**ORIGINAL ARTICLE**

# Safety and Efficacy of Percutaneous Nephrolithotomy (PCNL) in Pediatric Patients with Deranged Renal Functions

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## ABSTRACT

**Objective:** The objective of this study is to assess the effectiveness of PCNL in children with deranged renal functions and to compare the safety and efficacy of PCNL in these patients with those having normal renal functions.

**Methodology:** Retrospective data for patients treated with percutaneous nephrolithotomy in a 3year period were collected. Serum creatinine (SCr) value of 0.7 mg/dL was set as cut off point. The patients who had creatinine level of <0.7 mg/dL labeled as having normal GFR (Group 1) while children having creatinine levels >0.7 mg/dL were categorized as having decreased GFR (Group 2). Stone clearance rate (SCR), hospital stay and mean change in hemoglobin and hematocrit were primary study outcomes. While complications of PCNL were secondary study outcomes.

**Results:** We evaluated 307 children in which male were 202(65.8%) while female were 105(34.2%), median age was 7. Median operative time was 80 minutes while median duration of stay in hospital was 4 days. Median length of stone was 1.5 cm while breadth was 1.3 cm. Most of stones were located in pelvic region (266), followed by 131 in lower calyx, 49 were in upper calyx and 40 were in mid calyx. In 301(98%) patients single tract was made while double tract was made in 6(2%) patients. Post-operative complications like need of blood transfusion, fever, pleural tap and urosepsis were not associated with deranged renal function (p value ≥ 0.05). Complete stone free rate was less in patients with decreased renal functions (p value=0.027). Pre-operative and post-operative differences of HB, HCT and creatinine levels were same in both groups of patients (p value ≥0.05).

**Conclusions:** PCNL is an effective feasible intervention for patients with chronic renal insufficiency and acceptable complication rates. Therefore, careful patient selection and through surgical practice is required to yield favorable outcomes.

**Keywords:** Pediatric urolithiasis, Percutaneous nephrolithotomy, stone clearance rate.

## INTRODUCTION

Pediatric renal stone disease (RSD) have become an endemic in developing countries. Moreover, there is a higher incidence of recurrence of RSD in children as compared to the adult patients.[1] Metabolic disturbances, congenital defect and higher risk of infections are considered main predisposing factors of recurrence in children.[2] Reported reoccurrence rate is 55% within 5 years.[3] So treatment of RSD in children using minimal invasive techniques is more impartment than adult patients due to repeated risk of procedures.

An ideal technique to treat RSD in children should be that with minimum morbidity and maximum success rate. Retrograde intra-renal surgery (RIRS), extra-corporeal shock wave lithotripsy (ESWL) and percutaneous nephrolithotomy (PCNL) are minimal invasive techniques to treat RSD in pediatric population.[4,5]

The first report of the use of PCNL in children was reported by Woodside et al. in 1985.[6] After that its use increased in children and it has now become a gold standard treatment for management of pediatric RSD. Pediatric kidneys are fragile and have small collecting ducts so many of the urologists are still hesitant to use PCNL for pediatric RSD because of the risk of damage to the kidneys.[7]

In present study we assessed the effectiveness of PCNL in patients with deranged renal functions and compared the safety and efficacy of PCNL in these children with those having normal renal functions.

## METHODOLOGY

In this retrospective analysis we presented in data of 307 children with RSD who were treated with PCNL in our institute within the duration of three and half years from January-2015 to June-2018. Children with diagnosis of RSD having age 1 year to 14 years regardless of gender were included in this analysis. Children who underwent any previous renal surgery were excluded.

Pre-op serum creatinine (SCr) levels were measured in all children. Children were divided into 2 groups on the basis of creatinine levels. SCr value of 0.7 mg/dL was set as cut off point. The patients who had creatinine level of <0.7 mg/dL labeled as having normal GFR (Group 1) while children having creatinine levels >0.7 mg/dL were categorized as having decreased GFR (Group 2).

Urine analysis, complete blood count and co-agulation profile was checked in all children before PCNL. X-rays KUB and digital ultrasonography was done to determine the size, location and number of renal stones. PCNL was done in all patients using pneumatic lithotripsy. Amplatz dilators were used for tract dilatation, amplatz size ranging from 8 Fr to 20 Fr were used subjected upon the length of the nephroscope and the sheath size used. The sizes of nephroscope used were ranging from 11-15.9 Fr, were based on the age of children. After stone disintegration, 2 to 3 logged for-ceps were used for stone extraction. At the end of surgery, all calyxes were observed by using a flexible nephroscope to monitor residual stones,

if any stones were found Ho-YAG lithotripter was used to disintegrate residual stones.

