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ORIGINAL ARTICLE

Effectiveness of Percutaneous Nephrolithotomy in Children: A Retrospective Study of 76 Patients

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ABSTRACT

Purpose: To determine the effectiveness and safety of percutaneous nephrolithotomy (PCNL) and its use in kids with renal calculi.

Methods: It was a retrospective observational study involving 76 patients with renal stones undergoing PCNL in a Farooq Hospital between January 2022 and December 2024. There was an analysis of demographic characteristics, stone burden, operative details, stone-free rate, hospital stay, and complications. At week 4, ultrasonography and / or plain radiography were used to determine if the patient was stone-free and non-contrast computed tomography was used to evaluate the pertinent equivocal cases. Stone-free was characterized as complete lack of stones or any non-clinically significant residual stones less than 4 mm.

Results: The mean age was 9.3 ± 3.4 years. There were 44 males (57.9%) and 32 females (42.1%). The mean stone size was 22.4 ± 6.8 mm. Single stones were present in 49 patients (64.5%), while 27 (35.5%) had multiple stones. In 12 patients (15.8%), there were partial staghorn stones and 6 (7.9%), complete staghorn stones. Only 63 patients (82.9%), had only 1 percutaneous tract, and 13 (17.1) patients would not need only 1 percutaneous tract. The average healthcare time was 67.8 before and after +18.6 min and average they lost per hemolytic drop of hemoglobin was 1.2 before and after -0.7 g/dL. The initial stone-free rate and PCNL single session was 86.8 percentage (66/76) rate, after auxiliary procedures, this percentage was 94.7 percentage (72/76). Eighth patients (10.5%) had postoperative fever, 3 (3.9%) patients needed blood transfusion, 2 (2.6) patients required urine leakage, and 1 (1.3) patient had sepsis. No belly injury or death observed. The average length of stay at the hospital was 3.7 days.

Conclusion: PCNL is a safe and effective intervention that shows a high rate of stone-free and reasonable complication profile in the management of pediatric renal stones. It is still an option, particularly when children have numerous, large, and intricate calculi in the kidney.

Keywords: children, percutaneous nephrolithotomy, children urolithiasis, renal stones, and stone-free rate, and complications.

INTRODUCTION

Pediatric urolithiasis is a clinical issue that draws much attention due to the possibility of recurrent pain, urinal tract infection, obstruction, hematuria, and permanent renal impairment when it is not treated properly[1,2]. Despite extracorporeal shock wave lithotripsy and retrograde intrarenal surgery as effective options to use in the selected cases, percutaneous nephrolithotomy (PCNL)

has emerged as a one of the most effective treatments in children with big renal stones, high stone burden, lower calyceal stones and staghorn calculi[1-4]. The advancement of endoscopic instruments, endoscopic apparatus and imaging-guided procedures have rendered the procedure safer when treating the disease in children compared to previous generations[5-8].

The key benefit of PCNL is that it offers high stone clearance rate per single session, especially in children with complicated stones[6-10]. Nevertheless, there are still apprehensions about bleeding, fever, sepsis, and renal parenchymal trauma, particularly in younger children[4,5,11]. Thus, the institutional outcome data are useful in the evaluation of the efficiency and safety of this procedure in the actual, pediatric practice.

The aim of the current study was to determine the success of PCNL in children through the assessment of stone clearance, operative results and postoperative complications in a population of patients undergoing PCNL in a tertiary care center (n=76).

MATERIAL & METHODS

Design and setting of the study

The present retrospective observational study entailed the review of PCNL cases of pediatric patients who underwent PCNL between January 2022 and December 2024 in the department of urology of a Farooq Hospital.

Study population

They were 76 children under the age of 16 years. The children were chosen based on the presence of renal stones that needed PCNL due to large stones, presence of multiple calculi, failing shock wave lithotripsy, lower calyceal stones with poor anatomy, or partial/complete staghorn stones. Patients who developed incomplete records, bleeding diathesis, had uncorrected urinary infection during surgery, a congenital anomaly that required alternative reconstruction, or follow-up less than 4 weeks were eliminated.

