnormality was on the right and left in seven and four cases, respectively. The median observation time at the normal side (the time from the start of observation to vigorous outflow confirmation; "observation time A") was 45 s (0, 210). The median observation time at the abnormal side (the time from the start of observation to the time when the vigorous outflow was not confirmed and observation was aborted; "observation time B") was 250 s (105, 390). The median observation time at the abnormal side after the outflow improved by remedial manipulations (the time from the start of observation to vigorous outflow confirmation; "observation

Table 1: Eleven cases of abnormal urine outflow on cystoscopy

Age	Surgical indication	Operation time (min)	Amount of bleeding (mL)	Weight of specimen (g)	Abnormal side	Observation time (A)* (s)	Observation time (B)† (s)	Observation time (C)‡ (s)	Hourly urine volume (mL)	Procedures to improve urine outflow
43	Myoma	245	135	235	Right	0§	210	0§	80	Removal of two sutures and two re-sutures
44	Myoma	246	100	250	Right	50	160	100	195	Removal of one suture
47	Adenomyosis	209	160	520	Left	90	280	30	160	Removal of one suture and one re-suture
44	Myoma	297	320	710	Right	‖	‖	‖	118	Removal of one suture
68	Pelvic organ prolapse	216	100	65	Left	30	200	90	94	Removal of one suture and one re-suture
39	Myoma	286	100	240	Right	170	330	30	29	Removal of three sutures and two re-sutures
43	Myoma	198	50	NA	Right	40	390	300	55	Removal of two sutures and two re-sutures
52	Myoma	200	400	NA	Right	20	330	0§	64	Removal of one suture and one re-suture
43	Myoma	188	90	160	Left	210	390	110	17	Removal of two sutures and two re-sutures separation of ureter
47	Endometriosis	203	300	145	Right	55	105	0§	50	Removal of one suture and one re-suture
43	Myoma	213	80	85	Left	20	220	0§	105	Removal of one suture and one re-suture

*(A) The observation time at the normal side (the time from the start of observation to vigorous outflow completion), †(B) The observation time at the abnormal side (the time from the start of observation to the time when vigorous outflow was not confirmed and observation was aborted), ‡(C) The observation time at the abnormal side after outflow was improved (the time from the start of observation to vigorous outflow confirmation), §Observation time was 0 s when urine was flowing when observation of the ureteral orifice started, ‖Case 4 could not be evaluated for the observation time because there was no recorded video

time C") was 30 s (0, 300). The observation time tended to be shorter with greater hourly urine volume [Figure 1]; however, the difference was not significant. The correlation coefficients between the hourly urine volume and observation times A, B, and C were −0.412 (P = 0.237), −0.742 (P = 0.169), and −0.085 (P = 0.815), respectively. The correlation coefficient between the observation times A and B, A and C, and B and C was 0.502 (P = 0.140), 0.093 (P = 0.800), and 0.483 (P = 0.157), respectively.

In ten cases, the urine outflow improved by the removal of sutures on the abnormal side of the vaginal stump. Intraoperative images of the initial and revised anterior vaginal wall sutures in three cases are shown in Figure 2. In the remaining case, urine outflow was not improved by the removal of sutures and was finally improved by separation of the ureter to its entry site into the anterior vesicouterine ligament.

Discussion

There are several possible reasons that urine outflow from the ureteral orifice cannot be confirmed: (1) no urine production in the kidney (renal agenesis or renal atrophy), (2) amputation of the ureter, or (3) obstruction or peristaltic disorder of the ureter due to ligation. In all cases, the first two scenarios were ruled out because urine outflow was improved by some manipulation, and efflux of indigo carmine into the peritoneal cavity was not observed. Figure 2 is an intraoperative image showing the first suture of the affected end of the vaginal stump and re-suturing after extracting the original thread in cases 3, 5, and 7. These images show a needle penetrating the anterior wall of the vagina. In the initial sutures, the needle picked up some connective tissue on the bladder side of the anterior vaginal wall. In the re-suturing, the bladder was separated from the anterior vaginal wall to completely expose the vaginal fascia,

