

## Original Research Article

# Safety and efficacy of percutaneous nephrolithotomy in paediatric age group: our 3 year experience in Western Rajasthan

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**Received:** 01 March 2020

**Revised:** 13 March 2020

**Accepted:** 16 March 2020

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### ABSTRACT

**Background:** Percutaneous nephrolithotomy (PCNL) has become a well-established procedure for the management of pediatric renal calculi. Paediatric PCNL has been performed using both adult and paediatric instruments. Objectives: To evaluate the safety, efficacy and complications using the Modified Clavien scoring system (MCSS) in children undergoing PCNL using adult sized instruments.

**Methods:** All patients less than 16 years old were analyzed retrospectively in Western Rajasthan undergoing PCNL procedure at Dr. SN Medical College and Hospital from April 2016 to March 2019. All PCNL procedures were performed in prone position under general anaesthesia with fluoroscopic guidance and using adult size instruments. All the demographics, surgical data and perioperative information were collected.

**Results:** Total 112 patients with 120 renal units (8 patients with bilateral stones), (66 boys and 46 girls), with a mean (range) age was 10.01±4.02 (2-16) years. The mean (range) stone size in our study was 28.94±1.10 (20-50 mm). Overall, stone-free rate after PCNL was 95%. Twenty five (25) children (20.8%) had operative complications; 23/25 (92%) had, Clavien grade I in 15 (60%), grade II in 8 (32%) and all managed conservatively. 2 patients had hydropneumothorax, managed with ICD tube. Stone size, operative duration and haemoglobin drop were significantly associated with complications on Univariate analysis ( $p < 0.05$ ).

**Conclusions:** In paediatric age group PCNL is considered safe with MCSS showing grade I and grade II complications in majority (92%) of patients.

**Keywords:** Complications, Clavien score, Percutaneous nephrolithotomy, Pediatric

### INTRODUCTION

As humans have evolved, in a similar way evolution has occurred in treatment of renal stone disease due to advances in access techniques and instrumentation. In present scenario, minimally invasive procedure like percutaneous nephrolithotomy has replaced open surgery for large stone in children for last two decades.<sup>1</sup> Endoscopic treatment for renal stone disease considered technically difficult in children due to small size and

mobility of the kidney, friable renal parenchyma, small collecting system and deleterious effects of the radiation.

Predisposing factors for pediatric nephrolithiasis includes urinary tract infections (UTI), metabolic disturbances and anatomic abnormalities. Incidence of renal stones in children in developing countries is on rise of all age groups worldwide.<sup>1</sup> Initially, ESWL was used to treat renal calculi but it has low success rate in larger stones (>1.5 cm) and leads to large ureteric fragments which is very difficult to manage in children. So, percutaneous

nephrolithotomy (PCNL) is usually preferred for large complex or multiple renal stones, lower calyceal stone and presence of renal anatomic variation and in those where ESWL is contraindicated or failure of Extracorporeal shock wave lithotripsy (ESWL).<sup>1</sup> Moreover, PCNL has high stone clearance rate and low morbidity.

Woodside et al was the first to describe PCNL in children in 1986.<sup>2</sup> The pediatric PCNL procedure has been performed with both adult and pediatric instruments. Since clearance outcome and complication rate vary depending on technique used and surgeon experience.

There are few studies on the efficiency and safety of PCNL in children, with respect to different age groups.<sup>3-5</sup> In this present study, we aimed to describe our 3 years experience of PCNL using adult instruments in managing pediatric renal calculi in Western Rajasthan and evaluated the safety and efficiency of standard PCNL.

## METHODS

This cross sectional study was conducted over a period of 3 years from April 2016 to March 2019 at Dr. S N Medical College and Hospital in Western Rajasthan. The clinical details of all pediatric patients with renal stone, aged less than 16 years who underwent PCNL were noted down from the patient's hospital records. A preoperative evaluation included complete blood count, bleeding and coagulation profile, urine analysis, urine culture and sensitivity, renal function test were noted down from all the patients. The radiologic evaluation included plain film of the kidney, ureter, bladder (KUB), pelviabdominal ultrasonography and intravenous urography were done in all patients. The demographic characteristics including size, location and multiplicity of stones were all noted. In addition, mean operative time, mean hemoglobin change, number of percutaneous access, analgesic requirement, mean hospitalization time, stone-free rate, complications and need for subsequent treatment of residual stone are all recorded and compared.

