Original Article

Safety and Efficacy of Minimally Invasive Percutaneous Nephrolithotomy for Kidney Stones in Infants in Pakistan

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ABSTRACT

Objective: To assess the safety and effectiveness of minimally invasive percutaneous nephrolithotomy in infants of age less than 12 months in Pakistan.

Study Design: Analytic study

Place and Duration of Study: This study was conducted at the Pediatric Urology Department at Institute of Kidney Diseases Peshawar from March 2020 to March 2021.

Materials and Methods: Children under the age of 12 months having renal stone of size ≥ 1cm in greatest dimension on CT-KUB were enrolled in this study. Patients with positive urine cultures, elevated serum creatinine, horse shoe kidneys, ectopic kidneys and bleeding diathesis were omitted from this study. All patients underwent mini-PCNL under general anesthesia in prone position.

Results: A total of 33 patients with mean age 9.3 ± 2.05 months were included in this study. The mean stone size, operative time, hospital stay and drop in hemoglobin (Hb) were 11.50 ± 1.37 mm, 52.12 ± 8.23 mins, 2.36 ± 0.74 days and 1.65 ± 0.89 g/dl respectively. We attained stone free status in 84.85% of the patients. Postoperative complications developed in 21.21% of the patients. Only 15.15% patients required retreatment.

Conclusion: We concluded that for renal stones, in the infantile stage group, mini-PCNL is safe and effective treatment for renal stones in infants.

Key Words: Infants, Pediatrics, Percutaneous, mini-PCNL, Urolithiasis

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INTRODUCTION

The prevalence of pediatric urolithiasis in comparison to adult population is low but is steadily increasing[1]. The clinical presentation of renal stones in infants is variable because of their incapability to communicate. The main presentations are but not limited to fever, oliguria, hematuria, listlessness or crying and poor appetite[2]. Minimally invasive options for renal stones in infants include extracorporeal shockwave lithotripsy (ESWL), flexible ureteroscopy (URS) and percutaneous nephrolithotomy (PCNL). ESWL is the preferred technique to manage renal stones <2 cm diameter. However, ESWL in infants is performed under general anesthesia (GA) and requires repetitive sessions[3]. Furthermore, residual stones after ESWL may lead to recurrence. Pediatric URS has excellent stone free rate (SFR) with minimal intra or post-operative complications[4]. Flexible URS, however, requires LASER, which is not available in our part of the world. Besides, the procedure requires instruments that are disposable and costly, making it difficult to afford. Therefore to treat infantile nephrolithiasis mini-PCNL is suggested. This procedure does not need disposable instruments and can safely be done with pneumatic lithoclast[5]. Nonetheless, PCNL is associated with several complications and requires a steep learning curve especially in infants[6].

This research study was carried out in the Pediatric Urology Department, Institute of Kidney Diseases (IKD) Peshawar to assess the safety and effectiveness of minimally invasive percutaneous nephrolithotomy in infants of age less than 12 months.

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MATERIALS AND METHODS

This study was conducted in the Pediatric Urology Department, Institute of Kidney Diseases Peshawar from March 2020 to March 2021. Approval was obtained from the hospital ethical committee. All children included in this study were of ≤ 12 months age and diagnosed with renal stone ≥ 1cm in size in greatest dimension on CT KUB. Patients with positive urine culture, raised serum creatinine, horse shoe kidneys,

ectopic kidneys and bleeding diathesis were omitted from this study. An informed written consent was taken from the parents of all infants. All children underwent mini-PCNL with 10 Fr pediatric scope under GA in prone position. Renal access was obtained by single supracostal puncture and secured with 12 Fr or 14 Fr Amplatz sheath. Tubeless-PCNL was defined as insertion of DJS only without placing a nephrostomy tube whereas totally tubeless-PCNL was defined as inserting neither DJS nor nephrostomy tube. Plain CT-KUB was performed at one month post-operatively to look for any residual fragments in the ureter or kidney. The patients with no residual fragments at one month after the procedure were categorized as stone free and procedure was labelled as successful. SPSS version 26 was used to analyse the data. Mean±SD were computed for quantitative variables whereas percentages and frequency were also computed for categorical variables.

