Title

Laparoscopic excision of an acquired ureteral diverticulum: A case report

Running title

Laparoscopy for ureteral diverticulum

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Key words: diverticulum, ureter, laparoscopy, stone

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Abstract

Ureteral diverticula, especially acquired diverticulum, are rare diseases and they have surgical indication when accompanied by complications such as stones, pyelonephritis, stenosis and signs of malignancy. A 59-year-old woman visited our urology department with asymptomatic macrohematuria and enhanced computed tomography (CT) scan revealed a right ureteral diverticulum having a diameter of 16 mm and containing two tiny stones inside. After eight months, the size of these stones increased; therefore, she underwent laparoscopic resection of the ureteral diverticulum and end-to-end anastomosis of the ureter. Subsequent histopathology of the excised specimen revealed an acquired diverticulum. Follow-up intravenous pyelography showed adequate urine passage with only minor dilatation of the pelvis after three months of the operation. Laparoscopic approach is believed to be feasible for ureteral diverticula cases that require ureteral end-to-end anastomosis.

Key words: diverticulum, laparoscopy, ureter

Introduction

Ureteral diverticula are rare urogenital conditions and reviewed of only 45 cases updated in 2013 (1). Laparoscopic treatment was reported in only one case for a true ureteral diverticulum (2). Ureteral diverticula are sub-classified into three categories: 1) abortive ureteral duplications, 2) true congenital diverticulum, and 3) acquired diverticulum (3). Abortive ureteral duplications is the most common and acquired ureteral diverticulum is the least. Surgical indication is controversial but does include complications such as stone, urinary tract infection, obstruction, and signs of malignancy. This paper reported an acquired ureteral diverticulum with stone formation, which was successfully managed by laparoscopic resection of the diverticulum and ureteral end-to-end anastomosis.

Case Presentation

A 59-year-old woman presented with a chief complaint of asymptomatic macrohematuria. Her medical history revealed dilated cardiomyopathy, while cystoscopy and ultrasound did not show any abnormality and urine cytology was negative for malignancy. Six weeks later, enhanced computed tomography disclosed a right middle ureter diverticulum with a diameter of 16 mm accompanied by two tiny stones inside and a right mild hydronephrosis (Figure 1a, b). A diuretic renogram did not show obstructive patterns. Eight months later, ultrasound revealed the slight increase of the right hydronephrosis with a renal stone, which was in parallel to the increase in serum creatinine level from 0.69 mg/dL to 1.39 mg/dL, and the enlargement of stone size in the diverticulum (Figure 1c). Retropyelography showed a diverticulum of the ureter with mild stenotic lesion on the diverticulum (Figure 2a). Diagnosed as having ureteral diverticulum with stones inside, she underwent laparoscopic resection of the diverticulum. In advance of the procedure, a 5 Fr ureteral catheter was indwelled in the lithotomy position. The laparoscopic procedure was performed via transperitoneal approach with 5 ports using 3-D surgical endoscope system in the left semi-lateral decubitus position (Figure 2b). Keeping the distal part of the right ureter fixed using a vessel tape, and drawing the diverticulum by an anchor suture to the diverticulum, the diverticulum was dissected from the surrounding tissue without any severe adhesion (Figure 2c). An anchor suture of the proximal side of the ureter was performed prior to resection of the diverticulum completely (Figure 2d). The edge of the ureter was negative for malignancy in the intra-operative frozen section. The specimen was entrapped in a bag and retrieved through a 12-mm port. The lateral and lower side of the kidney was dissected and mobilized for tension-free anastomosis of the ureter. Both ends of the ureter were spatulated and then, anastomosed end-to-end with 7-stiches of interrupted suture using 5-0 PDS C-1 (Figure

2e). A 6 Fr double-J catheter was indwelled in the lithotomy position after the laparoscopic procedure. The time required in total and for laparoscopic operation was 5 hrs 46 mins and 3 hrs 40 mins, respectively. The histopathological diagnosis displayed an acquired ureteral diverticulum without malignancy (Figure 3). Obtained stones constituted 91% of calcium oxalate and 9% of calcium phosphate. The patient had minor pyelonephritis and was discharged on post-operative day 16. Five weeks later, the double-J catheter was removed and the intravenous pyelogram showed adequate passage of urine with only minor dilatation of the pelvis performed at 3 months post-operatively (Figure 4).

