Diagn Interv Radiol 2026; DOI: 10.4274/dir.2025.253520

INTERVENTIONAL RADIOLOGY

ORIGINAL ARTICLE

Factors affecting the difficulty of transurethral double J stent removal in patients with renal transplants

Elisabeth R. Seyferth
Gregory J. Nadolski
Jeffrey I. Mondschein
Ryan M. Cobb
Scott O. Trerotola

Division of Interventional Radiology, Department of Radiology, University of Pennsylvania Perelman School of Medicine, Philadelphia, United States of America

PURPOSE

This study aimed to identify factors affecting the difficulty of transurethral double J (JJ) stent removal in patients with renal transplants, using fluoroscopy time as a surrogate for procedural difficulty.

METHODS

Between January 2016 and November 2023, transurethral stent removal was attempted in 996 procedures (342 women, mean age 53.1 years). The following potential predictors of fluoroscopy time were investigated using bivariate analysis: patient age, sex, performance of the procedure by an attending physician alone, time from stent placement to removal, configuration and location of stent loop in the bladder, and device used for removal. For each stent retrieval device type, a multivariable model was created, including covariates of interest.

RESULTS

Stent removal was technically successful in 99.2% of procedures. The mean fluoroscopy time for successful removals was 4.9 minutes (range 0.1–39.6 minutes). There were 5 adverse events (5/996, 0.5%), consisting of 3 moderate and 2 mild severity events. A complex snare was used in 72.5% of procedures, a simple snare in 6.0%, a looped guidewire in 31.6%, and forceps in 2.5%; multiple devices were used in 11.9% of procedures. Patient sex, number of intravesicular stent loops, and use of a simple snare, looped guidewire, and forceps predicted fluoroscopy time in bivariate analyses. In multivariable models, mean fluoroscopy time was estimated to be 0.78 minutes less when a complex snare was used ($P = 0.018$), 1.87 minutes greater when a simple snare was used ($P = 0.002$), and 0.86 minutes greater when a looped guidewire was used ($P = 0.014$); the use of forceps was not significant. When procedures using multiple devices were excluded, only the use of a complex snare and looped guidewire remained significant.

CONCLUSION

Transurethral JJ stent removal has a high success rate and can be performed with a single device in most cases. Use of complex snares and looped guidewires is associated with decreased and increased fluoroscopy time, respectively, suggesting that use of these devices may impact procedural difficulty.

CLINICAL SIGNIFICANCE

These results demonstrate that fluoroscopically guided transurethral JJ stent retrieval is an efficient technique that may be offered instead of cystoscopic stent removal. Careful choice of removal device may improve speed and ease of transurethral stent retrieval.

KEYWORDS

Renal transplantation, renal, double J stent, snare

Corresponding author: Elisabeth R. Seyferth

E-mail: Elisabeth.seyferth@pennmedicine.upenn.edu

Received 12 August 2025; revision requested 08 September 2025; accepted 15 October 2025.

Epub: 12.11.2025

Publication date: 02.01.2026

DOI: 10.4274/dir.2025.253520

You may cite this article as: Seyferth ER, Nadolski GJ, Mondschein JI, Cobb RM, Trerotola SO. Factors affecting the difficulty of transurethral double J stent removal in patients with renal transplants. *Diagn Interv Radiol.* 2026;32(1):119-124.

Double J (JJ) ureteral stent placement has become commonplace in renal transplantation, as data show that stent placement results in reduced rates of post-operative urinary leakage and ureteral obstruction.[1-3] A Cochrane systematic review found that the incidence of major urologic complications in renal transplants is reduced with routine prophylactic stenting, with a number needed to treat of 13 to prevent such a complication.[4]

Stents are typically removed within several weeks following transplant, either under fluoroscopic guidance via a sheath inserted into the urethra or using cystoscopy; removal by tying the stent end to a Foley catheter and then removing both by retracting the Foley, as well as other techniques not guided by imaging, may also be used.[5-9]

When performed under fluoroscopy via a transurethral approach, several different stent capture devices for the removal or exchange of JJ stents have been used, including complex (multi-lobed) snares, simple (single-lobed) snares,[10,11] grasping devices (forceps),[12] a guidewire that is looped and bent to form a lasso ("looped guidewire"),[12-14] and a "modified snare" technique in which a guidewire is advanced around the stent and then captured with a snare to form a lasso.[5] Sometimes, a variety of these devices and techniques is required, particularly in the era of supply chain disruptions due to the COVID-19 pandemic and other global events. Understanding how the choice of removal device and other controllable factors affect-procedural difficulty is important in maintaining procedural efficiency despite these challenges. The goal of this study is to assess the technical success of the procedure and factors that affect fluoroscopy time, using this variable as a surrogate for procedural difficulty.

