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Outcome of mini percutaneous nephrolithotomy 'miniPCNL' in children

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Abstract

Introductions: Renal stone disease is one of the common urological disorders with prevalence approximately 2-3% in the general population and the incidence in children is increasing at a rate of 4% per year. Miniaturization of endoscopic instruments, minimally invasive endoscopic procedures of mini percutaneous nephrolithotomy (miniPCNL) in children is increasingly used. This study was conducted to assess the outcome of miniPCNL in pediatric population.

Methods: This retrospective study analyzed the outcome of miniPCNL in children below 18 years of age from August 2015 to July 2018 at Patan Hospital, Nepal. Ethical approval was obtained. Outcome was assessed descriptively on stone localization, puncture success, stone clearance, bleeding requiring transfusion, gross hematuria, urosepsis, operative time, hospital stay, mortality and need of second procedures.

Results: A total of 26 patients underwent miniPCNL, mean age 10.8±5.45 years (1-18 years), mean operative time was 122±26.03 minutes and mean hospital stay was 3.2±1.12 days. Postoperative transfusion was required in 1 (2.6%), gross hematuria occurred in 1 (2.6%), no urosepsis, no conversion to open surgery. Complete stone clearance was achieved in 22 (84.61%) patients. Mortality was nil. Second procedure was required in 4 (15.38%) to achieve residual stone clearance.

Conclusions: Our study shows miniPCNL is an effective and safe procedure with minimal morbidity for the treatment of pediatric renal stones.

Keywords: mini percutaneous nephrolithotomy (miniPCNL), renal stones, children

Introductions

Nephrolithiasis is a common urological disorder with significant economic burden.[1] The goal of active stone treatment strategies should aim to achieve complete stone clearance in a short operative time, short hospital stay and minimal complications.[2] Renal stone disease in children poses a clinical management dilemma due to the size of the urinary tract and risk of recurrence.[3] The majority of renal stones are due to metabolic disorders or infection with a consequently high lifetime risk of recurrence.[4]

The advent of new technologies, for example, mini percutaneous nephrolithotomy (miniPCNL), minimally invasive percutaneous nephrolithotomy (MIP) and retrograde intrarenal surgery (RIRS) have revolutionized the traditional open surgery for the management of renal stone disease in children. The miniPCNL is a well-established safe and effective technique in adults.[5] Its use in children is increasing.[6]

This is relatively new modality locally, and there is limited published data of its application in children. In this study, we aim to analyze the outcome of miniPCNL in children.

Methods

This retrospective cross sectional study was conducted at Patan Hospital, Patan Academy of Health Sciences, Lalitpur, Kathmandu, Nepal, from August 2015 to July 2018. Inclusion criteria were children below 18 years of age with uncomplicated renal stones, who underwent miniPCNL. Exclusion criteria were patients with anatomic abnormalities of the kidney (horseshoe kidney/malrotated kidney/pelvic kidney/cross ectopia), complex staghorn stones, pathogen-positive urine cultures, previously operated kidney (open surgeries), deranged renal functions and bleeding disorders.

At Patan Hospital, miniPCNL is done by a standard technique under general anesthesia. Prophylactic antibiotics (inj. amikacin & ceftriaxone) is routinely given. In lithotomy position under C-arm guidance, a 4Fr - 6Fr (French) open end ureteric catheter is passed cystoscopically up to renal pelvis. Patient is then changed to prone position. Under C-arm control, pelvi-calyceal system (PCS) is punctured using 23Fr spinal needle through infra-costal approach to minimize pleural injury. After contrast exposure of PCS, mid or lower pole puncture, single or multiple, is done in order to gain comfortable access to stone for maximum clearance guided by C-arm exposure. Glide wire is passed through the puncture needle and tract dilated using plastic & metallic dilators over the glide wire. A 16Fr amplatz sheath is introduced over metallic dilators into pelvi-calyceal system under C-arm guidance. A 14Fr nephroscope is then introduced through amplatz. Pneumatic lithotripter/holmium laser is used to break the stones and tri-prongs grasper/suction irrigation used to extract the stone fragments. Double-J (DJ) stent is placed in those with presence of inflammatory edema of PCS, suspected uretero-pelvic junction obstruction, to assist passage of small stones (<4 mm) fragments (also called as clinically insignificant radiological fragments 'CIRF'). The PCN tubes are placed in patients with intraoperative bleeding. After completion of the procedure, the endoscopic examination of PCS is done to ascertain complete stone clearance. Finally, access sheath is removed and skin approximated. The PCN tube is removed on 3rd postoperative day when the drain minimizes and there is no obvious sepsis. The DJ stent is removed at two weeks after surgery when KUB (kidney ureter bladder) X-ray reveals no residual stones.

