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INTERVENTIONAL RADIOLOGY

ORIGINAL ARTICLE

Management of single double-J stent failure in malignant ureteral obstruction: tandem ureteral stenting with less frequent stent exchange

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PURPOSE

To evaluate the safety and efficacy of the placement and exchange of tandem ureteral stents (TUS) under fluoroscopic guidance in the management of indwelling single double-J stent (DJS) failure in patients with malignant ureteral obstruction. We also aimed to investigate whether the generally accepted exchange period of DJSs could be extended using TUS.

METHODS

This retrospective study involved 11 patients (10 female) with an age range of 27–64 years, median of 49 years, who underwent TUS (ipsilateral two 8F DJSs) placement due to indwelling single DJS failure occurring in less than 3 months. TUS exchanges were performed initially at 6-month intervals, and subsequent exchange intervals were extended to 9 and 12 months for seven patients. The interval from initial TUS placement to percutaneous nephrostomy, repeat exchange, or death was defined as the duration of stent patency.

RESULTS

Indwelling single DJS failure occurred during a median follow-up of 45 days (range, 35–60 days) in 14 ureters of 11 patients. TUS were successfully placed and exchanged with a technical success rate of 100% without any early major complications. Thirty-nine procedures (11 placement and 28 exchange procedures) in 55 ureters were performed. The median duration of urinary patency was significantly higher with TUS [300 days (range, 60–440 days)] compared with single DJSs [45 days (range, 35–60 days)] ($P < 0.001$).

CONCLUSION

The placement and exchange of TUS can be safely and effectively performed under fluoroscopic guidance. The need for frequent DJS exchange could be reduced with increased duration of stent patency using TUS.

KEYWORD

Tandem ureteral stents, double-J stent, malignant ureteral obstruction, retrograde exchange, stent failure

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Malignant ureteral obstruction (MUO) is a common manifestation of metastatic disease and requires urinary diversion. Ureteral stenting in an antegrade or retrograde fashion is an effective and safe method of choice in such cases, offering superior quality of life compared with percutaneous nephrostomy.[1-3] Nevertheless, ureteral polymeric double-J stent (DJS) malfunction rates are between 19% and 58%.[4-6] Metal-mesh stents, metallic stents, and tandem stents (two ipsilateral DJSs) are alternative options to maintain urinary diversion and percutaneous nephrostomy in cases of single DJS malfunction.[7-12]

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Tandem ureteral stenting (TUS) has been shown to have good clinical success by providing extra space and drainage capacity between the stents and ureteral wall in a limited number of studies.[8,10,12,13] However, these studies recommended the frequent exchange of the TUS every 3–6 months, similar to single DJS, and did not investigate whether the routine exchange period could be extended by using TUS.

In this study, our aim was to evaluate the safety and efficacy of the placement and exchange of TUS under fluoroscopic guidance in the management of indwelling single DJS failure in patients with MUO. We also aimed to investigate whether the generally accepted exchange period of DJSs could be extended with TUS, which might eliminate the need for frequent stent exchanges.

Methods

This retrospective study was approved by our institutional review board (HEK 09/64-3, 02/07/2009). Informed consent for each procedure was obtained prior to the procedure for all patients.

Patients

Eleven (10 female) patients with an age range of 27–64 years, median of 49 years, underwent TUS placement due to single DJS failure occurring in less than 3 months. An exchange of TUS was also performed in seven patients. TUS exchanges were performed initially at 6-month intervals, and subsequent exchange intervals were extended to 9 and 12 months after observing the patency of TUS. Ultrasound examinations were routinely performed on follow-up every 3 months after TUS placement; each patient had an empty bladder and was in a supine position to check for the presence of hydronephrosis.

Main points

- Ureteral stenting with a single double-J stent (DJS) is an established method of choice in the management of malignant ureteral obstruction.
- Tandem ureteral stents (TUS) have been shown to have better clinical success and higher patency rates. However, previous studies suggest the frequent exchange of TUS every 3–6 months, similar to single DJSs.
- The need for frequent DJS exchange could be reduced with TUS, which may maintain ureteral patency for up to 9–12 months.

