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Case Report

Combined ureteroscopy and percutaneous nephroscopy in the oblique supine position successfully treated a ureteral double J stent misaligned to the inferior vena cava

Wen-Zhen Ai[1], Hong-Bing Wei[1], Jun Zhou[1], Qi Lei[2]

[1]*Department of Urology, The Third People's Hospital of Hubei Province, Wuhan 430030, Hubei, China;*
[2]*Department of High Fever, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, Hubei, China*

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Abstract: The intravascular migration of double J stent (DJS) represents an uncommon complication in urological surgery, necessitating prompt intervention to prevent a severe outcome. This report details an infrequent instance of double J stent transposition into the inferior vena cava (IVC) that was effectively addressed using a combined approach of ureteroscopy (URS) and percutaneous nephroscopy (PCNL) performed in the oblique supine position (OSP), without significant complications.

Keywords: Double J stent, malposition, intravascular migration, complication, treatment

Introduction

Ureteral double J stent (DJS) placement following ureteroscopic lithotripsy (URSL) is a standard practice in urology. Ureteral stents serve to ensure the continuous flow of urine from the renal calyces to the bladder and to preserve the integrity of the urinary tract. The complications associated with indwelling ureteral stents encompass lumbar distension, frequent urination, urination urgency, infection, hematuria, stone formation, fragmentation, and migration. Although most complications are typically mild and manageable, the intravascular migration of a DJS represents a rare but serious complication and is a challenge in URSL. In this case, the combination of ureteroscopy and percutaneous nephrolithotomy (PCNL) in the oblique supine position (OSP) was successfully used to resolve a ureteral stent that migrated into the inferior vena cava (IVC) due to complete ureteral atresia during URSL.

Case presentation

A 64-year-old male patient was admitted to the Department of Urology, Third People's Hospital of Hubei Province, after experiencing left lower back pain for more than two weeks, accompanied by symptoms of incomplete voiding and a thin urine stream. The patient had a medical history of rectal cancer, bilateral kidney stones, right ureteral stones, bladder stones, and urethral stricture. The surgical history included radical resection of rectal cancer with anal preservation in 2004. On December 1, 2015, the patient underwent right URS and double J stent placement. On June 8, 2016, transurethral bladder calculi lithotripsy was performed. On May 8, 2017, right URS, double J tube placement, and urethral dilatation were completed. On September 15, 2021, urethral dilatation and transurethral cystoscopic holmium laser lithotripsy were performed to address bladder stones. The patient had a smoking history and denied any family history of hereditary diseases. Physical examination revealed no tenderness in the left renal area, no percussion pain, no tenderness along the bilateral ureteral course, and no tenderness in the suprapubic bladder region. A plain computed tomography (CT) scan was performed upon admission on February 28, 2022, which displayed multiple ureter stones (**Figure 1**). Left transurethral ure-

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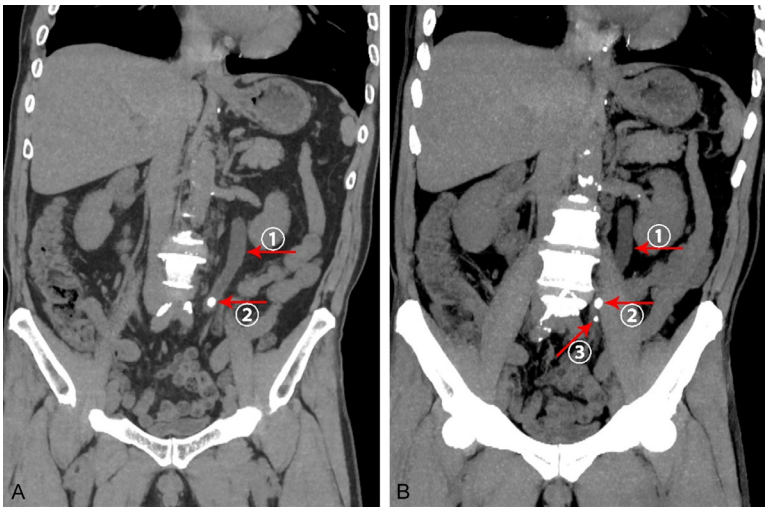

Figure 1. Plain CT tomography was performed on admission. A. ① Left ureteral dilatation; ② Ureteral calculi. B. ① Left ureteral dilatation; ②, ③ Ureteral calculi. CT, computed tomography.