Discussion

Ureteral diverticula have been addressed mostly in case reports. The most recent comprehensive review paper came from McLoughlin *et al* which examined 45 cases (1). Acquired ureteral diverticulum is the least common type of ureteral diverticula and the most frequent lesion is lower part of the ureter (2,4,5). The etiology of the acquired ureteral diverticlura is unknown but is thought to be due to inflammation, infection and mostly obstructive uropathy the distal part of the ureter which induces high pressure to the proximal part (6). This high pressure in turn contributed to mucosal herniation in the weak part of the ureter such as the bladder diverticula due to lower urinary tract obstruction. In this case, the patient's acquired diverticulum was supposed to derive from this mechanism, although a diuretic renogram did not show obstructive patterns initially. Hydronephrosis emerged and increased in the right kidney during eight months following her first visit. This patient might have temporal inflammation or minor stones at site of mild stenosis of the ureter just distal to the diverticulum or might develop the diverticula due to a check valve structure there. Ureteral diverticula are recommended for conservative treatment in asymptomatic patients without hydronephrosis (1), although the deterioration of stone formation as reported in this patient had surgical indication. Mori *et al* reported a case of true ureteral diverticulum with a stone inside that was successfully treated with diverticulectomy (7). A common surgical procedure of middle ureteral diverticula is resection of the diverticula and end-to-end anastomosis of the ureter (8). Li *et al* successfully treated a true ureteral diverticulum at the ureteropelvic junction by laparoscopy though post-operative ileus occurred due to a minor urine leakage from the anastomosis site (2). Laparoscopic treatment for the ureteral diverticula can be feasible but it may need some know-hows for the procedure.

Preoperative stenting is necessary for proper handling of the ureter and assisting anastomosis. It is essential to dissect ureter adequately and kidney also, if required, to

minimize the tension that may arise with anastomosis, while it should be careful not to damage the ureter's blood supply. Three-D surgical endoscopic system was used for higher precision in the anastomosis of the ureter. If normal 2-D system were applied, the needle handling would require stereoscopic recognition by operators themselves, which could be more challenging to perform given such a delicate procedure. Flexible endoscope is also helpful to keep an appropriate view without interfering with other instruments of the operator. Finally, fine laparoscopic forceps play an important role at grasping the ureter appropriately and directing the needle path. Robotic procedure might be a viable option yet should be performed with care for the present absence of tactile sensing functions. We used a 12-mm port for the operator's right hand; however, a 5-mm port could be enough if an additional 5-mm camera was prepared.

In conclusion, we experienced a rare case of acquired diverticulum with stones inside. Laparoscopic procedure is believed to be feasible for the resection of the ureteral diverticulum and end-to-end anastomosis of the ureter.

Acknowledgments

The authors have no conflicts of interest directly relevant to the content of this article. Informed consent was obtained from the patient for this case report.

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Figure legends

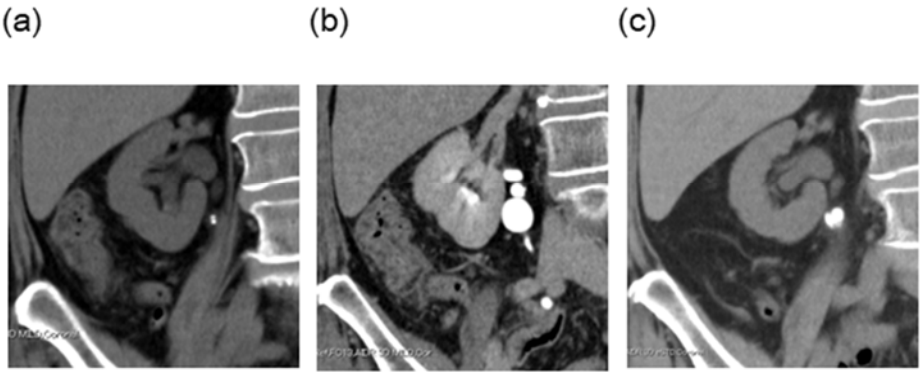

Figure 1: Non-contrast computed tomography (CT) (a) and CT urography (b) showed a ureteral diverticulum with stones inside. (c) Follow-up CT scan after eight months disclosed the enlargement of stone size.

