MINI-PCNL IN PEDIATRIC PATIENTS WITH LARGE RENAL STONES- A SAFETY DATA

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ABSTRACT

Percutaneous Nephrolithotomy (PCNL) is a recent advancement in the management of urolithiasis, it has now become the gold standard. This study aimed to assess the safety of mini PCNL in pediatric patients with large renal stones. This cross-sectional study included pediatric patients (n=12) who underwent mini-PCNL. Age, gender, number of stones, size of stones, and position in the renal system were documented. The mean age of the patients in the study was 7.67 years. The stones ranged from 10 mm to 20 mm with a mean size of 10 mm. Complete clearance of stones was achieved in 83.7%. 16.7% had incomplete clearance with clinically insignificant residual stones (i.e. < 4mm) requiring no further treatment except follow-up. The major complication in our series was hydroperitoneum in one patient, which was identified and managed by placing the intraperitoneal drain. Patients were discharged from the hospital on or before 3rd post-operative day. The study concludes that Mini-PCNL method is effective, safe, and economical for the removal of renal calculi in the paediatric age group. Further large scale studies exploring methods to lessen its morbidity would be recommended specially in patients with renal stone complications like hydroperitoneum.

Key Words: MiniPCNL, Urolithiasis, Renal stone pediatric patients

INTRODUCTION

Urolithiasis are defined as the stones in the renal system / kidney. Regardless of age strandarization, the incidence of urolithiasis has increased during the past few years with the recent rate of almost 9% per annum (1). The preventive measures and advancement in the management have not yet reduced incidence, neither related complication appears to be declined. The resultant complications of morbidity in all age groups and carries a significant economic burden as when they produce pain its an acute emergency and patients are devastated. Thus the cost of surgery and the days out of work produce both direct and indirect burden over economy(2, 3). Urolithiasis in children is also common, but the new surgical techniques are mainly directed to explore the outcome in adults.

Percutaneous nephrolithotomy (PCNL) has been introduced for large kidney stones and now being used as the gold standard treatment. The tools utilised have been miniaturised during the last 20 years to reduce surgical procedure-related morbidity such as standard PCNL and boost the effectiveness of removal of the stone. Mini-percutaneous nephrolithotomy (mPCNL) was introduced to treat children with the added benefit of reduced blood loss. Given the low blood volume in children blood loss is the major and potentially lethal complication. Depending upon

the track size i.e. 14Fr and 22Fr the procedure is termed as mini-perc, or mini-PCNL (mPCNL). However, clear demarcation of the size and names still not exist (4). The primary purpose of the procedure is to remove the stone with minimal complications, where removal of stone capacity should be similar to conventional PCNL, but the rate of complications per operative or post-operative must be inferior to the conventional procedure. The size of the tract has significant influence on the rate of complications both during surgery and post-operatively (5). On the other hand, small tract size may make the stone removal difficult and prolonged surgical procedure causing anaesthesia-related complications(6).

The increasing rate of paediatric patients with urolithiasis has diversified the management. Thus this study was conducted to evaluate the safety during procedure and immediate post-operative period to make clear guidelines and design signposts for surgeons so that morbidity and mortality can be reduced and patients with clear indications and minimal risk can be identified.

METHODS

A total of 12 pediatric patients were recruited in this study, their per-operative and post-operative data were collected and analyzed. These all patients underwent mPCNL at the Department of Urology, Liaquat University of Medical and Health sciences Jamshoro, Pakistan between July 2018 to October 2018. Patients included in the study were seen at urology clinic and planned for mPCNL. They were aged between 4 to13 years with normal renal function and mean stone size was 10 mm. The patients were thoroughly examined with detailed history, physical examination and basic laboratory investigations, including complete blood count, blood urea and creatinine levels, serum electrolytes, urinary analysis including culture & sensitivity, ultrasound abdomen and pelvis, X-ray kidney, ureter, and bladder (KUB), and Computed Tomography (CT) scan-KUB (Figure 1 and 2).