Main points

- Double J (JJ) ureteral stents are routinely placed at the time of renal transplantation, and stent removal is required postoperatively. In 996 patients with renal transplants in this study, JJ stent removal performed as an outpatient procedure by interventional radiology via a transurethral approach had a >99% technical success rate, with a mean fluoroscopy time of <5 minutes.
- Complex snares, simple snares, looped guidewires, and forceps were used to capture JJ stents, and a single removal device was successful in the great majority of procedures.
- The use of a complex snare and the use of a looped guidewire were associated with decreased and increased fluoroscopy time, respectively, suggesting differences in procedural difficulty when these stent capture devices were used.

Methods

Data collection and baseline characteristics

Patients with renal transplants who underwent transurethral JJ stent removal at a single academic center between January 2016 and November 2023 were identified retrospectively using a procedural database. The study was approved on July 8, 2024 by the Institutional Review Board of the University of Pennsylvania (protocol #829470), and a waiver of informed consent was obtained. Data were collected from the patient chart, imaging dictation, and the database of devices used in each procedure (QSight, Owens & Minor, Inc., Richmond, VA, USA). Procedures in which the intent was to remove a renal transplant JJ stent via a transurethral approach were included. The exclusion criteria for analysis of predictors of fluoroscopy time were removal of multiple stents in the same procedure, performance of another procedure using fluoroscopy in the same encounter, inconsistency of the removal device noted in the imaging dictation and that noted in the procedural device database, the distal stent terminating in the ureter or urethra, use of ultrasound only, or technical failure. Technical success was defined as the complete removal of the JJ stent from the patient. Adverse events were identified and classified using the Society of Interventional Radiology guidelines.[15]

A total of 996 patients underwent stent removal in this period; 116 were excluded from the analysis of factors correlating with total fluoroscopic time (Figure 1). After exclusions, transurethral JJ stent removal was performed in 880 procedures. Patient age ranged from 20 to 77 years, with a mean age of 53.1 ± 12.9 years (Table 1). A total of 61.1% of the patients were male (538 of 880), and 38.7% were female (342 of 880). The attending physicians' years of experience ranged from <1 year to >35 years, with a mean of 14.4 ± 9.6 years. The time to stent removal ranged from 4 to 211 days, with a mean of 33.6 ± 10.8 days.

