Modification of tubeless percutaneous nephrolithotomy with a ureteropelvic junction stent

Tian C. Zhou, MD, Joshua M. Stern, MD
Department of Urology, Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, New York, USA

ZHOU TC, STERN JM. Modification of tubeless percutaneous nephrolithotomy with a ureteropelvic junction stent. *Can J Urol* 2017;24(5):9030-9034.

Introduction: *To introduce the ureteropelvic junction stent as a safe and effective modification to tubeless percutaneous nephrolithotomy for select patients to maintain antegrade access to the collecting system.*

Materials and methods: *From April 2014 to December 2015, 31 patients underwent modified tubeless percutaneous nephrolithotomy with ureteropelvic junction (UPJ) stent left in situ and an extraction string coming out the nephrostomy tract. Primary study endpoints included complications, emergency department visits, or re-admissions. Secondary endpoints were perioperative parameters including mean operative time, blood loss, length of stay, and time to stent removal.*

Results: *There were three Clavien grade III complications: one patient required exchange of her UPJ stent with a double-J stent due to distal ureteral obstruction and two patients required ureteroscopic retrieval of retained stents. Minor issues included one patient with stent discomfort and another who experienced a vasovagal response during stent removal. Patients stayed an average of 2.2 ± 1.5 days, including six discharged same day. Of 31 patients, 30 were successfully drained by ureteropelvic junction stent.*

Conclusions: *UPJ stent is a safe and effective modification to percutaneous nephrolithotomy to maintain antegrade access and minimize stent discomfort. Further studies should be performed to determine optimal candidate selection and quantify stent-related symptoms.*

Key Words: percutaneous nephrolithotomy, stent, tubeless

Introduction

Percutaneous nephrolithotomy (PCNL) traditionally necessitated placement of a postoperative nephrostomy tube intended to tamponade bleeding, decompress the collecting system, and maintain access for second-look. In recent years nephrostomy tube drainage has been recognized as a significant cause of increased analgesic requirement and patient discomfort. Consequently, modifications to the original procedure have been developed in an attempt to decrease morbidity.[1] Revisions to the PCNL "exit" that limit external drainage have also allowed for consideration of PCNL as an outpatient ambulatory case.[2]

Accepted for publication June 2017

Address correspondence to Dr. Tian C. Zhou, Department of Urology, Montefiore Medical Center, 3400 Bainbridge Avenue, 5th Floor, Bronx, NY 10467 USA

Tubeless PCNL, whereby a ureteral stent is left in lieu of nephrostomy drainage, was recently introduced as a successful drainage technique that obviates the need for external drainage.[3-5] Nevertheless, ureteral stenting has been associated with flank and suprapubic pain, frequency, urgency, dysuria, hematuria, UTI, and may require cystoscopy for removal.[6,7] Recent reports have therefore advocated for a totally tubeless approach, without stent or nephrostomy tube, in appropriately selected patients.[8-10] Given that most symptoms from the ureteral stent originate from the bladder we sought to investigate the safety and efficacy of an alternative exit strategy after tubeless PCNL: the ureteropelvic junction (UPJ) stent. This modified approach was considered in select patients in whom only the UPJ or proximal ureter required stenting. UPJ stent is a standard stent with the distal coil cut and discarded such that what remains is a single-J stent with its straight portion within the distal ureter and a curl within the renal pelvis.

Materials and methods

Patients

Between April 2014 and December 2015, UPJ stent was inserted in 31 out of 107 patients undergoing PCNL by a single surgeon. This surgeon typically leaves a double J stent or a UPJ stent or utilizes a totally tubeless approach. In rare circumstances he will leave percutaneous nephrostomy tube. Albert Einstein College of Medicine Institutional Review Board approval was obtained for the prospective maintenance of this database. Inclusion criteria consisted of patients undergoing PCNL who had single-tract access, no significant residual stone fragments seen on flexible nephroscopy, nephrostogram and ureteroscopy demonstrating distal ureteral patency, and no significant bleeding. The UPJ stent was used when the UPJ or the proximal ureter was considered edematous or traumatized. Exclusion criteria included large estimated residual stone burden, solitary kidney, active bleeding, distal ureteral injury or edema or stricture of the proximal ureter. Preoperative complete blood count, basic metabolic panel, and urine culture were performed along with radiological evaluation with non-contrast enhanced computed tomography.

Stent usage and insertion

Standard PCNL was performed with patient in prone position under general anesthesia. Prone placement of retrograde ureteral occlusion balloon was followed by percutaneous access and dilation into an appropriate calyx. After stone clearance, flexible nephroscopy, antegrade flexible ureteroscopy and nephrostogram were used to ensure stone clearance and assess patency of the distal ureter. The most common indication for stent placement was edema at the ureteropelvic junction or proximal ureter.