The time interval from the initial TUS placement to percutaneous nephrostomy, exchange time, or death was defined as the duration of stent patency. The results of the treatment were evaluated by reviewing patients' electronic records through the Picture Archiving and Communication System. Complications were classified according to the Cardiovascular and Interventional Radiological Society of Europe classification system.[14]

Technique

Routine hemogram, blood biochemistry, and the coagulation profile were checked before each procedure.

All patients received prophylactic broad-spectrum antibiotics prior to the procedure. All procedures, including antegrade single DJS placements, were performed in the interventional radiology unit with the patient under conscious sedation. A combination of fentanyl (50–100 µg), midazolam (3–4 mg), ketamine (10–20 mg), and propofol (20–50 mg) was used for sedation.

The TUS placement was performed using the access route gained by retrieving the indwelling single DJS using the guide wire lasso technique.[2] First, a 9-10F vascular sheath was placed inside the bladder over a 0.035-inch hydrophilic guide wire (Terumo, Japan). A 0.035-inch guide wire (Starter Guide Wire, Bentson; Boston Scientific, USA), folded in two, was then inserted to create a lasso in the bladder. One end of the folded wire was advanced while holding the other steady to manipulate the lasso to pass through the pigtail or around the shaft of the stent. Once the indwelling stent was retrieved from the bladder, care was taken not to lose access to the renal pelvis by maintaining the upper end of the DJS in the ureter. A 0.035-inch guide wire (Terumo, Japan) was inserted through the withdrawn stent to reach the renal pelvis. After reaching the renal pelvis, a 5F catheter (Imager II Angiographic Catheter, Bern; Boston Scientific, USA) was placed over the hydrophilic guide wire, and this was exchanged for a stiff guide wire (Amplatz, Super Stiff; Boston Scientific USA). Dilatation of the ureteral stricture with an 8 mm balloon catheter was performed. After advancing the sheath to the distal ureter to maintain access for the second stent, a 5F catheter and a hydrophilic guide wire were inserted in retrograde fashion through the sheath, and the ureteral stricture was passed. After reaching the collecting system, the second stiff guide wire was left there. Two parallel 8F DJ stents (Flexima Ureteral Stent, Boston Scientific, USA) were inserted separately with the support of pushers through a sheath that had been advanced over one of the wires. The nylon thread attached to the proximal part of the first stent was held tightly to prevent migration while pushing the second stent through the ureter. After obtaining the desired position of both stents, the nylon threads of both stents were removed (Figure 1). To exchange the TUS, the same retrograde approach was used (Supplementary Video 1).

For the male patient, the technique was the same, except a longer introducer sheath and a longer nylon thread were used to compensate for the longer urethra.

If the occluded stent lumen and pores precluded the advancement of a guide wire through the stent, a vascular sheath with the valve end cut off was advanced over the occluded stent into the distal ureter. A hydrophilic guide wire was then inserted beside the occluded stent through the lumen of the sheath, and access to the collecting system was achieved. All ureteral stents, including initial failed ones and tandem stents, were 8F in size.

Statistical analysis

SPSS version 22.0 (IBM Corporation, Armonk, NY, USA) was used for statistical analysis. The Shapiro–Wilk test was used for normality analyses. Descriptive statistics of the data are presented as frequencies and percentages. Variables with normal distribution are shown as mean ± standard deviation, whereas non-normalized distributions are reported as median (min–max). The Mann–Whitney U test was used to investigate whether the duration of urinary patency could be increased with TUS; $P < 0.05$ was taken as the level of significance.

Results

A total of 11 patients (10 women) with an age range of 27–64 years, median of 49 years, were enrolled. Indwelling single DJS failure occurred at a median follow-up of 45 days (range, 35–60 days) in 11 patients with 14 ureters. In these patients, the single DJSs were exchanged for TUS, with a technical success rate of 100% in retrograde fashion. TUS were placed bilaterally in three patients. The most common history of malignancy was cervix carcinoma (n = 7, 60%) followed by breast carcinoma, (n = 2, 20%) ovarian carcinoma (n = 1, 10%), and sacral Ewing sarcoma (n = 1, 10%).

