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ORIGINAL ARTICLE

Retrograde ureteral stent exchange under fluoroscopic guidance

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PURPOSE
The aim of this study was to assess the safety and efficacy of fluoroscopy-guided retrograde double-J stent exchange.

MATERIALS AND METHODS
Between March 2003 and June 2005, 39 retrograde ureteral stent exchange procedures on 19 patients and 24 ureters were performed under fluoroscopic guidance. Seventeen of the patients were female and 2 were male. All procedures were done on an outpatient basis unless the patient was already an inpatient. All exchanges were performed through 10 F introducer sheaths. Once the stent was grasped, the sheath, the snare and/or the wire holding the stent were pulled out as a unit. For retrieving the stents, several different techniques (guide wire lasso and wire snaring) were used in addition to simple snare technique. Two parallel stents were placed for each ureter in 2 patients (3 ureters) after a history of stent occlusion in less than 3 months.

RESULTS
Technical success rate was 100%. Procedure time ranged from 16 to 38 minutes (average, 21 min). There were no major complications. All patients had minor hematuria after the procedure which resolved within one day.

CONCLUSION
Fluoroscopy-guided retrograde double-J stent exchange is a safe and effective procedure and can easily be performed with equipment and techniques used in daily interventional practice.

Key words: • *interventional radiology* • *ureter* • *stents*

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Ureteral stents have been used for maintaining luminal patency in ureteral obstruction cases since the late 1970s (1). These so-called double-J stents are an essential part of management in many malignant and benign conditions. They have many advantages over nephrostomy catheters in patient comfort and infection control; their main drawback is the requirement for frequent exchange. These exchanges are usually done under cystoscopic guidance, but fluoroscopic guidance can serve as a reasonable alternative as well, especially in female patients (2). We report our experience in exchanging these catheters in both male and female patients under fluoroscopic guidance using different techniques.

Materials and methods

This is a retrospective observational review of the first 39 retrograde ureteral exchange procedures performed in two tertiary referral centers.

Between March 2003 and June 2005, there were 39 retrograde ureteral stent exchange procedures involving 19 patients and 24 ureters (5 patients had bilateral stent exchanges) performed under fluoroscopic guidance. Seventeen of the patients were female and 2 were male. Sixteen of the patients had occlusion as a result of malignancy; three had strictures secondary to iatrogenic trauma (Table 1). The total number of exchanges was 1 on 17 ureters, 2 on 4 ureters, 3 on 1 ureter, 5 on 1 ureter, and 6 on 1 ureter. For the majority of patients 8 F ureteral stents (Flexima Ureteral Stent, Boston Scientific, USA) were used, but 6 F and 7 F stents (C-Flex, Cook Urological, Spencer, Indiana, USA) were used early in the experience and 10F stents (Flexima Ureteral Stents) were used for 2 patients who had early occlusion with 8 F stents. Most stents were 24 cm; one 22 cm stent and one 26 cm stent were used, and a 5 F 12 cm stent (Cook Urological) was used for a patient with transplant ureteral stricture. Procedures were performed under conscious sedation and on outpatient basis, unless the patient was already hospitalized for other reasons. Intravenous antibiotic prophylaxis with of 1 g ceftriaxone was used routinely. All exchanges were performed through 10 F introducer sheaths. Once the stent was grasped, the sheath, the snare, and/or the wire holding the stent were pulled out as a unit. Special attention was paid not to pull the stent out so much that the superior tip of the stent would drop into the bladder. A hydrophilic guide wire was then passed through the stent and advanced into the collecting system of the kidney. After removing the stent, a multipurpose catheter was advanced for sampling and retrograde pyelogram. A stiff wire (Amplatz Super Stiff, Boston Scientific, USA) was used to advance the double-J stent. Once the superior tip reached the renal pelvis, the stiffener was pulled back to allow the loop to form over the wire. Then the wire was pulled back and the pusher was used to position the inferior

Table 1. Indications for double-J stent placement

Cause of obstruction	n
Cervix cancer	8
Ovarian cancer	5
Iatrogenic trauma	1
Radiation injury	1
Lymphoma	1
Prostate cancer	1
Stricture in transplant ureter	1
Ewing sarcoma	1

Figure 1. Encrusted tip *(arrow)* of a double-J stent. The stent did not have a free-floating end to allow snaring.