Data of intra-operative and post-operative complications were noted. SCR, hospital stay and mean change in hemoglobin and hematocrit were primary study outcomes. While complications of PCNL were secondary study outcomes. Patients were followed for 3 months after surgery and stone clearance rate (SCR) was noted at the end of follow-up using X-rays KUB.

Data analysis was performed using SPSS v23. Mean ± std was observed for continuous variables while in case of categorical variables, frequency with percentages were noted. Normality of data was checked by Shapiro wilk test. Mean differences was assessed using independent sample t-test in normally distributed variables, while in case of skewed parameters Mann Whiteney U test was used. Association of categorical variables was established by chi square test.

## RESULTS

We recruited total 307 children in our study. There were 202 (65.8%) male and 105 (34.2%) female. Median age of children was 7 (interquartile range (IQR)=8)) years. Most of patients had single stone (58.6%) while only 4.2 % patients had 4 stones. Majority of stones were located in pelvis (55.6%) (Table 1). Majority of PCNL was approached from inferior site (59.9%) [Figure no 1].

Table no 1: Description of stone

| Description of stone | | N (%) |
|---|---|---|
| *Total No. of Stones* | | *478* |
| Stone frequency | 1 | 180 (58.6) |
| | 2 | 92 (30) |
| | 3 | 22 (7.2) |
| | 4 | 13 (4.2) |
| Stones Location | Pelvic | 266 (55.6) |
| | Lower Calyx | 131 (27.4) |
| | Upper Calyx | 41 (8.5) |
| | Mid Calyx | 40 (8.3) |

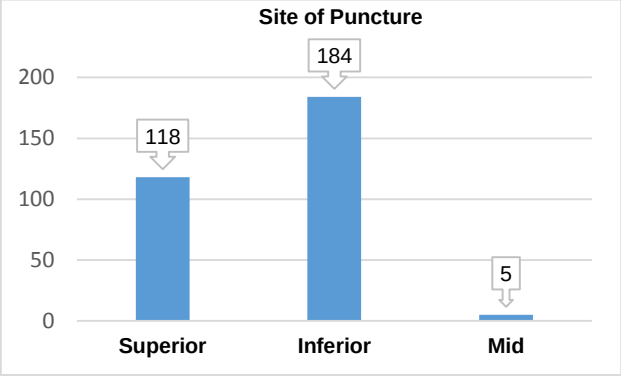


Figure 1: Frequency of puncture site of PCNL

Mean VAS pain score and duration of stay in hospital were less in children with normal GFR as compare to decreased GFR and these differences are statistically significant too (P-value<0.05). While no difference was found in laboratory parameters between two groups. (Table 2).

When we compare complication rate in both groups, we observed that pleural effusion, chest tube insertion and nephrostomy tube insertion were more associated with decreased GFR, while there was higher stone free rate in children with normal GFR (p value <0.05) [Table no 3].

Table 2. Diference in clinical and laboratory parameters between children with Normal GFR and Decreased GFR.

| Variables | Normal GFR *(Mean±std)* | Decreased GFR *(Mean±std)* | *p* Value |
|---|---|---|---|
| Pain VAS Score | 4.51±0.89 | 5.02±1.23 | 0.002 |
| Duration of Hospital Stay (days) | 4.09±0.6 | 4.56±1.3 | <0.001 |
| Change in Hemoglobin (mg/dl) | 0.9±1.1 | 1.2±1.1 | 0.190 |
| Change in Hematocrit (mg/dl) | 2.5±3.1 | 2.6±3.7 | 0.200 |
| Difference in Sr. Creatinine (mg/dl) | 0±0.19 | 0.05±0.33 | 0.180 |

Table 3: Association of complication with GFR

| Variables | Children with normal GFR n(%) | Children with decreased GFR n(%) | p value |
|---|---|---|---|
| Complete stone removal | 222 (85.7) | 35 (72.9) | 0.027 |
| Fever | 43 (16.6) | 13 (27.1) | 0.084 |
| Pleural effusion | 3 (1.2) | 3 (6.2) | 0.019 |
| Pleural tap | 0 (0) | 1 (2.1) | 0.156 |
| Chest tube intubation | 1 (0.4) | 4 (8.3) | 0.002 |
| Uro sepsis | 17 (6.6) | 6 (12.5) | 0.15 |
| Blood transfusion | 34 (13.1) | 10 (20.8) | 0.162 |
| Nephrostomy tube | 47 (18.1) | 17 (35.4) | 0.007 |