teroscopic lithotripsy was scheduled for March 3, 2020. During the procedure, an anterior urethral stricture was identified. The urethra was dilated using an F20 urethral probe, and a ureteroscope was subsequently inserted, revealing a stricture 14 cm into the ureter. Using a loach guide wire, the stricture segment was dilated to approximately 0.5-1 cm. A small amount of stone residue and a ureteral stricture ring that could not be further expanded were observed. The procedure was terminated, and a double J tube was inserted using a loach guide wire without significant resistance. An F20 three-lumen urinary catheter was retained. Postoperative urinary catheter drainage was noted to be bloody. During the operation, an anterior urethral stricture was identified, and the urethra was dilated using an F20 urethral probe. A ureteroscope was subsequently inserted, revealing a ureteral stricture approximately 14 cm into the ureter. Using a loach guide wire, the stricture segment was dilated to approximately 0.5-1 cm. A small amount of stone residue and a ureteral stricture ring that could not be further expanded were observed. The procedure was terminated, and a double J tube was inserted with the assistance of a loach guide wire, with no significant resistance encountered. An F20 three-lumen urinary catheter was retained. Postoperative drainage from the urinary catheter was noted to be bloody.

On the first postoperative day, the patient's condition was stable, and he was able to ambulate. A CT reexamination on the second postoperative day (March 5, 2022) revealed that the double J stent had inadvertently entered the IVC through the left iliac vein, without reaching the heart (**Figure 2**). After immediate departmental discussion, a left PCNL in the OSP was planned for the following day (March 7, 2022) to remove the misplaced double J stent, with preparations made for possible open surgery. During the procedure, PCNL successfully treated the left ureteral calculi and residual stricture. The malpositioned double J tube was removed by transurethral URS, and a new double J tube was successfully placed in an anterograde manner. A plain CT scan on March 9, 2022, conducted on the second postoperative day (**Figure 2**), confirmed that the stones were completely cleared and that the double J tube was correctly positioned. After a two-week follow-up, the patient's IVC and left iliac vein showed no abnormalities, with no bleeding tendency, no pulmonary embolism, clear urine, and no evidence of ureteroiliac venous fistula. It was recommended that the ureteral stent remain in place for 3 to 6 months. Continued follow-up was advised in the outpatient department.

Discussion

Placing an indwelling ureteral stent is a common urological procedure; however, it is often associated with complications, among which intravascular migration of the ureteral stent is a rare but serious occurrence. To date, the reported locations of intravascular migrating of ureteral stents include the external iliac vein [1-4], IVC [4-12], right ventricle [13-15], right atrium [2, 15-18], pulmonary artery [16, 19], and abdominal aorta [20] (**Table 2**). If visual acuity is poor during cystoscopy or URS, a ureteral stent may penetrate the ureteral wall and adjacent communicating vein and be inserted into the vascular system and IVC through this vein [9]. The migration of DJS to the IVC during

