

# Safety and Efficacy of Percutaneous Nephrolithotomy in Children

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## ABSTRACT

**Background:** Renal stone disease is a common problem in children in developing countries. Its prevalence in children varies from 5% to 15%. It is suggested that anatomic abnormalities, recurrent urinary tract infections, metabolic disturbances, dietary and environmental factors are the predisposing factors. The aim of this study is to evaluate the safety and efficacy of percutaneous nephrolithotomy in children.

**Methods:** Between May 2012 and Dec 2016, 25 children with renal stone diseases underwent percutaneous nephrolithotomy and were evaluated for stone free rate, complications, blood transfusion rate, sandwich therapy, etc.

**Results:** The mean age of children was 9.3 years (7-15 years) and the mean size of the stone was 20 mm (13-27 mm). The anatomical location of stone was important in terms of stone clearance. Three patients needed blood transfusion. The overall stone free rate was 88% before discharge. Three patients had residual stones and were treated with extracorporeal shockwave lithotripsy. Complications included fever, haematuria, ileus and urine leak. No major complications were noted. There were no significant differences in haemoglobin and creatinine levels before and 12 hours after the surgery.

**Conclusions:** Percutaneous nephrolithotomy (PCNL) can be considered a safe, effective and feasible modality of treatment for children with an average of 2 cm sized renal stones.

**Keywords:** Extracorporeal shock wave lithotripsy; percutaneous nephrolithotomy; retrograde intrarenal surgery.

## INTRODUCTION

Majority of renal stone diseases occur due to anatomic abnormalities, urinary tract infections and metabolic disturbances.<sup>1-7</sup> It is also suggested that the incidence of stone diseases is growing in children due to dietary and environmental factors. Minimally invasive treatments such as percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS) and extracorporeal shock wave lithotripsy (ESWL) and laparoscopic procedures have completely replaced open surgery.<sup>8</sup> PCNL is the treatment of choice for large complex or multiple lower pole stones, cystine stones and stones in anomalous kidneys.<sup>9</sup> PCNL is safe and effective in paediatric population.<sup>10</sup>

The aim and objective of the current study was to evaluate the safety and efficacy of percutaneous nephrolithotomy in the children using 20 Fr Wolf

nephroscope despite the recent tendency towards replacing the standard dilatation techniques with small access tracts. In experienced hands, the complication rates are pretty low.

## METHODS

This was a prospective observational study including 25 children who underwent PCNL from May 2012 to Dec 2016 in the Department of Surgery, Kathmandu Medical College and Teaching Hospital. The infants, preschool children and children with complete staghorn calculus were not included in the study. The patients above the age of 15 years were also not included in the study. Approval from ethical committee was taken and informed consent was taken from the parents of the patients.

All the patients were evaluated with complete urine

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analysis, urine culture and sensitivity, complete haemogram, coagulation tests, renal parameters, X-ray KUB, ultrasonography of abdomen and Intravenous urography. Positive cultures were treated with antibiotics. All the patients were given intravenous antibiotics one day before the procedure. The procedure was performed based on the standard technique under general anaesthesia. After ureteral catheterization with 5 Fr catheter and delineation of pelvicalyceal system, puncture was done to the desired calyx under fluoroscopic guidance. Acute dilatation of the tract was done up to 22-24 Fr as per the stone burden with metallic coaxial dilators. 20 Fr nephroscope (Wolf) was used and advanced to the pelvicalyceal system. The stone was fragmented with pneumatic lithotripter and fragments removed. Double J stent and nephrostomy tube was kept in all patients at the end of the procedure. The preoperative parameters like age, sex, onset manifestations, stone characteristics such as size and location, levels of hemoglobin and creatinine etc. and per-operative parameters like total operating time, technical details, site of operation, stone clearance under fluoroscopy, estimation of blood loss and other intraoperative complications were all noted. Similarly postoperative data like levels of hemoglobin and creatinine, stone free rate (SFR), complications, etc was also documented for each patient. The post-operative complications were assessed according to the Clavien classification of surgical complications, which was first introduced in 1992.

Data was statistically analyzed using SPSS 18. Analytical evaluation was carried out using Chi-Square and independent T test. P value less than 0.05 was considered significant.