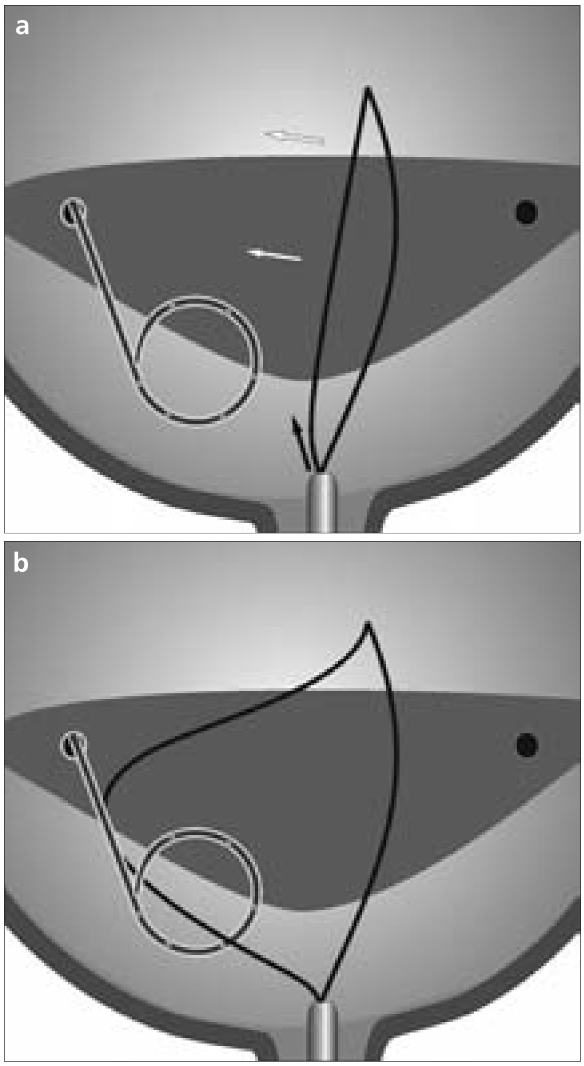

Figure 2. Technique for using a lasso formed by folding a wire. When one limb of the wire is advanced in the direction of the black arrow, the loop opens on the same side.

loop in the bladder. After the wire was completely removed, using the suture tied on the bladder end of the stent, the stent was pulled back to place the loops in the ideal position. For male patients, the technique was the same except a longer introducer sheath and a longer suture (instead of the standard previously placed suture) were placed in the bladder end of the stent to compensate for the longer urethral length. A Foley catheter was placed at the completion of the procedure to drain the urine for 3 hours.

We placed 2 parallel stents for each ureter in 2 patients (3 ureters) after a history of stent occlusion in less than 3 months. For these patients, we dilated the entire ureter with a balloon and used a long introducer sheath to advance the second wire. Then we placed the stents one after the other.

For retrieving the stents several different techniques (guide wire lasso and wire snaring) were used in addition to simple snare technique. Passing a gooseneck snare around the stent was not always possible. The main reason for this was the difficulty associated with lassoing the tip of the stent, which was usually hidden inside the J-loop or encrusted (Fig. 1). Creating a bigger lasso with the help of a wire (Starter Guide Wire, Bentson, Boston Scientific, USA) folded in two proved successful in some cases. We found it useful to advance one limb of the wire while holding the other steady to manipulate the lasso, rather than advancing both limbs (Fig. 2). Another useful technique was snaring a wire that passed through the loop or around the shaft of the stent (wire snaring). The details and an example of this technique are shown in Figs. 3 and 4. This technique does not require a free-floating end; therefore, it can be used even for stents with encrusted tips.