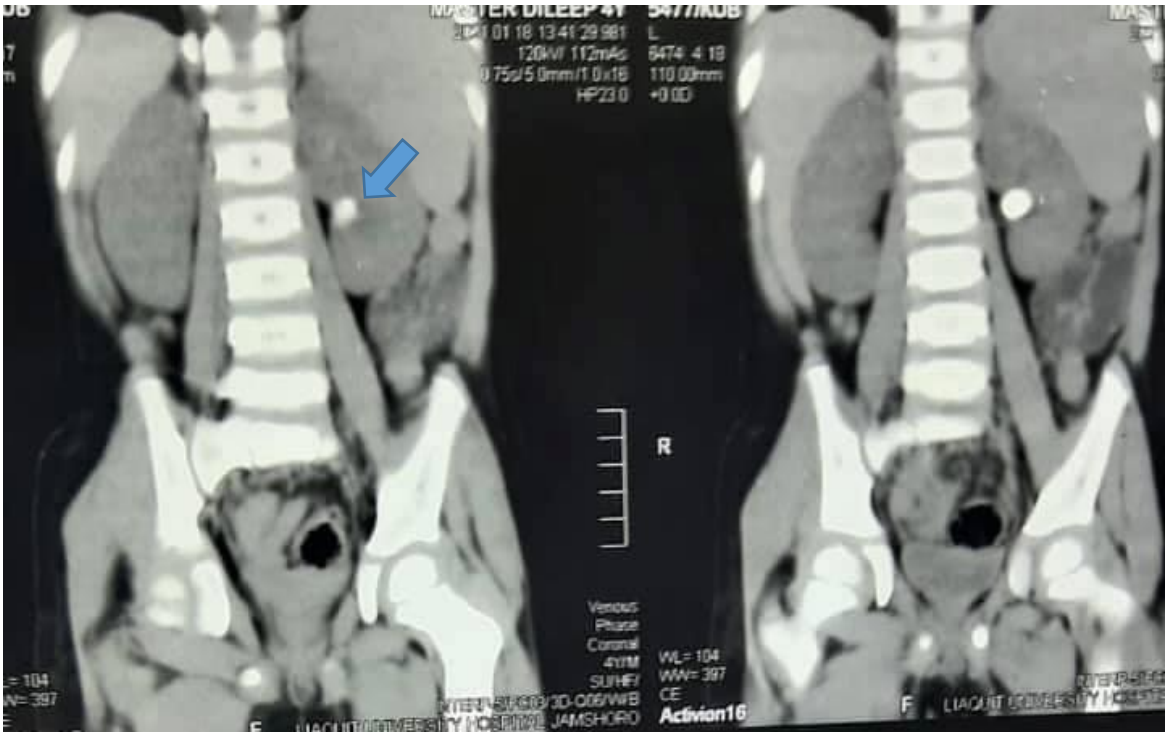

Figure 1. Computed Tomography (CT): Kidney Ureters and Bladder (KUB)

The patients' age and gender were documented, as well as the size of stone was measured in mm, the number of stones were recorded as dichotomized variable i.e. single or multiple, hydronephrosis was looked at, site of stones in the kidney, (i.e. renal pelvis and different calyceal stones) was also documented. Tract access such as upper, middle or lower pole calyx puncture were also documented. The outcome of the procedure was measured in terms of stone clearance, weither it was complete or incomplete, and the decision was made on the basis of stone fragments seen on table fluoroscopy and post-operative X-ray KUB. Incomplete clearance was defined as any clinically inconsequential stone whereas, no residual stone were considered as complete clearance. On 1st post-operative day complications such as significant bleeding in Foley's catheter or nephrostomy tube requiring blood transfusion, rise in temperature more than 99 °F or pain requiring more than three doses of injectable pain killers were recorded.