After the initial placement of TUS in 14 ureters, 41 exchange procedures were per-

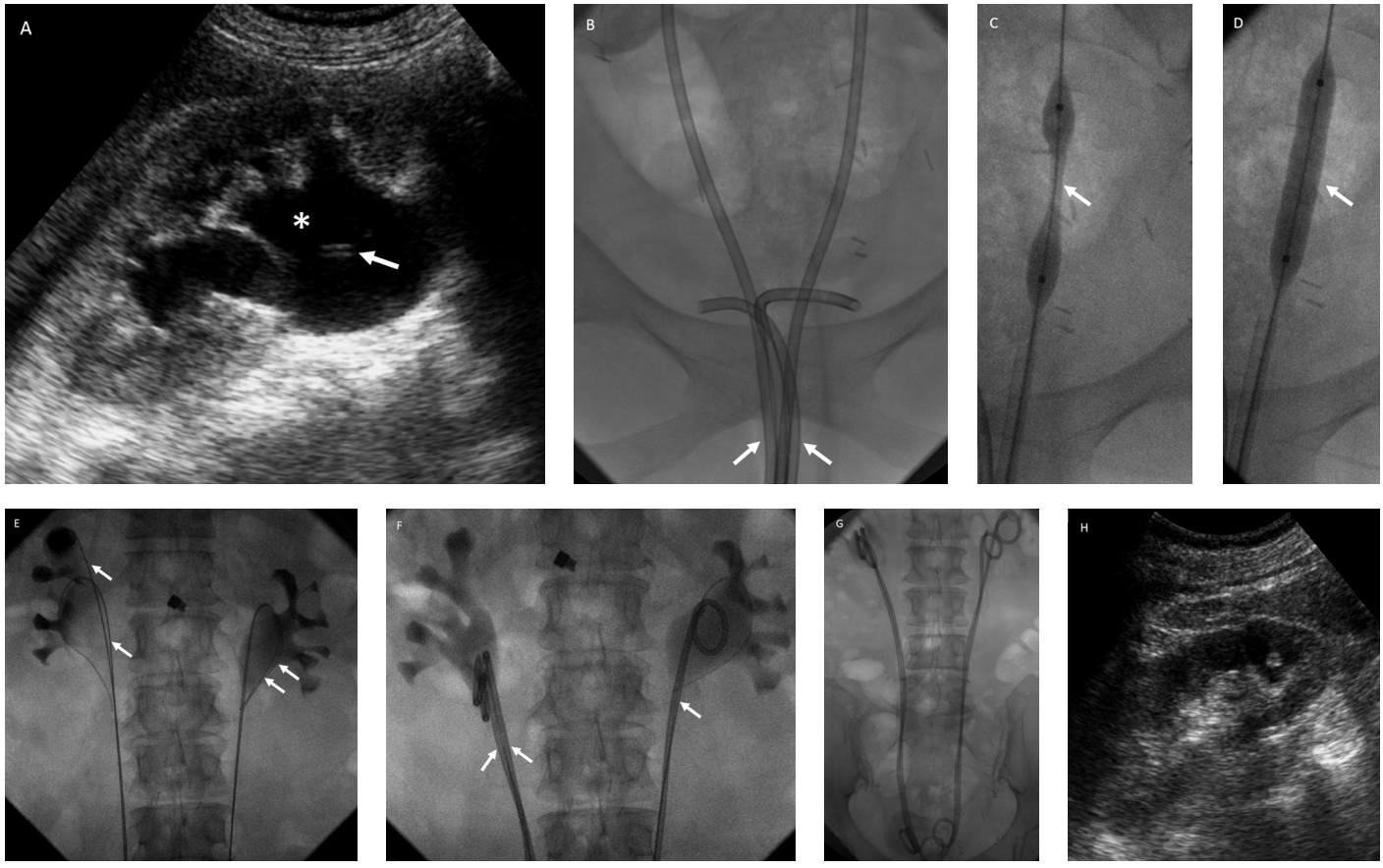

Figure 1. A 49-year-old woman with a previous history of cervix carcinoma underwent tandem ureteral stent (TUS) placement due to failure of indwelling single double-J stent (DJS). **(a)** Grayscale sonogram demonstrates presence of hydronephrosis (asterisk) due to non-functioning DJS (arrow). **(b)** First, the indwelling DJSs (arrows) were retrieved (retrograde fashion). **(c, d)** Prior to TUS placement, the ureteral strictures were dilated with balloon catheters (arrows). **(e)** Following balloon dilatation, bilateral guide wires (arrows) were guided into the renal pelvis. **(f, g)** Consequently, the ureteral stents were placed separately in retrograde fashion. **(h)** Grayscale sonogram obtained after the TUS placement reveals no hydronephrosis.

