Outcomes of mini-percutaneous nephrolithotomies in children: a single centre experience

Abdülkadir Kandemir¹, Mehmet Balasar², Mehmet Mesut Pişkin², Ahmet Öztürk²

¹Department of Urology, Kelkit State Hospital, Kelkit, Turkey
²Department of Urology, Necmettin Erbakan University, Meram Medical Faculty, Konya, Turkey

Article history
Submitted: Feb. 13, 2018
Accepted: April 11, 2019
Published online: April 12, 2019

Introduction
The aim of this study was to present our experiences with pediatric mini-percutaneous nephrolithotomies (MPNL) in our center.

Material and methods
A total of 85 MPNLs performed on 79 pediatric patients being treated for upper urinary tract stones from 2007 to 2017 were analyzed retrospectively in order to determine their safety, efficacy, and relevant outcomes.

Results
85 MPNLs performed on 79 patients with a mean age of 6.58 (1–14) years were included in this study. The mean size of the stones was 1.99 (1–6.4) mm. A 17 Fr rigid pediatric nephroscope with a pneumatic intracorporeal lithotripsy was used through a 20 Fr access sheath. The stone-free rate was 87.1% at 1 month postoperatively. Mean operative time was 56.4 (20–120) min. Mean fluoroscopy screening time was 183.2 (40–510) sec. Average hospitalization duration was 4.78 (2–13) days. Auxiliary procedures were performed on 7 (8.2%) patients (5 extracorporeal shock wave lithotripsy, 2 re-percutaneous nephrolithotomy). The complication rate of these cases was 6.3% according to the modified Clavien Classification System. However, no major complications classified as Clavien IV–V were observed in the study group.

Conclusions
The outcomes of the contemporary analysis confirm that MNPL is a safe and efficient method of intervention resulting in a stone-free state in pediatric cases.

Key Words: children ▶ complication ▶ mini-PNL ▶ renal stone

INTRODUCTION
Whereas pediatric cases constitute 2–4.3% of the total population of patients with kidney stones [1], important changes have been witnessed in the surgical management of pediatric urolithiasis in the last few years. Among the numerous treatment modalities, mini-percutaneous nephrolithotomy (MPNL) offers various advantages.

MPNL, a modified standard percutaneous nephrolithotomy (PNL) with a smaller percutaneous tract size (14–20 F), has been proven a safe and efficacious treatment option for both adult and pediatric cases [2]. As the pelvicalyceal system in children is less robust and the tolerance for blood loss is more limited, there are fewer margins of error, thus presenting an important challenge to the endourologist. According to the literature, pediatric PNL tends to use different surgical equipment for different age groups [3, 4]. The aim of the present study is to evaluate the safety and efficacy of mini-PNL to treat kidney stones in patients aged <14 years.

MATERIAL AND METHODS
Data was reviewed retrospectively for 79 patients who underwent one-stage MPNL for upper urinary tract calculi between 2007 and 2017 in the Necmettin Erbakan University Urology Department, for a total of 85 procedures. Stone size, location, infection and hydronephrosis were the necessary indications for MPNL. Urine culture, serum biochemistry and co-
were generally discharged. Significant drainage from the nephrostomy tube. If they were afebrile, asymptomatic and did not have free or had clinically insignificant stones (4 mm) and the tubes were removed once the patients were stone-free or had clinically insignificant stones (4 mm) and if they were afebrile, asymptomatic and did not have significant drainage from the nephrostomy tube. Upon the removal of the nephrostomy tube, patients were generally discharged.

**RESULTS**

Between January 2007 and January 2017, 79 cases underwent 85 MPNL procedures in our institute (six patients had treatment for bilateral renal stones). Thirty-eight of these were female (48.1%) and 41 male (51.9%). The mean stone size was 1.99 (1–6.4) cm (evaluation was made on the largest stone diameter). Demographics, preoperative, intraoperative and postoperative findings of patients, stone composition and factors that affected the stone-free status of the patients are summarized in Tables 1 and 2. Briefly, 81 (95.3%) procedures required a single nephrostomy tract, and 4 (4.7%) required two tracts. In these cases, stones were located on the right in 37 (46.8%) and on the left in 36 (45.6%), and 6 (7.6%) of the stones were bilateral.

