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POD1 STENT REMOVAL AFTER PCNL: POSTOPERATIVE EVENTS WITH POSTOPERATIVE DAY ONE STENT REMOVAL AFTER PERCUTANEOUS NEPHROLITHOTOMY

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Abstract

Introduction: Percutaneous nephrolithotomy (PCNL) is the gold standard for treating large or complex renal stones. Renal drainage after the procedure is most commonly via nephrostomy tube or indwelling ureteral stent, but the optimal duration of ureteral stents after PCNL is unknown. This study describes the post-operative events occurring with early stent removal on postoperative day one (POD1) in patients undergoing uncomplicated PCNL.

Methods: We identified 336 patients from a single institution that underwent PCNL between 1/1/2020 and 6/1/2021. Of these, 106 patients with uncomplicated procedures that met inclusion criteria for early stent removal on POD1 were included. In addition, a retrospective chart review was performed to collect demographic information, operative data, and to identify adverse outcomes including additional procedures, patient telephone calls for symptoms, complications and emergency department (ED) visits.

Results: Mean (SD) patient age was 54 (15.1) years and 56% of patients were morbidly obese (Body Mass Index [BMI] > 30). Overall post-operative complication rate was low (18.8%) and limited primarily to Clavien I/II complications with only two Clavien III (1.9%) complications. Telephone calls or electronic messages were received from 37.7% of patients, with 16% requiring a visit to the ED or clinic. The most common reason for an ED visit was flank pain (11.1%).

Conclusions: Early stent removal on POD1 may lead to pain-related telephone calls but appears to be a generally safe and effective management option in carefully selected patients undergoing uncomplicated PCNL.

Keywords: *Nephrolithiasis*, *Percutaneous nephrolithotomy*, *Tubeless percutaneous nephrolithotomy*, *Post-operative outcomes*, *Renal drainage techniques*

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is the procedure for treating large and/or complex stone burden when minimally invasive techniques are more likely to fail.[1,2] Historically, a nephrostomy tube (NT) was placed after the procedure,[1] but now other exit strategies include placement of an indwelling ureteral stent,[2] leaving an externalized 5 French ureteral catheter,[3] or a "totally tubeless" approach with no mechanism for artificial urinary drainage.[4,5] Placing an indwelling double-J ureteral

stent has become the exit strategy of choice in most of the authors' PCNL cases. Primary advantages of a stent include decompression in the setting of residual clots and improving drainage and future access for ureteroscopy. These advantages have precluded using the totally tubeless approach in most patients.

The optimal time for an indwelling ureteral stent to remain in place after an uncomplicated PCNL procedure is unknown. Traditionally, patients are discharged with their indwelling stent still in place and return to the clinic one to two weeks post-operatively to remove their stent. This requires an additional visit/procedure for flexible cystoscopy and stent removal and exposes patients to documented associated risks of storage lower urinary tract symptoms, back pain, hematuria, and urinary tract infection.[6-9]

Prior studies performed for other renal stone procedures have confirmed that overnight stenting[10] or even no stenting[11] can be feasible and safe, while others have concluded that it may result in increased ED visits or telephone calls for pain.[12] Due to the general acceptance of short-term stent dwell times,[4,13,14] we now elect in the majority of our cases at our institution to leave the tether attached to the ureteral stent and remove it on postoperative day one (POD1) if the patient meets predetermined criteria including adequate pain control and appropriate resolution of hematuria. This shift in practice is relatively recent and in part driven by the COVID-19 pandemic increasing the risks of additional post-operative visits for stent removal. The objective of this retrospective study was to evaluate whether the new practice of removing the stent on post-operative day one after uncomplicated PCNL procedures resulted in any significant post-procedural events that would compromise its clinical appropriateness to adopt as practice.

MATERIALS AND METHODS

This study was approved by the Ohio State University's Institutional Review Board (#2021H0297). This study assessed patients treated for stones with uncomplicated PCNL between January 1, 2020 – June 1, 2021 at a single clinical institution in a retrospective fashion. All patients undergoing PCNL were evaluated for inclusion. Exclusion criteria included (i) younger than 18 years, (ii) spinal cord injury and/or presence of neurogenic bladder or with reconstructed or altered urogenital anatomy, (iii) procedures with incomplete stone clearance with a planned second procedure, (iv) patients with an NT or other tubes, and (v) concomitant bilateral procedures. Any of these criteria defined the PCNL procedure as "complicated" and were thus excluded.