SPSS version 11.0 (SPSS Inc., Chicago, USA) was used for the statisti-

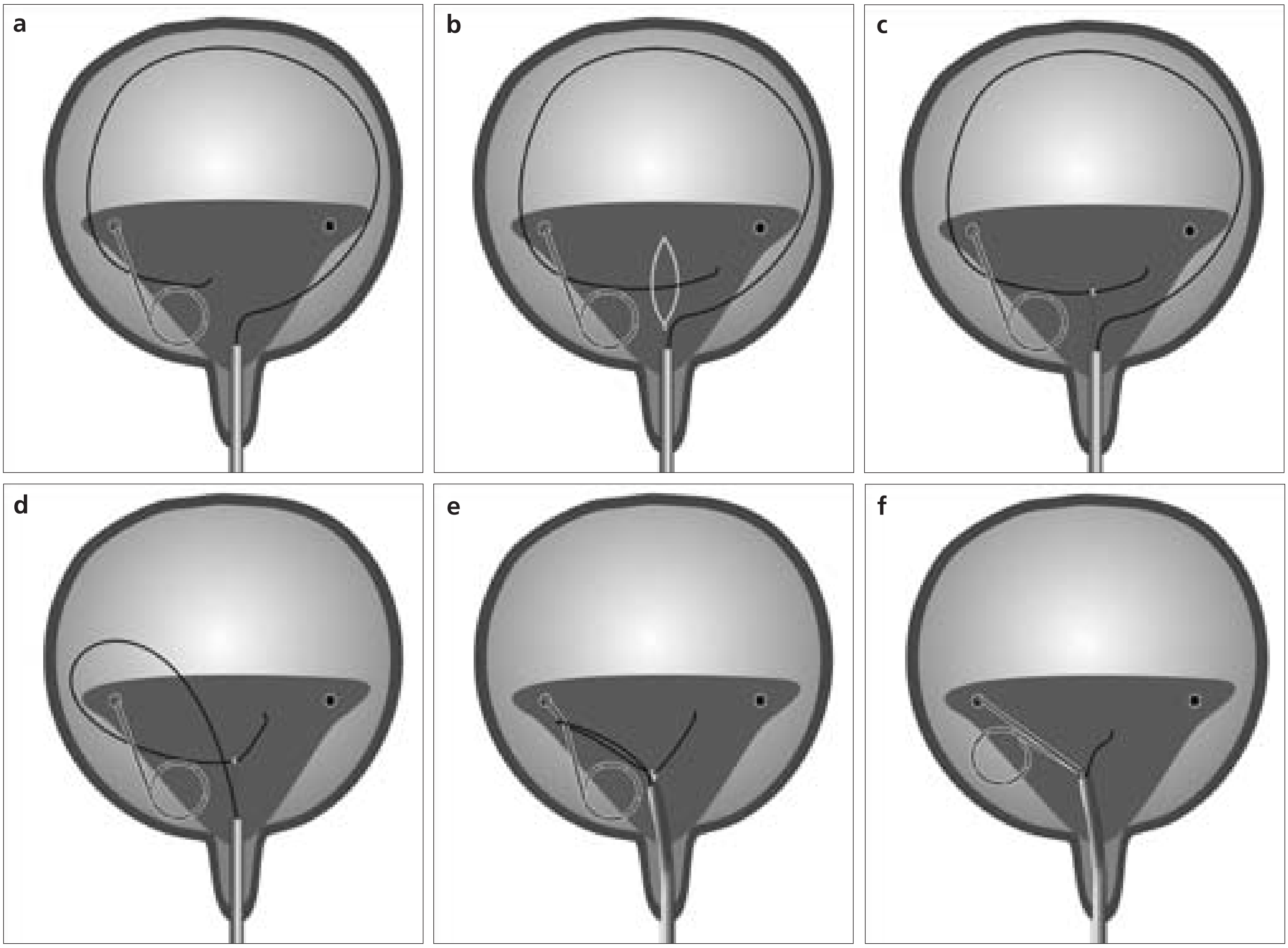

Figure 3. a–f. Wire snaring technique. **(a)** First, the wire is looped in the bladder, ensuring passing around the stent. **(b)** The tip of the wire is passed through a snare that is advanced alongside the wire through the same sheath. **(c)** The wire is grasped by the snare. **(d)** The wire is pulled back. **(e)** The sheath is advanced over the wire and the snare. **(f)** The wire is pulled back farther, and a tight loop forms around the stent. Then the sheath, wire, and snare can be pulled out as a unit.

Table 2. Comparison of patency rates between initially placed and exchanged stents

	Initial double-J placement (n = 24)		Exchange (n = 39)		
		n			n
Excluded stents		0	<3 months follow-up	Expired in <3 months	9
				Operated in <3 months	3
				Follow-up <3 months (recent cases)	8
				Upsizing in <3 months	1
Occluded <3 months	13			6	
Patent >3 months	11			12	
Three-month patency rate	11/24 (45.8%)			12/18 (66.7%)	

cal analysis. Our institutions do not require institutional review board approval for retrospective studies.

Results

Technical success rate was 100%. Procedure time ranged from 16 to 38 minutes (average, 21 minutes). The indications for replacement were infection, occlusion, discomfort, upsizing, and routine 3-monthly exchange. In 3 patients (4 ureters) cystoscopic route had been used for the initial double-J stent placement. The rest were placed via the nephrostomy access by interventional radiologists. Three-month patency rate for these initial stents was 11/24 (45.8%). After exchange, 21 stents were not followed up for 3 months in more recent cases, in expired patients, patients who had surgery, or when the stent was replaced for reasons other than stent malfunction. These were excluded from the patency rate calculation for the replacement group. Three-month patency rate after fluoroscopy guided retrograde exchange was 12/18 (66.7%) (Table 2). Although 3-month patency rate was higher after fluoroscopically guided retrograde exchange than the