formed in 10 ureters of seven patients on 28 occasions, with a technical success rate of 100% (Figure 2). TUS exchange procedures were performed 22 times in one patient for both ureters (11 times each), eight times in one patient, five times in one patient, once in two patients, and once in two patients for both ureters (total of four procedures in two patients) (Figure 3).

In the remaining four patients, TUS exchange was not performed. Two of these patients died within a short time of follow-up after TUS placement (60 and 122 days); this was due to underlying disease progression, without any complications related to TUS. One patient is alive with patent TUS, and the other patient had a poor treatment response and underwent permanent percutaneous nephrostomy due to TUS occlusion 210 days after placement (Figure 3).

The median duration of urinary patency was significantly higher with TUS [300 days (range, 60–440 days)] compared with single DJSs [45 days (range 35–60 days)] ($P < 0.001$).

In 9 out of 55 ureters with TUS, patients presented with hydronephrosis due to stent occlusion at a median follow-up of 315 days (range, 210–365 days). In three ureters of two patients with TUS occlusion, temporary nephrostomy was performed due to pyonephrosis. After 1 month with temporary nephrostomy and subsequent TUS exchange, these two patients were catheter free with normal renal function on follow-up. However, one of these two patients underwent permanent nephrostomy 1535 days after temporary nephrostomy and five TUS exchange procedures because of borderline renal function. Further exchange procedures were not considered in this patient (patient no: 1). However, the remaining patient is still alive with normal renal function and patent TUS. Other patients underwent permanent nephrostomy because of infravesical obstruction caused by tumor progression (patient no: 4) and borderline renal function (patient no: 5) (Figure 2).

Neither mortality nor early complications related to TUS procedures occurred. Pyonephrosis was detected in 5 out of 55 ureters with TUS (9%) in two patients as a grade 3 late complication after 210, 335, and 365 days of patency; this was managed with percutaneous nephrostomy and TUS exchange procedures. Urinary tract infection (n = 4, 36.36%), lower urinary tract symptoms (n = 3, 27.27%), and hematuria (n = 3, 27.27%) were the grade 2 late complications. Hematuria was managed conservatively and resolved over time. Urinary tract infection was managed with outpatient oral antibiotic therapy.

Discussion

The results of our study reveal that the placement and exchange of TUS can be safely and successfully performed under fluoroscopic guidance to increase the duration of stent patency. Our results reporting a median duration of stent patency of 300 days also suggest that TUS might be changed at greater intervals than 3–6 months, as previously reported.[10,13,15]

A limited number of studies have reported the efficacy of TUS in indwelling single DJS failure.[8,10,12,13] These studies are summarized in Table 1. First, Liu and Hrebinko[13] used two 4.8F DJSs and reported no need for percuta-