The PCNL procedure was performed by one of two surgeons (BK or MS). The decision to plan for POD1 stent removal was made at the operating surgeon's discretion at the case's conclusion. For a PCNL to be deemed "uncomplicated," there had to be no unanticipated intraoperative challenges such as severely impacted stones, collecting system/ureter injury, vital sign instability, excessive bleeding during the procedure, or known residual fragments. In those cases, a stent would usually be left longer.

After the procedure, the surgeon places the double-J ureteral retrograde from the urethra with the patient in either the prone or supine position. The stent was left on its tether and attached to the Foley catheter, allowing for easy removal of the Foley and the stent the following morning of discharge on POD1. The patients were observed for at least two hours or until they successfully passed a void trial to ensure no issues arose after stent removal. If the patient experienced fever, excessive bleeding, or significant acute kidney injury (AKI) the stent was not removed on POD1, and the patient was excluded from the cohort. In most of these situations, the Foley and stent remained in place until the patient was appropriate for discharge, at which time both were removed on the day of discharge from the hospital. All patients in this study returned to their prior residence, whether living independently or in a skilled nursing facility. Patients in our practice were discharged with scheduled acetaminophen, diclofenac, or a short course of narcotics depending on renal function, tamsulosin daily for two weeks, and stool softeners with a standardized discharge instruction handout. The first scheduled follow-up was at 8–12 weeks post-operatively with renal

ultrasound, abdominal x-ray, and occasionally basic labwork if needed.

The electronic medical record was accessed and reviewed for data collection. Baseline demographic data was collected, including age, gender, race, body-mass index (BMI) history of nephrolithiasis, and smoking history. Operative characteristics including operative time, total stone burden and location (renal, ureteral or both) with calculated Guy's Stone Score[15], tract size, laterality, lithotripter, patient positioning, and the presence of concomitant procedures. Concomitant procedures included ipsilateral ureteroscopy (endoscopic combined intrarenal surgery, ECIRS) or cystolithalopaxy.

We then reviewed post-operative events in this cohort, including telephone calls, postoperative complications, unplanned clinic visits, emergency department (ED) visits or secondary procedures. In-person visits for medical care, telephone calls resulting in additional prescriptions, and postoperative complications were categorized according to the Clavien-Dindo classification. All data was de-identified before analysis.

Statistical Analysis

Study data were collected and managed using REDCap electronic data capture tools hosted at Ohio State University.[16,17] REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies, providing (1) an intuitive interface for validated data capture; (2) audit trails for tracking data manipulation and export procedures; (3) automated export procedures for seamless data downloads to common statistical packages; and (4) procedures for data integration and interoperability with external sources. All data analysis was performed using Excel and SPSS Statistics software (IBM SPSS Statistics for Windows, version 26.0. Armonk, NY: IBM Corp). Data are descriptive, exploratory, and presented as means (standard deviations) or proportions (percentages).

RESULTS

336 patients underwent PCNL, and 241 were eligible for inclusion based on the above exclusion factors. Of these, 106 patients (44% of cohort) had uncomplicated PCNL and had their ureteral stents removed on postoperative day one (POD1) and were included for analysis in the study cohort. Mean patient age for the cohort was 54.6 years (±15.1), and most patients (56%) were obese (BMI > 30). 48% of patients were female and the cohort was primarily Caucasian (95%). 75.4% of patients had a prior history of stones. Demographic data for the cohort is summarized in Table 1.

Operative characteristics are summarized in Table 2. Mean operative time in our cohort was

TABLE 1 Demographic Information for Patients with Stent Removal On Post-operative Day One after Uncomplicated PCNL

Characteristics	Total Patients N = 106	Percentage of Cohort
Age		
18–34	12	11%
35–49	24	23%
50–64	38	36%
>64	32	30%
Gender		
Female	54	51%
Male	52	49%
Race		
White	101	95%
Black/African-American	3	3%
Other/Unidentified	2	2%
BMI		
<18.5	3	3%
18.5–24.9	16	15%
25.0–29.9	28	26%
≥30	59	56%
Smoking History		
Yes	65	61%
Never-smoker	41	39%
History of Stones		
Yes	80	75%
No	26	25%

BMI, body-mass index; PCNL, Percutaneous nephrolithotomy.