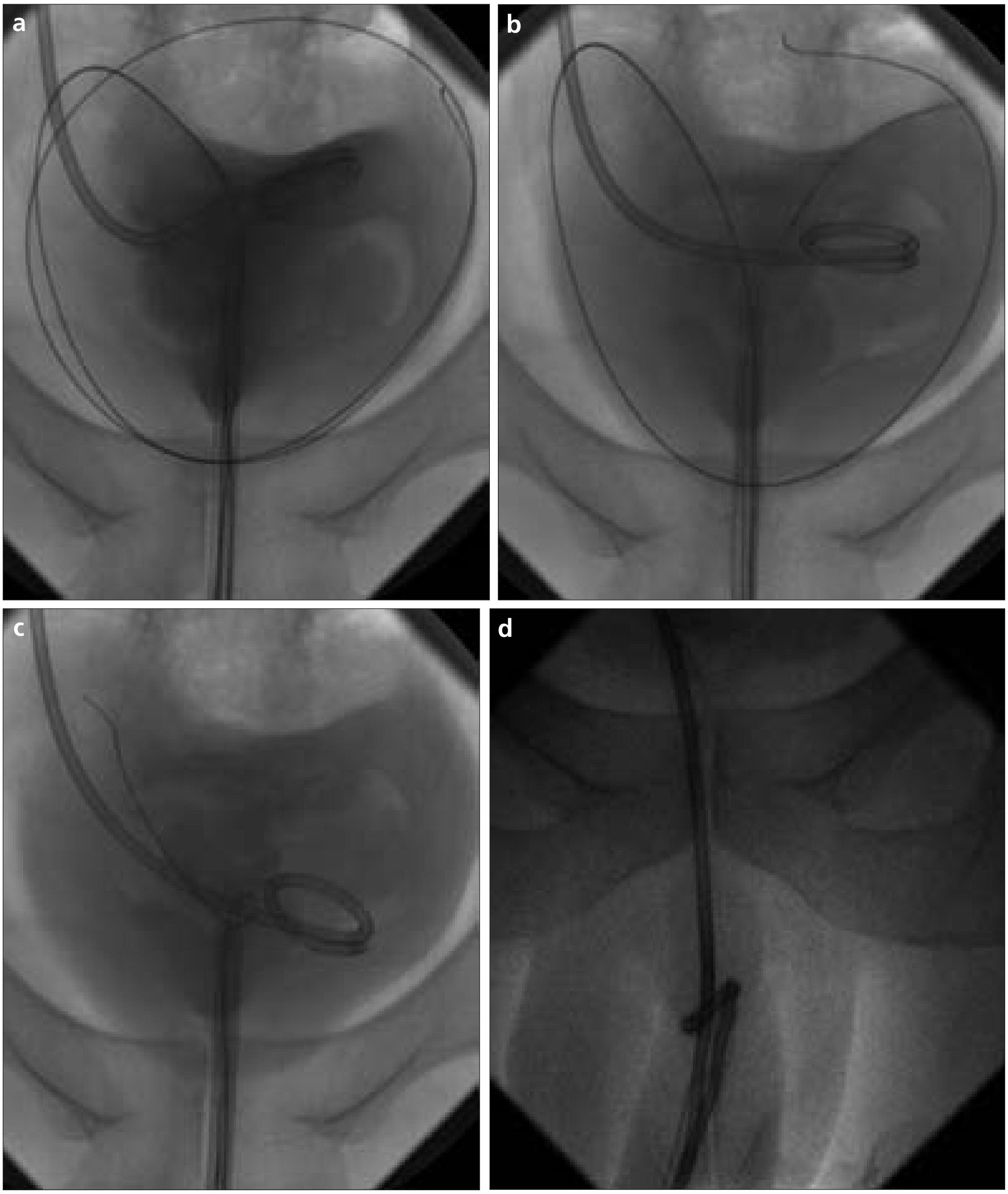

Figure 4. a–d. Fluoroscopic view of wire snaring technique in a male patient. **(a)** The wire is passed around the stent. **(b)** The tip of the wire is grasped with snare. **(c)** The wire is pulled back while the sheath is advanced. **(d)** The wire, snare, and the sheath are pulled back as a unit.

patency rate after initial placement, the difference was not statistically significant ($P = 0.221$, Fisher exact test).

There was no major complication. All patients had minor hematuria after the procedure, which resolved within one day. One patient, who had pyonephrosis due to an occluded stent, developed bacteremia shortly after the procedure. She had a history of several episodes of sepsis before the procedure, and she continued to have infections after the procedure. A nephrostomy catheter, which finally helped to clear the sepsis, was placed, and the stent was removed via the antegrade route. The stent was patent at the time of removal. Two other patients had urinary tract infection that responded poorly to antibiotics after stent replacement. They both had early occlusion due to encrustation. For both of these patients (3 ureters) we placed two double-J stents in each renal unit (Fig. 5). These double stents were patent without overt infection in these patients 32 and 56 days after exchange. One patient had 5 F cystoscopically placed double-J stents with no end hole on the renal end. Before pulling this stent out, using it as a guide and by manipulating a catheter and a hydrophilic wire alongside it, we could catheterize the ureter to allow placement of another stent.

Discussion

Malignant ureteral obstruction is a common problem in pelvic malignancies. Although percutaneous nephrostomy provides immediate decompression, long-term management is problematic. Metallic stents are associated with epithelial hyperplasia and have not been helpful, even in malignant cases with short survival expectancy (3).

Figure 5. Fluoroscopic view of bilateral parallel double-J stents in a patient who had early occlusion with single stents.