Preoperative evaluation

Detailed history taking, physical examination, urine routine examination, urine culture, complete blood count, renal function tests, coagulation profile, and imaging were performed on all the children. Where relevant, initial imaging was ultrasonography and plain kidney-ureter-bladder radiography. In some patients presenting with complex or uncertain anatomy or radiolucid calculi, non-contrast computed tomography was done. Culture-directed antibiotics was administered as preoperative measures on positive urine cultures.

Surgical technique

Cystoscopy was initially done under general anesthesia and a ureteric catheter inserted. The patient was turned onto his back. The percutaneous access to the renal tract was achieved using the fluoroscopic guidance of the procedure, and ultrasonography was used when necessary. The size of the tract was also based on patient age, amount of stones in the patient, and calyceal anatomical structure, and typically measured between 16 Fr and 24 Fr. Pneumatic lithotripsy and graspers and irrigation were used to fragment stones, extract stone fragments and debride the bladder. One nephrostomy tube and/or double-J stent was fitted at the conclusion of the procedure based on intraoperative observations which included bleeding, remnant pieces, swelling, or suspected urinary leakage.

Outcome measures

The first of the outcomes was stone-free rate. The criteria involved stone-free status, which was considered total clear or a residual of less than 4 mm at 4 weeks of postoperative. Secondary outcomes were operative time, hemoglobin drop, blood transfusion, postoperative fever, sepsis, urinary leak, hospital stay and the use of auxiliary procedure.

Statistical analysis

Descriptive statistics were used to enter and analyze data. Mean, SD was used to represent continuous variables whereas frequency, percentage were used to represent categorical variables.

RESULTS

A cohort of 76 children aged on average 9.3 years was involved in the study with boys prevalent over girls. The larger stones were 21-30 mm and almost 2/3 of the children carried a solitary stone. The most common were lower calyceal and renal pelvic stones and the staghorn stones made nearly a quarter of all. Prior to PCNL, almost a quarter of patients had undergone shock wave lithotripsy to the point of failure.

A majority of children responded to a single tract successfully, which implied that satisfactory access to the stone could be repeatedly obtained in most cases without repeated puncture points. Poor accessibility of the calyceal access was the most frequent. The mean operative time was about 68 minutes, the mean fall in hemoglobin was not high. Approximately one-third of the procedures performed were done without the use of nephrostomy tubes.

In a baseline of one PCNL session 86.8% was the main stone-free rate, but this percentage rose to 94.7%

following auxiliary procedures. A second-look PCNL was needed by only one child, and five children improved with adjunctive shock wave lithotripsy. Mean hospital stay was less than four days, which shows most of it had a satisfactory outcome in terms of postoperative recovery.

The majority of complications were not severe, and they were treated in a conservative or simple supportive manner. The most common one was fever. There were only three children who needed blood transfusion, and one experienced sepsis that reacted to immediately administration of antibiotics and supportive care. None of the children had thoracic or visceral injuries, or mortality. All in all, the complication profile demonstrates that PCNL is safe enough in this cohort.

Table 1: Demographic and stone-related characteristics of the study population (n = 76)

Variable	Value
Mean age (years)	9.3 ± 3.4
Age range (years)	2–15
Male	44 (57.9%)
Female	32 (42.1%)
Mean stone size (mm)	22.4 ± 6.8
Stone size 10–20 mm	24 (31.6%)
Stone size 21–30 mm	39 (51.3%)
Stone size >30 mm	13 (17.1%)
Single stone	49 (64.5%)
Multiple stones	27 (35.5%)
Right-sided stones	38 (50.0%)
Left-sided stones	35 (46.1%)
Bilateral disease*	3 (3.9%)
Renal pelvis	21 (27.6%)
Upper calyx	7 (9.2%)
Middle calyx	10 (13.2%)
Lower calyx	20 (26.3%)
Partial staghorn	12 (15.8%)
Complete staghorn	6 (7.9%)
Previous failed SWL	18 (23.7%)
Preoperative urinary tract infection history	15 (19.7%)

*PCNL was performed on the symptomatic or dominant stone-bearing side first.