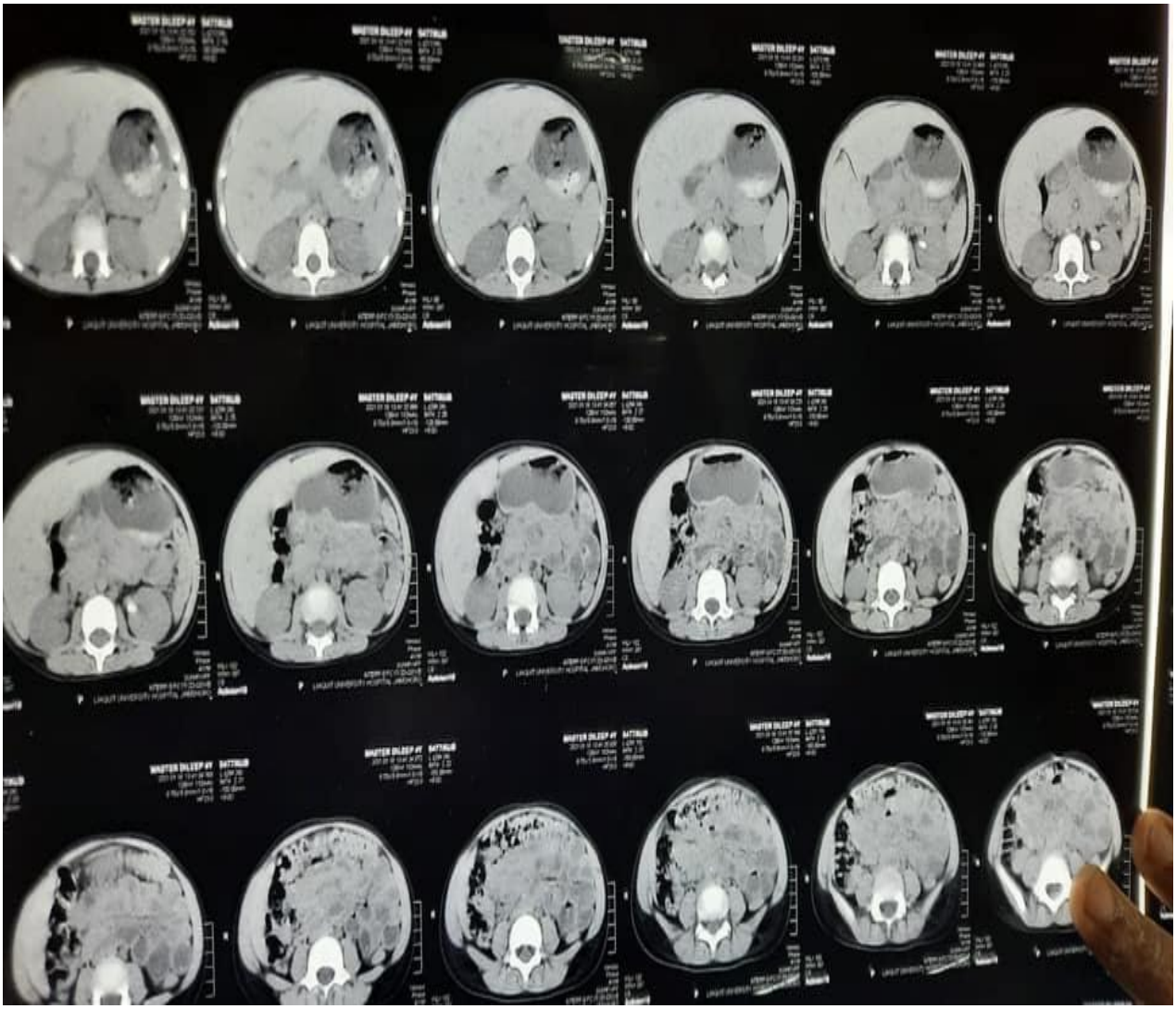

Figure 2. Computed Tomography (CT) Kidney Ureter and Bladder Showing left renal stone

The procedure was performed under general anesthesia in all patients. 10Fr pediatric cystoscope was used to get retrograde urography under the Fluoroscope in lithotomy position and open ended 3-5Fr ureteric catheter were placed and secured to a Foley's catheter. Mini-PCNL was done in prone position. Punctures were made under Fluoroscopic guidance where ureteric catheters used to fill the system with contrast material. The contrast material is used for opacification of the system and

distention of the collecting system (Figure 3). The urinary collecting system was accessed through lower calyx. Through out the procedure patients were maintained in prone position. The track was dilated over a suitable guide wire of up to 21Fr than the amplatz sheath of 22Fr was inserted through which Storz rigid nephroscope 18Fr was passed (Figure 4). Pneumatic probe was used for stone fragmentations, in all patients except one 16Fr Nephrostomy catheters were used. Only one patient required to be double punctured. Ante grade double J stenting was also done in selected patients at the end of the procedure. The Nephrostomy tube was left until the second postoperative day then it was removed, while the DJ stent was removed after two weeks, as per standard protocol. Procedure was successfully carried out in all patients with complete clearance of the calculi.

Figure 3. Left retrograde Pyelography (RGP)

Figure 4. 22 Fr amplatz sheath is being placed

All patients were monitored for complications such as fever, pain and bleeding on the first postoperative day. All patients were healthy enough to be discharged on or before the third postoperative day.

The study's data was collected using Statistical Package for Social Sciences (SPSS version 22.0). Continues variables were summarized as mean and Standard Deviation (SD); i.e. age (in years) and stone size (in mm). Frequency distribution with percentages were calculated for categorical variables; i.e. gender, stone site, number of stones, presence of hydronephrosis, calyx puncture, clearance status of the stone and complications.

RESULTS

Twelve patients underwent mini percutaneous nephrolithotomy, the mean age of the patients was 7.67 years. Mean size of the renal stones was 10 mm with a range of 10–20 mm. Out of 12 patients, 7 (58.7%) were males and 5 (41.7.3%) were females. All patients had pelvic stones, in addition to pelvic stones 3 patients had lower pole stones. Different degree of hydronephrosis was observed, where five (41.7%) patients had mild and seven (58.3%) patients had moderate hydronephrosis. A preoperative antibiotic regimen was prescribed for five patients with positive urine cultures. Complete clearance of stone was achieved in 10 patients (83.7%) and 2 patients (16.7 %) had incomplete clearance, with clinically insignificant residual stones which were <4mm and were not required any auxillary procedure. All patients had lower pole punctures to gain access to pelvi-calyxeal system, for which bull's eye technique was applied in 11 (97.7 %) patients and the triangulation technique in one (8.3%) patient. Only two patients had nephrostomies implanted; the others remained tubeless. Ante-grade DJ placement was done on 2 patients. The mean operative duration of the procedure was < 1.1hr.