Various length, 6Fr double-J stents from various manufacturers were chosen based on availability, and prepared in the following manner. The tapered proximal curl of a double-J ureteral stent was cut and removed. The cut end of the remaining single-J was advanced antegrade over our safety wire through our access sheath and into the distal ureter under fluoroscopic guidance, with the pigtail curling in the renal pelvis, Figure 1. In order to visually confirm appropriate stent placement we also performed flexible nephroscopy after removal of the wire. The single-J string was brought out through the nephrostomy tract. Floseal hemostatic matrix (Baxter International Inc., Fremont, CA, USA) was introduced through the sheath as it was removed. Pressure was held for hemostasis, followed by dressing application.

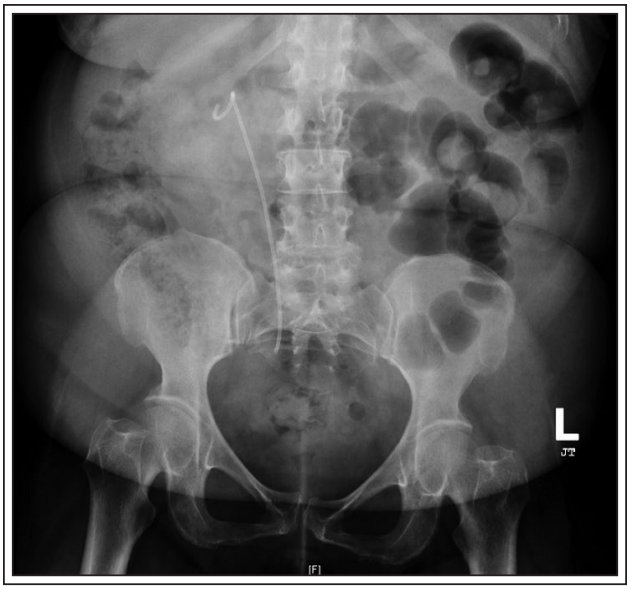

Figure 1. Plain film of ureteropelvic junction stent in situ.

The patients were then instructed to pull the string at the designated time after surgery to remove the stent. The timing of removal was within several days of surgery before the tract fully sealed. After one patient cut the string rather than pulling it, we redoubled our patient education during discharge, routinely distributing pictures to patients of appropriate stent appearance after removal. Additionally UPJ stent patients now receive a reminder phone call from our urology nurse. Routine postoperative imaging included a 6 week ultrasound. The primary study endpoints were complications classified by the Clavien-Dindo system, as well as emergency department visits or re-admissions. Secondary endpoints included perioperative parameters such as mean operative time, blood loss, length of stay, and time to stent removal.

TABLE 1. **Patient and stone characteristics**

Mean age ± SD (year)	52.6 ± 13.6
Male (n)	10
Female (n)	21
Mean body mass index ± SD (kg/m^2)	30.3 ± 6.5
Left (n)	15
Right (n)	16
Mean stone diameter ± SD (cm)	1.8 ± 0.5

TABLE 2. **Perioperative and postoperative outcomes**

Mean operative time ± SD (minutes)	120 ± 43
Mean estimated blood loss ± SD (mL)	54 ± 51
Mean length of stay ± SD (days)	2.2 ± 1.5
Same day discharge (n)	6
Next day discharge (n)	17
Mean day of stent removal ± SD	5.3 ± 2.5
Complications and emergency department visits (n)	5

Results

A total of 31 consecutive patients that met criteria underwent successful PCNL with UPJ stenting. Sixty-eight percent of our patients were female and 48% were obese (BMI > 30 kg/m^2). Additional patient and stone characteristics may be found in Table 1. Perioperative and postoperative outcomes are summarized in Table 2. No difficulty was encountered during placement of the UPJ stent. Mean operative time was 120 ± 43 min with estimated blood loss (EBL) of 54 ± 51 mL. Patients stayed an average of 2.2 ± 1.5 days, including 6 (19%) who were discharged the same day and 17 next day discharges. Two patients stayed 6 and 7 days due to PCNL-specific complications unrelated to UPJ stent. Time to stent removal was 5.3 ± 2.5 days after surgery and was performed according to surgeon instructions. There were no reports of difficulty pulling the extraction string through any potential adhesions or scar tissue of the PCNL tract within that time.

Three of the 31 patients (10%) were subsequently seen in the emergency department and are presented in chronologic order in Table 3. Patient number 3 in our series was seen on postoperative day (POD) 4 with complaints of persistent nausea, vomiting and abdominal pain since surgery. Ultrasound demonstrated no hydronephrosis or visible residual fragments and her UPJ stent maintained a proximal curl on plain x-ray. Her stent was removed, symptoms resolved, and a follow up ultrasound demonstrated no visible stones and no hydronephrosis. Patient number 4 in our series presented on POD 2 with fevers, flank pain, and leakage from her nephrostomy site. The stent was pulled by its string to the skin and a new wire was used to place an antegrade double J stent. Fever and flank pain subsided, and she was discharged home and the stent removed 2 weeks later without complications. Patient 26 removed her stent on POD4 and experienced a vasovagal response. She was assessed and discharged from the emergency department. The UPJ stent was well tolerated in the other 28 patients.