TABLE 2 Operative Characteristics for Patients with Stent Removal On Post-operative Day One after Uncomplicated PCNL

Operative Characteristics	Cohort Value(s) N = 106	Percentage of Cohort
Mean Operative Time	90 minutes (± 22.9)	N/A
Stone Burden <2 cm	49 patients	46%
Stone Burden 2–5 cm	54 patients	51%
Stone Burden >5 cm	3 patients	3%
Guy's Stone Score 1	48 patients	45%
Guy's Stone Score 2	45 patients	42%
Guy's Stone Score 3	12 patients	11%
Standard Tract (>22 Fr)	28 patients	26%
Mini Tract (<22 Fr)	78 patients	74%
Concomitant Procedure*	35 patients	33%
Laterality - Right	41 patients	39%
Laterality - Left	65 patients	61%
Lithotripter - Shockpulse/Trilogy	26 patients	25%
Lithotripter - Laser	71 patients	67%
Lithotripter - Both	9 patients	9%
Renal Stone Only	95 patients	90%
Ureteral Stone Only	1 patient	1%
Renal + Ureteral Stone	10 patients	9%
Supine Positioning	81 patients	76%
Prone Positioning	25 patients	24%

PCNL, Percutaneous nephrolithotomy.

**Concomitant procedures included ipsilateral ureteroscopy (endoscopic combined intrarenal surgery), cystolithalopaxy, or urethral stricture dilation.*

90 minutes (± 22.9). Most patients (51%) had a stone burden 2–5 cm, and 90% of patients had renal stone burden only. In addition, 45% of patients had a Guy's stone score of 1, and 42% had a score of 2. Regarding procedural technique, 73.5% of patients had mini-PCNL (tract size <22 French), and 76.4% were supine for their procedure. Holmium:YAG laser was the lithotripter of choice in 66.9% of procedures, while ShockPulse/Trilogy was used in 25%. Ipsilateral concomitant procedures were performed in 33.0% of patients, including cystolithalopaxy or endoscopic-combined retrograde intrarenal surgery.

Patients with POD1 stent removal had a minimal post-operative complication rate (18.8%) and primarily minor grades. Two patients (1.9%) had a Clavien-Dindo Grade III complication. One of these events was an outside hospital stent placement for obstructing residual stone fragments; the other was an unplanned ureteroscopy and laser lithotripsy for obstructing fragments. The cohort experienced no Grade IV or V complications.

Calls or electronic messages were received from 40/106 patients (37.7%), with 17/106 (16%) requiring a visit to the ED or clinic (Figure 1). The most common reason for a telephone call to the office was pain (19/40 calls), followed by concerning hematuria (8/40), fever (5/40), or post-op nausea/vomiting (5/40). The most common reason for an ED visit was flank pain in 4/106 patients (4%), followed by hematuria in 2/106 patients (2%).

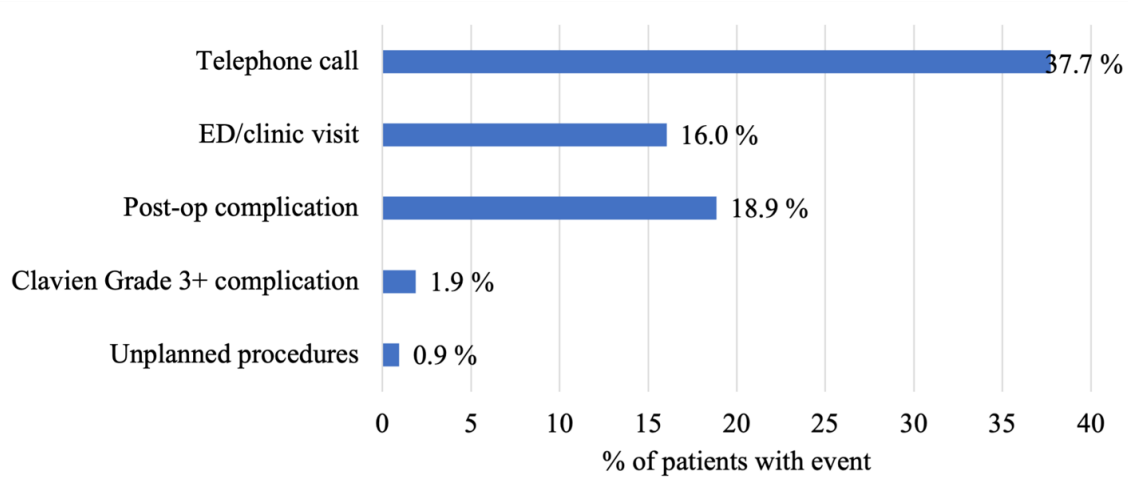

FIGURE 1 Rates of important post-operative events in patients with stent removal on post-operative day one after uncomplicated percutaneous nephrolithotomy. The most common reasons for telephone calls and ED visits was pain (19/40 calls and 2/17 visits). The unplanned procedures represented one stent placement and one second look ureteroscopy.