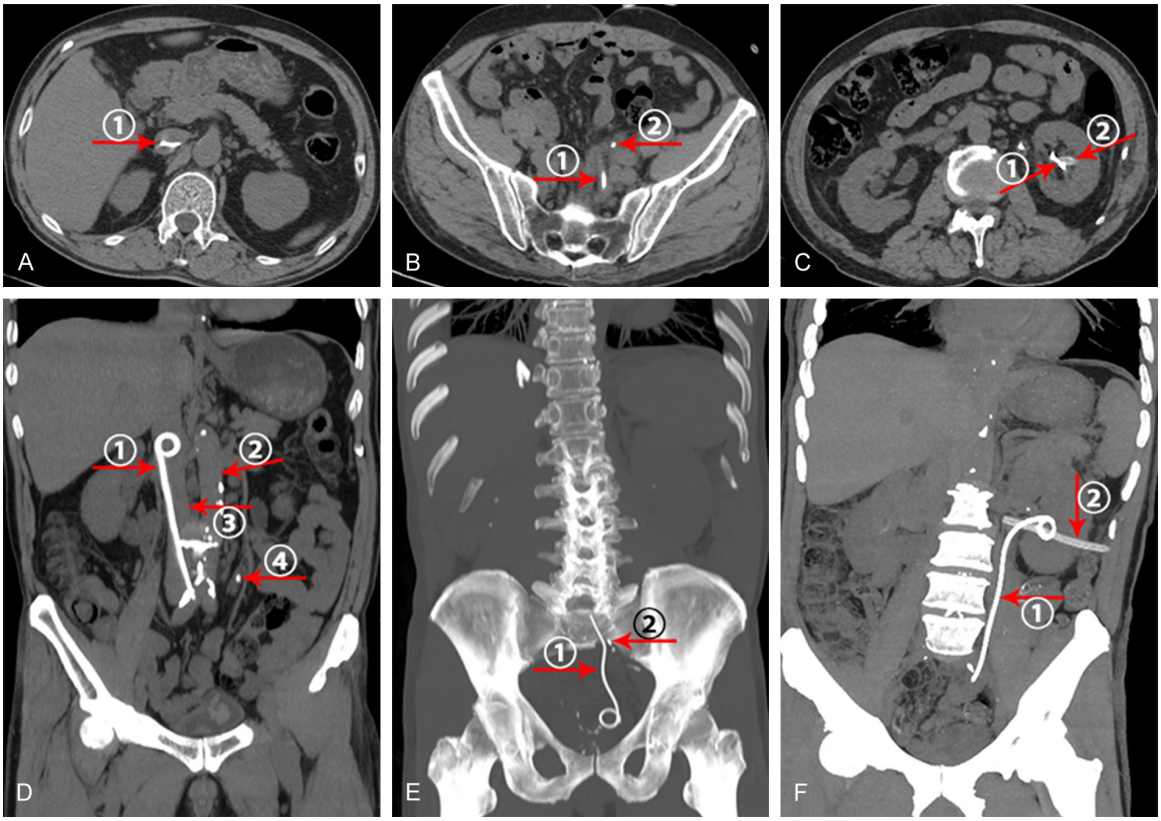

Figure 2. (A, B, D and E) show the first postoperative plain CT scans of the patient. (C and F) show the second postoperative CT scans of the patient. (A. ①, B. ①, C. ①, D. ①, E. ①, F. ①) are double J tubes; (B. ②, D. ④, E. ②) are ureteral calculi; (C. ② and F. ②) are nephrostomy tubes; (D. ②) Abdominal aorta; (D. ③) is the inferior vena cava.

ureteroscopic surgery due to a poor surgical field has been reported [3, 19]; unfortunately, our case fell into this category. In this case, we analyzed the factors contributing to intravascular migration of the ureteral stent. First, the patient's radical resection of rectal cancer with anal preservation in 2004 led to alterations in the internal abdominopelvic anatomy and fibrotic scarring of the surgical site. Second, the ureter crossing the iliac vessels is affected by surgical scarring, leading to restricted movement and increased distortion compared with normal anatomic conditions. Third, the combination of risk factors with recurrent ureteral calculi and infections contributes to ureteral stenosis, fragility of the walls [21], and even atresia, complicating ureteroscopic catheterization. Fourth, factors such as the surgeon's experience and the use of X-rays and other imaging modalities also play a role. Some scholars suggest that if feasible, intraoperative C-arm fluoroscopy [22] and postoperative X-ray examinations should be considered, with ultrasound serving as an alternative for pregnant women. However, these recommendations are often theoretical and not always practical in clinical settings.

Postoperatively, monitoring patients for symptoms is crucial, since these may indicate complications [20]. Special attention should be given to severe complications such as bleeding, infection, and pulmonary embolism. Many reports have indicated only microscopic or no hematuria [1, 13, 23] (**Table 2**), which may be attributed to blood clots obstructing the ureteral stent [24]. Additionally, some studies suggest that intrapelvic pressure exceeds IVC pressure in patients with obstructive hydronephrosis [24]. Consequently, urine is more likely to reflux into the bloodstream, increasing the risk of infection. The literature suggests that erosion of the aortic vein by ureteral stents can lead to severe retroperitoneal hemorrhage [16], a complication that was not observed in our patient. In this case, the drainage fluid from

Table 1. Laboratory test results

		Pre-operation	First post-operation	Second post-operation		Follow-up
		Mar 1st	*Mar 4th*	*Mar 8th*	*Mar 12th*	*Mar 29th*
Blood routine	WBC (10^9/L)	5.29	7.69	4.43	7.07	4.97
	NEUT%	55.7	76.6	76.9	49.1	61.6
	RBC (10^12/L)	4.09	3.89	3.89	4.22	3.98
	HGB (g/L)	142	134	131	142	133
Liver function	AST (U/L)	69.7	35.4	60.9	48.8	10.9
	ALT (U/L)	58.8	36.1	47.9	50.9	18.9
	γ-GGT (U/L)	389.7	308.4	278	274.4	160.6
Renal function	CR (umol/L)	68	68	66		63
	BUN (mmol/L)	5.6	4.6	3.4		5.8
Urine routine	U-RBC (/ul)	148		12881	2600	2600.5
	U-WBC (/ul)	73		2590	195	137.4

