Original Research Article

Surgical Approaches to Proximal Ureteral Stones >1 Cm: A Comparative Study of M-PCNL and Semirigid URSL

ABSTRACT

Background

For the management of proximal ureteric calculi modalities like Extracorporeal shockwave lithotripsy, mini-Percutaneous Nephrolithotomy, UreteroRenoscopic Lithotripsy, and Retrograde Intra-Renal Surgery have been commonly used. The objective of this study is to compare the efficacy and safety of mini-Percutaneous Nephrolithotomy and semirigid Ureterorenoscopic Lithotripsy in terms of the total operation time, stone clearance rate, duration of hospital stays, post-operative hemoglobin drop, and peri-operative complications.**Methods:** This study was a hospital-based, prospective, comparative study conducted in the Urology Unit of Nepalgunj Medical College (NGMC). Eighty patients were included in the study, divided into two groups: 40 patients in the m-PCNL group (Group A) and 40 patients in the URSL group (Group B). **Results**: The mean age of the total patients was 36.34 ± 12.68 years. The mean duration of surgical procedure in m-PCNL Group was 26.93±9.43 minutes and in URSL it was 20.88±7.06 minutes. The mean duration of hospital stay in m-PCNL Group was 3.63±1.10 days and in URSL group it was 2.70±1.24 days. In m-PCNL, 5 cases (12.5%) had fever, 2 cases (5%) had hematuria and in URSL, 10 cases (25%) had a fever, 7 cases (17.5%) had hematuria and 1 case (2.5%) had dyspnea because of pulmonary complication.**Conclusion:** Our findings demonstrate that both m-PCNL and URSL can be done for proximal ureteric calculi >1cm but m-PCNL has significantly better stone clearance with no residual stone and thus concludes m-PCNL is better than semirigid URSL for the management of proximal ureteric calculi greater than 1cm.

Key Words: m-PCNL,NephrolithotomyUretericCalculi, URSL

INTRODUCTION

Large upper ureteric calculus mostly hasunfavorable conditions to pass spontaneously because of the size, shape and surface of the stone and less caliber of ureter. Extra Corporeal Shockwave Lithotripsy (ESWL) has been the first-line choice for upper ureteral stones that do not pass spontaneously,[1] but for large proximal ureteric stones, ESWL is not the best choice due to poor overall success rate.[2] The introduction of minimally invasive treatments like URSL and PCNL has dramatically increased the stone-free rate for upper ureteral calculi.[3]

However, there are limitations of each treatment modality. In semirigid URSL, migration of stones is a common phenomenon, during the procedure the proximal ureteric stone may get migrated to the renal calyx. [4] when the stones are located in a high position and are close to the renal pelvis, which results in the failure of URSL [2]. Retrograde intrarenal surgery is another alternative but limited because of poor financial condition in certain set of patients. On the other hand, PCNL is an invasive technique that has increased transfusion rate and there is a chance of wound infection too. [5] So, it is a challenge to choose treatment modality for the patients with large proximal ureteric calculi, and the optimal treatment for larger stones of 10 mm diameter or more remains in debate. Semirigid URSL once not feasible, can be readily converted to mPCNL for best stone clearance in non-availability of flexible ureteroscopy. These mini-invasive treatment approaches can be used to treat upper ureteral stones, but the selection criteria and their efficacy remain [11].

The majority of patients presenting to our center for ureterolithiasis undergo either URSL or m-PCNL for the management of upper ureteric calculi more than 10 mm in size. Considering similar safety profiles of URSL and mini PCNL, and the paucity of similar studies conducted in

our region, we intended to compare and evaluate these two procedures m-PCNL and URSL for the management of upper ureteric calculi more than 10 mm.

MATERIALS AND METHODS

This study was a hospital-based, prospective, comparative study conducted in the Urology Unit of NepalgunjNepalgunj Medical College (NGMC). The study was carried out over a period of one year from January, 2021 to January, 2022.A total of 80 patients were included in the study, divided into two groups: 40 patients in the m-PCNL group (Group A) and 40 patients in the URSL group (Group B). Ethical clearance for the study was obtained from the Institutional Review board. Radiopaque upper ureteric calculus >10 mm in longest dimension was included as confirmed by plain Xray or CT KUB and assessed for stone burden, hydronephrosis, and renal function. Patients were randomized into two groups based on a lottery system: Group A underwent m-PCNL and Group B underwent URSL.

Patients in Group A underwent mini percutaneous nephrolithotomy (m-PCNL) in prone position under spinal anesthesia with the use of 15-18 Fr amplatz sheath and 12 Fr Karl Stortz mini nephroscope.Procedure was completed using pneumatic lithotriptor).

Patients in Group B underwent semirigid ureteroscopy (URSL) under spinal anesthesia. They were positioned in a modified lithotomy position. A semi-rigid 7.5 Fr ureteroscope was used to visualize and pneumatic lithotripter to fragment the stone. Follow-up X-ray KUB was performed on postoperative days 1 and 21 to check for residual stones.