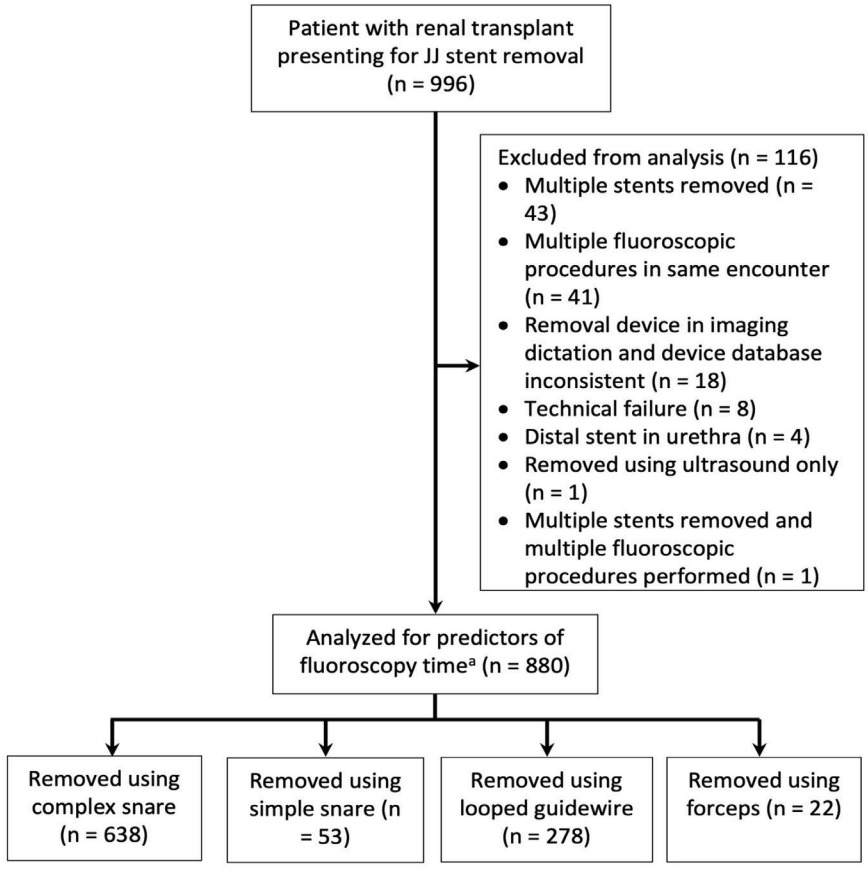

Figure 1. Flowchart of the study population. [a], note that multiple devices were used in some procedures; JJ, double J.

Table 1. Baseline characteristics of patients and procedures, and bivariate associations between characteristics and fluoroscopy time

Variable	Mean (SD) or count (%) (n = 880)	*P* value
Sex (female)	342 (38.9%)	< 0.001
Age (years)	53.1 (12.9)	Not significant
Performed by attending physician alone	166 (18.9%)	Not significant
Attending physician years of experience	14.4 (9.6)	Not significant
Time to stent removal (days)	33.6 (10.8)	Not significant
Double J loops in the bladder		0.016
No complete loop	58 (6.8%)	
Single	523 (61.7%)	
Double	267 (31.5%)	
Double J loop bladder quadrant		Not significant
12 to 3 o'clock	92 (10.9%)	
3 to 6 o'clock	348 (41.2%)	
6 to 9 o'clock	219 (25.9%)	
9 to 12 o'clock	81 (9.6%)	
Central	105 (12.4%)	
Double J loop located in bladder half opposite from kidney	572 (67.7%)	Not significant
Use of complex snare	638 (72.5%)	Not significant
Use of simple snare	53 (6.0%)	< 0.001
Use of looped guidewire	278 (31.6%)	< 0.001
Use of forceps	22 (2.5%)	< 0.001
Use of multiple devices	105 (11.9%)	< 0.001

SD, standard deviation.

Procedural technique

Prophylactic pre-procedural intravenous antibiotics were administered, and the procedure was performed under moderate sedation. After insertion of a sheath through the urethra and into the bladder over a wire, the tip of the JJ stent was captured with a complex snare [i.e., a multi-lobed or three-dimensional snare, such as an EN Snare® (Merit Medical, South Jordan, UT, United States)], simple snare [i.e., a single-lobed or gooseneck-type snare, such as a ONE Snare® (Merit Medical, South Jordan, UT, United States)], looped guidewire, or forceps and was removed through the sheath or together with the sheath (Figure 2). The looped guidewire technique has been previously described;[13] in brief, a 0.018" or 0.025" guidewire was bent into a lasso shape and advanced through the sheath and then maneuvered around the distal tip of the JJ stent before being retracted to capture the stent between the lasso and the sheath tip. The guidewire, sheath, and JJ stent were then removed together, and a final fluoroscopic image was obtained to document complete removal.