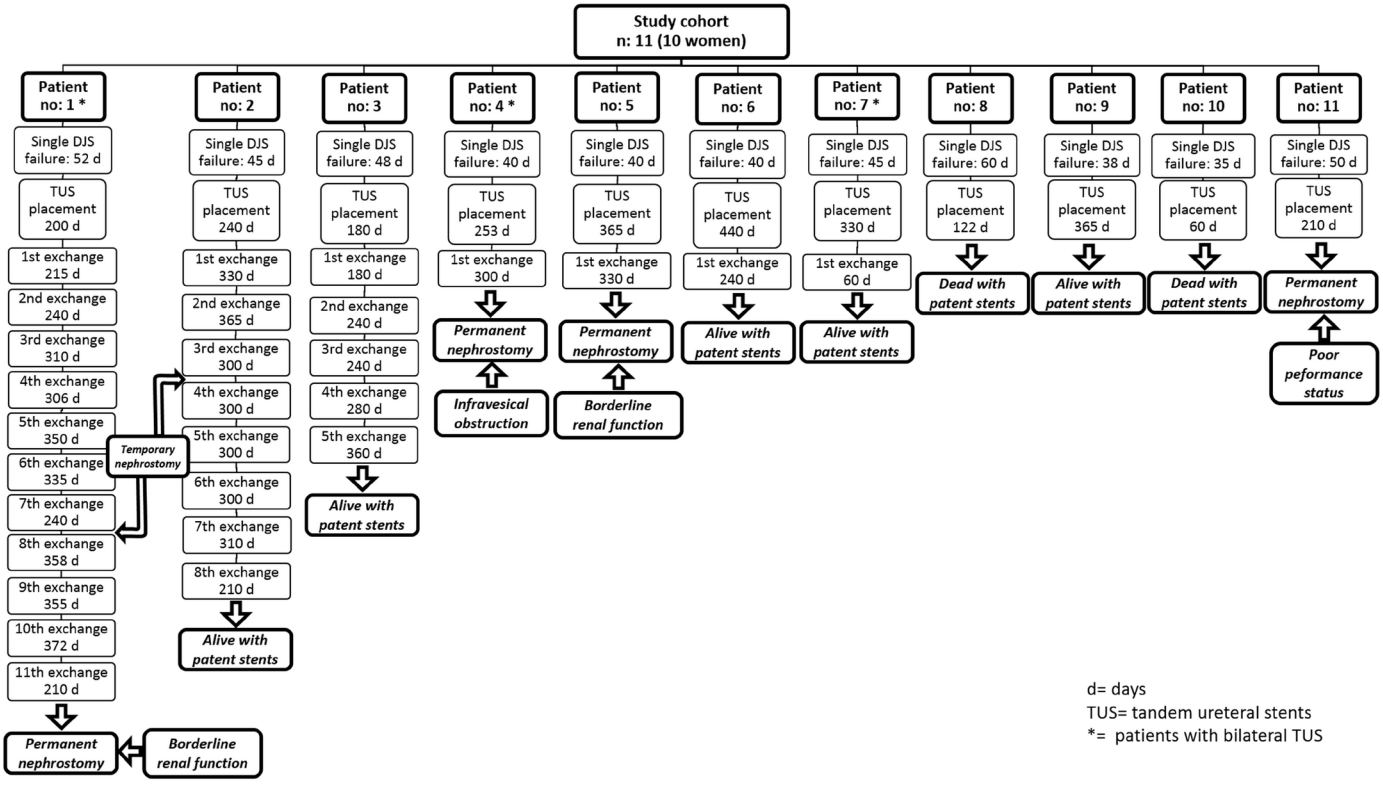

Figure 2. Patient outcomes after single double-J stent failure, tandem ureteral stent (TUS) placement, and TUS exchange procedures.

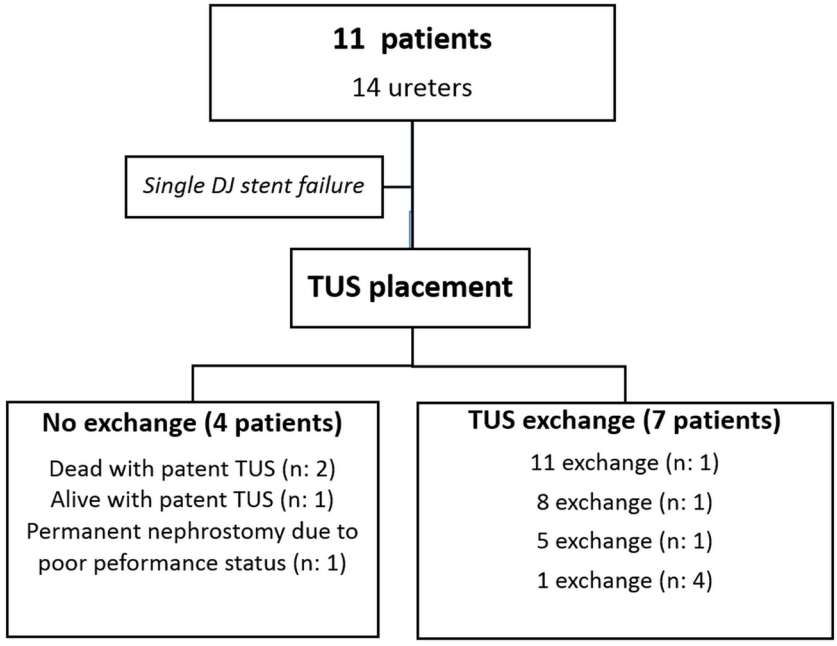

Figure 3. Study flowchart.