Table 2: Operative characteristics

Variable	Value
Single tract PCNL	63 (82.9%)
Multiple tracts PCNL	13 (17.1%)
Inferior calyceal access	48 (63.2%)
Middle calyceal access	19 (25.0%)
Upper calyceal access	9 (11.8%)
Mean operative time (minutes)	67.8 ± 18.6
Mean fluoroscopy time (minutes)	2.9 ± 1.1
Mean hemoglobin drop (g/dL)	1.2 ± 0.7
Nephrostomy tube placed	51 (67.1%)
Tubeless PCNL	25 (32.9%)
Double-J stent inserted	46 (60.5%)

Table 3: Stone clearance and postoperative outcomes

Outcome	Value
Stone-free after first PCNL session	66 (86.8%)
Residual fragments after first session	10 (13.2%)
Auxiliary ESWL required	5 (6.6%)
Second-look PCNL required	1 (1.3%)
Final stone-free rate	72 (94.7%)
Clinically insignificant residual fragments	4 (5.3%)
Mean hospital stay (days)	3.7 ± 1.2

Table 4: Postoperative complications

Complication	n (%)
Fever	8 (10.5%)
Transient hematuria >24 hours	5 (6.6%)
Blood transfusion	3 (3.9%)
Urine leakage >48 hours	2 (2.6%)
Sepsis	1 (1.3%)
Pelvic perforation	1 (1.3%)
Thoracic complication	0 (0.0%)
Visceral injury	0 (0.0%)
Mortality	0 (0.0%)

Table 5: Complications according to modified Clavien-Dindo classification

Grade	Description	n (%)
Grade I	Mild fever, transient hematuria, observation only	9 (11.8%)
Grade II	Blood transfusion, intravenous antibiotics	8 (10.5%)
Grade IIIa	Persistent urine leakage requiring stent adjustment/intervention	2 (2.6%)
Grade IIIb or higher	Complication requiring major surgery, ICU, or life-threatening event	0 (0.0%)

DISCUSSION

The current research showed PCNL to be very effective in children with an initial stone-free rate of 86.8 and final stone-free rate of 94.7 following auxiliary procedures. These results agree with other pediatric series that have shown high clearance of stone using PCNL particularly in patients that have large stones or complicated anatomy[4-10]. The clearance rate at the end with the favourable results in our cohort indicates the capability of PCNL to treat massive stone burden with minimal interventions.

The average size of the stones in the current study was 22.4 mm and almost a quarter of the children possessed staghorn stones. This is significant since the success rate of treatment in pediatric stone disease tends to decrease with the increase in stone complexity[7,9].

Nonetheless, the stone-free success of our series was, nevertheless, positive, which confirms the role of PCNL as a follow-up tool with larger or more complicated stones in children[1,2,10]. Our findings are consistent with other studies of mini-PCNL and standard PCNL which have demonstrated that both the two methods have the potential of realizing satisfactory clearance when chosen appropriately[6-9,12,13].

The other significant finding in our study was that the morbidity was acceptable. The average hemoglobin decrease was 1.2 g/dL, and only 3.9% of them needed blood transfusion. This is in contrast to previous issues with bleeding in pediatric PCNL[3-5]. Smaller tracts, enhanced optics, and enhanced energy sources have probably helped to reduce blood loss in modern practice[6,8,12,13]. The majority of our patients were treated using a single tract, which also possibly contributed to mitigating the risk of hemorrhagic.

Ten-point five percent of patients developed postoperative fever and only one of the children developed sepsis. The presence of infective complications in PCNL even in the case of sterile preoperative urine due to the presence of infected stones and intrarenal pressure may cause postoperative systemic inflammatory response to become a recognized complication[1]. However, the low incidence of sepsis observed in the current study indicates that morbidity associated with severe infections can be curtailed by putting into place stringent measures such as sterilization of preoperative urine, antibiotic prophylaxis and proper drainage.

Our mean pediatric PCNL hospital stay was 3.7 days, similar to published experiences[8,10,14]. A small group of our patients had tubeless PCNL and these children mostly cured well. Modern experiences and guidelines have indicated that tubeless PCNL or an entirely tubeless PCNL is possible in the selected uncomplicated cases, primarily due to the lesser postoperative pain and necessitate shorter hospital stay[1]. Nevertheless, normal drainage is also wise in cases of bleeding, left over stone load, edema as well as risk of excess urinary leakage.

Our results also confirm the notion that PCNL is still a useful modality of treatment even in the presence of increasing utilization of retrograde intrarenal surgery and shock wave lithotripsy in kids[1,14,15]. PCNL has a profound place, seemingly given the lower invasiveness of other possible treatments, but still high one-session efficacy particularly when dealing with large-volume or staghorn stones. In this series 23.7 percent of children had previously failed shock wave lithotripsy, which supports the idea that PCNL is an effective salvage as well as initial operation.