Statistical analysis

Initially, technical success was calculated from all 996 procedures performed. After ex-

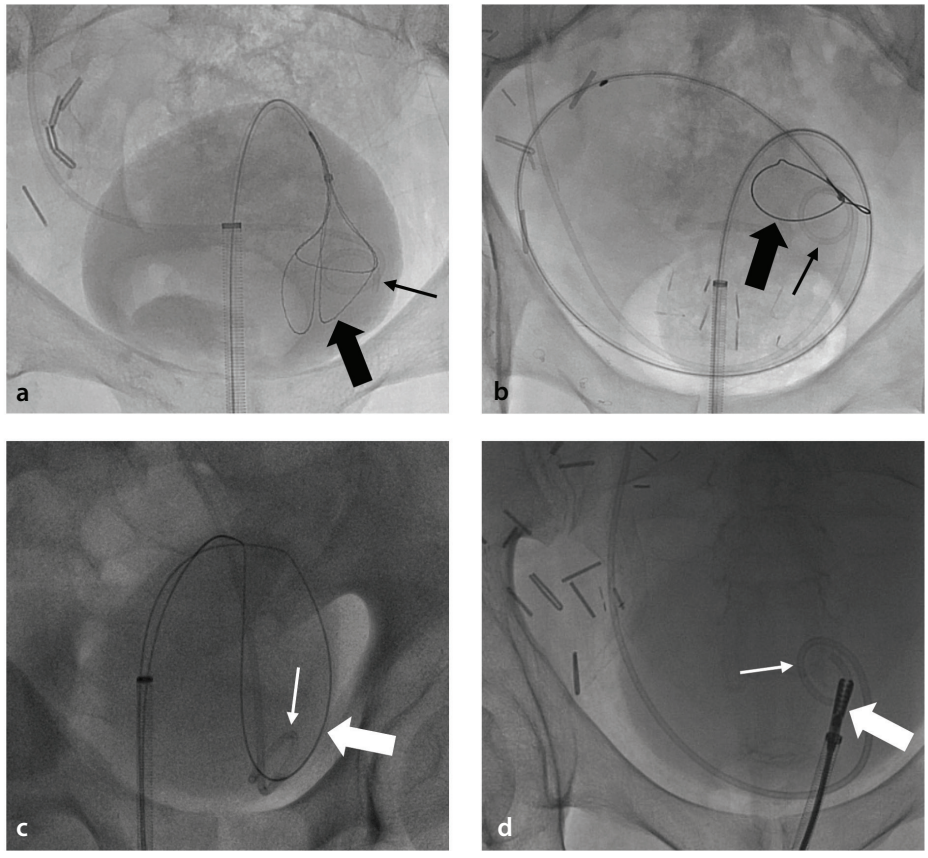

Figure 2. Four methods of transurethral double J (JJ) stent removal performed via a sheath positioned in the bladder. In each frame, the removal device is denoted by the thick arrow and the end of the JJ stent by the thin arrow. Removal with **(a)** complex snare (i.e., multi-lobed or three-dimensional snare), **(b)** simple snare (i.e., single-lobed or gooseneck-type snare), **(c)** looped guidewire, and **(d)** forceps are shown.

clusions, summary statistics were computed as means and standard deviations for continuous variables. Percentages and frequencies were used to summarize categorical measures. Bivariate associations between each predictor variable and the fluoroscopy time outcome measure were obtained using linear regression. Next, a separate multivariable linear regression model was constructed for each removal device type to assess the extent to which device types were predictive of fluoroscopy time while adjusting for covariates of interest. Each of these separate models was adjusted for patient sex, performance of the procedure by an attending physician alone (i.e., without a resident/fellow trainee), the attending physician's years of experience, number of complete JJ stent loops in the bladder, location of the distal JJ loop within the bladder, time from stent placement to stent removal, and use of multiple devices in a single procedure. In addition, a sensitivity analysis was conducted in which procedures with multiple devices were excluded from multivariable models. Statistical analysis was conducted using SAS Version 9.4 for Windows. An alpha level of 0.05 was used to determine statistical significance.