Table 1. Literature summary for the use of tandem ureteral stents in malignant ureteral obstruction

	Our results	Varnavas et al.[12]	Haifler et al.[17]	Ozyer and Dirim[10]	Elsamra et al.[16]	Liu et al.[9]	Chen et al.[18]	Rotariu et al.[15]	Fromer et al.[8]	Liu and Hrebinko[13]
Year	2020	2016	2020	2017	2013	2019	2011	2001	2002	1998
Number of patients	11	15	81	14	34	48	17	7	5	4
Number of exchanges	41	7	NA	7	15 pts (2–16 times)	NA	NA	NA	NA	NA
Stent size	2 8F	28F	2 6F	2 8/2 10F	2 6F	2 7F	2 6F	2 7F/ 8–6F	2x8F	2 4.7F
Mean dwell time of TUS between exchange	300 days*	156 days*	NA	181 days	128 days	214.7 days	NA	4–6 months	2–3 months	3 months
Technical success rate	100%	100%	100%***	95%	100%	95.2%	94.1%	100%	100%	100%
Method for placement	Retrograde	Retrograde	Retrograde	Antegrade/ retrograde	Retrograde	Antegrade	Antegrade	Retrograde	Retrograde	Retrograde
Guide for procedure	Fluoroscopy	Cystoscopy	Cystoscopy	Fluoroscopy	Cystoscopy	Fluoroscopy/ cystoscopy**	Fluoroscopy	Cystoscopy	Cystoscopy	Cystoscopy
Type of anesthesia	IV sedation	General	General	IV sedation	NA	Local analgesia	NA	General	NA	IV sedation

*median; **for exchange; ***procedure failed for three patients, who were excluded from the study cohort. Pts, patients; TUS, tandem ureteral stent.

neous nephrostomy, with a mean follow-up of 5.8 months in four patients. Rotariu et al.[15] achieved marked improvement in hydronephrosis and the alleviation of flank pain in seven patients with urinary diversion failure with indwelling single ureteral stents during a mean follow-up of 16 months. They used two 7F stents or a combination of 8F/6F DJSs, and the routine exchange period was every 4 to 6 months.[15] Fromer et al.[8] were able to successfully manage hydronephrosis and renal insufficiency by using two 8F DJSs in five patients and eight ureters with indwelling single DJS failure. The mean follow-up period was 12 months in their study. One patient developed pyonephrosis and underwent permanent nephrostomy.[8] Elsamra et al.[16] reported a 13% TUS failure rate in 34 patients (39 renal units) who underwent a total of 132 procedures for MUO. Mean stent duration was 128 days (4.3 months) with a mean follow-up of 23 months. Varnavas et al.[12] performed 15 cystoscopic primary TUS insertions and 7 subsequent exchanges in 15 patients with MUO. The failure rate was 20% at 3 months, and the median stent patency was 156 days. Haifler et al.[17] performed cystoscopic two-6F TUS placement in 81 patients with MUO and reported a 27.1% failure rate during a median follow-up of 32 weeks.

Ozyer and Dirim[10] investigated the efficacy and safety of TUS in 14 women experiencing gynecological malignancies. They reported a stent failure rate of 21.4% during a mean follow-up of 180.1 days; the median exchange time was 181 days. They suggested that the routine exchange of TUS might be extended to 6 months.[10] Chen et al.[18] reported a higher failure rate of 72.7% with TUS at 3 months after placement in patients with MUO. In contrast to our study and previous ones, they inserted a new DJS alongside the indwelling malfunctioning ureteral stent instead of inserting two new stents. Their higher failure rate might be attributed to this technique because an indwelling malfunctioning ureteral stent could be a source of infection and encrustation and a reason for obstruction. Liu et al.[9] recently compared antegrade single and TUS in the management of MUO. They reported significantly improved ureteral patency with TUS (214.7 ± 21.0 days) compared with single ureteral stents (176.7 ± 21.3 days), with technical success rates of 93.6% and 95.2%, respectively. However, they did not mention the failure rates and exchange times of single and TUS in the follow-up period.