WBC, white blood cell count; NEUT%, neutrophilic granulocyte percentage; RBC, red blood cell count; HGB, hemoglobin; AST, aspartate aminotransferase; ALT, alanine aminotransferase; γ-GGT, gamma-glutamyltransferase; CR, creatinine; BUN, blood urea nitrogen; U-RBC, urinary red cell count; U-WBC, urinary white blood cell count.

the nephrostomy tube and urinary catheter transitioned from bloody to clear within 1-2 days, and the hemoglobin level did not significantly decrease upon reexamination. This verified that no complications, such as significant bleeding or ureteroiliac venous fistula, were observed in this case. Furthermore, it is believed that during the ureteroscopic procedure, the ureteral stent enters the left iliac vein through a perforation below the ureteral obstruction, subsequently entering the IVC.

From a cardiology perspective, possible complications of intracardiac or vascular foreign bodies include multiorgan embolism (the most serious potential complication), tricuspid insufficiency, myocardial injury, endocarditis, recurrent pericardial effusion, and chest pain [25]. **Table 2** shows two cases [7, 19] of thrombosis, and many centers recommend adequate prophylactic anticoagulation before and after ureteral stent removal [3, 7, 16, 19, 23] (**Table 2**). In our case, no prophylactic anticoagulant was administered. The absence of significant complications, such as pulmonary embolism, was confirmed because the patient did not exhibit symptoms such as shortness of breath, distress, difficulty, or chest pain. In addition, the patient's heart rate, blood pressure, and blood oxygen saturation were confirmed to be normal. Considering the adverse effects of anticoagulants, we believe that their administration should be guided by individualized assessment. Tilborghs et al. [11] performed immediate postoperative angiography of the IVC, revealing limited contrast leakage at the perforation site. Emergency intervention or open surgery is recommended when the DJS completely enters the vasculature and is undetectable by endoscopy. Specifically, if a patient's vital signs are unstable and severe complications such as massive bleeding or embolism may occur, open cardiothoracic surgery under cardiopulmonary bypass becomes essential, necessitating adequate blood preparation. Our patient subsequently developed a severe infection. On the third postoperative day following the second surgery (March 10, 2022), the patient experienced chills and a high fever, with a recorded temperature of 39.3°C. Routine blood tests (**Table 1**) and blood cultures were promptly conducted.

The removal of ureteral stents from the circulatory or vascular system often necessitates a multidisciplinary approach. The literature we reviewed suggests that cystoscopy, percutaneous nephrolithotomy (PCNL), laparoscopic surgery, endovascular surgery, and open surgery can be employed to address intravascular migration of ureteral stents [3, 4, 7, 10] (**Table 2**). The selection of treatment depends on the patient's condition; the location of the stent; the presence of bleeding, infection, or thrombosis; and the surgeon's experience. Immediate intervention is required in cases of stent malposition or displacement [20]. In this case, URS and PCNL were employed in the

Table 2. Previous case reports in the literature on intravascular migration of DJS