There are certain limitations to this study. It was retrospective, single center and descriptive analysis with no comparison group. The recurrence rates were not evaluated after long term, metabolic analysis was not done carefully and renal functioning was not re-assessed. Irrespective of these, the study offers clinically applicable data on a fairly large pediatric cohort size and indicates that PCNL can be undertaken with great efficacy and agreeable complications in children.

CONCLUSION

Percutaneous nephrolithotomy is a highly efficient and fairly safe treatment of pediatric renal stones. In this analysis of 76 children PCNL has high initial and final stone-free rates with the majority of complications minor and manageable. The process is still especially applicable in children who have large stones, have more than one calculus, have failed treatment history, and staghorn disease. It is important to select patients carefully, use a meticulous technique and practice good perioperative infection control to achieve optimal outcomes.

DECLARATION

Conflict of Interest: The authors declare no conflict of interest.

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REFERENCES

1. European Association of Urology. EAU Guidelines on Urolithiasis. Arnhem: EAU Guidelines Office; 2025.
2. Schuster TK, Russell KY, Bloom DA, Koo HP, Faerber GJ. Percutaneous nephrolithotomy in children. J Endourol. 2009;23(9):1419-25.
3. Ganpule AP, Mishra S, Desai MR. Percutaneous nephrolithotomy for pediatric urolithiasis. Indian J Urol. 2010;26(4):531-5.
4. Jackman SV, Docimo SG, Cadeddu JA, Bishoff JT, Kavoussi LR, Jarrett TW. Percutaneous nephrolithotomy in infants and preschool age children. J Urol. 1998;160(3 Pt 2):1088-90.
5. Mahmud M, Zaidi Z. Percutaneous nephrolithotomy in children before school age. J Urol. 2004;171(1):263-6.
6. Wah TM, Kidger L, Kennish S, Irving H, Najmaldin A. MINI PCNL in a pediatric population. Cardiovasc Intervent Radiol. 2013;36(1):249-54.
7. Bhageria A, Nayak B, Seth A, Dogra PN, Kumar R. Paediatric percutaneous nephrolithotomy: Single-centre 10-year experience. J Pediatr Urol. 2013;9(4):472-5.

8. Dede O, Sancaktutar AA, Dagguli M, Utangac M, Bas O, Penbegul N. Ultra-mini-percutaneous nephrolithotomy in pediatric nephrolithiasis: Both low pressure and high efficiency. J Pediatr Urol. 2015;11(5):253.e1-6.
9. Daw K, Orabi H, Hanno A, Shokeir A, Elsobky E, Badawy H. Outcome of mini-percutaneous nephrolithotomy for renal stones in children. Urology. 2015;86(5):1019-23.
10. Gamal W, Moursy E, Hussein M, Mmdouh A, Hammady A, Aldahshoury M. Supine pediatric percutaneous nephrolithotomy (PCNL). J Pediatr Urol. 2015;11(2):78.e1-5.
11. Nerli RB, Jali SM, Hiremath MB, Alur SB, Patil S, Ravish IR. Percutaneous nephrolithotomy in children. Turk J Urol. 2021;47(5):395-400.
12. Ahmad T, Minallah S, Khaliq J, Rashid M, Syed A, Almuradi B. Safety and efficacy of minimally invasive percutaneous nephrolithotomy in infants with 1-2 cm renal stones. Front Surg. 2023;10:1070136.
13. Kumar N, Seth A, Dogra PN, et al. Mini-versus standard percutaneous nephrolithotomy in pediatric urolithiasis: A systematic review and meta-analysis. J Pediatr Urol. 2023;19(6):760-768.
14. Ramez M, ElSheemy MS, Shoukry AI, et al. Supine versus prone pediatric percutaneous nephrolithotomy: A systematic review and meta-analysis. Arab J Urol. 2024;22(4):253-260.
15. Madarriaga YQ, Donmez MI, Juliebø-Jones P, et al. Present insights and future perspectives in pediatric percutaneous nephrolithotomy: A systematic review by the EAU-YAU Pediatric Urology Working Group. J Endourol. 2025;39(6):711-723.