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OUTCOME OF MINI-PERCUTANEOUS NEPHROLITHOTOMY(MPCNL) FOR RENAL CALCULI IN PEDIATRICS AGE GROUP: A TERTIARY CARE CENTRE STUDY

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ABSTRACT

Introduction: This is a prospective study conducted in the Department of Urology, Government Medical College, Kota from May 2019 to April 2022 to identify the postoperative outcome of MPCNL in children of age group(5-18 years). **Objective:** This study aimed to evaluate the experience of MPCNL, with the primary outcome being the rate of stone clearance and secondary outcome requirement of postoperative analgesics, intraoperative and postoperative blood transfusion rate, average hospital stay, and morbidity. **Material and methods:** A total of 56 patients underwent MPCNL over three years; the mean age of patients was 9.3 years (range:5-18 years). The fluoroscopic guided puncture was taken and the nephrostomy tract was dilated over guidewire up to maximum Amplatz sheath size of 16-French. Subsequently, the stone was retrieved with an 11Fr nephroscope after the disintegration of renal stones by pneumatic lithotripsy. Follow-up renal ultrasound and plain radiograph KUB was performed. **Results:** Out of 56 patients, 8 patients didn't follow up during the postoperative period, and hence were excluded from the study. The mean stone size was 12mm (range 8-25mm). The mean surgical operative time was 45min (range 30-60min). Complete stone clearance was achieved in 87.5% (42/46) of patients. Two children had residual fragments and one child developed a postoperative fever which was managed conservatively by intravenous antibiotics and hydration. Outcomes measured were stone-free rate, the requirement of postoperative analgesics, intraoperative and postoperative blood transfusion rate, average hospital stay, and morbidity

KEYWORDS :

INTRODUCTION

The incidence of renal calculi in pediatric patients has been steadily increasing over the past decades, an increase that has been attributed to environmental changes in diet, fluid intake, and obesity [1]. The management of urolithiasis can be difficult in children. Over the years, open surgery was the mainstay surgical treatment option for the management of renal calculi, but with the introduction of the less invasive surgeries like percutaneous nephrolithotomy (PCNL) and MPCNL procedures, management shifted towards minimally invasive surgical options due to the distinct advantages of these techniques in efficient stone removal with minimal side effects[2,3]. PCNL allows direct visualization and clearance of stone fragments, often in one session, thus minimizing the need for recurrent hospital visits and multiple procedures [4].

Bleeding is the most frequently reported complication of MPCNL which is sometimes a life-threatening event. It is, therefore, important to clarify the important risk factors for bleeding to reduce bleeding during MPCNL. Many authors evaluated factors affecting blood loss during PCNL, which predominantly consists of adult patients [5]. However, there are limited and conflicting data available on the risk factors responsible for the bleeding after PCNL amongst children [6]. With the advancement in endourology, MPCNL has gained popularity over recent years, with stone clearance reported as 80-85% [7] following a single session. An ideal choice of "perc" in children would be a track that is large enough to remove all of the fragmented stones but small enough not to increase the risk of bleeding.

PATIENTS AND METHODS

This is a prospective study conducted between May 2019 to April 2022, a total of 56 patients were enrolled, and 8 patients didn't follow up during the postoperative period, hence were excluded from the study. Inclusion criteria were 1) Patients between 5-18 years of age with renal calculus and 2)preoperative sterile urine culture. Exclusion criteria were 1) Patients < 5 years and > 18 years 2) patients who didn't follow up in the postoperative period 3) preoperative positive urine culture 4) stone size >25mm. 48 patients with renal calculi who underwent MPCNL were considered in the study. The age of the patients at the time of surgery ranged from 5 -18years (mean- 9.3years). Routine coagulation profiles were obtained before the MPCNL. Preoperative imaging used were X-KUB, renal ultrasound, and NCCT (KUB). Tests done were complete blood count, preoperative and postoperative blood urea and creatinine levels, and urine culture. UTIs if detected preoperatively were treated with a course of antibiotics and the surgery was done, once the repeat urine culture came negative. All cases were performed under General anesthesia. Postoperative pain was measured by a visual analog scale where patients were asked to mark on the line where they think their pain was. Those patients reporting pain between 3-6 and 6-10 on VAS were managed with simple non-opiate analgesia and weak opioid (intravenous tramadol) respectively. All patients had a regular follow-up with ultrasound scans and plain radiograph KUB in the OPD. Patient's demographic details, information (PCNL puncture site, stone burden, screening, and total procedural time), and post-treatment outcomes (stone-free rate and complications) were prospectively documented.