Operation room register was used to obtain the patient file numbers. Data were collected from the patient's files kept in hospital record section. The variables analyzed were age, gender, presenting symptoms (flank pain), renal stone location, stone size, PCNL approach, operative time, hospital stay, per-operative and postoperative complications

and need of adjunctive procedure to achieve residual stone clearance. Intraoperative blood loss was determined by fall in hematocrit level and transfusion if hematocrit (HCT) fall was more than 10% compared to preoperative value or maintain a HCT of 21% in presurgical periods as hospital practice. Sepsis was defined as postoperative fever (temperature more than 38°C or less than 36°C), pulse more than 100/minute, respiratory rate more than 20/minute, total leukocyte count more than 12000/mm^3 or less than 4000/mm^3. Complete stone clearance was defined as absence of radio opaque shadow in renal area on KUB X-ray on 1st post-operative day (POD).

Outcome of miniPCNL in children was assessed by stone clearance, need for blood transfusion, presence of residual stones and need for adjunctive procedures for stone clearance, analgesic requirement, hospital stay and mortality. Ethical approval was taken from institutional review committee of PAHS. The SPSS version 16 was used for descriptive data analysis.

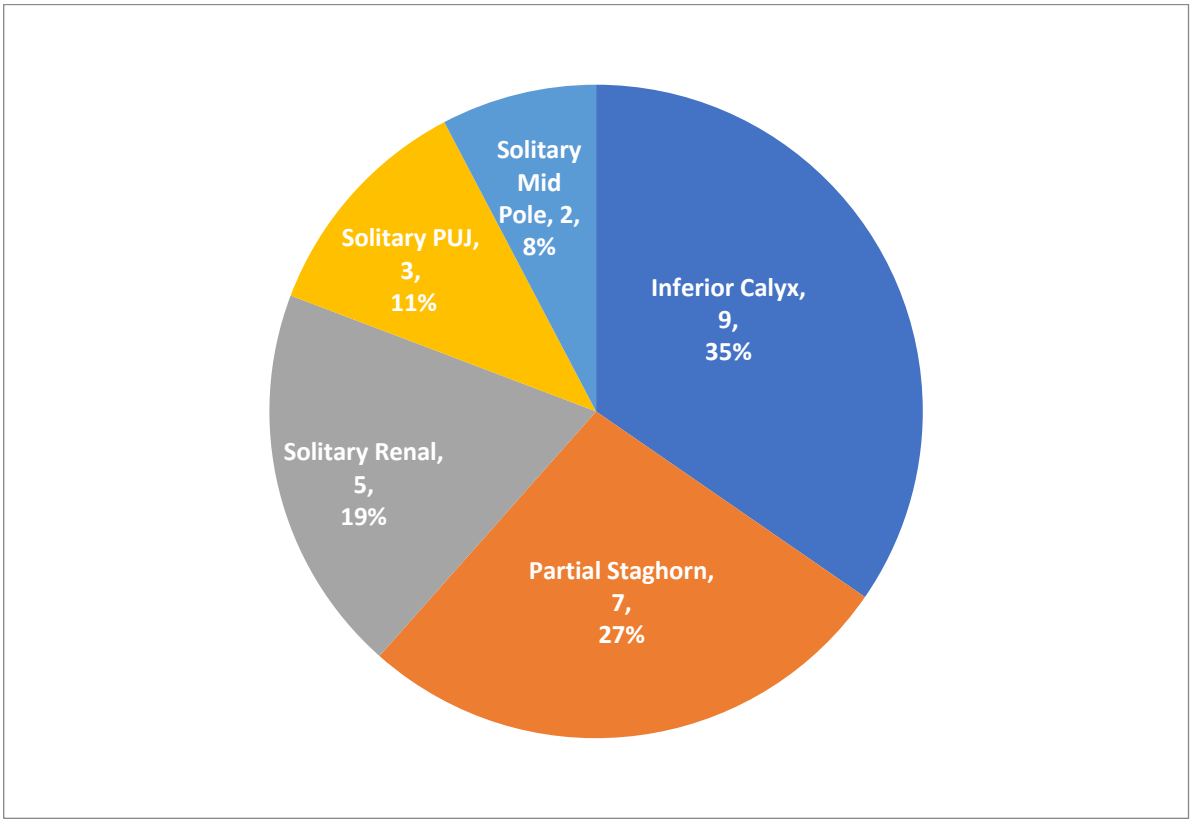

Figure 1. Renal stones (position, number, percentage) in children (n=26) under 18 years of age who underwent mini percutaneous nephrolithotomy (miniPCNL)

Results

There were 26 children, mean age 10.8±5.45 years (range 1-18 years), male 20 (76.92%) and female 6 (23.08%). Successful first pass puncture was achieved in 23 (88.5%) and a second puncture was required in 3 (11.5%). Solitary stones were in 19 (73%) and staghorn in 7 (27%), (Figure 1)