Stone clearance or stone free rate (SFR) was defined as the absence of any residual fragments, size more than 4 mm on KUB X-rays postoperatively. The assessment of postoperative complications was done based on modified Clavien classification.<sup>6</sup>

Categorical variables were summarized as frequency and percentage and were analyzed using Chi square/Fischer Exact test as applicable. Continuous variables were summarized as mean and standard deviation and were analyzed using student t test/Mann Whitney test based on normality of variable. A p value <0.05 was taken as statistically significant. All statistical analysis was done using Epi Info Version 7.2.1.0

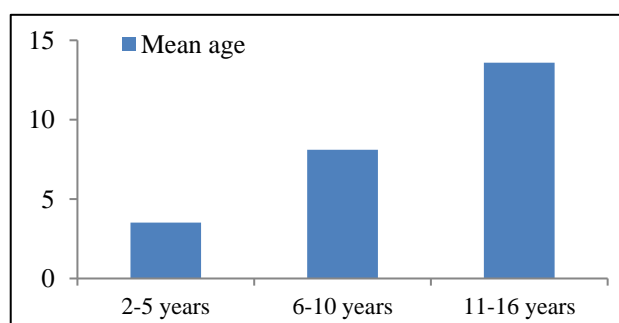
## Operative technique

All PCNLs were performed with Bulls eye technique under GA. Prophylactic antibiotics were administered to all children at the time of induction. Patient in lithotomy position, paediatric cystoscope introduced and 4 or 5F ureteral catheter was inserted for opacification of pelvicalyceal system. C-arm fluoroscopy guided puncture by 18 gauge needle were done at appropriate calyx with the patient in prone position. Guide wire was introduced. Subsequent tract formation was performed by serial, coaxial dilation using Alken dilators and placement of a 20-28 Fr Amplats sheath based on the degree of hydronephrosis observed at fluoroscopy after contrast injection and surgeon preference.

A 24-26 French Karl-storz rigid nephroscope was used for all cases. Stones were fragmented with pneumatic lithotripter and extracted by grasper. Stone clearance confirmed by visualizing with nephroscope and fluoroscopy. On completion of the procedure, urethral catheter, 14-16 Fr nephrostomy was left in situ based on surgeon discretion. Percutaneous nephrostomy tube removed on next day and followed which ureteral catheter removed as urine became clear. Patient were discharged home when there was no urine leakage or fever. Before discharge from the hospital, KUB radiography and USG was performed to determine stone clearance.

## RESULTS

The present study included a total of 112 patients (66 males and 46 females) who underwent 120 PCNL procedures for renal stones between a period of 3 years, from April 2016 to March 2019. The age of the patients included in the study ranged from 2 to 16 years with a mean (range) age of 10.01±4.02 years. The age wise distribution of patients is shown in the Figure 1.



**Figure 1: Age wise distribution of patients.**

Of the 120 renal units, the stones in the right kidney were 53 (44.2%) and in the left were 67 (55.8%). The stones were located in the renal pelvis 22 (18.3%), calyceal 23 (19.2%), pelvicalyceal 50 (41.7%) and staghorn 25 (20.8%). The mean stone burden size was calculated as 28.94 mm (range 20-50). Single access was sufficient for retrieval of stones in 102 procedures. However, in 18

interventions 2 accesses were necessary. In 2 patients anatomic abnormalities like single kidney and malrotated kidney were observed in the perioperative evaluation. (Table 1).

**Table 1: Demographic data and preoperative characteristics of patients.**

Variables	Value	
<b>Total number of cases</b>	112	
<b>Total number of renal units</b>	120	
<b>Age groups (in years) N (%)</b>	≤5	18 (16.1)
	6-10	40 (35.7)
	≥11	54 (48.2)
<b>Mean age in years (Mean±SD)</b>	10.01±4.02	
<b>Gender, N (%)</b>	Male	66 (59)
	Female	46 (41)
<b>Stone location</b>	Right	53 (44.2)
	Left	67 (55.8)
<b>Stone complexity and location, N (%)</b>		
Single	Pelvic	22 (18.3)
	Calyceal	23 (19.2)
Multiple	Calyceal and pelvic	50 (41.7)
<b>Staghorn</b>	Partial	13 (10.8)
	Complete	12 (10)
<b>Stone size, mm (Mean±SD)</b>	28.94±1.10	
<b>Kidney anomaly</b>	Single	01
	Malrotated	01
<b>Preoperative Hb, gm% (Mean±SD)</b>	11.42±1.20	
<b>Comorbidities (DM, HTN)</b>	0	

The mean operative time was 58.50 minutes (range 30-110). The postoperative mean hemoglobin decrease was 0.82% (range 0-4.2%). No major intraoperative complications and organ injury were observed.