Frequencies and percentages were used to summarize categorical variables like gender distribution. Mean was computed for numerical variables like age distribution, stone size, and operative time.

MINI PCNL Technique

Initially, the patient was placed in lithotomy after administration of general anesthesia, and a 4F retrograde open-end ureteric catheter is inserted with the help of a pediatric cystoscope. Ureteric catheter placement is confirmed under fluoroscopy. A (10-12 Fr) Foley catheter is inserted depending on the patient's age and size after lubricating the urethra with lignocaine gel and then taped with the ureteric catheter to secure it. This prevents the risk of accidental displacement of the ureteric catheter during the procedure.

The patient turned prone with appropriate padding done to prevent compression injuries, also additional padding to maintain a stable horizontal plane. The Pelvicalcyceal system is opacified by retrograde contrast injection under fluoroscopy to identify the interest of calyx to be punctured. The selected calyx is punctured using an 18G initial puncture needle. Once access is obtained, a 0.035-inch diameter, 180cm length, Teremo guidewire is negotiated past the stone into the distal ureter and preferably in the bladder. The track is then dilated in sequence by using fascial dilators of 6Fr, 8Fr, and 10Fr. Subsequently, after dilation by fascial dilators, 8Fr Alkens metal guide rod is introduced, and a serial co-axial method of dilation is used by placing 9Fr,12Fr, and then 15Fr. Over 15 Fr Alkens dilator 16Fr Amplatz sheath is placed, the metal dilators removed under fluoroscopic guidance. 11Fr rigid nephroscope was employed to visualize the pelvicalyceal system and stone.

Stone once identified is fragmented with a pneumatic lithotripter, and the fragments are irrigated or removed sequentially using stone grasping forceps. After satisfactory stone clearance is checked under fluoroscopy, removal of ureteric catheter and placement of Double J stent is done. 14Fr suction tube is placed as a covering nephrostomy to provide drainage and tamponade the track. The nephrostomy tube is kept in situ for a "second look" if significant accessible residual stones are identified within the pelvicalyceal system or ureter. Stone-free status was defined as the complete absence of stones or the presence of peripheral small <4mm stone fragments after the primary procedure.

The patient was discharged 2-3 days after MPCNL. The first follow-up visit was made within 1 and 3 weeks to find out whether the patient was well clinically and consisted of ultrasound scans, plain radiograph KUB, and urine analysis.

RESULTS

Patient demographics and operative and outcome details are presented in table1, 2, and 3 respectively. A total of 56 patients Mini PCNL were performed, 8 patients didn't follow up in the postoperative period, hence were excluded from the study. Out of 48 patients, 30(62.5%) were male and 18(37.5%) were females with the average age being 9.6 years and 9 years, respectively.

There were varying degrees of stone burden ranging from a single stone to staghorn calculus with a mean stone size of 12mm (range 8-25mm). Twenty-five patients had right renal stones and Twenty-three had left renal stones. In 44(91.66%) patients, only one puncture was required, and in 4(8.33%) cases 2 tracts were needed. Overall the mean operative time was 45minutes.

After a single session of MPCNL, 87.5% of patients achieved 100% stone clearance. Two patients did not achieve complete stone clearance and underwent a second look MPCNL to achieve complete stone clearance after 3 days of the primary procedure. Postoperatively, 20 (41.6%) patients received simple non-opiate analgesia, and 4 patients (8.33%) patients received weak opioids (intravenous tramadol) based on the visual analog scale. All children had their hemoglobin levels performed preoperatively as a baseline, and blood products were available during the perioperative period. No child required blood transfusion during or after surgery. The mean length of hospital stay was 2.25 days (range was 2-5 days). One child developed a postoperative fever which was managed by intravenous antibiotics and hydration and stayed was prolonged to 8days.