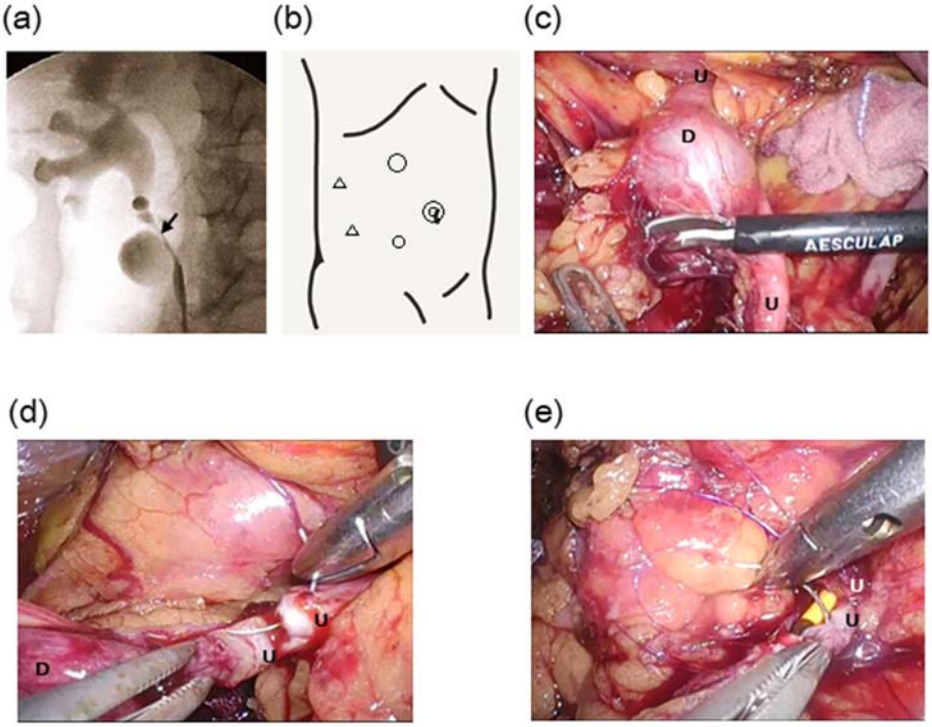

Figure 2: (a) Retropyelogram preoperatively showed a shape of diverticulum with infundibulum (arrow). (b) Port sites. A double circle, a 10-mm port for camera; a large single circle, a 12-mm port for right hand of the operator; a small single circle, a 5-mm port for left hand of the operator; triangles, 5-mm ports for the assistant. (c-e) Intraoperative laparoscopic view, (c) dissecting the diverticulum (above is the head side); (d) anchor suture of the proximal part of the ureter (right is the head side); (e) end-to-end anastomosis of the ureter. D, diverticulum; U, ureter.

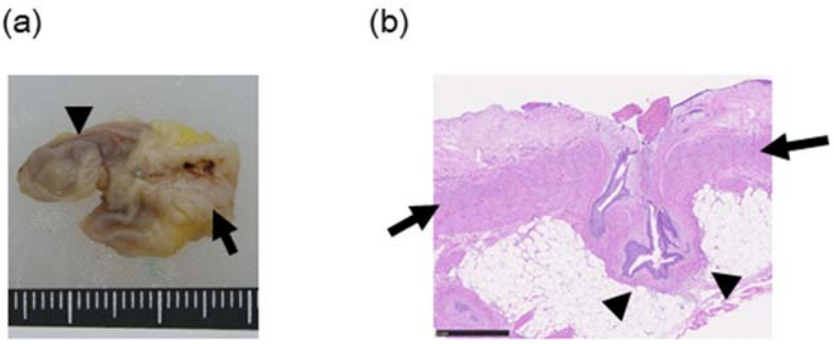

Figure 3: (a, b) Macroscopic (a) and microscopic (b) view of the specimen. (a) Arrow indicates ureter and arrow heads show wall of the diverticulum. (b) Arrows indicate smooth muscle layer, which lost continuity at the site of mucosal herniation (arrow heads). Upper is inside of the ureter and below is outside of the ureter. Bar indicates 1 mm.

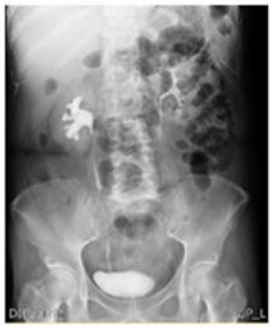

Figure 4: Intravenous pyelography showed adequate urine passage with only minor dilation of the pelvis performed 3 months after the surgery.