Double pigtail or double-J stents establish physiological urine flow and avoid patient discomfort related to nephrostomy tubes and external drainage bags. The main disadvantage associated with double-J stents is the need for periodic replacements. Replacements are usually done under cystoscopy guidance, but several papers have also addressed this issue in the radiology literature (2, 4, 5). Cystoscopy certainly has advantages, such as direct visualization, but its use cannot guarantee perfect placement or replacement (Fig. 6). Interventional radiologists also have a variety of techniques and equipment in their armamentarium to make fluoroscopy-guided exchange a reasonable alternative to cystoscopy.

We used a number of techniques for ureteral stent replacements. We started with a snare or a lasso formed by the folded Bentson wire. This did not always work due to the difficulty of passing the snare over the tip of the stent. Some authors have previously reported failed cases when they used only lassos made out of guide wires (4). Sometimes finding a free-floating end to pass the lasso is impossible because of encrustation of the bladder end of the stent.

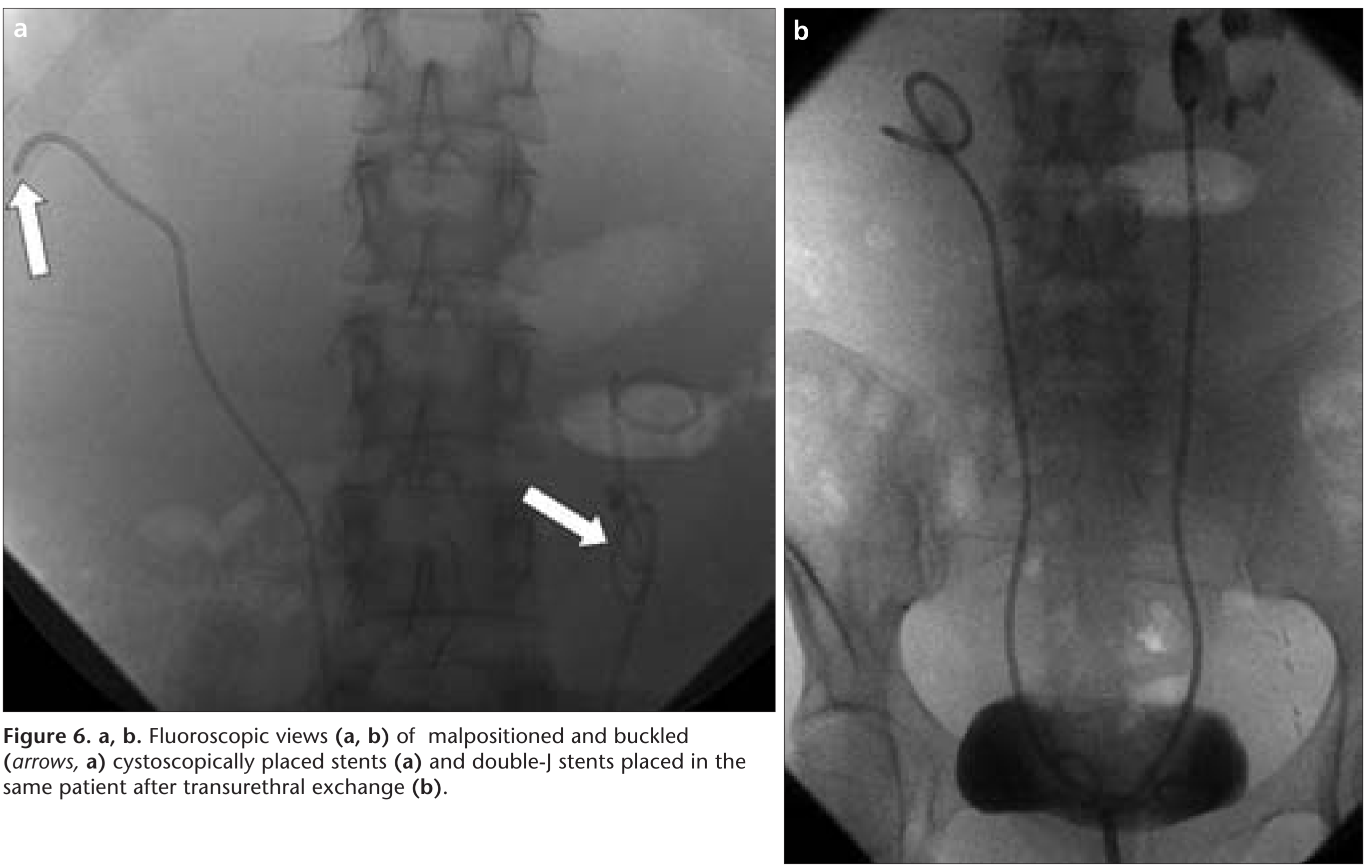

Figure 6. a, b. Fluoroscopic views **(a, b)** of malpositioned and buckled (*arrows,* **a**) cystoscopically placed stents **(a)** and double-J stents placed in the same patient after transurethral exchange **(b)**.

In those circumstances, snaring a wire that passed around the stent allowed us to retrieve stents (Fig. 4). A pigtail or Simmons catheter can aid in passing a wire around the stent. If used with a big enough snare or basket and oblique projections, this technique has a very high success rate. This may be the reason that none of our patients required cystoscopic replacement.

Malignant ureteral obstruction with extrinsic compression carries a higher risk for ureteral stent malfunction. Thinner stents in particular have poorer performance in these cases. Multiple parallel stents have been reported to have more successful outcomes (6–8). Placing multiple parallel stents was more successful in our limited experience with cases that had problems with single stents. Multiple stents may also help maintain dilation after balloon ureteroplasty of strictures in patients with benign disease or non-malignant strictures (such as radiation-induced strictures), allowing function similar to the large catheters placed after dilatation of benign biliary strictures.