The mean hospitalization time was 3.45 days (range 3-7). Complete stone-free status was achieved in 107 patients (114 renal units). In 5 patients (6 renal units), residual fragments were detected postoperatively for which PCNL procedure was performed in second sitting. The overall complication rate was 20.8% (n=25) (Table 2).

There was no significant different between two groups in respect to sex, anatomy of kidney, number of dilatation and Amplatz size while stone burden size, haemoglobin drop, and operation duration, were significantly associated with complications on univariate analysis (p<0.05).

Twenty five children (20.8%) were noted to have intraoperative/postoperative complications; most of them 23/25 (92%) were minor. A total of 8 patients had significant hemorrhage and hemoglobin decrease in postoperative period received a blood transfusion (Clavien grade II complication). Fever and UTI (Clavien grade I complication) was noted postoperatively in 15 patients, which is relieved by giving antipyretics. Hydropneumothorax (Clavien grade IIIb complication) was observed in two patients for which chest tube insertion was done. There were no Clavien grade IV or V complications (Figure 2).

**Table 2: Predictors of complications.**

Variables	Total procedures N (%)	With complications N (%)	Without complications N (%)	P value
<b>Gender</b>				
Male	66 (59)	12 (18.1)	54 (81.9)	0.303
Female	46 (41)	13 (28.2)	33 (71.8)	
<b>Age (years)</b>				
<5	18 (16.1)	08 (44.4)	10 (55.6)	
6-10	42 (35.7)	09 (21.5)	33 (78.5)	
11-16	60 (48.2)	08 (13.3)	52 (86.7)	
<b>Side of stone</b>				
Right	53 (44.2)	10 (18.9)	43 (81.1)	0.806
Left	67 (55.8)	15 (22.4)	52 (77.6)	
<b>Anatomy</b>				
Normal	118	25 (21.2)	93 (78.8)	
Anomaly	02	0	02 (100)	
<b>Stone complexity</b>				
Single				
Pelvis	22 (18.3)	02	20	
Calyceal	23 (19.2)	03	20	
Multiple				
Pelvicalyceal	50 (41.7)	16	34	

Continued.

Variables	Total procedures N (%)	With complications N (%)	Without complications N (%)	P value
<b>Staghorn</b>				
Partial	13 (10.8)	0	13	
Complete	12 (10)	04	08	
Stone size (mm)		41.92±5.02	30.09±4.90	<0.001*
<b>No. of punctures</b>				
1	108	22 (20.4)	86 (79.6)	1.000
2	12	03 (25)	09 (75)	
<b>Tract dilatation (fr)</b>				
20	02	0	02 (100)	0.914
22	05	01 (20)	04 (80)	
24	11	03 (27.3)	08 (72.7)	
26	12	03 (25)	09 (75)	
28	90	18 (20)	72 (80)	
Operation time (min)		65.52±11.72	52.86±10.72	<0.001*
Hb drop		2.08±0.75	1.43±0.43	<0.001*
Hosp. stay, days (mean±S.D)		2.92±1.30	1.91±0.59	
<b>Stone clearance</b>				
Clearance	114	22 (19.3)	92 (80.7)	0.197
Residual	06	03 (50)	03 (50)	

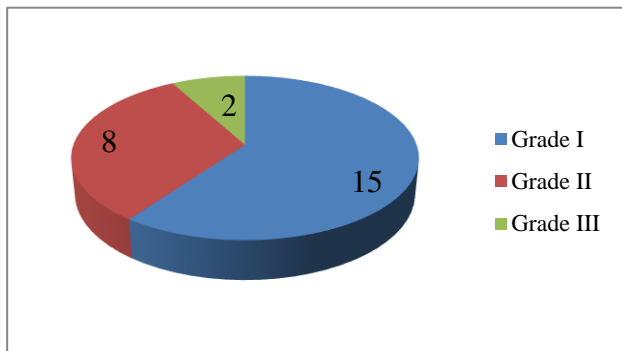


Figure 2: Incidence of complications.

