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ORIGINAL ARTICLE

Percutaneous Nephrolithotomy is Safe and Efficient when Performed on Early Adolescents with Adult-Sized Tools

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ABSTRACT

Aim: To report our experience of percutaneous nephtrolithotomy using adult size instruments in young adolescents.
Study design: Retrospective case series
Place and duration of study: Department of Urology, Isra University Hospital Hyderabad between 1st January 2006 and December 2016,
Methodology: Twenty five adolescents underwent percutaneous nephrolithotomy were enrolled. The records of patients between the ages of 10 and 15 years underwent percutaneous nephtrolithotomy at our institute was examined. The percutaneous nephtrolithotomy was performed using a 24-Frnephroscope. Stone burden and location were reviewed. Stone clearance was reviewed after the surgery. Renal units with ≤4mm residual stone on postoperative imaging were considered stone free.
Results: Mean age of patients was 12±2 yrs. Extracorporeal Shockwave Lithotomy (ESWL) was required in 4 patients and one patient had retrograde intrarenal surgery (RIRS) for residual stones. The total percentage of stones removed was 84% (21/25). One patient in our group had factor VII deficiency, another had a kidney with a horseshoe shape, and a third had post-pyelolithotomy residual stones. Three patients needed blood transfusions, and one patient experienced transitory urine leakage for more than 12 hours. There were no complications that required medical or surgical attention.
Conclusion: Percutaneous nephrolithotomy in young adolescents is safe and effective. Adult size instruments can be used safely for percutaneous nephtrolithromy in this group of patients.
Keywords: Percutaneous nephrolithotomy (PCNL), Adolescents, Nephrolithiasis

INTRODUCTION

Development of two treatment modalities during 1980s has revolutionized surgical management of nephrolithiasis. The first was extracorporeal shockwave lithotripsy, reported by Chaussy in 1980[1]. Although, nephroscopy was first described by Rupel and Brown in 1941 but actual development of endourological removal of stone percutaneously happened during the late 1980s and early 1990s[2]. Since the advent of ESWL and PCNL, open surgery has become almost obsolete for renal stone removal. However, there are still specific indications for open surgery for example skeletal deformities such as severe kyphoscoliosis, which precludes a percutaneous approach or ESWL. In some parts of the world, unavailability of expertise and instruments also becomes a hindrance[3].

Urolithiasis in adolescents represents a special cohort. The incidence of nephrolithiasis in children is rising[4] and there has been a shift in the age group experiencing first stone episode. In a nationwide survey from Japan, the annual incidence (per 100,000) of first stone episode in patients 10-19 years of age, shifted from 11 to 17.7 between 1965 and 2005[5]. This translates into fact that more children now present for surgical removal of nephrolithiasis.

Although PCNL is considered the gold standard for large stone in adults, its use in children is still limited, mainly attributable to two factors. Firstly, the smaller organ in children becomes an important consideration when selecting the instruments for PCNL[6]. In western world the rate of open procedure for pediatric stone disease has dropped significantly, which parallels the development of miniaturized endoscopic instruments. In our part of the world, the availability of such instrument is often cited as a limitation.[7] Rizvi et al[8] from Sindh institute of urology reported in their series of approximately four thousand interventions for stone in children that 70% were minimally invasive and 30% were open surgeries. Second, adolescents often present to a pediatric surgeon who are mostly trained in open surgical technique with little exposure of endourology.

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In this study we aim to determine the safety and efficacy of PCNL in young adolescents using adult size instruments.

MATERIALS AND METHODS

This was a case series for which data was retrospectively reviewed from 1st January 2006 and December 2016. Patients between 10-15 years of age undergoing PCNL using 24-Fr nephroscope were included. PCNL was performed in prone position using fluoroscopic guidance for puncture. Tract was dilated using serial metallic dilators and either 26 or 28Fr amplatz sheath was placed depending upon stone burden. A 12Fr nephrostomy tube was placed in all patients at the end of procedure and removed on 2nd postoperative day. Data was collected for patient age, sex, site, height, weight, clinical presentation, operative parameters, early complications and ancillary procedures. Preoperative imaging was reviewed for stone burden. Stone burden was calculated in terms of diameter in case of a single stone or by adding the diameter of the two largest stones in case of multiple stones. Postoperative imaging was reviewed for stone clearance. Renal units with stone fragments of <4mm were considered as stone free. The data was entered analyzed through SPSS-25.

RESULTS

Most of the patients presented with flank pain 13 but hematuria 4 and febrile UTI 4 were not uncommon presentations in these children. The mean duration of symptoms was around one year (1.1±2.2 years). One patient had a horseshoe kidney, one had factor VII deficiency, and one had post-pyelolithotomy residual stones. The patient and stone related factors are given in table 1. We managed all of our patients with a single lower pole puncture, except two patients who required an additional mid-pole puncture to achieve stone clearance. We performed serial dilatation with metallic dilators in all of our patients. For 24-Fr nephroscope, we used a 26-Fr sheath. In three children, 28-Fr Amplatz sheath was used. In terms of efficacy, the initial stone free rate i.e. stone cleared with PCNL alone was 72% (18/25), whereas four patients required ancillary procedure ESWL, and one patient required

retrograde intrarenal surgery (RIRS) to achieve stone clearance. The overall stone clearance rate after ancillary procedures was 21 (84%) [Table 2]. In terms of safety, we encountered four Grade I UK Class complications. Transfusion was required in two patients. One patient had urinary leakage of more than 24 hours duration, which settled with conservative management. One patient had perinephric hematoma detected on ultrasound performed for postoperative fever and this was also managed conservatively. No complication requiring surgical/radiological intervention was encountered (Table 1).