The major complication was hydro-peritoneum in one patient who was recognized immediately in the operation room and managed by placing the intra-peritoneal drain. The haemoglobin level of one patient dropped as a result of intraoperative bleeding, requiring a blood transfusion, but the other patients experienced no serious complications. Three patients (25%) experienced moderate pain in the first 24 hours following surgery and needed injectable analgesics. Vomiting occurred in 8 patients (67%) and was treated with antiemetics.

DISCUSSION

Patients with renal stones treated with mPCNL and traditional PCNL experienced similar stone-free rates. However, with the small tracts, the risk of blood is significantly lower and the need for blood transfusion reduced to nominal or insignificant. Though it substantially raises the time duration of the procedure (7). On the other hand, there are reports presenting significantly shorter duration of the hospital stay with mPCNL compared to the conventional procedure (7). In the study published by Misra et al., they found that mean hospital stay after mPCNL was 1.5 days, but in this study we have found that most of the patients were discharged from the hospital within two days of the procedure. Only one patient required a longer hospital stay for more than 3 days secondary to complication of hydroperitoneum. Thus, it is suggested that mPCNL safe from a complication point of view, so it can be considered an effective evolution of the cPCNL technique. There are limited high level evidence which compares two procedures using same indications in children such as large Randomised clinical trials (RCTs), preferably multi-center trials. The carefully designed RCTs will certainly wash out selection bias and operating surgeon introduced bias. Because high level expertise in surgical procedures reduce the risk of complications anyway. The shorter hospital stay was previously reported in another series by Jackman et al, this has strongly supported our results (6). The stone clearance rate in children or adults as has been reported to be comparable at 85% when the stone size is measured between 12 to15 mm. There were a few studies which however have shown inferior stone fragmentation in children with smaller instrument such as the series reported by Giusti et al (7). In our study complete stone clearance was achieved in 83.7 % of patients and 16.3 % of patients had incomplete clearance with clinically insignificant residual stones of < 4mm. This can attributed to the size of the stone being removed. Though the small instrument has a limitation of removing very small stone, fragments must be made into very small pieces to fit in the narrower sheaths. This significantly raises the operating times, whereas during standard PCNL, relatively larger fragments can fit in the sheaths thus crushing into tiny bits is not essentially required allowing removal of large stone fragments by using forceps and baskets.

Minimizing invasiveness of the PCNL was driven from the concept of lower morbidity as compared to the conventional PCNL. The robust data in support of lower morbidity is still controversial, in order to confirm the findings Li et al (8) compared mPCNL and conventional protocol and measured acute-phase proteins. The study found no significant difference. Another experimental study was conducted using Pigs and compared renal parenchymal damage with the use of 11Fr versus 30 Fr nephrosotomy tubes (9). The study showed no significant difference in the resultant were no detectable differences in the degree of damage and the resultant scar volumes. There are other studies which confirmed small amount of blood loss in cases of mPCNL as compared to the conventional PCNL. A similar study by Mishra et al (10) reported a clinically significant advantage for using 18 Fr as compared to the 26 Fr.

The size of the stone as one of the indications of mPCNL and this is the crucial point. However, the data reported till date remains inconsistent regarding the indications thus the resultant stone fragmentation rate and the rate of complications among studies also differ. Though for small stones

mPCNL has shown high effectiveness has been reported as compared to relatively larger renal stones i.e. 20 mm or bigger (9,11,12).

According to the Clavien-Dindo classification, the rate of complications ranges from 11.9% to 37.7% (11), out of which majority of complications were of low grade. These findings are consistent with our results where only one patient developed major complication of hydroperitoneum which was recognized immediately and managed conservatively. There was a prospective study to explore the hemodynamic, electrolytes, and metabolic changes and compared conventional versus mPCNL (12) and there was a trend of metabolic acidosis in patients undergoing mPCNL. These findings can be biologically explained by prolonged operating time associated with longer duration of anesthesia and given the smaller track size higher pressure intra renal irrigation is used.

This a small scale study from a single centre confirming safety of the procedure in children with minimal complications and there was low morbidity. The smaller sample size and non-randomized/ convenient sampling technique are considered the study's limitations. However large scale multi-center randomized controlled trials comparing conventional versus mPCNL in children need to be established to produce robust scientific evidence.

CONCLUSION

This small study indicates that mini PCNL may be an effective and safe procedure for removing renal calculi in the pediatric age group with less morbidity; however, there is a slight increased risk of longer intraoperative duration.

ETHICAL CONSIDERATION

The study was approved by local ethics committee; informed consent was taken from all the patients.

CONFLICT OF INTEREST

Authors declare no conflict of interest

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