Flank discomfort and pain was presenting symptom in all patients. Stone size was 1.92 cm (range 1.3-3.1 cm). Lower pole approach to inferior calyx was used in 15 (57.70%), mid pole in 11 (42.30%) and both in 3 (11.53%) patients. Mean operative time was 122.4±26.03 minutes and mean hospital stay was 3.2±1.12 days. Postoperative transfusion was required in 1 (2.6%) who had intraoperative blood loss and hematocrit drop by 12% on immediate postoperative assessment. Postoperative pain in 13 (50%) patients were effectively managed with non-steroidal anti-inflammatory drugs (NSAID)-

Table 1. Outcome of miniPCNL for renal stones in children (n=26) under 18 years of age

Outcome	N(%)
Primary Procedures (26)	
Complete Stone Clearance	22 (84.61%)
Residual Stone	4 (15.38%)
Secondary Procedures (4)*	
Second Session MiniPCNL	1
Retrograde Intrarenal Surgery (RIRS)	1
Extracorporeal Shock Wave Lithotripsy (ESWL)	2
Post-Operative Analgesia Requirement	
NSAIDs	13
NSAIDs + Opioids	13
Mean Hospital Stay (Days)	3.2±1.12
Postoperative Blood Transfusion	1
Mortality	0

Note: In one patient 'RIRS' was chosen, as stone was in upper calyx, and in two cases 'ESWL' the stone density was +683 HU and +613 HU (also one patient did not want 2nd miniPCNL)

ketorolac, paracetamol; and rest of the 13 patients required opioids (pethidine, tramadol).

Flank pain secondary to fluid extravasation owing to high pressure irrigation was seen in 5 (19.23%). Postoperative gross hematuria occurred in 1 (2.6%). It was managed with fluid and close monitoring, and did not require blood transfusion. There were no urosepsis and no conversions to open surgery. The DJ stent were placed in 16 (61.53%) and PCN tube in 4 (15.38%).

The PCN were removed on 3rd POD and DJ at two weeks. Postoperative KUB showed complete stone clearance in 22 (84.62%) and residual renal stones in 4 (15.38%). Patients with residual stones required adjunct procedures for complete clearance, (Table 1).