Results

Technical success was achieved in 99.2% of procedures (988/996). The most common cause of failure was heavy encrustation of the stent, resulting in the inability to remove it. In three such patients, the stent was captured and pulled to the perineum, but the proximal loop could not be dislodged from the renal pelvis; the distal loop was then replaced in the bladder. In all three patients, the stents were ultimately removed using percutaneous nephrolithotomy after failed cystoscopic removal. In another patient, the intravesicular portion of the stent fractured as it was pulled; the fractured portion was removed and was found to be heavily encrusted. The retained stent portion was then successfully removed using cystoscopy. The times between stent placement and stent removal in these four patients with encrustation were 28 days, 36 days, 69 days, and approximately 15 years (this patient had had renal transplantation performed at an outside institution). The other failures consisted of one patient who did not tolerate placement of a sheath through the urethra; one in whom the procedure was aborted due to perforation at the proximal urethra during wire and catheter placement into the bladder; one in whom the distal JJ loop was found to be in the ureter on the initial image; and one patient, who had a preexisting percutaneous nephrostomy tube, in whom multiple initial attempts to capture the JJ loop with various snares failed, and therefore the stent was captured via the existing nephrostomy access. There were five adverse events (5/996, 0.5%), consisting of three moderate and two mild severity events (Table 2). There were no severe or life-threatening adverse events.

After exclusions, fluoroscopy time for successful cases ranged from 0.1 minutes to 39.6 minutes, with a mean of 4.9 ± 4.8 minutes. A single device was successful in 88.1% of cases, with multiple devices used in 11.9% of procedures (Table 1). A complex snare was used in 638 (72.5%) procedures, a simple snare in 53 (6.0%), a looped guidewire in 278 (31.6%), and forceps in 22 (2.5%). A 27–45 mm EN Snare® was the most used complex snare, accounting for 96.2% (614/638) of cases in which a complex snare was used; 4–8 mm, 12–20 mm, and 18–30 mm EN Snares® were used in 0.2% (1/638), 1.6% (10/638), and 2.7% (17/638) of cases in which a complex snare was used**,** respectively. The most used simple snare was a 35 mm snare (92.5%, 49/53 cases); a 5 mm snare was used in 1.9% (1/53) and a 25 mm snare in 5.7% (3/53) of cases in which a simple snare was used. A 0.025" wire was used in 93.2% (259/278) of cases in which a looped guidewire was used, and a 0.018" wire was used in 9.7% (27/278) of these cases.

Bivariate analysis

Patient sex ($P < 0.001$), JJ loops in the bladder ($P = 0.016$), and the use of a simple snare ($P < 0.001$), looped guidewire ($P < 0.001$), or forceps ($P < 0.001$) were identified as predictors of fluoroscopy time in bivariate analyses (Table 1). Male patients had a mean fluoroscopy time of 5.4 ± 0.2 minutes, and female patients had a mean fluoroscopy time of 4.1 ± 0.3 minutes. JJ stents with no complete pigtail loop in the bladder were associated with increased fluoroscopy time compared with those with single and double loops in the bladder, with mean differences of 1.3 minutes ($P = 0.041$) and 1.9 minutes ($P = 0.005$), respectively. The time from stent placement to stent removal, performance of the procedure by an attending physician alone without a trainee, attending physician years of experience, location of the distal JJ loop in the bladder, positioning of the distal JJ loop in the bladder half opposite from the transplant kidney, and use of a complex snare were not found to be significantly associated with fluoroscopy time ($P > 0.05$).

Multivariable analysis

Multivariable models by device type adjusted for potential confounders estimated mean fluoroscopy time to be 0.78 ± 0.33 minutes less when a complex snare was used ($P = 0.018$), 1.87 ± 0.61 minutes greater when a simple snare was used ($P = 0.002$), and 0.86 ± 0.35 minutes greater when a looped guidewire was used ($P = 0.014$) (Table 3). The use of forceps was no longer significantly associated with fluoroscopy time in this model. Patient sex remained significantly associated with fluoroscopy time within each model, with female sex associated with a decreased mean fluoroscopy time ranging

Table 2. Adverse events associated with double J (JJ) stent removal in 996 procedures

Event severity	Description and outcome
Mild	Perforation of hydrophilic wire through bladder during sheath placement. Foley catheter was placed after JJ removal due to hematuria. Urine cleared in recovery and Foley was removed. Patient voided without issue.
Mild	Perforation of hydrophilic wire through urethra during sheath placement. Foley catheter was placed after JJ removal. After discussion with transplant team, Foley was removed in recovery area. Patient voided without issue.
Moderate	Perforation of wire through proximal urethra/bladder neck. JJ removal aborted, Foley left in place. Patient returned 1 week later for repeat attempt and JJ stent was removed. Foley catheter removed at that time. Following this, patient had acute urinary retention requiring outpatient Foley replacement, removed after 1 day.
Moderate	JJ removal was performed while patient was on oral antibiotics for urinary tract infection (UTI). Single dose of ceftriaxone was also given pre-procedure. Patient was admitted to hospital for fever and nausea 8 days after JJ removal, found to have pseudomonas UTI. Sent home the next day on course of oral antibiotics.
Moderate	Fracture of stent during removal; removed portion found to be heavily encrusted. Retained portion removed through cystoscopy.