Metallic stents have also been used to maintain patency in MUO, and most studies have reported failure rates of approximately 20% to 40%.[4,7,19] With metallic spiral-coiled double-pigtail stents (Resonance, Cook Medical), a 79% overall success rate and 1% migration rate have been reported.[20] Self-expandable coated metallic stents (Uventa, Taewong Medical) have been found to be superior to DJSs in terms of patency in MUO.[7] Despite the increased patency rates of metallic stents compared with single DJSs, their cost effectiveness remains questionable, and there can also be issues with difficult technical insertion, exchange, and high migration rates.[21-24] We can conclude that TUS seems to be a strong alternative to metallic ureteral stents in patients with single DJS failure, offering a long duration of ureteral patency for up to 9–12 months. Because single DJS exchange every 3–4 months is associated with increased cost and procedural risks, Taylor et al.[11] compared the costs associated with metallic resonance ureteral stents and single DJSs. They found a cost reduction of roughly 48%, 61%, and 74% with metal stents for 3, 4, and 6 DJS exchanges per year, respectively.[11] However, no study has investigated the additional benefit of TUS in reducing the frequency of stent exchange and the financial cost savings to patients. Elsamra et al.[16] reported the average exchange of TUS at a mean of 4.3 months (128 days) for MUO. They also hypothesized that TUS could be exchanged at greater intervals than 4 months; thus, the cost analysis might no longer favor metallic stents.[4] Herein, our results support this hypothesis, demonstrating an increased median dwell time of TUS of approximately 10 months (300 days). In our study, initial TUS exchanges were performed at 6 months with no failure. After observing the efficacy of TUS in durations of 6 months, subsequent exchanges were performed at greater intervals of up to 9 and 12 months. This is the longest duration of ureteral patency with TUS in patients with indwelling single DJS failure. Our longer patency rate might be attributed to assessing the presence of hydronephrosis every 3 months after TUS placement rather than conducting a routine exchange.

Our study has several limitations including its retrospective nature with a relatively

small patient population. Another potential limitation is the heterogeneity of etiologies of MUO. However, our study has the longest follow-up and dwell time of TUS, showing an increased stent patency rate (300 days).