The mean operative time for PNL was 56.4 (20–120) min, and the mean fluoroscopy screening time was 183.2 (40–510) sec. The mean hemoglobin (Hb) loss was 0.79 (0.2–2.4 g/dl), and blood transfusion was required for four of the patients, including two cases during the perioperative period. The mean postoperative third-month serum creatinine levels were not statistically different as compared to the mean preoperative levels, \( p = 0.083 \). The mean hospital stay was 4.78 days (2–13 days). During the third-month postoperative controls, a complete stone-free state was achieved in 87.1% of cases (74/85). Still, clinically significant \( (n = 2) \) cases or insignificant \( (n = 5) \) residual stones were determined in the children. Cases with clinically significant stones underwent re-PNL \( (n = 2) \), and those with insignificant stones underwent extracorporeal shock wave lithotripsy (ESWL) \( (n = 5) \).

There were complications in five cases, categorized according to the modified Clavien Classification System. Postoperative hypertension, observed in one case, was immediately treated until the patient became normotensive (grade 2). Another patient revealed postoperative convulsions and was treated with anti-epileptic drugs after the necessary consultations. Thus, the convulsions were stopped, and no recurrence was reported (grade 2). A further patient developed postoperative abdominal distension. The patient’s oral intake was stopped, and appropriate diuretic treatment was administered (grade 2). Two other patients required postoperative blood transfusion (grade 2), due to low Hb levels.

**DISCUSSION**

Upper tract urolithiasis management for children includes shock wave lithotripsy, percutaneous nephrolithotomy, retrograde intra-renal surgery (RIRS) and open surgery. Nevertheless, despite the presence of various alternatives, a balance between stone clearance and procedure-related morbidity must be considered. Although it is a low-risk procedure, ESWL has high retreatment rates (18–67%), often leading to persistent residual stones [5]. RIRS, on the other hand, can minimize the risks associated with bleeding and visceral injury, but seeing as the pelvicalyceal anatomy is not always ideal, and due to the anatomical delicacy
of the pediatric ureter, flexible ureteroscopy may not be the golden option [6]. PNL in children was first described by Woodside et al. in 1985, with 100% stone removal in one session, using standard adult instruments in seven children (24–34 F) [7]. Many studies have reported the efficacy and safety of pediatric PNL. Likewise, we have also reported our experience using our version of MPNL in infants as young as 36 months with complex stone disease [8].

The stone free ratio (SFR) after PNL in pediatric patients ranged from 59 to 98%. Samad et al. reported a 59% SFR after PNL monotherapy. The mean stone burden was 3.1 cm [2]. Badawy et al. reported an 83.3% SFR after single treatment session [9]. In another series of 135 children with an average age of 8.9 years, Salah et al. reported a 98.5% SFR [10]. Pelit et al. reported a SFR of 84.7% and 94.4% after single and additional sessions respectively [11]. In the present study, patients’ records revealed that on the first postoperative day, complete stone-free state was achieved in 87.1% of cases (74/85). Only two of the children with clinically significant stones underwent re-PNL (n = 2).

The main concern in pediatric cases is related to the percutaneous access renal damage potential. Traditionally, PNL required a 30 Fr nephrostomy sheath for renal access. However, the development of smaller sheaths allowed for mini-PNL or ‘miniperc’ (tract size ≤20 F) to be performed with minimal damage to renal parenchyma of children resulting with reduced procedure related morbidity without conceding from therapeutic efficacy [12, 13]. Besides the undesired conditions in adults that may occur during and after PNL, some of the drawbacks of PNL in children are small kidneys operated with relatively big endoscopic devices, the inability of pediatric cases to tolerate massive hemorrhage, comparatively easier hypothermia, liquid absorption and overload. Among these complications, hemorrhage is the most common. The most important factor is the dilatation diameter and the number of tracts. Multiple tracts and dilatation with more than 24 F have been reported to lead to critical drops in Hb [14]. Rates of blood transfusion vary according to the stone burden reported in the series [14, 15, 16]. Although a maximum 20 F dilatation was used in our series, the need for transfusion emerged in 2 cases (2.1%).

The present study is the first of its kind using the modified Clavien system to compare MPNL driven complications in children. Complications according to the Clavien classification were reported in 29.2% of the adults by Tefekli et al. [17] and in 30% of children by Ozden et al. [18]. Yadav et al. reported complication in 21.66% of cases and the majority of patients (97.9%) had minor complications (Clavien grade 1 & 2) [19]. In our study, complications emerged in 5 children (6.3%). According to the modified Clavien Classification System, all of the complications were Grade 2 (hypertension, transient convulsions, abdominal distention, and blood transfusion). No complications of grade III, IV, or V emerged, nor selective angiographic embolization was required in the MNPL intervened pediatric cases.

The drawbacks of this study are the small sample size and retrospective nature.