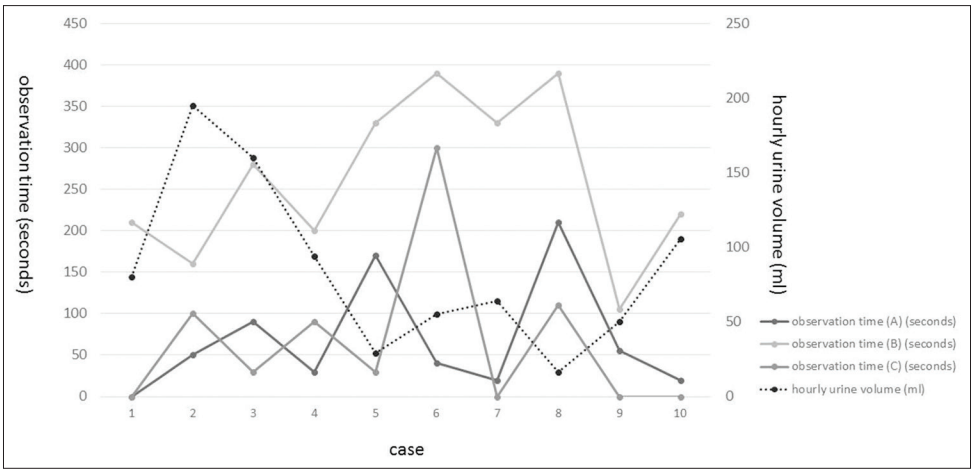

Figure 1: Observation time and hourly urine volume

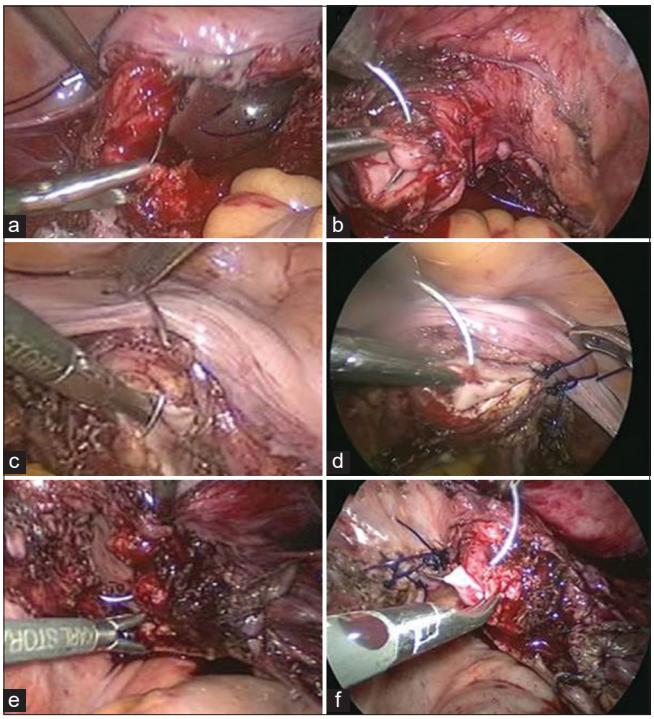

Figure 2: Intraoperative image of the needle placed on the anterior vaginal wall. (a) case 3 first suture of the left end of the vaginal stump, (b) case 3 re-suture of the left end of the vaginal stump, (c) case 5 first suture of the left end of the vaginal stump, (d) case 5 re-suture of the left end of the vaginal stump, (e) case 6 first suture of the right end of the vaginal stump, (f) case 6 re-suture of the right end of the vaginal stump

and the needle picked up the anterior vaginal wall alone. The depth was >1 cm with the initial suture, decreasing to <1 cm in after re-suturing. Re-suturing procedures improved the abnormal urine outflow. In the initial sutures, a needle might have picked up the ureter. However, the needle does not appear to have picked up the ureter in case 5 [Figure 2c]. We speculated that the initial suture picked up connective tissue near the ureter, disturbing the course of the ureter and causing ureteral peristalsis, leading to abnormal urine outflow. Although there was no significant difference, the hourly urine volume and the observation times A and B showed a trend of inverse correlation. The urine outflow may be particularly susceptible to ureteral deviation when the urine volume is small.

In this study, the right and left sides were affected in seven and four cases. When the surgical ports are arranged in a diamond shape, and a right-handed operator stands on the left side of the patient, the needle may run outward to the posterior vaginal wall during vaginal stump suture of the left side, making it easier for the operator to inadvertently pick up the posterior tissue. If the handling of a needle in the posterior vaginal wall was related to abnormal urine outflow, the abnormal urine outflow should have been observed more frequently on the left side. We speculated that abnormal urine outflow subsequent to manipulation is mainly due to needle manipulation in the anterior vaginal wall and can see no particular grounds for the difference between the right and left sides.