RESULTS

A total of 33 patients, 21 male (63.64 %) and 12 female (36.36 %) were included in this study. The overall mean age and stone size were 9.3±2.05 months and 11.50±1.37mm respectively. 17(51.52 %) of the patients had stones in the right kidney whereas 16(48.48%) had renal stones in the left. Renal pelvis was the only location of all 33 stone (100%). 25(75.76%) of the patients had Grade 0 hydronephrosis (HDN) and 8(24.24%) had Grade 1 HDN (Table-1). The mean operative time and hospital stay were 52.12±8.23 mins and 2.36±0.74 days respectively. 12(36.36%) patients had totally tubeless-PCNL and 21 (63.64%) required insertion of double J stent (DJS). The mean hemoglobin (Hb) drop observed was 1.65±0.89 g/d1. Overall, stone clearance was attained in 28/33(84.85%) patients. None of the patient had any major intra-operative complication. Patients having post-operative problems were 7(21.21%), including fever in 4(12.12%), transient haematuria in 1(3.03%) and haematuria requiring blood transfusion in 2 (6.06%) of the patients. 5(15.15%) patients required retreatment, including ESWL in 1(3.03%) and URS in 4(12.12%) patients. Stone analysis showed that 25(75.76%) patients had CaOx.CaP stones, 6(18.18%) patients had cystine stones and 2(6.06%) patients had uric acid stones (Table-2).

Table No.1: Patients and Stone Characteristics

Characteristic	Result
n	**33**
Gender	
Male	21(63.64 %)
Female	12(36.36 %)
Age (months)	9.3±2.05
Stone-Size (mm)	11.50±1.37
Stone Laterality	
Right	17(51.52 %)
Left	16(48.48%)

Table No. 2: Perioperative and Postoperative characteristics of patients

Characteristic	Result
n	**33**
Operative Time (minutes)	52.12±8.23
Hospital Stay (days)	2.36±0.74
Exit Strategy	
Totally-Tubeless	12(36.36%)
Tubeless	21(63.64%)
Drop in Haemoglobin (g/dl)	1.65±0.89
Stone Free Rate	28(84.85%)
Re-treatment Rate	5(15.15%)
ESWL	1(3.03%)
URS	4(12.12%)
Complications	7(21.21%)
Intraoperative Complications	None
Postoperative Complications	
Clavien Grade I	
Postop Fever	4(12.12%)
Transient Hematuria	1(3.03%)
Clavien Grade II	
Hematuria & Blood Transfusion	2 (6.06%)
Clavien Grade III	-
Clavien Grade IV	-
Stone Composition	
CaOx.CaP	25(75.76%)
Uric acid	2(6.06%)
Cystine	6(18.18%)
Struvite	-
Unknown	-

DISCUSSION

The procedure for infant's urinary tract stones is quite complicated. This is because of many factors such as anatomic abnormalities, the relatively smaller kidney, and developing parenchyma[7]. Consequently, the chance of stone recurrence in infants is more than that of in adults. It is critical to offer minimally invasive procedures in the pediatric age group. The less invasive approaches that are currently available for renal stones in pediatric patients include ESWL, PCNL, and flexible URS alone, or in combination[8]. ESWL is the recommended approach for paediatric renal stones. However, in addition to kidney damage, it may result in high retreatment rates due to residual stones[9].

Some studies show that RIRS could be a promising procedure while treating renal stones in infants[10]. However, in such cases the pelvicalyceal anatomy and narrow diameter of ureter may cause complications. These include ureteral injury, avulsion, perforation, ureteral stricture and pyelonephritis[11]. Since anesthesia is a prerequisite for all of the less invasive procedures in infants, thus a procedure should be selected which gives high success rate as monotherapy in infants. PCNL has become the preferable treatment option in children who require surgery for the kidney stone

disease. In addition, PCNL is recommended for those with a large stone burden, cysteine stones and residual fragments in case of ESWL failure[8]. However, percutaneous treatment of renal stones in infant remains a difficult task for urologist. Many studies have suggested the effectiveness as well as the safety of PCNL in preschool children (less than three years), On the other hand few studies have reported the efficacy and safety of this procedure for patients less than 12 months of age[12,13]. The PCNL procedure in children has been reported to have stone clearance rates of 80 to 100%[14].