**DISCUSSION**

Pediatric nephrolithiasis is very rare in developed countries (1% to 5%) but its incidence is increasing in developing countries.<sup>1</sup> Fernstrom and Johansson were the first to report PCNL in adults in 1976,<sup>7</sup> and Woodside and colleagues were the first to report PCNL in pediatrics in 1986.<sup>2</sup> A study done by Zeren et al reported 24% incidence rate of bleeding with PCNL procedure requiring blood transfusion so less invasive technique like ESWL was used to treat for even ≥2 cm renal calculi over the past years.<sup>8</sup>

ESWL has shown stone free rate of 79% with the need of retreatment and auxillary procedures which repeatedly exposes children to anaesthesia.<sup>9</sup> ESWL is safe and mainly used for treating upper-tract calculi up to 2 cm in size; however, its efficacy falls with increasing stone size/multiplicity.<sup>10</sup> PCNL has become preferred treatment

modality because of being minimally invasive and high clearance rate and less use of axillary procedures. The presence of anatomical and metabolic abnormalities, staghorn calculi (risk of persistent infections with residual) and being of small age children making them more prone to stone recurrence which justifies the use of minimal invasive procedure like PCNL.<sup>11</sup> At present, pediatric PCNL is indicated in children with a renal stone >2 cm or with staghorn stones, lower caliceal stones >1 cm, failed SWL, or anatomic abnormal kidneys.<sup>1</sup> Percutaneous nephrolithotomy in children was performed by using either adult-size or pediatric instruments. Although pediatric PCNL is difficult because of the small sized kidneys and large instruments, but there is no significant difference in the clinical outcome. These findings were comparable with other studies.<sup>12-15</sup> While few studies suggesting that as the tract size increases, the risk of blood loss and need of transfusion increases. In our study we dilated upto 28 Fr and found no significant increase in blood loss.<sup>16,17</sup>

Another important point to notify is site of pelvicalyceal system entry. The superior calyx provides best access to the renal pelvis, major calyces and upper ureter which was partly responsible to give a high clearance rate with single access. In this current study, we preferred to enter the PCS from where the stone can easily be removed based on best visible access and if required supracostal puncture also taken (not above 11th rib due to significant risk of pleural injury).

The overall stone-free rate after PCNL ranges between 58% to 94% and complication rates of 0–30%. Our study

have shown good stone clearance rate (95%) with overall complications rate of 20.8% and majority of complications are minor in magnitude i.e. grade I and II. This was favourably comparable with published series by Nouralizadeh et al, Samad et al.<sup>12,14</sup> The largest series was reported by Nouralizadeh et al in 2016 reported on 211

cases in Iran with a mean age of 137. 15 months with overall clearance rate of 73.9% using a single tract and post-operative complication rate of 10.6%.<sup>14</sup> Dongol et al reported a stone free rate of 88% in a study of 25 children with complication rate of 12%.<sup>5</sup>

**Table 3: Comparison of paediatric PCNL series.**

Study	No. children /renal units	Mean age (years)	Mean stone size	Tract size (Fr)	Single tracts (%)	Stone free rate (%)	Complication (%)
Samad et al <sup>12</sup>	169/188	6.5	26.2 mm	22	90	76	5
Kapoor et al <sup>17</sup>	31/31	9.6	15 mm	24-30	100	84	0
Unsal et al <sup>13</sup>	44/45	9.3	52 mm	24-26	90	83	22
Kumar et al <sup>18</sup>	11/12	11.7	848 mm <sup>2</sup>	24-30	53.3	91.6	8
Veeratterpillay et al <sup>3</sup>	31/32	10.8	19 mm	28	81	84	0
Goyal et al <sup>4</sup>	153/158	10.03	376 mm <sup>2</sup>	24-30		83	27.8
Nouralizadeh et al <sup>14</sup>	211/211	137.15 months	23.5 mm		92.4	73.9	10.6
Dongol et al <sup>5</sup>	25/25	9.3	20 mm	20		88	12
Present series	112/120	10.01	28.94 mm	20-28	85	95	20.8

The requirement to take multiple tracts in staghorn calculi depend upon the stone anatomy, calyx and stone size so it is preferable to re-look through the original tract in the second sitting because sometimes stones are not visible during the initial PCNL due to bleeding and clot in the collecting system. In present study, we did second stage procedure in 12 staghorn stones. Due to high renal vascularity along with variable vascular anatomy makes it more prone to complicate with percutaneous punctures. The complication rate in the present study was (20.8%), However 92% of the total complications were minor i.e. Clavien score I and II, which were managed conservatively. There are few studies in the literature using the modified Clavien classification system to report PCNL complications in children and our results were favorably comparable to them.<sup>3,12,13,16-18</sup>

In the present study evaluating various factors affecting complications, we found that stone burden size, haemoglobin drop, and operation duration, were significantly associated with complications on univariate analysis ( $p < 0.05$ ). While sex, age, number of puncture, renal anomaly and tract dilatation not significantly associated with complications.