DISCUSSION

Our data show that POD1 stent removal after uncomplicated PCNL can be performed safely with low rates of complications and an acceptable rate of other post-operative events. Although a relatively high proportion of patients called in with questions or concerns (37.7%), very few required an unplanned clinic appointment, ED visit, or secondary procedures and most were managed conservatively. Most commonly these calls were for pain or hematuria and simple reassurance or behavioral recommendations, including rest and hydration, were recommended.

Overall complication rate was modest at 18.8%, with the vast majority being Clavien-Dindo Grade I and II with only two (1.9%) Grade III complications occurring and no Grade IV or V complications. Our results are comparable to other reviews of patient outcomes after routine PCNL regardless of post-operative stent management; Bhat *et al.* (2017) reported a 20% complication rate in stented patients[13] and 16% in patients left with a NT, and Ichaoui *et al.* (2019) reported a complication rate of 25.5% in their stented group.[18] The low rate of complications in our cohort support the safety of POD1 stent removal and consideration of more study and/or more widespread adoption, particularly considering the similar success rates of totally tubeless approaches.[4,19]

A short-term indwelling stent over a "totally tubeless" approach has some potential advantages. Stenting with a Foley allows renal decompression after this procedure and provides for the rapid identification of patients with severe bleeding that may need additional procedures. In addition, many of our patients at our tertiary care medical center live far away and prefer to stay overnight, allowing them to be discharged the next day without tubes. However, data supporting one technique over the other are conflicting with most studies showing equivalent results on most parameters.[8,9,20] Some studies show a slight advantage with stent over totally tubeless in terms of hospital stay,[21] while others favor totally tubeless in terms of hemoglobin drop.[20] Some protocols for "totally tubeless" PCNL include a short-term (<24 hour) placement of an indwelling ureteral catheter,[8,19] which essentially supports the data presented in our current series.

If feasible, POD1 stent removal is preferable to prolonged stenting time to mitigate the commonly encountered stent-related symptoms which can severely adversely impact the quality of life. Another significant benefit to POD1 stent removal is avoiding additional clinic visits or procedures

to manage the stent in the outpatient setting. This visit increases costs to the patient and the healthcare facility and, in some studies, has been shown to expose patients to additional risks of infection and bleeding secondary to the stent.[8,9] The COVID-19 pandemic has also raised pressure to limit unnecessary in-person visits, increasing the desirability of this approach for patients and surgeons alike, and was a primary reason this change in practice was implemented.

There are several limitations to this study. First, no direct cohort comparison exists for our POD1 stent removal patients. Patients in this cohort should ideally be compared to patients traditionally stented for one to two weeks post-operatively to see if the outcomes differ before a definitive recommendation for this practice can be made. Second, our cohort had a relatively small sample size, and most were mini-PCNL with relatively straightforward stones (Guy 1 and 2), exposing the cohort to potential selection bias. However, there is some variability in how the PCNL procedure is carried out by the two surgeons, and given the overall low complication, this may speak to the generalizability of the concept of early stent removal and should be further explored in larger series. Third, we did not collect data on stone-free rates which theoretically might decrease with reduced stent time. However, on a practical basis, only two patients required a second unplanned procedure after POD1 stent removal, supporting high efficacy with this approach.

In terms of future directions, our preliminary data suggests that more patient education should be implemented before surgery to pre-empt the relatively minor concerns (pain, hematuria, etc.) that were often managed conservatively with reassurance or behavioral modifications. Additionally, we are exploring how this practice may be safely performed on more complex stones or patients, and to further examine the impact on quality of life associated with this practice.

CONCLUSION

This retrospective series shows that early stent removal on POD1 after uncomplicated PCNL in carefully selected patients, may result in telephone calls primarily related to pain issues, most of which can be managed conservatively without the need for additional interventions or procedures. In addition, this practice allows patients to be discharged from the hospital without any tubes, minimizing the morbidity of prolonged stenting without significant adverse events and low rates of complications.

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