During follow up, radiological assessment of the stone clearance was done after surgery. X-ray KUB and ultrasonography was done in all patients before discharge from the hospital and at 3 weeks to assess the stone clearance. Stone free rate (SFR) was defined as the absence of any residual fragments greater than 4 mm post-operatively. Nephrostomy tube was removed on third day.

**RESULTS**

Total 25 children with renal stones underwent PCNL. There was no open conversion in the study. The age of the patients ranged from 7 years to 15 years (average 9.3 years). Among all patients, 14 were male and 11 were female. Four patients had past history of open surgery before. The size of stone varied from 0.9 cm to 2.7 cm with mean size of 2.0 cm. The commonest presenting

features of these patients were pain abdomen (68.2%) followed by haematuria and urinary tract infections.

The mean operating time was 92 mins (range 58-170 mins). Three patients needed blood transfusion. The complications included fever, haematuria, ileus and urine leak. The urine leak stopped with Tamsulosin for 5 days. Antibiotics were upgraded in patients with fever and ureteral stent was removed. Haematuria was not significant except in three patients. The stone clearance rate was 88%. Three patients needed sandwich therapy. They were treated with ESWL at 6 weeks before removal of ureteral stent. There were no significant differences between changes in haemoglobin and creatinine level before and 12 hours after the surgery. The patient characteristics and operative parameters were compared below.

**Table 1. Baseline characteristics of the patients who underwent PCNL.**

Variables	Value	
Mean weight (kg)	42	
Mean age (years)	9.3 (7-15)	
Age groups	7-10 yrs	12
	10-15 yrs	13
Gender	Male	14
	Female	11
Stone location	Right	16
	Left	9
Stone size	<2cm, multiple	10
	>2 cm, single Partial staghorn	12
	staghorn	3
Anatomical location	Pelvis and upper ureter	12
	Pelvis and lower calyx, multiple	10
	Partial staghorn	3

All the data were statistically analyzed using SPSS 18. Analytical evaluation was carried out using Chi-Square and independent T test. P value less than 0.05 was considered significant .

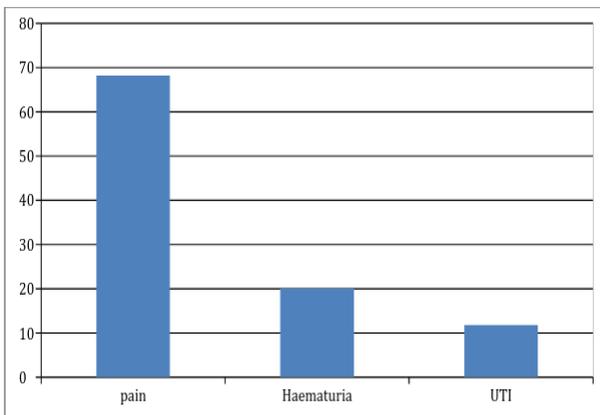
In three patients small clinically insignificant residual fragments (CIRF) were seen in ultrasonography of abdomen before discharge from the hospital. However at three weeks follow up before removal of Double J stent, they did not need any treatment. The complications encountered were of Clavien grade 2 category.

**Table 2. Comparison between patients undergoing PCNL.**

Variables	Group	Stone free status (n)	Stone residue status (n)	P value
Age (years)	5-10	10	2	0.18
	10-15	11	2	
Sex	Male	12	2	0.70
	Female	9	2	
Stone location	Right	13	1	0.52
	Left	8	3	
Anatomical location	Pelvis and upper ureter	11	0	0.05
	Pelvis and lower calyx	8	3	
	Partial staghorn	2	1	
Operating time	92 mins (58-170 mins)			

**Table 3. Pre and post operative parameters of haemoglobin and serum creatinine.**

Variables	pre-operative	post-operative (after 12 hours)	P value
Haemoglobin gm/dl	13.6	12.8	0.31
Creatinine mg%	1.1	1.15	0.67



**Figure 1. Symptoms/presentations of patients undergoing PCNL.**

**Table 4. Complications of the patients undergoing PCNL.**

Complications	No of patients (%)
Haematuria	6 (24)
Fever	3 (12)
Ileus	2 (8)
Urine leak	2 (8)