Table 1: Patient and stone related factors

Mean age	12±2 yrs.
Mean weight	35±1.78 Kg
Mean Height	149±4.2 cm
Mean stone diameter	3.24 cm (Range 2.1-5.2 cm)
Stone location	
Pelvis	17(68%)
Upper pole	1(4%)
Lower pole	6(24%)
Upper ureter	1(4%)

Table 2: Initial stone free

Stone cleared	**No. (%)**
PCNL alone	18(72%)
ESWL	4(16%)
RIRS	1(4%)

DISCUSSION

Adolescents are defined by WHO as young people between the age of 10 and 19 years[9]. The clinical presentation of renal stones in these young patients is a combination of presentation in adults (e.g. flank pain, hematuria) and children (febrile illness). A mean stone diameter of >3cm in our series is reflective of our high threshold for subjecting these young children to invasive procedure like PCNL as opposed to ESWL. We prefer ESWL for renal stones of up to 2.0 cm specially if anatomy in favorable in these young patients as per current standard practice[10]. Our choice of PCNL is also guided by social factors besides stone burden and unfavorable anatomy. Such factors include patients from outside town who want to avoid multiple visits for ESWL sessions and time off work for both parents and patients.

We avoided upper pole puncture in these small children because of concern regarding increased respiratory complications with upper pole puncture using larger instruments. Although safety of upper pole puncture is well established[11], respiratory complication can occur in up to 10% patients[12].

We used 26Fr amplatz sheath in all but two of our patients. The selection of amplatz sheath size is based upon the size of the stone, as larger stone fragments are more efficiently retrieved with a larger sheath. There are pros and cons of using smaller instruments in children. Jackman first performed a mini perc in 1998 using an 11-Fr vascular sheath. He emphasized that this technique is suitable for small stones only.[13] Beside stone size, the other limitation of using smaller size instruments is cost of keeping and maintaining an additional set of instruments.

On the other hand, there are concerns of damage caused by large instruments, especially in young children. Firstly, larger sheaths are theoretically associated with increased complications. In a retrospective review of 1205 PCNL procedures in pediatric patients, sheath size was found to be a significant predictor of complications on multivariate logistic regression analysis (B-coefficient−4.886, p-value <0.001). However odds ratio was low (OR 0.008, CI 1.210–2.995) for association of sheath size with complications.[14] Furthermore, the reported increased blood loss with larger sheath sizes may not be clinically relevant.[15] Li et al[16] have questioned the value of using smaller sheath by measuring systemic response to surgery-induced tissue trauma. They found no significant difference in the levels of acute-phase markers for 18vs 30Fr access tract.

Secondly, there is increasing awareness of renal damage caused by puncture and dilatation of renal parenchyma which led to usage of smaller and smaller instruments. In a series of 60 renal units, cortical defects on 99mTc-DMSA scan done 4-6 weeks postoperatively, the site of defect corresponded to the access tract site in only 3 patients.[17] The risk of clinically significant renal scarring in pediatric patients subjected to PCNL is small[18]. Dewaba et al[19] showed an improvement in the mean postoperative GFR of the corresponding kidney (28.8±11.2 ml/min vs 36.1±9.9ml/min; p <0.01) after PCNL. This improvement is attributable to relieve of obstruction moreover, a review of the DMSA radioisotope scans of these patients revealed no evidence of significant gross cortical scarring in any patient. On the contrary open surgery for nephrolithiasis is associated with deterioration of renal function. In a series of 13 patients undergoing anatrophic nephrolithotomy, Thomas and colleagues reported 30% reduction in function of the operated kidney at a mean of 13.6 months after surgery.

Our cohort included some patients which traditionally are considered relative contraindication to percutaneous endourological approach. One such contraindication is uncorrected coagulopathy[20], the key word here being “uncorrected.” We managed one patient with Factor VII deficiency under Factor VII cover according to hematologist’s advice. We had one patient with horseshoe kidney and one with post pyelolithotomy residual stones. Both of these patients had complete clearance with PCNL alone. We did not require any blood transfusion in these unusual cases. Anatomic abnormalities are no more considered a contraindication to percutaneous approach. there is increasing experience in dealing with nephrolithiasis in such technically challenging cases, for both adult[21] and pediatric patients[22].

Since we retrospectively reviewed the data, we only were able to record major complications requiring intervention and minor complications e.g. postoperative fever were not recorded. Also we did not quantify change in renal function in these patients as preoperative serum creatinine values were not always available. We have limited our study to patients above 10 years of age though others have shown that PCNL can be done safely in even preschool children.[23] Whether these smaller children can also be operated using adult size instrument remain to be determined.

CONCLUSION

PCNL can be performed on a few carefully chosen early teenagers using equipment designed for adults. With reasonable safety, stone clearance rates comparable to adult PCNL can be attained. Unavailability of miniaturized instruments should not be considered a contraindication to PCNL in these young patients.

Conflict of interest: Nil

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