Author and publication year	History and initial diagnosis	Reason and method of DJS placement	Postoperative symptoms	Location of proximal end	Location of distal end	Duration of catheterization	Removal method	Thrombosis and anticoagulants use	Prognosis
Michalopoulos et al. 2002 [16]	Left kidney agenesis	Pyelolithotomy, open surgery, antegrade	Early postoperative pulmonary thromboembolism	Right heart	Left pulmonary arterial tree	1 day	Endovascular	No thrombosis, postoperative prophylactic anticoagulants	Not described
Ioannou et al. 2009 [1]	Left urolithiasis and recurrent pyelonephritis	To decongest a new episode of pyelonephritis, not described, retrograde	Microscopic hematuria after surgery	Left common iliac vein	IVC	During hospitalization	Open surgery	Not described	Uneventful within 2.5 years of follow-up
Falahatkar et al. 2012 [4]	True urinary incontinence and left hydronephrosis after hysterectomy	To relieve urinary incontinence and hydronephrosis, ureteroscopy, retrograde	Gross hematuria	IVC next to the right atrial inlet	Left external iliac vein	20 days	Endovascular	Not described	Deep vein thrombosis developed 7 days after discharge which needed specific treatment
Sabnis et al. 2013 [3]	Right ureteric calculus	To relieve hydronephrosis and defer the lithotripsy, cystoscopy, retrograde	Not described	Right atrium	Right external iliac vein	Not described	Open surgery	No thrombosis, postoperative prophylactic anticoagulants	Uneventful
Kim et al. 2014 [15]	Right ureteroneocystostomy with bladder rupture repair after a right lower ureteral transaction injury	To prevent urinary leakage, open surgery, retrograde	Mild back pain and suprapubic discomfort after voiding	Right cardiac chamber	Right ovarian vein and IVC	2 weeks	Endovascular	No	Normal urinary and vascular structures within 5 months of follow-up
Hastaoglu et al. 2014 [14]	Right ureteric calculus	Lithotripsy, not described but not cystoscopy	Massive hematuria	Right ventricle	Right ureteral lumen with calcification	3 years	Endoscopically and open surgery	No	Uneventful
Farshi et al. 2015 [13]	Gestational right hydronephrosis and pyelonephritis	To relieve hydronephrosis, cystoscopy, retrograde	Asymptomatic	Right ventricle	Right ureteral lumen	5 months	Ureteroscopy	No	No adverse effects
Hajji et al. 2015 [2]	Gestational hydronephrosis and pyelonephritis	To relieve hydronephrosis, not described	Palpitations and moderate right flank pain	Right atrium	Right iliac vein	Placed in 12 weeks pregnant and removed after delivery	Endovascular	No	Discharged on the following day
Arab et al. 2016 [19]	Right ureteric calculus	Lithotripsy, ureteroscopy, retrograde	Gross hematuria	Completely in the pulmonary artery	Completely in the pulmonary artery	2 weeks	Endovascular	Thrombus formation and prophylactic anticoagulant	No symptoms within 6 months of follow-up
Maheshwari et al. 2016 [9]	Open abdominal hysterectomy, right mid-ureteric stricture	Not described, presumed to be cystoscope	Persistent flank pain and urinary infection	Supra-renal IVC	Bladder	6 weeks	Cystoscopy	no complications	Followed up 2 months, doing well
Marques et al. 2018 [23]	Right renal lithiasis and pelvic stone	Lithotripsy for the pelvic stone, not described, retrograde	Asymptomatic	IVC	Intravesical	3 months	Endoscopically	No thrombosis, preoperative prophylactic anticoagulants	No long-term complications
Mao et al. 2018 [10]	Left ureteral stone, anuria	Treatment anuria, not described, presumed to be cystoscope	Postoperative X-rays demonstrated malpositioning of the left DJS	IVC at the level of the right renal vessels	Bladder	During hospitalization	Laparoscopic surgery	No thrombosis, postoperative anticoagulant	Followed up 1 year, no sequelae