Cystoscopy is unnecessary in radical or modified radical hysterectomy, in which the ureter is completely isolated by excising the anterior layer of the vesicouterine ligament. In a simple hysterectomy, the ureter is not isolated at all, or it is isolated at most to the intersection with the uterine artery, increasing the risk of ureteral injury in excising the cardinal ligament or the vaginal wall. In laparotomy, the cardinal ligament is excised incrementally from the cranial side with strong traction of the uterus toward the cranial direction and retraction of the bladder to the caudal direction with surgical hooks. This manipulation decreases the risk of ureteral injury in excising the cardinal ligament. In laparotomy, the vaginal wall can be strongly pulled up with the forceps to easily suture the vaginal wall alone without involving the bladder-side tissue when suturing the vaginal stump. In laparoscopy, these manipulations tend to be inadequate, increasing the risk of ureter injury. Further, in laparoscopy, a thermal device is more frequently used instead

of ligatures, which also increases the risk of ureteral injury in TLH. This study suggested that vaginal stump suturing that picks up a small amount of the bladder-side tissue may cause deviation of the ureter and ureteral peristalsis, influencing urine outflow from the ureteral orifice. When the ureter is isolated to the entrance of the vesicouterine ligament and the bladder is sufficiently separated from the anterior vaginal wall, it is considered that ureteral deviation can be minimized. However, when the ureter is not isolated and the bladder is not sufficiently separated from the anterior vaginal wall, the bladder-side tissue is more likely to be picked up in the vaginal stump sutures, possibly disrupting the urinary outflow. It is unclear whether the aforementioned issue could cause late complications, such as hydronephrosis. However, when TLH is performed without sufficient ureter isolation, adequate bladder separation with exposure of the vaginal wall and careful vaginal stump suturing that does not involve bladder-side tissue are recommended to avoid ureteral injury. We usually separate the bladder approximately 1 cm beyond the contour of the delineator cup rim fitted to the vaginal fornix. However, the delineator cup is removed when the vaginal wall is incised so that the vaginal wall shrinks, making it easier to pick up the bladder-side tissue during vaginal stump suturing. The vaginal stump suture margin should be sufficiently small or bladder separation should be larger. When the ureter is well-isolated, as in modified radical hysterectomy, these delicate manipulations would be unnecessary.

There are contradictory views regarding whether cystoscopy should be used in all TLH cases. Partial occlusion and thermal damage of the ureter are not observed with cystoscopy.[3,4] Sandberg *et al*. argued that injury of the bladder and ureter cannot be found with cystoscopy in many cases and that cystoscopy should be used selectively when injury of the lower urinary tract is suspected.[5] Visco *et al*. reported that intraoperative routine cystoscopy is cost-effective when ureteral injury exceeds 2% in TLH.[6] As ureteral injury in TLH is correlated with the surgeon's inexperience, cystoscopy is advisable in all cases for the inexperienced practitioner, and should be used selectively by experienced surgeons.[7] Approximately half of all Canadian gynecologists use intraoperative cystoscopy, and it is interesting that the most common reason for not using cystoscopy is the lack of experience.[8] Cystoscopy can be easily performed by replacing the laparoscopic camera, and when there is no abnormal urine outflow, the surgical time is only increased by several minutes. At our hospital, abnormal urine outflow on cystoscopy was found in 5% of TLH cases. We do not know whether complications, such as hydroureteronephrosis or ureteral rupture, would have occurred if these cases had not improved. The abnormal urine outflows may have had no influence on postoperative courses. However, in TLH without sufficient ureter isolation, ureteral deviation in the vaginal stump suture can be avoided by sufficiently separating the bladder from the anterior vaginal wall and carefully suturing the vaginal wall alone without involving the bladder-side tissue. Careful manipulation would make cystoscopy unnecessary.

This study has several limitations. The normal interval of urine outflow from the ureter is unknown, and the optimal approach to determining abnormal urine outflow is undefined. Although re-suturing of the vaginal stump immediately improved urine outflow, ureteral peristalsis disorder caused by initial suturing is only speculative. It is not known whether the observed abnormal urine outflow from the ureter ultimately leads to clinically significant complications such as hydronephrosis.

Conclusion

TLH without ureter isolation requires sufficient separation of the bladder from the anterior vaginal wall and careful vaginal stump suture without involving the bladder-side tissue to avoid ureteral injury.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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