Table1: Patient demographics and clinical characteristics

Variable	Value (total -48)
Age in years, median	9.3
Gender n (%)	
Male	30 (62.5%)
Female	18 (37.5%)
Degree of hydronephrosis n (%)	
None or mild	40 (83.33%)
Moderate or severe	8 (16.66%)
Stone location,%	
Single (upper/middle/lower/pelvis)	36 (75%)
Multiple(multiple calyces/pelvis+calyx	10 (20.83%)
Staghorn	2 (4.16%)
Mean stone size (range)	12mm (10-25mm)
Number of stones n (%)	
Single	32 (66.66%)
Multiple	16 (33.33%)

Table 2: Operative variables

Variable	Value
Laterality of surgery n (%)	
Right	25 (52.08%)
Left	23 (47.91%)
Number of tracts n (%)	
Single	44 (91.66%)
Multiple	4 (8.33%)
Mean operative time	45min(30-60min)
Puncture taken n (%)	
Superior	31 (64.58%)
Middle	9 (18.75%)
Inferior	8 (16.66%)

Table 3: Outcome data

Primary procedure success	Number
Complete stone clearance n (%)	42 (87.5%)
Second look MPCNL n (%)	2 (4.1%)
Postoperative analgesia usage n (%)	
Simple non-opiate analgesia	20 (41.6%)
Weak opiate	4 (8.33%)
Mean hospital stay (days, range)	2.25 (2-5)
Blood transfusion in postoperative period	nil
Postoperative fever(>100 degree F) n (%)	1 (2%)

DISCUSSION

In children, the management of urolithiasis can be challenging. With any treatment options, there must be a balance between stone clearance and operative morbidity[8]. The small size of the kidneys and the high risk of recurrent stone formation increases the importance of minimally invasive procedures that permit the achievement of stone-free status with the least morbidity[9]. The advancement of surgical tools and their miniaturization, in conjunction with the use of the mini-PCNL technique, has led to a decrease in complications. Theoretically, because smaller tract has fewer complications rate [10].

Here we have presented our experience with mini pcnl using 11Fr nephroscope in the treatment of pediatric renal calculi, showing it to be highly effective and safe with low morbidity. The advantage of this technique is that the stones are fragmented using pneumatic lithotripsy until they can be removed through the working sheath, this translates into efficacious stone removal without any increase in intraoperative or postoperative complications. However, since using multiple access tracts during PCNL is both modifiable and strongly associated with bleeding, the suggestion may be offered that complex stones may potentially be staged rather than approached with multiple-tract, single-stage PCNL. In addition, to minimize bleeding during MPCNL in patients with complex stones, using flexible instruments for stone fragments in other calyces with single percutaneous access may be a favorable option [11].

One of the main concerns regarding blood loss during pediatric PCNL is sheath size. In our current study, we noted

that sheath size 16F was not significantly associated with an increase in blood transfusion requirement after pediatric PCNL. Bilen et al. compared PCNL in children after using different sizes of instruments through a 14F, a 20F, and a 26F tract. They concluded that low blood transfusion rates were only reached in children operated through a 14F tract despite no significant difference in hemoglobin level between groups[12]. According to Desai et al., limiting the tract dilatation to 22F is important in reducing blood loss [13]. Ozden et al. reported that greater than 24F significantly affected the decrease in hemoglobin values but did not affect the rates of transfusion[14]. Zeng et al. reported their experience of 331 renal units in children, with stone clearance rates reaching 80.4% and a blood transfusion rate of 3.1%[15]. Mini percutaneous nephrolithotomy has become increasingly popular over recent years, with stone clearance reported as 80-85% [15,16] following a single session of MPCNL as monotherapy.

In the present study, postoperative hemoglobin levels were performed if required, and any investigations are performed on an intention-to-treat principle. Many centers performing MPCNL in children have found that in the vast majority of cases there is no requirement for blood transfusion. Bilen et al. reported no blood transfusions being required in their cohort of patients undergoing MPCNL and this is supported by Yan et al. [16].

CONCLUSION

With the advancement in endourology, Mini PCNL is an emerging, safe and effective method of managing pediatric calculi with efficacious stone clearance rates with low morbidity. Stone clearance is achievable in the majority of patients through a single nephrostomy tract and complications are minimal.

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