The two groups were compared in terms of hemoglobin drop, hospital stay, clearance of calculus and need of auxillary procedure.

IBM SPSS (version 20.0) was used for analysis of data. Chi square and independent t-Test was applied where applicable, and p value of < 0.05 was considered significant.

RESULTS

Eighty patients who met inclusion criteria were included in the study with 40 patients in each

group. The age of patients enrolled in our study ranged from 17 years to 78 years.

The majority of cases were between 20 to 50 years of age in both groups whereas a smaller number of patients were above 60 years of age. The mean age of the total patients was 36.34 ± 12.68 years. The mean age of patients in URSL group was 34.75 ± 11.008 which was comparable with m-PCNL group 37.93 ± 14.116 years (p=0.26).

In our study, male patients outnumbered female patients in both groups, 45 (56.25%) were male and 35 (43.75%) were female (n=80) which was statistically non-significant (p=0.49).

The size of Stone ranged from 10mm to 30mm in diameter with the mean being 14.98±3.62mm in overall cases.

The mean size of stone in URSL group was 14.27 ± 2.64mm and that of m-PCNL group was 15.69 ± 4.51mm (p=0.79).

The mean duration of surgical procedure in m-PCNL Group was 26.93±9.43 minutes (mins) and in URSL it was 20.88±7.06 mins. URSL took lesser time to be performed in comparison to m-PCNL. The difference was statistically significant (p= 0.02).

The mean duration of hospital stay in m-PCNL Group was 3.63±1.10 days and in URSL group it was 2.70±1.24 days.

Patient who underwent m-PCNL needed more hospital stay than URSL. The difference was statistically significant (p=0.01).

Hemorrhage was the only complication observed during the procedure which was more in m-PCNL group than the URSL group but was statistically insignificant (p= 0.11). (Table 1)

Table1: Comparison of intra operative parameters between m-PCNL and URSL groups

Variables		Surgery		Total
		m-PCNL	URSL	
Intraoperative complications	Hemorrhage	9	4	13
	None	31	36	67
Total		40	40	80

During the post-operative period fever, hematuria, and Shortness of breath due to the pulmonary complication were observed in both groups which were statistically insignificant (p=0.22). In m-PCNL, 5 cases (12.5%) had a fever, 2 cases (5%) had hematuria and in URSL, 10 cases (25%) had a fever, 7 cases (17.5%) had hematuria and 1 case (2.5%) had shortness of breath because of pulmonary complication. (Table2)

All 80 patients had grade I and grade II complications. Most of the patient had clavien-Dindo score of Grade I. 31 cases (77.5%) in m-PCNL & 34 cases (85%) in URSL had Clavien-Dindo grade I complications and 9 cases (22.5%) & 6 cases (15%) had Clavien-Dindo grade II complications. (None of the patients required any endoscopic or radiological intervention. No patients developed any life-threatening complications following either procedure. (p=0.39) (Table 3)

Table 2: Comparison of post-operative parameters between m-PCNL and URSL groups.

		Surgery		Total
		URSL	m-PCNL	
Post-Operative complications	Fever	5	5	10
	Hematuria	2	7	9
	SOB	0	1	1
	None	33	27	60
Total		40	40	80

Table 3: Comparison of Clavien-Dindo score Grading between URSL and mini-PCNL

		Surgery		Total
		m-PCNL	URSL	
Clavien score	Grade-I	31	34	65
	Grade-II	9	6	15
Total		40	40	80

DISCUSSION

For the management of Upper ureteral calculi, different treatment modalities like ESWL, m-PCNL, URSL, and RIRS are commonly being used and are well accepted. In our center, semirigid URSL and m-PCNL are usually performed.

Many studies have been done comparing m-PCNL and URSL for the management of proximal ureteric calculi >1 cm. A similar study conducted by Juan YS et al in 2008 concluded that for upper ureteral calculi >15mm in diameter, PCNL had better stone-free rates and could treat

coexisting renal stones simultaneously but URSL had shorter operative times, shorter hospital stays, and fewer postoperative complications.[6]

A study conducted by Sun X in 2008 et al concluded that m-PCNL is better than URSL with a higher stone-free rate but had higher operative time and longer hospital stay.[7]

A review conducted by Zhao J et al in 2020 concluded that stone migration was the main concern while performing URSL and in comparison, to m-PCNL, URSL group had shorter operative time, shorter hospital stays, URSL along with the use of stone cone could decrease the stone migration to the renal calyx and increase the overall success rate.[8]

Our study had comparable demographic data between m-PCNL and URSL groups. There was no significant difference in mean age, gender, and presence of hydronephrosis with a mean stone burden of 14.98mm. Similar was the observation by Sun et al in 2008 where a comparison was done in 91 patients (m-PCNL 44 and URSL 47). Similar to ours, they had comparable demographic data with a mean stone burden of 14.64mm.