Tilborghs et al. 2019 [11]	Bilateral renal colic led by bilateral ureteric calculus	Relive symptoms before lithotripsy, not described, retrograde	Right renal colic persisted gross hematuria and high fever occurred	IVC at the level of the left renal vein	Intravesical	During hospitalization	Cystoscopy	No	Laser lithotripsy was performed 4 weeks later, and the follow-up was uneventful
Jiang et al. 2019 [7]	Left renal calculi	Pyelolithotomy, not described, retrograde	Persistent moderate flank pain	IVC at the level of the left renal vein	Left renal pelvic	5 months	Percutaneous nephroscope under C-arm guidance	Small mural thrombus in the IVC pre and postoperative anticoagulants	Uneventful
Kochhar et al. 2019 [8]	Boari flap for posthysterectomy ureterovaginal fistula	Right- sided ureteroneocystostomy	Fever, pain abdomen and recurrent vomiting	IVC	Bladder	1 week	Cardiovascular surgery	No	Uneventful
Arts et al. 2020 [17]	Gastric bypass, right hemicolectomy, sigmoidal perforation and cholecystectomy, radiotherapy for cervical carcinoma	Bladder fistulae, bilateral symptomatic hydronephrosis, open surgery	Clinical deterioration with fecal losses through the laparotomy wound and suspicion of new enteric fistulae	Right atrium	Ureterocutaneostomy	2 weeks	Interventional	No	Died a month later due to several other complications and very poor general condition
J et al. 2020 [21]	Retroperitoneal mass biopsy was reported as acute suppurative inflammation	Mild hydronephrosis, details unavailable	Right flank pain with intermittent episodes of fever with chills and rigors on and off	Second part of the duodenum	Bladder	3 months	Laparoscopic/ open right nephrectomy	No	Uneventful
Hu et al. 2021 [6]	Right ureteric calculus, hydronephrosis	Post-PCNL, retrograde	Impingement pain in the right kidney area	IVC at the level of the right renal vein	Right external iliac vein	Not described	Intravascular interventional therapy	No thrombosis, perioperative anticoagulation therapy	Two weeks later right flexible ureteroscopic lithotripsy and after 1 year follow-up period no sequelae
Abedi et al. 2021 [5]	Retroperitoneal fibrosis	To relieve bilateral moderate hydronephrosis, cystoscopy, retrograde	Gross hematuria	IVC	Bladder	3 days	Cystoscopy	Not described	Followed up 3 months, condition good
Wang et al. 2022 [22]	Right kidney and ureteral calculus	Ureteroscopic pneumatic lithotripsy, retrograde	No obvious postoperative complications	IVC	Under the serosa of the distal ureter	2 months	Cystoscopy and ureteroscopy, open surgery	No thrombosis	During a 1-year follow-up no complication
Wang et al. 2022 [22]	Postoperative recurrence of endometrial carcinoma, right ureter and bladder invaded, dilated right hydronephrosis ureter	To relieve obstruction, cystoscopy, retrograde	Without obvious postoperative complications	IVC at the level of upper renal polar	Intravesical	1 week	Cystoscope	Not described	Percutaneous nephrostomy and catheterization; no signs after 8 months of follow-up
Prijovic et al. 2022 [20]	Bilateral hydronephrosis caused by cervical cancer	To relieve left obstruction and ureteral calculus, ureteroscopy with ultrasonic lithotripsy, retrograde	Slightly red urine, good general postoperative condition	Abdominal aorta at the level of the 11th thoracic vertebrae	Left ureteral orifice in bladder	1 day	Cystoscope, vascular and endovascular surgery	Not described	Discharged on the fourth postoperative day with stable vital signs
Armas-Phan et al. 2022 [18]	Total abdominal hysterectomy for surgical treatment of uterine leiomyomatosis	To manage right ureteral injury, robotic ureteral reimplantation, retrograde	Vital signs stable	Right atrium	Bladder	Not described	Vascular surgery, cystoscopy	No thrombosis, aspirin	Followed up 1 month doing well

DJS, double J stent; IVC, inferior vena cava; PCNL, percutaneous nephrolithotomy.

oblique supine position (OSP) to manage the left middle ureteral calculi and stricture, stent malposition. Under percutaneous nephroscopy guidance, the displaced ureteral stent was removed using a ureteroscope, and a new stent was placed anterograde from the top to the bottom under ureteroscopic monitoring. Some studies have stated that the OSP might be superior in operative time and complications than prone position during PCNL, especially for patients with severe cardiopulmonary disease, anesthesia risk and morbid obesity [26]. This approach can shorten the operation and provide better comfort and quicker recovery to the patients [27]. The OSP offers the advantage of allowing simultaneous performance of PCNL and transurethral URS. In the OSP, the middle and lower ureter can be effectively visualized with URS. A ureteroscope was chosen to remove the DJS because the distal portion of the stent was located in the bladder, and the patient was stable with no evidence of retroperitoneal hematoma. The clinical significance of this study is that the method we adopted avoids the time-consuming and labor-intensive multidisciplinary method that must be used, and avoids possible greater damage that may be caused by endovascular intervention, laparoscopic surgery, or open surgery. It provides a feasible scheme for urological surgeons to deal with the case of intravascular migration of DJS.

Conclusion

Ureteroscopic lithotripsy complicated by the misplacement of a double J stent into the inferior vena cava is exceptionally rare. In this case, URS and PCNL in the oblique supine position were effectively employed to address the misplaced double J stent, as well as the left middle ureteral calculi and stenosis. The precise replacement of the ureteral stent was achieved through the combined use of URS and PCNL, providing a valuable treatment strategy and approach for managing this rare complication.

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Disclosure of conflict of interest

None.

Address correspondence to: Dr. Wen-Zhen Ai, Department of Urology, The Third People's Hospital of Hubei Province, No. 26 Zhongshan Avenue, Qiaokou District, Wuhan 430030, Hubei, China. Tel: +86-027-83743017; E-mail: aiwenzhenyx@163.com

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