Table 3. Multivariate associations between device used and fluoroscopy time[a]

Variable	Change in estimated mean fluoro time (minutes)	Standard error	*P* value
Use of complex snare	−0.78	± 0.33	0.018
Use of simple snare	1.87	± 0.61	0.002
Use of looped guidewire	0.86	± 0.35	0.014

[a]Each model was adjusted for the following covariates of interest: patient sex, whether the procedure was performed by an attending physician alone, the attending physician's years of experience, number of complete loops at the distal end of the double J (JJ) stent in the bladder ("JJ loops in bladder"), location of the distal JJ loop within the bladder, time from stent placement to stent removal, and use of multiple devices in a single procedure.

from 0.95 ± 0.29 minutes ($P = 0.001$) in the model assessing the effect of simple snare use to 1.07 ± 0.29 minutes ($P < 0.001$) when assessing looped guidewire use. The number of complete JJ stent loops in the bladder was no longer significant in these multivariable models.

Sensitivity analysis

Due to the underrepresentation of procedures using multiple devices (11.9%), a sensitivity analysis was conducted where procedures in which multiple devices were used were excluded. When these multiple device procedures were excluded from the multivariable models, the use of a complex snare remained significantly associated with decreased fluoroscopy time ($P = 0.019$), with a mean fluoroscopy time decreased by 0.69 ± 0.29 minutes, and use of a looped guidewire remained significantly associated with increased fluoroscopy time ($P = 0.014$), with a mean fluoroscopy time greater by 0.76 ± 0.31 minutes. However, the use of a simple snare was no longer significant.

Discussion

This study demonstrates a technical success rate of 99.2% for transurethral JJ stent removal following renal transplant, with a mean fluoroscopy time of <5 minutes and an extremely low adverse event rate. This is in line with previous studies, which have reported technical success rates of 95.7%–98.2% in large series assessing JJ stent removal or removal and replacement and a mean fluoroscopy time of 12.7 minutes in a study assessing removal alone.[10,11,16] Half of the eight failures in this study were related to heavy encrustation causing difficulty dislodging the stent from the renal pelvis. Interestingly, the time from stent placement to stent removal in three of these patients was well within the range of time to stent removal in successful cases, and in two patients was within one standard deviation of the mean time to stent removal in successful cases. Overall, encrustation leading to procedural failure was extremely rare among stents removed within and beyond the approximately 30-day timeframe typically utilized at our institution. Additionally, time from stent placement to stent removal did not correlate with fluoroscopy time in bivariate analysis. The formation of significant encrustation causing difficult stent removal may be more related to differences in patient physiology than to the timing of stent removal.

Successful transurethral JJ stent removal required only a single removal device in approximately 90% of patients. Multivariable analysis demonstrated that the use of a complex snare was associated with decreased fluoroscopy time, and the use of a looped guidewire was associated with increased fluoroscopy time; each remained significantly associated with increased fluoroscopy time when procedures in which multiple devices were used were excluded. Choosing to use a complex snare as the initial removal device may increase procedural efficiency, whereas choosing to use a looped guidewire may reduce efficiency and increase procedural difficulty compared with other devices. Despite this, looped guidewires remain a viable option, an important consideration when the availability of preferred devices may be disrupted by supply chain issues or in low-resource environments. Looped guidewires do have the advantage of lower equipment cost compared with snares; further studies could investigate whether this may partially offset the increased cost of greater mean procedural time.

Use of a simple snare was also associated with fluoroscopy time in a multivariable model; however, this relationship did not persist when procedures in which multiple devices were used were excluded from the model. This finding was likely due to the relatively rare use of simple snares as an initial removal device at our institution; these snares were the device of choice in only 4.0% (31/775) of procedures in which a single device was used. Additionally, 41.5% of procedures using simple snares were procedures in which multiple devices were used, compared with only 33.5% of procedures using looped guidewires and 13.3% of those using complex snares.