Two other patients were found on follow up to have retained UPJ stents, also shown in Table 3. Patient 8 in our series reported successful removal of his UPJ stent during his postoperative visit. However, routine 6 week postoperative ultrasound noted the stent still coiled within the left upper pole and upon further questioning he had cut the string rather than pulling it. Retrograde ureteroscopy was used to retrieve the stent. Patient 16 in our series had reported cutting the stent string at the level of the skin and imaging confirmed the retained stent in situ; ureteroscopy was used to retrieve the stent.

TABLE 3. **Complications and emergency department visits**

Number in series	Age (years)	Chief complaint	Etiology	Treatment
3	59	Nausea, vomiting, abdominal pain	Stent discomfort	Removal of UPJ stent
4	57	Leakage around nephrostomy tract	Distal ureteral obstruction	Placement of double-J stent
8	71	Retained stent	n/a	Removal with ureteroscopy
16	67	Retained stent	n/a	Removal with ureteroscopy
26	44	Lightheadedness when removing stent	Vasovagal response	Observation

UPJ = ureteropelvic junction

Discussion

Double-J ureteral stent placement is a long standing method of ensuring ureteral patency after instrumentation. Nevertheless, placement of a double J stent may require cystoscopic removal and if a string is left exiting the urethra up to 15% of patients experience premature stent dislodgement.[11] Furthermore Joshi et al established that stents cause urinary symptoms and pain that in turn have a marked impact on general health.[6] Seventy-eight percent of their cohort reported bothersome urinary symptoms including storage problems, hematuria, and incontinence. Greater than 80% of their patients reported stent-associated pain significant enough to affect daily activities, and 58% reported reduced work capacity. A systematic review has confirmed that patients with stents have more pain and irritative bladder symptoms while incurring higher costs and increasing unplanned hospital visits.[12]

Attempts have been made to modify drainage after PCNL due to the growing recognition of significant postoperative morbidity and pain following a standard PCNL. Istanbulluoglu et al compared PCNL with dual stent and nephrostomy tube drainage, PCNL with stent only drainage, and totally tubeless PCNL.[10] They noted that the tubeless variants significantly reduced length of stay (2.09 and 1.74 days versus 2.96 days, $p < 0.001$) and analgesia requirements ($p < 0.05$). Al-Ba'adani et al observed short hospital stay, low postoperative pain and reduced analgesic requirements using a tubeless PCNL technique incorporating a 6Fr ureteral catheter stitched to a urethral foley catheter which would be removed together prior to discharge.[13] Lingeman et al trialed the placement of a biodegradable temporary ureteral stent after routine ureteroscopy with spontaneous dissolution in a matter of days.[14]

Here we assess the utility of a new adjunct technique for PCNL. The theoretical advantages to the UPJ stent include sparing the patient the discomfort of an office cystoscopy, reducing stent-related pain and irritative voiding symptoms from the distal stent curl, and facilitating same-day discharge from the hospital; all while maintaining antegrade access to the collecting system. A UPJ stent may also serve to moderate healthcare costs. Choi et al demonstrated that totally tubeless PCNL reduced overall treatment costs compared to a standard PCNL cohort, at least in part due to the incurred costs associated with cystoscopic ureteral stent removal.[15]

The UPJ stent functioned appropriately in 97% of our patients. Nineteen percent of UPJ stent patients were discharged same day. Ten percent of the entire group experienced Clavien grade III complications. Ten percent of the entire cohort returned to the emergency department postoperatively with a 3% readmission rate, similar to the 12% and 4% rates, respectively, observed by Beiko et al in their ambulatory PCNL cohort.[2] In one case ureteral spasm, clot, or a stone fragment not seen on ureteroscopy obstructed the ureter distal to the stent. While this is a disadvantage of the UPJ stent, it did allow for easy access to the ureter with a wire facilitating a stent exchange. Routine postoperative imaging further identified two patients who had misunderstood how to remove the stent. These foreign bodies were retrieved successfully with retrograde ureteroscopy. Patients subsequently chosen for UPJ stent were shown a sample of the stent, given detailed instructions on pulling rather than cutting the retrieval string and received a phone call from our nurse to review instructions the day of the stent removal.