In conclusion, the placement and retrograde exchange of TUS are safe and effective in patients with MUO. The need for frequent DJS exchange could be reduced with TUS, which may maintain ureteral patency for up to 9–12 months. This might be helpful in reducing health-care costs.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Hyams ES, Shah O. Malignant extrinsic ureteral obstruction: a survey of urologists and medical oncologists regarding treatment patterns and preferences. *Urology.* 2008;72(1):51-56. [CrossRef]
2. Ozkan O, Akinci D, Bozlar U, Ustünsöz B, Ozmen M, Akhan O. Retrograde ureteral stent exchange under fluoroscopic guidance. *Diagn Interv Radiol.* 2009;15(1):51-56. [CrossRef]
3. Song Y, Fei X, Song Y. Percutaneous nephrostomy versus indwelling ureteral stent in the management of gynecological malignancies. *Int J Gynecol Cancer.* 2012;22(4):697-702. [CrossRef]
4. Elsamra SE, Leavitt DA, Motato HA, et al. Stenting for malignant ureteral obstruction: tandem, metal or metal-mesh stents. *Int J Urol.* 2015;22(7):629-636. [CrossRef]
5. Feng MI, Bellman GC, Shapiro CE. Management of ureteral obstruction secondary to pelvic malignancies. *J Endourol.* 1999;13(7):521-524. [CrossRef]
6. Yossepowitch O, Lifshitz DA, Dekel Y, et al. Predicting the success of retrograde stenting for managing ureteral obstruction. *J Urol.* 2001;166(5):1746-1749. [CrossRef]
7. Chung HH, Kim MD, Won JY, et al. Multicenter experience of the newly designed covered metallic ureteral stent for malignant ureteral occlusion: comparison with double J stent insertion. *Cardiovasc Intervent Radiol.* 2014;37(2):463-470. [CrossRef]
8. Fromer DL, Shabsigh A, Benson MC, Gupta M. Simultaneous multiple double pigtail stents for malignant ureteral obstruction. *Urology.* 2002;59(4):594-596. [CrossRef]
9. Liu KL, Lee BC, Ye JD, et al. Comparison of single and tandem ureteral stenting for malignant ureteral obstruction: a prospective study of 104 patients. *Eur Radiol.* 2019;29(2):628-635. [CrossRef]
10. Ozyer U, Dirim A. Tandem ureteral stents in the management of double-J stent dysfunction in gynecological malignancies. *Diagn Interv Imaging.* 2017;98(9):601-608. [CrossRef]
11. Taylor ER, Benson AD, Schwartz BF. Cost analysis of metallic ureteral stents with 12 months of follow-up. *J Endourol.* 2012;26(7):917-921. [CrossRef]
12. Varnavas M, Bolgeri M, Mukhtar S, Anson K. The role of tandem double-J ureteral stents in the management of malignant ureteral obstruction. *J Endourol.* 2016;30(4):465-468. [CrossRef]
13. Liu JS, Hrebinko RL. The use of 2 ipsilateral ureteral stents for relief of ureteral obstruction from extrinsic compression. *J Urol.* 1998;159(1):179-181. [CrossRef]
14. Filippiadis DK, Binkert C, Pellerin O, Hoffmann RT, Krajina A, Pereira PL. Cirse quality assurance document and standards for classification of complications: the cirse classification system. *Cardiovasc Intervent Radiol.* 2017;40(8):1141-1146. [CrossRef]
15. Rotariu P, Yohannes P, Alexianu M, et al. Management of malignant extrinsic compression of the ureter by simultaneous placement of two ipsilateral ureteral stents. *J Endourol.* 2001;15(10):979-983. [CrossRef]
16. Elsamra SE, Motato H, Moreira DM, et al. Tandem ureteral stents for the decompression of malignant and benign obstructive uropathy. *J Endourol.* 2013;27(10):1297-1302. [CrossRef]
17. Haifler M, Shvero A, Zilberman D, et al. Tandem ureteral stents for malignant ureteral obstruction. *J Endourol.* 2020;34(2):222-226. [CrossRef]
18. Chen HC, Shen SH, Wang JH, et al. Parallel second stent placement for refractory ureteral stent malfunction in malignant ureteral obstruction. *J Vasc Interv Radiol.* 2011;22(7):1012-1016. [CrossRef]
19. Kim KH, Cho KS, Ham WS, Hong SJ, Han KS. Early application of permanent metallic mesh stent in substitution for temporary polymeric ureteral stent reduces unnecessary ureteral procedures in patients with malignant ureteral obstruction. *Urology.* 2015;86(3):459-464. [CrossRef]
20. Khoo CC, Abboudi H, Cartwright R, El-Husseiny T, Dasgupta R. Metallic ureteric stents in malignant ureteric obstruction: a systematic review. *Urology.* 2018;118:12-20. [CrossRef]
21. Goldsmith ZG, Wang AJ, Bañez LL, et al. Outcomes of metallic stents for malignant ureteral obstruction. *J Urol.* 2012;188(3):851-855. [CrossRef]
22. Lang EK, Irwin RJ, Lopez-Martinez RA, LaNasa J Jr, Kasabian N, Watson RA. Placement of metallic stents in ureters obstructed by carcinoma of the cervix to maintain renal function in patients undergoing long-term chemotherapy. *AJR Am J Roentgenol.* 1998;171(6):1595-1599. [CrossRef]
23. Liatsikos EN, Kagadis GC, Barbalias GA, Siablis D. Ureteral metal stents: a tale or a tool? *J Endourol.* 2005;19(8):934-939. [CrossRef]
24. vanSonnenberg E, D'Agostino HB, O'Laoide R, et al. Malignant ureteral obstruction: treatment with metal stents--technique, results, and observations with percutaneous intraluminal US. *Radiology.* 1994;191(3):765-768. [CrossRef]

Supplementary Video 1. https://www.youtube.com/watch?v=QjFWQ0CprF0