Few previous studies have assessed factors influencing fluoroscopy time in transurethral JJ stent removal. One study found that the distal stent loop position in the bladder and the number of loops in the JJ stent were significantly associated with fluoroscopy time.[10] In contrast, we found no association of JJ loop position with fluoroscopy time, and although we did find a bivariate correlation of the number of JJ loops in the bladder with fluoroscopy time, this did not persist in a multivariable analysis. In this prior study, time from stent placement to removal was not predictive of fluoroscopy time, which was corroborated in our study. Our study also found female patient sex to be associated with decreased fluoroscopy time in both bivariate and multivariate analyses; this may be due to differences in anatomy requiring more fluoroscopic guidance during placement of the transurethral sheath prior to stent removal. One prior study of de novo retrograde ureteral stent placement found that use of ultrasound to guide the sheath to the ureteral orifice during the procedure was associated with a significant decrease in fluoroscopy time.[17] Although we used ultrasound for stent removal in only 1 of 996 procedures, it is possible that using ultrasound as an adjunct imaging technique could reduce fluoroscopy time in cases where engaging the end of the stent with the capture device is difficult, and this could be considered for future study.

This study is by far the largest in existence to examine transurethral JJ stent removal due to our institution's high volume of renal transplants, as well as referral pattern to interventional radiology for stent removal rather than to urology for cystoscopic removal. The size of the cohort increases the accuracy of our estimation of technical success and peri-procedural adverse events. Additionally, the inclusion of only a relatively homogenous population by limiting the study to patients with renal transplants allows more precise analysis of technical factors that may affect procedural difficulty. Although two prior studies focused on factors affecting procedural time in transurethral JJ stent removal, one only used snares – therefore,

different removal methods were not compared[10] – and one only compared the use of forceps to a modified loop snare technique.[5] In contrast, our study includes four different methods of stent removal while examining a variety of other factors that could affect the difficulty of stent removal.

Patients with renal transplants are a unique population with key differences from other populations that typically require JJ stent removal or replacement. JJ stents in these patients are placed during surgery and typically left in place for only 4–6 weeks before removal, rather than the 3–6 months that JJ stents are usually left in place before exchange in patients requiring chronic stenting. Stenting at the time of transplant is associated with a lower rate of urinary obstruction and leak than in non-stented groups; however, there is an increased risk of urinary tract infection if the stent is left in place for >30 days.[3,4] Despite this finding and the immunosuppressed nature of these patients, our data show that periprocedural infection-related adverse events are exceedingly rare with transurethral JJ removal.

Our study has several limitations. Although it has a large sample size, the fact that it is retrospective makes it difficult to fully account for inherent biases – even through using multivariable regression and a sensitivity analysis – such as the preferential use of devices as a first-line choice among different interventionalists. Use of forceps was relatively uncommon, occurring in only 2.5% of procedures; therefore, the lack of a significant association of forceps use with fluoroscopy time is difficult to interpret. Similarly, the sample is unrepresentative of cases with multiple devices, which were only used in 11.9% of procedures. Additionally, the medical record does not document which device was first used, which device was ultimately successful in removing the stent, or how long each device was used during multiple device procedures, limiting the conclusions that may be drawn. Finally, other factors that may have an influence on the difficulty of stent removal, such as the exact brand and size of the stent and the years of experience of the resident or fellow who assisted with the procedure, were not assessed.

In conclusion, transurethral JJ stent removal in patients with renal transplants has a high technical success rate and short mean fluoroscopy time and requires only a single device in most patients. The use of a complex snare is associated with decreased fluoroscopy time, and the use of a looped guidewire is associated with increased fluoroscopy time, suggesting decreased and increased procedural difficulty with these removal devices, respectively.

Footnotes

Conflict of interest disclosure

The authors declared that there is no conflict of interest.