We acknowledge that our technique and this study have several limitations. In this small pilot study we evaluated efficacy and safety of the UPJ stent but did not measure objective patient feedback. The surgeon did however question patients regarding stent comfort. Joshi et al have developed and validated the Ureteral Stent Symptom Questionnaire (USSQ), an instrument that assesses the impact of stents on health-related quality.[16] We intend to use this tool to discern any improvement in stent symptoms offered by the UPJ stent going forward. Another drawback of our study is the indication for stent placement. The decision to leave a UPJ stent is based on intraoperative findings of a narrow edematous UPJ or upper ureter. While admittedly subjective this indication is not different from the decision to place a double-J ureteral stent for ureteral edema, perforation, or an impacted stone following ureteroscopy. Furthermore, UPJ edema is not a routine finding in every case and in suitable uncomplicated PCNL or mini-PCNL cases we leave the patient totally tubeless. Finally, a cost-analysis will also be valuable to compare to traditional PCNL and tubeless PCNL with a stent.

Conclusion

To our knowledge this is the first study to use a UPJ stent as described. Modifications to standard PCNL with tubeless technique and mini-PCNL have been made to decrease pain, hospitalization time, and morbidity. We offer the UPJ stent as a safe and effective modification to tubeless PCNL for select patients that maintains antegrade access to the collecting system in a minimally bothersome fashion and reduces hospitalization time. Further studies are needed to determine whether it improves quality of life relative to a standard double-J stent. □

References

1. Desai MR, Kukreja RA, Desai MM et al. A prospective randomized comparison of type of nephrostomy drainage following percutaneous nephrostolithotomy: large bore versus small bore versus tubeless. *J Urol* 2004;172(2):565-567.
2. Beiko D, Elkoushy MA, Kokorovic A, Roberts G, Robb S, Andonian S. Ambulatory percutaneous nephrolithotomy: what is the rate of readmission? *J Endourol* 2015;29(4):410-414.
3. Wang J, Zhao C, Zhang C, Fan X, Lin Y, Jiang Q. Tubeless vs standard percutaneous nephrolithotomy: a meta-analysis. *BJU Int* 2012;109(6):918-924.
4. Zilberman DE, Lipkin ME, de la Rosette JJ et al. Tubeless percutaneous nephrolithotomy--the new standard of care? *J Urol* 2010;184(4):1261-1266.
5. Ghani KR, Andonian S, Bultitude M et al. Percutaneous nephrolithotomy: update, trends, and future directions. *Eur Urol* 2016;70(2):382-396.
6. Joshi HB, Stainthorpe A, MacDonagh RP, Keeley FX Jr., Timoney AG, Barry MJ. Indwelling ureteral stents: evaluation of symptoms, quality of life and utility. *J Urol* 2003;169(3):1065-1069.
7. Pengfei S, Yutao L, Jie Y et al. The results of ureteral stenting after ureteroscopic lithotripsy for ureteral calculi: a systematic review and meta-analysis. *J Urol* 2011;186(5):1904-1909.
8. Aghamir SM, Hosseini SR, Gooran S. Totally tubeless percutaneous nephrolithotomy. *J Endourol* 2004;18(7):647-648.
9. Karami H, Gholamrezaie HR. Totally tubeless percutaneous nephrolithotomy in selected patients. *J Endourol* 2004;18(5):475-476.
10. Istanbulluoglu MO, Cicek T, Ozturk B, Gonen M, Ozkardes H. Percutaneous nephrolithotomy: nephrostomy or tubeless or totally tubeless? *Urology* 2010;75(5):1043-1046.
11. Althaus AB, Li K, Pattison E, Eisner B, Pais V, Steinberg P. Rate of dislodgment of ureteral stents when using an extraction string after endoscopic urological surgery. *J Urol* 2015;193(6):2011-2014.
12. Haleblian G, Kijvikai K, de la Rosette J, Preminger G. Ureteral stenting and urinary stone management: a systematic review. *J Urol* 2008;179(2):424-430.
13. Al-Ba'adani TH, Al-Kohlany KM, Al-Adimi A et al. Tubeless percutaneous neprolithotomy: the new gold standard. *Int Urol Nephrol* 2008;40(3):603-608.
14. Lingeman JE, Preminger GM, Berger Y et al. Use of a temporary ureteral drainage stent after uncomplicated ureteroscopy: results from a phase II clinical trial. *J Urol* 2003;169(5):1682-1688.
15. Choi SW, Kim KS, Kim JH et al. Totally tubeless versus standard percutaneous nephrolithotomy for renal stones: analysis of clinical outcomes and cost. *J Endourol* 2014;28(12):1487-1494.
16. Joshi HB, Newns N, Stainthorpe A, MacDonagh RP, Keeley FX, Jr, Timoney AG. Ureteral stent symptom questionnaire: development and validation of a multidimensional quality of life measure. *J Urol* 2003;169(3):1060-1064.