**DISCUSSION**

Paediatric urolithiasis poses management challenges because of small kidney sizes and less knowledge about the etiology of renal stones<sup>4</sup>. Though extracorporeal shock wave lithotripsy is the treatment of choice for the most of the small stones, with increasing experience, PCNL is currently being used for the treatment of nephrolithiasis in children achieving stone free rate of 68-100%.<sup>15,16</sup> Recent large retrospective series of PCNL monotherapy have demonstrated high efficacy rates that approach 90%.<sup>17</sup> Mahmud and associates<sup>29</sup> reported a 60% stone free rate after PCNL monotherapy and 100% after sandwich therapy of ESWL. The first series on paediatric PCNL was published by Woodside et al claiming 100% stone free rate with no significant complications.

In our study, pain abdomen was the commonest presentation (68.2) followed by haematuria and urinary tract infections. After the surgery, the characteristics of the patients in terms of the stone free outcome are compared. The overall stone free rate was 88%. Three patients needed ESWL. There were no significant differences in respect of parameters evaluated except for the location of stone. In three patients, clinically insignificant residual fragments (<4 mm) were seen. They did not need any further treatment. In a series of 56 children (mean age 9.1 years) with mean stone burden of 37.5 mm, Desai et al., reported a stone free rate of 89.8%.<sup>17</sup> Similarly, Zeren and associates<sup>18</sup> reported a 90% stone free rate with tract dilatation from 18-30 Fr in a study of 52 children with mean age of 7.9 years and mean stone burden of 28 mm. Complications included postoperative fever (30%) and need for transfusion (24%). In one of the largest series of 211 children including PCNL in anomalous kidneys in Iran by Nouralizadeh et al,<sup>19</sup> the stone free rate was 74% without major surgical complications. Samad et al.,<sup>20</sup> retrospectively evaluated 188 consecutive PCNLs in 169 children with the mean stone burden of 19.1-33.3 mm and the mean duration of PCNL was 69-115 mins with the stone free rate of 90-100% by the single tract access.

In our study three patients (12%) needed blood transfusion. Though the average haemoglobin level was 13.6 gm%, these three patients had their haemoglobin level at 10 gm% pre-operatively which dropped by 1.6 gm% after the surgery. However, overall there were no significant differences in haemoglobin and creatinine levels before and 12 hours after the surgery. Complications encountered were fever, haematuria, ileus and urine leak. The urine leak stopped in 5 days. In patients with fever, antibiotics were upgraded and DJ stent was removed. The ileus resolved in 4 days spontaneously. In a study by Salah and colleagues,<sup>21</sup> which included 135 children aged 8.9 years in average and with mean stone burden of 50.7 mm, stone free rate was 98.5%. Complications noted were 8% urine leak and 0.7% transfusion rate. Buddy et al.<sup>22</sup> reported 90% stone free rate with sequential dilatation of tract up to 24-26 Fr.

In our study, we used adult instruments (20 Fr Wolf nephroscope). Acute dilatation of the tract was done up to 22 to 24 Fr depending upon the stone burden. PCNL procedure in children using adult instruments is considered safe and effective for managing both simple and complex renal calculi.<sup>23</sup> However, due to presumed risk of operative damage, a technique in which 15 Fr peel away vascular sheath known as mini perc has been developed where smaller skin incision and the tract size are used.<sup>24</sup> Unsal et al.<sup>25</sup> compared the efficacy of PCNL using adult versus pediatric sized instruments and found it to be safe and efficient except slight increased bleeding with larger tracts. In the study by Fattini et al.<sup>26</sup> of 19 PCNL procedures on 15 children aged from 8 months to 16 years with complex renal stones and with the position (prone and supine), 14 patients were stone free without any major complications. It is believed that the use of adult instruments in children with large kidney stones might have a positive impact on SFR, operation time, and fluoroscopy time without increasing the complication rate.<sup>27</sup> Segura<sup>28</sup> also has suggested the use of adult instruments in children.

## CONCLUSIONS

PCNL can be considered a safe, effective and feasible single modality of treatment for children with average 2 cm sized renal stones. However, future studies should be performed to evaluate the efficacy of utilizing different instruments and approaches during PCNL especially in infants and preschool group of children.

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