References

1. Buttigieg J, Agius-Anastasi A, Sharma A, Halawa A. Early urological complications after kidney transplantation: an overview. *World J Transplant*. 2018;8(5):142-149. [Crossref]
2. Kumar A, Verma BS, Srivastava A, Bhandari M, Gupta A, Sharma R. Evaluation of the urological complications of living related renal transplantation at a single center during the last 10 years: impact of the double-J* stent. *J Urol*. 2000;164(3 Pt 1):657-60. [Crossref]
3. Tavakoli A, Surange RS, Pearson RC, Parrott NR, Augustine T, Riad HN. Impact of stents on urological complications and health care expenditure in renal transplant recipients: results of a prospective, randomized clinical trial. *J Urol*. 2007;177(6):2260-2264; discussion 2264. [Crossref]
4. Wilson CH, Rix DA, Manas DM. Routine intraoperative ureteric stenting for kidney transplant recipients. *Cochrane Database Syst Rev*. 2013;(6):CD004925. [Crossref]
5. Grasso RF, Faiella E, Cazzato RL, et al. Retrograde fluoroscopy-guided trans-urethral exchange of ureteral stents: comparison of direct grasping vs. modified snare. *Indian J Radiol Imaging*. 2013;23(4):347-350. [Crossref]
6. Nadjafi-Semnani M, Simforoosh N, Basiri A, Tabibi A, Nadjafi-Semnani A. Comparison of removing double-J stent with and without cystoscopy in kidney transplant patients: a randomized clinical trial. *Urol J*. 2020;17(2):173-179. [Crossref]
7. Simforoosh N, Obeid K, Javanmard B, Rezaeetalab GH, Razmjoo S, Soltani MH. Stent removal in 200 kidney transplant recipients: nonoperative versus endoscopic removal. *Exp Clin Transplant*. 2016;14(4):385-388. [Crossref]
8. Yu C, Wei C, Dong J, et al. Transurethral retrograde fishing the double j urethral stent: a tertiary children hospital's experience with a new technical strategy. *Front Pediatr*. 2022;10:802741. [Crossref]
9. Kawahara T, Ito H, Terao H, Yamagishi T, Ogawa T, Uemura H, Kubota Y, Matsuzaki J. Ureteral stent retrieval using the crochet hook technique in females. *PLoS One*. 2012;7(1):e29292. [Crossref]
10. Chen CS, Shin JH, Li HL, et al. Analysis of the factors influencing retrograde removal of double J ureteral stents using a simple snare technique in female patients. *Ann Transl Med*. 2021;9(8):674. [Crossref]
11. Carrafiello G, Coppola A, De Marchi G, et al. Trans-urethral ureteral stent replacement technique (TRUST): 10-year experience in 1168 patients. *Cardiovasc Intervent Radiol*. 2018;41(4):610-617. [Crossref]
12. de Baere T, Denys A, Pappas P, Challier E, Roche A. Ureteral stents: exchange under fluoroscopic control as an effective alternative to cystoscopy. *Radiology*. 1994;190(3):887-889. [Crossref]
13. Park SW, Cha IH, Hong SJ, et al. Fluoroscopy-guided transurethral removal and exchange of ureteral stents in female patients: technical notes. *J Vasc Interv Radiol*. 2007;18(2):251-256. [Crossref]
14. Akıncı D, Ünal E, Çiftçi TT, Özkan OŞ, Akhan O. Management of single double-J stent failure in malignant ureteral obstruction: tandem ureteral stenting with less frequent stent exchange. *Diagn Interv Radiol*. 2023;29(2):312-317. [Crossref]
15. Khalilzadeh O, Baerlocher MO, Shyn PB, et al. Proposal of a new adverse event classification by the Society of Interventional Radiology Standards of Practice Committee. *J Vasc Interv Radiol*. 2017;28(10):1432-1437.e3. [Crossref]
16. McCarthy E, Kavanagh J, McKernan S, et al. Fluoroscopically guided transurethral removal and/or replacement of ureteric stents in women. *Acta Radiol*. 2015;56(5):635-640. [Crossref]
17. Ünal E, Çiftçi TT, Akhan O, Akinci D. Imaging-guided de novo retrograde ureteral access and stent placement without cystoscopy in women. *J Vasc Interv Radiol*. 2023;34(5):902-909. [Crossref]