The majority of m-PCNL were done via supracostal approach and through upper calyx with the use of 15 Fr sheaths. URSL was done by retrograde ureteroscopy with per urethral approach.Similarly, a study conducted by Sun et al upper caliceal puncture was preferred as it provided more direct access to the ureter than middle caliceal access whereas for impacted stones at pelviureteric junction middle posterior calyx was punctured.[7]

In our study, the operative time was significantly higher in m-PCNL group than that in URS ($p=0.02$) suggesting m-PCNL takes a longer time to perform.

The duration of hospital stay was also significantly longer in m-PCNL than that in URSL ($p=0.01$)

A similar observation was made on a study done by Sun X with mean operative time and mean hospital stay suggesting that m-PCNL took a longer time to perform and patient needed to be admitted in hospital for a longer time.[7] Similar findings were observed in studies conducted by Zhao et al. [8]

Other than hemorrhage there was no complication in both groups during the procedure The observation was clinically insignificant. A similar observation was made by Wang et alon operative-related complications and concluded complication in both groups is statistically insignificant ($p>0.05$).[9]

Postoperatively major complications seen were fever, hematuria, and shortness of breath in both groups but data suggested that there is no significant difference (p=0.22), similar to observation made by Lai et al (2020) with p>0.05 in m-PCNL and URSL based on postoperative complications.[10]

In URSL group 7 patients had proximal migration of stone fragments. Stone migration was missed during the procedure and was evidentonly on X-Ray KUB on 1st postoperative day. Stone fragments < 8mm were left for spontaneous passage. The stone clearance of 82.5% was calculated for patients undergoing URSL, whereas 100% stone clearance was achieved with m-PCNL. During the follow-up on the 21st day, residual stone was present on 5 patients, 6-8mm stone fragments could be seen on plain X-ray KUB with SFR 87.5% in URSL group. With m-PCNL SFR was 100%. URSL was again done for the residual stones.

In a similar study conducted by Sun et al in 91 patients, SFR was 100% in m-PCNL group whereas 86.4% in URSL group (p=0.02).[7]

We observed that the main obstacle while performing URSL in the upper ureter was stone migration to the renal pelvis and the presence of residual stone during follow-up after 21 days.

CONCLUSION

For the management of proximal ureteric calculi, semirigid URSL and m-PCNL are comparable in terms of Hemoglobin drop and operation-related complications. While m PCNL has better stone clearance, URSL is lesser invasive but requires more retreatment PCNL is thus more preferable for such stones larger than 1 cm in upper ureter.

Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Consent

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

CONFLICT OF INTEREST: The Author declares no conflict of interest

Disclaimer (Artificial intelligence)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

REFERENCES

1. Wah TM, Kidger L, Kennish S, Irving H,Najmaldin A. Mini PCNL in a pediatric population. Cardiovasc InterventRadiol. 2013;36(1):249-54.
2. Bozkurt IH, Yonguc T, Arslan B,et al. Minimally invasive surgical treatment for large impacted upper ureteral stones: Ureteroscopic lithotripsy or percutaneous nephrolithotomy? Can Urol Assoc J. 2015;9(3):E122.
3. Türk C, Petřík A, Sarica K, et al. EAU guidelines on interventional treatment for urolithiasis. Eur Urol. 2016;69(3):475-82.
4. Elashry OM, Tawfik AM. Preventing stone retropulsion during intracorporeal lithotripsy. Nat Rev Urol. 2012;9(12):691-8.
5. De S, Autorino R, Kim FJ et al. Percutaneous nephrolithotomy versus retrograde intrarenal surgery: a systematic review and meta-analysis. Eur Urol. 2015;67(1):125-37.

6. Juan YS, Shen JT, Li CC, Wang CJ,et al. Comparison of percutaneous nephrolithotomy and ureteroscopic lithotripsy in the management of impacted, large, proximal ureteral stones. Kaohsiung J Med Sci. 2008;24(4):204-9.

7. Sun X, Xia S, Lu J, Liu H, Han B, Li W. Treatment of large impacted proximal ureteral stones: randomized comparison of percutaneous antegrade ureterolithotripsy versus retrograde ureterolithotripsy. J Endourol. 2008;22(5):913-7.

8. Zhao J, Yang S, Xiao Z, et al. Comparison of Percutaneous Nephrolithotomy and Ureteroscopic Lithotripsy for Upper Ureteral Calculi. Signa Vitae. 2020;16(2):104-8.

9. Wang Q, Guo J, Hu H,et al. Rigid ureteroscopic lithotripsy versus percutaneous nephrolithotomy for large proximal ureteral stones: A meta-analysis. PLoS One. 2017;12(2):e0171478.

10. Lai S, Jiao B, Diao T, Seery S, Hu M, Wang M, et al. Optimal management of large proximal ureteral stones (>10 mm): A systematic review and meta-analysis of 12 randomized controlled trials. Int J Surg. 2020;80:205-17

11. Sfoungaristos S, Mykoniatis I, Isid A, Gofrit ON, Rosenberg S, Hidas G, Landau EH, Pode D, Duvdevani M. Retrograde versus antegrade approach for the management of large proximal ureteral stones. BioMed Research International. 2016;2016(1):6521461.