Discussions

In this study of miniPCNL in 26 children, mean age was 10.8±5.45 years, stone size of 1.92 (1.3-3.1) cm and operative time 122±26.03 minutes; comparable to the published data with mean age of 7.8±3.9 years, stone size 2.3±0.6 cm and operative time 73.6±20.2 minutes.[6] Stone clearance and operative morbidity are significant issues to consider owing to small kidney and low tolerance to blood loss in children. There are increasing reports in the literature with the use of miniPCNL in children as young as seven months of age.[6]

Standard PCNL remains the treatment of choice for renal stones greater than 2 cm in diameter, and miniaturized PCNL techniques such as Miniperc, Microperc, and Ultraminiperc has further expanded the indications of PCNL for small-size stones.[7] Improvements in technology and growing experience have dramatically changed the concepts of urolithiasis management in the last two decades.[8]

We had longer operative time probably due to available small sized amplatz sheath (16Fr), smaller field of vision and longer fragmentation time needed to extract the stone fragments through a small-caliber tract to achieve stone free status. In addition, this was our initial experience of miniPCNL in children. However, the super-mini-percutaneous nephrolithotomy (SMP) is increasingly used in clinical practice recently with miniature 7Fr nephroscope and modified metal 12Fr - 14Fr access sheath.[9]

Regarding puncture of pelvicalyceal system, we opted inferior calyx most of the time 15/26 (57.70%), with good outcome except hematuria and blood transfusion in one

patient each. Similar study reports access via inferior calyx without significant postoperative morbidity.[11] Despite the high success rate of miniPCNL, serious complications and higher transfusion rates is associated with stone size, sheath caliber, and number of tracts, and operative time.[10] The transfusion rate in pediatric PCNL in literature is higher (4% to 23.9%), than ours 1/26 (3.8%).[11,14]

Clearance rate and operative time are important factors for minimally invasive surgeries which restricts its use. In the present work, the initial stone-free clearance rate was 84.61% comparable to other studies with 80-84% stone-free without significant complications.[12,16] Our experience shows the failure during initial learning phase, were mainly in establishing a satisfactory PCNL tract. Traditional fluoroscopic guidance is now increasingly shifted to ultrasound guidance for more accurate renal puncture to reduce intraoperative bleeding and residual stones.

We had incomplete stone clearance in 4/26 (8.7%) after 1st miniPCNL who required secondary procedures; one 2nd miniPCNL and one RIRS (due to stone migration to upper calyx during 1st session), and two ESWL (due to low stone density of +683 HU and +613 HU, also one of these patients did not want 2nd miniPCNL). During 1st sessions, these two low density stones were given miniPCNL choice because our patients did not want ESWL as first procedure of choice due to low clearance of ESWL compared to PCNL.[16] Complete stone clearance were verified by absence of radio opaque shadow in renal area on KUB done on 1st POD. We routinely do KUB because C-arm x-ray may not visualize small fragments during surgery. Further, this provides documentation for residual stone and DJ stents.

The miniaturization of PCNL techniques has progressed in recent years.[17] However, the superiority of minimally-invasive nature is still under debate for safety and efficacy compared to conventional PCNL in children. The recent review on this topic summarizes available modalities of PCNL instruments and miniaturized PCNL which appears to be safe and effective for both adult and children.[17]

Our series shows that miniPCNL is safe in children. Our experience further strengthens the concept of proper access to correct calices whenever possible for complete stone clearance and better outcome with less morbidity. Limitation of our study was the small number of cases and retrospective review. Therefore, larger prospective series are needed to corroborate these findings and to make them generalizable to a wider population.

Conclusions

Mini percutaneous nephrolithotomy (miniPCNL) is safe and effective procedure in treating pediatric renal stones. The stone clearance is achievable through properly chosen single nephrostomy tract to minimise complications. In our series, there was no mortality.