Ureteral stricture formation complicates 2% to 10% of renal transplant surgeries and is the most common long-term urologic complication (9). Percutaneous management of these strictures with balloon dilation and long-term stenting has been shown to be successful (9–12). One has to be very careful when exchanging ureteral stents in transplant patients because of the short length of the ureter and, accordingly, the stent. If the stent is pulled out too much, one may lose access, which may necessitate cystoscopy or percutaneous nephrostomy. One way to avoid this problem is trying to grasp the tip, not the shaft, of the stent; another is advancing a wire alongside the stent before removing the stent. Negotiating a wire next to a present stent is much easier than gaining access to the ureter via retrograde approach, without a stent to mark the ureteral orifice and lead the wire.

Successful outcome with forceps has been reported, especially for antegrade or retrograde removal of ureteral stents (5, 13, 14). Although using a forceps can also allow one to grasp the stent at its shaft (not requiring a free-floating end), we preferred not to use forceps, so as to avoid traumatizing the bladder because of lack of direct visualization.

Park et al. published a series that included transurethral stent exchanges in 17 female patients; they also had a 100% technical success rate. They did not have any male patients; they used forceps in 3 patients in addition to the techniques we have described. They also found the wire snaring technique (which they called modified snare technique) useful after simple snare technique failure (14).

The biggest disadvantage of fluoroscopic guidance is the radiation associated with it. Although fluoroscopy is essential even with cystoscopic guidance, avoiding it while grasping the stent may decrease radiation dose. Performing the entire procedure under cystoscopic guidance but without fluoroscopy may cause improper placement. In our study, the 3-month patency rates after initial placements and replacements were 45.8% and 66.7%, respectively, but the difference was not statistically significant. This shows that, in our series, this technique allowed proper placement and stent survival to the same degree as cystoscopy-guided retrograde and fluoroscopy-guided antegrade techniques. However, we evaluated our data retrospectively and using multiple parallel stents only in exchange group might have caused a bias towards a longer survival in this group. Although, we had favorable outcome with this technique, randomized prospective studies are needed to better compare with the more established techniques.

In conclusion, fluoroscopy-guided retrograde double-J stent exchange is a safe and effective procedure and can easily be performed with equipment and techniques used in daily interventional practice.

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