CONCLUSIONS

With the findings of the present study, MPNL has been reaffirmed as a safe and effective treatment modality for children with large upper urinary tract stone disease. Complications after PNL, as assessed by the Clavien classification system, are mild and PNL in pediatric patients is safe.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.
References

1. Erdenetsesteg G, Manohar T, Singh H, Desai MR. Endourologic management of pediatric urolithiasis: proposed clinical guidelines. J Endourol. 2006; 20: 737-748.

2. Samad L, Aquil S, Zaidi Z. Paediatric percutaneous nephrolithotomy: setting new frontiers. BJU Int. 2006; 97: 359-363.

3. Guven S, Frattini A, Onal B, et al. Percutaneous nephrolithotomy in children in different age groups: data from the Clinical Research Office of the Endourological Society (CROES) Percutaneous Nephrolithotomy Global Study. BJU Int. 2013; 111: 148-156.

4. Desai MR, Kukreja RA, Patel SH, Bapat SD. Percutaneous nephrolithotomy for complex pediatric renal calculus disease. J Endourol. 2004; 18: 23-27.

5. Srisubat A, Potsat S, Lojanapiwat B, Setthawong V, Laopaiboon M. Extracorporeal shock wave lithotripsy (ESWL) versus percutaneous nephrolithotomy (PCNL) or retrograde intrarenal surgery (RIRS) for kidney stones. Cochrane Database Syst Rev. 2009; 4: ID CD007044.

6. Resorlu B, Oguz U, Resorlu EB, Oztuna D, Unsal A. The impact of pelvicaliceal anatomy on the success of retrograde intrarenal surgery in patients with lower pole renal stones. Urology. 2012; 79: 61-66.

7. Woodside JR, Stevens GF, Stark GL, Borden TA, Ball WS. Percutaneous stone removal in children. J Urol. 1985; 134: 1166-1167.

8. Guven S, İstanbulluoğlu O, Ozturk A, et al. Percutaneous nephrolithotomy is highly efficient and safe in infants and children under 3 years of age. Urol Int. 2010; 85: 455-460.

9. Badawy H, Salama A, Eissa M, Kotb E, Moro H, Shoukri I. Percutaneous management of renal calculi: experience with percutaneous nephrolithotomy in 60 children. J Urol. 1999; 162: 1710-1713.

10. Salah MA, To’th C, Khan AM, Holman E. Percutaneous nephrolithotomy in children: experience with 138 cases in a developing country. World J Urol. 2004; 22: 277-280.

11. Pelit ES, Kati B, Çanakci C, Sağır S, Çiftçi H. Outcomes of miniaturized percutaneous nephrolithotomy in infants: single centre experience. Int Braz J Urol. 2017; 43: 932-938.

12. Mishra S, Sharma R, Garg C, Kurien A, Sabnis R, Desai M. Prospective comparative study of miniperc and standard PNL for treatment of 1 to 2 cm size renal stone. BJU Int. 2011; 108: 896-899.

13. Jackman SV, Docimo SG, Cadeddu JA, Bishoff JT, Kavoussi LR, Jarrett TW. The ‘mini-perc’ technique: a less invasive alternative to percutaneous nephrolithotomy. World J Urol. 1998; 16: 371-374.

14. Özden E, Şahin A, Tan B, Doğan HS, Eren MT, Tekgül S. Percutaneous renal surgery in children with complex stone. J Pediatr Urol. 2008; 4: 295-298.

15. Zeren S, Satar N, Bayazit Y, Bayazit AK, Payasli K, Öztekezi R. Percutaneous Nephrolithotomy in the Management of Pediatric Renal Calculi. J Endourol. 2002; 16: 75-78.

16. Kapoor R, Solanki F, Singhania P, Andankar M, Pathak H. Safety and efficacy of percutaneous nephrolithotomy in the pediatric population. J Endourol. 2008; 22: 637-640.

17. Tefekli A, Ali Karadag M, Tepeler K, et al. Classification of percutaneous nephrolithotomy complications using the modified Clavien grading system: looking for a standard. Eur Urol. 2008; 53: 184-190.

18. Özden E, Mercimek MN, Yakupoğlu YK, Ozkaya O, Sankaya S. Modified Clavien classification in percutaneous nephrolithotomy: assessment of complications in children. J Urol. 2011; 185: 264-268.

19. Yadav SS, Aggarwal SP, Mathur R, et al. Pediatric Percutaneous Nephrolithotomy-Experience of a Tertiary Care Center. J Endourol. 2017; 31: 246-254.