In our view, the 80 % of stone clearance rate for PCNL as monotherapy in infants is acceptable. In this study, the stone clearance rate obtained was 84.85 %. This rate is higher than that reported by Dağgülli and Baydilli et al, which was 80% and 80.6% respectively[3,15]. Our stone clearance rate is comparable to Dede et al, which was 83.3 %[7]. In contrast, Jones et al, reported 97.1 % stone free rate, much higher than our study's observation[16]. To the best of our knowledge, this is, so far, the largest study which investigates the efficacy and safety of mini PCNL in infants under 12 months of age. Therefore, 84.85 % stone clearance rate with mini-PCNL monotherapy in infants is a successful procedure.

Renal access can be obtained through any of the upper, middle or lower calices, each having good efficacy to clear the stones[17,18,19]. In our study, supracostal puncture through upper pole by bull's eye technique was performed in all patients. The author has good experience with this puncture technique.

The mean operative time in the current study was 52.12 $\pm$ 8.23 minutes which is shorter than that reported by Pelit et al and Nadeem et al[12,13]. Our operative time is comparable to Dede et al[7]. We report, in our study, a mean hospital stay of 2.36 $\pm$ 0.74 days which is comparable to that reported by Dede et al.[7] and better than that reported by Pelit et al.[12] Tubeless or totally tubeless-PCNL method is associated with short hospital stay and reduced requirement for analgesia[20]. We did totally tubeless-PCNL in 12(36.36%) and tubeless-PCNL in 21(63.64%) patients. In the current study auxiliary procedures were needed in 5(15.15%) patients including ESWL in 1(3.03%) patient for residual renal stones and URS in 4 (12.12%) patients for migrated stone fragments into the ureter. Patients were stone free after performing these procedures under GA. Our re-treatment rate is comparable to that reported by Pelit et al.[12], however it is higher in comparison to that reported by Nadeem et al.[13]

In this study no major intra-operative complication was observed. 7 (21.21 %) of the patients developed minor post-operative complications (Clavien grade I and II). 4 (12.12%) patients developed post-operative fever who responded well to broad spectrum intravenous antibiotics. 3 (9.09 %) patients had postoperatively hematuria, two (6.06%) needed blood transfusion. Hematuria settled spontaneously without the need for angioembolization. The mean hemoglobin drop was 1.65 ± 0.89 mg/dL. Jones et al. stated a complication rate of 12.5 % for mini-PCNL, all Clavien grade I. Their complication rate is better than our study[14].

Bleeding is very critical factor because it affects both a patient's mortality and stone clearance rate. Keeping in mind small sized kidneys and compact collecting system in infants, we used 12 Fr and 14 Fr access sheath in order to minimize bleeding and renal trauma. Tracts of smaller size are not only effective in treating renal stones but also have the advantages of less blood loss, short hospital stay, reduced use of postoperative analgesia as well as overall reduced complication rates in comparison to standard PCNL[21]. Hence in children under age of 12 months during PCNL procedure small sized tracts and pediatric instruments should be used.

The PCNL procedure may result in hypothermia which in turn is due to the duration of anesthesia and the use of irrigation fluids during surgery[22]. However we did not encounter any such event in the current study. The reason was that during the perioperative periods, the room temperature was well adjusted and irrigation fluids were wormed to body temperature. The high pressure within pelvicalyceal system can result in extravasation of urine into the perirenal space or the abdominal cavity causing urinary ascites. During the course of this study, none of the patient reported this complication.

Even it has been more than forty years to the story of its development, PCNL still remains a bit difficult procedure to learn. It is an effective procedure for kidney stone removal. Nevertheless the complication rate is higher than other endoscopic procedures that are being followed for managing stones particularly in less experienced hands. In order to sustain it as a safe and effective procedure for the patients there is a strong need to improve the training for PCNL. For the procedure to be successful, urologists need to perform a handful of PCNLs to gain the required expertise and skills.

The limitations of our study may include small sample size and recruitment of patients from single institute. Another limitation is the need of GA for auxiliary procedure in this group of population.

CONCLUSION

Mini PCNL is a safe and effective treatment for managing renal stones in infants. It leads to higher stone clearance rates, lesser complications and shorter hospital stays.

Author's Contribution:

Concept & Design of Study:	Tariq Ahmad
Drafting:	Nasrum Minallah, Fazal e Manan

Data Analysis:	Nasrum Minallah, Fazal e Manan
Revisiting Critically:	Tariq Ahmad, Nasrum Minallah
Final Approval of version:	Tariq Ahmad

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