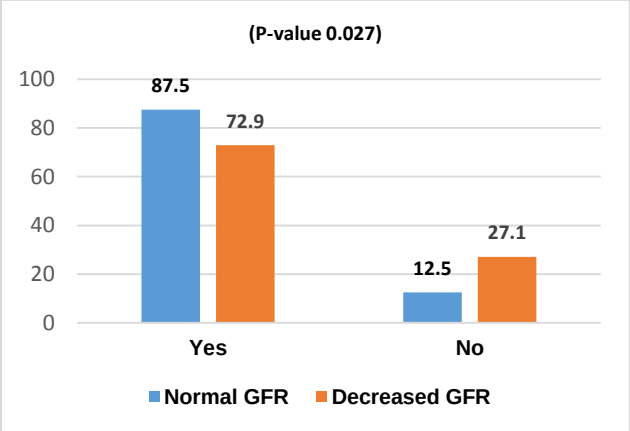


Figure 2. Comparison of Stone Clearance Rate in children with Normal GFR and Decreased GFR.

Table 4. Stone Clearance Rates (SCR) Reported by Different Studies.

| Study Conducted by | SCR | Hospital Stay (days) |
|---|---|---|
| Samad et al.[11] | 59.3% | 4.5 |
| Holman et al.[20] | 98.2% | 4.8 |
| Bhageria et al.[21] | 83.0% | Not mentioned |
| Rizvi et al.[22] | 67.7% | 4 |
| Raza et al.[5] | 79.0% | Not mentioned |
| Elderwy et al.[16] | 91.5% | 3.0 |
| Cicekbilek et al.[1] | 95.0% | 3.0 |

## DISCUSSION

The principal objective of all procedures for management of RSD is to achieve maximum stone clearance. ESWL is an ideal treatment for pediatric renal stones of <20 mm, because children can pass stone fragments more rapidly as easily as compared to adults.[8,9] But ESWL is done under general anesthesia and more often repeated procedures are needed so many urologists are not willing to use ESWL in pediatric patients. In 2017, European Association of Urology (EAU) recommended that PCNL should be considered as a first line procedure in children of RSD with stone size >20 mm and >10 mm if stone is in lower pole of calyx.[10]

Many studies have shown acceptable stone clearance using PCNL in pediatric patients of RSD. A study by Samad et al. demonstrated that impaired renal function is not a contraindication to PCNL and PCNL is these children is sometimes associated with improvement of renal function.[11]

In Present study, we determined the safety and efficacy of PCNL for management of RSD in children with and without impaired renal function. Hong et al. reported 90.9% SCR in pediatric patients after PCNL and it increased 96% when PCNL was combined with ESWL.

Median hospital stay in our study was 4 days with interquartile range zero in children with normal GFR and 1 in children with decreased GFR (p-value 0.003). Other studies have also reported similar hospital stay as that of our study.

A study by Mahmud et al. found SCR of only 60% after PCNL.[12] That is much lower when compared with our study. Initial studies of PCNL reported lower SCR only in up-to 68% patients (13-15).[13-15] But recent studies have reported SCR of 83-95% using PCNL in pediatric population.[1,16]

In our study, most frequent complication was necessity of NTI (overall 20.8%, in normal GFR 18.1% and in decreased GFR 35.4%) followed by fever reported in 18.24% children (16.6% in children with normal GFR and 27.1% in children with decreased GFR). Chest intubation was required in 1.6% children (0.4% in normal GFR and 8.3% in decreased GFR), pleural effusion was diagnosed in 1.9% children (1.2% in normal GFR and 6.2% in decreased GFR group) and transfusion was required in 14.33% children (13.1% in normal GFR and 20.8% in decreased GFR).

Hong et al. reported fever in 12.5% after ultrasound guided PCNL (7). Onal et al. also reported fever in 12% children, pleural injury in 1% and blood transfusion in 8.0% children.[17] Bayrak et al. reported fever in 5.4% children and blood transfusion in 8.1% children undergoing PCNL for RSD.[18] Guven et al. reported fever in 11.4% to 15.3% children and blood transfusion rate in 8.6% to 9.7% children.[19]

Cicekbilek et al. reported fever in 5.0% children, pleural effusion in 0.0%, transfusion requirements in 2.5% and UTI in 5.0% children.[1] Reported complications rate in this study was less as compared to our and other published studies.

We found higher post-op VAS pain score, hospital stay, frequency of NTI, pleural effusion and chest intubation in children with decreased GFR as compared to those with normal GFR. So PCNL can be safely used in children having RSD with decreased GFR.

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