Goyal et al found that stone size, tract size, number of the puncture and operation duration were significantly associated with complications on univariate analysis ( $P < 0.05$ ).<sup>4</sup> Ozden et al found stone burden and operation duration to be the only independent factors affecting complications on binary logistic regression analysis.<sup>6</sup> While Zeren et al<sup>8</sup> and Desai et al found that stone burden, operation duration, number and size of tracts to be significant predictors affecting blood transfusion.<sup>16</sup>

## CONCLUSION

Percutaneous nephrolithotomy in children using adult instruments is an effective and safe procedure for managing simple as well as complex renal calculi.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

- Smaldone MC, Docimo SG, Ost MC. Contemporary surgical management of paediatric urolithiasis. Urol Clin North Am. 2010;37:253-67.
- Woodside JR, Stevens GF, Stark GL, Borden TA, Ball WS. Percutaneous stone removal in children. J Urol. 1985;134(6):1166-7.
- Veeratterpillay R, Shaw MB, Williams R, Haslam P, Lall A, Hunt MD. Safety and efficacy of percutaneous nephrolithotomy for the treatment of pediatric urolithiasis. Ann R Coll Surg Engl. 2012;94:588-92.
- Goyal NK, Goel AS, Singh V, Singh BP, Sinha R. A critical appraisal of complications of percutaneous nephrolithotomy in paediatric patients using adult instruments. BJU Int. 2014;113:801-10.
- Dongol UMS, Limbu Y. Safety and efficiency of percutaneous nephrolithotomy in children. J Nepal Health Res Counc. 2017;15(36):130-4.
- Ozden E, Mercimek MN, Yakupoglu YK, Ozkaya O, Sarikaya S. Modified clavien classification in percutaneous nephrolithotomy: assessment of complications in children. J Urol. 2011;185:264-8.

7. Fernstrom I, Johansson B. Percutaneous pyelolithotomy: a new extraction technique. *Scandinavian J Urol Nephrol.* 1976;10(3):257-9.
8. Zeren S, Satar N, Bayazit Y, Bayazit AK, Payasli K, Ozkeceli R. Percutaneous nephrolithotomy in the management of pediatric renal calculi. *J Endourol.* 2002;16:75-8.
9. Al-Busaidy SS, Prem AR, Medhat M. Pediatric staghorn calculi: the role of extracorporeal shock wave lithotripsy monotherapy with special reference to ureteral stenting. *J Urol.* 2003;169:629-33.
10. Demirkesen O, Tansu N, Yaycioglu O, Onal B, Yalcin V, Solok V. Extracorporeal shockwave lithotripsy in the pediatric population. *J Endourol.* 1999;13:147-50.
11. Stapleton FB. Clinical approach to children with urolithiasis. *Semin Nephrol.* 1996;16:389-97.
12. Samad L, Aquil S, Zaidi Z. Paediatric percutaneous nephrolithotomy: setting new frontiers. *BJU Int.* 2006;97:359-63.
13. Unsal A, Resorlu B, Kara C, Bozkurt OF, Ozyuvali E. Safety and efficacy of percutaneous nephrolithotomy in infants, preschool age, and older children with different sizes of instruments. *Urology.* 2010;76:247-52.
14. Nouralizadeh A, Basiri A, Javaherforooshzadeh A, Soltani MH, Tajali F. Experience of percutaneous nephrolithotomy using adult size instruments in children less than 5 years old. *J Pediatr Urol.* 2009;5:351-4.
15. Guven S, Istanbuluoglu O, Gul U, Ozturk A, Celik H, Aygün C. Successful percutaneous nephrolithotomy in children: multicenter study on current status of its use, efficacy and complications using Clavien classification. *J Urol.* 2011;185:1419-24.
16. Desai MR, Kukreja RA, Patel SH, Bapat SD. Percutaneous nephrolithotomy for complex pediatric renal calculus disease. *J Endourol.* 2004;18:23-7.
17. Kapoor R, Solanki F, Singhanian P, Andankar M, Pathak HR. Safety and efficacy of percutaneous nephrolithotomy in the pediatric population. *J Endourol.* 2008;22:637-40.
18. Kumar R, Anand A, Saxena V, Seth A, Dogra PN, Gupta NP. Safety and efficacy of PCNL for management of staghorn calculi in pediatric patients. *J Pediatr Urol.* 2011;7:248-51.

**Cite this article as:** Sharma PK, Baweja S, Aggarwal V, Katti P, Nagori R, Chhabra MK. Safety and efficacy of percutaneous nephrolithotomy in paediatric age group: Our 3 year experience in Western Rajasthan. *Int Surg J* 2020;7:1127-32.