References

1. Scales CD Jr, Smith AC, Hanley JM, Saigal S. Prevalence of kidney stones in the United States. Eur Urol. 2012;62:160-5. DOI: 10.1016/j.eururo.2012.03.052
2. Zeng G. Zhu W, Lam W. Miniaturized percutaneous nephrolithotomy: its role in the treatment of urolithiasis and our experience. Asian J Urol. 2018;5(4);295-302. DOI: 10.1016/j.ajur.2018.05.001
3. Coward RJ, Peters CJ, Duffy PG, Corry D, Kellett MJ, Choong S, van't Hoff WG. Epidemiology of paediatric renal stone disease in the UK. Arch Dis Child. 2003;88(11):962-5. DOI: 10.1136/adc.88.11.962
4. Ghazali S, Barratt TM, Williams DI. Childhood urolithiasis in Britain. Arch Dis Child. 1973;48(4):291-5. PMCID: PMC1648335
5. Wah TM, Kidger L, Kennish S, Irving H, Najmaldin A. MINI PCNL in a pediatric population. Cardiovasc Intervent Radiol. 2012;36(1):249-54. DOI: 10.1007/s00270-012-0460-7
6. Zeng G, Zhao Z, Wan SP, Zhong W, Wu W. Comparison of children versus adults undergoing mini-percutaneous

nephrolithotomy: large-scale analysis of a single institution. PLoS One. 2013;24:8(6):e66850 DOI: 10.1371/journal.pone.0066850
7. Zeng G, Zhao Z, Zhao Z, Yuan J, Wu W, Zhong W. Percutaneous nephrolithotomy in infants: evaluation of a single-center experience. Urology. 2012;80(2):408-11. DOI: 10.1016/j.urology.2012.04.058
8. Bader MJ, Gratzke C, Seitz M, Sharma R, Stief CG, Desai M. The “all-seeing needle”: initial results of an optical puncture system confirming access in percutaneous nephrolithotomy. Eur Urol. 2011;59(6):1054-9. DOI: 10.1016/j.eururo.2011.03.026
9. Hernandez JD, Ellison JS, Lendvay TS. Current trends, evaluation, and management of pediatric nephrolithiasis. JAMA Pediatr. 2015;169(10):964-70. DOI: 10.1001/jamapediatrics.2015.1419 PMID: 26302045
10. Liu Y, Wu W, Tuerxun A, Liu Y, Simayi A, Huang J, et al. Super-mini percutaneous nephrolithotomy in the treatment of pediatric nephrolithiasis: evaluation of the initial results. J Endourol. 2017;31(S1):S38-42. DOI: 10.1089/end.2016.0572
11. Iqbal N, Shohab D, Hussain I, Sadaf R, Waqar S, Nawaz G, Akhter S. Paediatric percutaneous nephrolithotomy (PCNL). Paediatric percutaneous nephrolithotomy (PCNL). J Coll Physicians Surg Pak. 2015;25(8):610-2. PDF
12. Celik H, Camtosun A, Dede O, Dagguli M, Altintas R, Tasdemir C. Comparison of the results of pediatric percutaneous nephrolithotomy with different sized instruments. Urolithiasis. 2016;45(2):203-8. DOI: 10.1007/s00240-016-0887-4
13. Daw K, Shouman AM, Elsheemy MS, Shoukry AI, Aboulela W, Morsi HA, et al. Outcome of mini-percutaneous nephrolithotomy for renal stones in infants and preschool children: a prospective study. Urology. 2015;86(5):1019-26. DOI: 10.1016/j.urology.2015.08.019
14. Rassweiler JJ, Rassweiler MC, Michel MS. Classification of complications: is the Clavien-Dindo classification the gold standard? Eur Urol. 2012;62(2):256-8. DOI: 10.1016/j.eururo.2012.04.028
15. Veeratterapillay R, Shaw MB, Williams R, Haslam P, Lall A, De la Hunt M, Hasan ST, Thomas DJ. Safety and efficacy of percutaneous nephrolithotomy for the treatment of paediatric urolithiasis. Ann R Coll Surg Engl. 2012;94(8):588-92. DOI: 10.1308/003588412X13373405387014 PDF
16. Romanowsky I, Lismer L, Asali M, Rosenberg E, Kaneti J. Percutaneous nephrolithotomy for paediatric renal calculus disease: 5 years of local experience. Arch Ital Urol Androl. 2008;80(2):56-8. Web link PMID: 18683810
17. Zeng G, Zhu W, Lam W. Miniaturised percutaneous nephrolithotomy: its role in the treatment of urolithiasis and our experience. Asian J Urol. 2018;5(4):295-302. DOI: 10.1016/j.ajur.2018.05.001