Research Article

Efficacy of Miniperc in management of renal stones in children

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Abstract
Purpose: We test the efficacy of miniaturized percutaneous nephrolithotomy in pediatric population. **Objectives:** To assess safety and efficacy of treating pediatric stone disease using miniaturized PCNL to overcome anatomical considerations. **Methods:** A total of ٤٢ patients underwent miniaturized PCNL from June ٢٠١٤ to February ٢٠١٦; dilatation up to ١٤Fr was done to gain access to intrarenal stones. A ٩.٥Fr scope and Holmium Laser lithotripsy were used to fragment the stones. The incidence of complications, postoperative extravasation, perirenal collections, hospital stay, transfusion rate, stone burden, stone clearance, operative duration and outcome were all noted and recorded. **Results:** Patients' ages ranged from ١٩ to ١٤٤ months. Stone size ranged from ٥mm to ٤١mm in their longest dimension with a mean of ١٦.٤٨mm. Stone free rate was ٧٩٪ Mean length of hospital stay was ٤ days. Rate of blood transfusion was ٥٪ of patients. External ureteral stents were used in all patients. Relations between patient age, number of stones and outcome were statistically significant. **Conclusion:** Miniperc in pediatric population is a safe procedure and offers advantages over standard PCNL with adult sized instruments on children, it can be performed at younger ages and with larger stone burdens.
Keywords: Kidney, Nephrostomy, Percutaneous, Pediatric, Miniaturized, Nephrolithotomy, Miniperc

Introduction
Between ٥ and ١٠٪ of the human population suffer from urinary stone disease during their lifetime, and of these cases ٢-٣٪ are children. In children, stone recurrence rates range widely (from ٣.٦ to ٦٧٪), and appear mainly in children with metabolic abnormalities. As a result, it is important to receive a therapy that will render the patients stone free for as much time as possible[١].Most pediatric urinary stones can be managed effectively by minimally invasive treatment modalities such as extracorporeal shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS). However, PCNL can have a significant role in cases involving large and/or SWL resistant stones. According to the European Association of Urology guidelines, PCNL is recommended as primary treatment option for large renal stones (> ٢٠ mm) and also for > ١٠ mm stones of the lower renal pole[٢] .

The surgical management of pediatric kidney stones with PCNL has been developed due to improvement of endourology devices and acquired experiences. Standard PCNL required ٢٤-٣٠ F nephrostomy sheaths for renal access. But this method is associated with complications such as hemoglobin drop, blood transfusion, damage of renal parenchyma, and postoperative analgesic requirement. In order to decrease morbidity associated with PCNL in pediatric patients small size instruments have been used. Thus, PCNL is performed with small size endoscopes *via* smaller percutaneous tract in diameters ranging from ١١ F to ٢٠ F and this was named as Miniperc or Mini-PCNL [٢] Urologists were reluctant to perform PCNL in children due to concerns regarding the use of large instruments in pediatric kidneys, parenchyma damage and the associated effects on renal function, radiation exposure with fluoroscopy, and the risks of major complications, including sepsis and bleeding.

With significantly accumulated experience, however, PCNL is currently being used as monotherapy and in combination with SWL (sandwich therapy) in children, achieving stone-free rates ranging from ٦٨٪ to ١٠٠٪[٣].

Early published series of percutaneous renal stone extraction in children describe the use of adult-sized instruments, with acceptable success and complication rates .The uptake of this technique was slow, because there were reservations regarding the short- and long-term effects of using large instruments in small, pediatric kidneys. A ٢٤F sheath in an infant is said to correspond approximately to a ٧٢F sheath in an adult. Therefore, treatment was initially limited to children older than age ٥ years. Subsequent series have reported the safety and efficacy of the adult PCNL technique in children as young as ٣ months. Although the relationship of the tract size and the long-term renal damage has never been established, efforts have been made to reduce the tract size for small, pediatric kidneys. The risk of bleeding is increased with the number and size of the tracts [٤].

With the clinical introduction of smaller nephroscopes, "miniperc" procedures are feasible where hol: YAG laser, smaller pneumatic lithoclast and ultrasound probes can be used during PCNL in children. Concerning the appropriate age of the patients, PCNL has been performed in children as young as ١٩ months [٥]. The Miniperc technique is believed to have several advantages, including decreased blood loss, increased maneuverability, and shorter hospital stays. As the risk for bleeding complications is related to the number and caliber of tracts used, limited transfusion rates have been reported with this technique. [٦]

Patients and methods:

This study included ٤٢ pediatric patients who were presented during the period from June ٢٠١٤ to February ٢٠١٦ and underwent mini-percutaneous nephrolithotomy (Miniperc). Thorough medical history including personal, present and past surgical and medical history was taken mainly from the parents. KUB X-ray examination and abdominopelvic ultrasonography were done to all children. Also, all patients had non-contrast helical C.T examination of the urinary tract. Intravenous urography was available in ١٣ patients only. The procedure started by general anesthesia in all patients. Children was put in the dorsal lithotomy position first for insertion of ureteric catheter then converted into the prone position, then injecting radiopaque material (urographine) as ¼ ratio mixed with saline. After opacifying the pelvicalyceal, choosing the appropriate calyx, an ١٨ gauge puncture needle was inserted into the selected calyx under fluoroscopic guidance of the C-arm. Dilation after insertion of the guide wire was done either by metal Alken dilator or serial Amplatz dilators up to ١٤ F then the working sheath was inserted. Nephroscopy was done using ٩.٥F ureteroscope through ١٤f sheath. Fragmentation of the stone was done using Holmium laser lithotripsy and ٥٠٠ micron fiber. After finishing the procedure a ١٠F plastic tube was introduced through the renal access sheath as nephrostomy tube. Postoperative follow up using KUB film and abdominal U/S TO assess for residual stones.

Results

The results of this study will be divided into parts: Review of data of thesis as regards patients demographics and pre, intra and postoperative different data parameters elicited during the study and Analytical part of results showing the relationship between different parameters in relation to efficacy and complications Patients included in this study aged between ١٩ – ١٤٤ months old with mean age of ٦٨.١٥ months (٥.٦ years). Out of the ٤٢ children include in the study, there were ٢٨ males (٦٦.٦ %) and ١٤ females (٣٣.٣ %). ٢٥ children had right sided stones (٥٩.٥ %) and ١٧ had left sided (٤٠.٤ %). Nine patients (٢١.٤ %) underwent a failed SWL treatment after average of ٢ sessions of SWL. In this study, a total of ١٣ children (٣٠.٩٪) had history of previous surgeries, ٩ cases (٢١.٤٪) had open renal surgery and ٤ cases (٩.٥٪) had endourologic procedures. Of these ٩ cases with history of previous open

renal surgeries, ٦ patients had them on the same side of our Miniperc procedure. The degree of hydronephrosis was determined by ultrasonography mainly together with the IVU and CT scan, patients were divided into four groups according to the degree of hydronephrosis; patients that showed no backpressure changes (group I), mild backpressure changes (group II), moderate backpressure changes (group III) and severe backpressure changes (group IV). In this study ٨ patients (١٩٪) had mild degree of hydronephrosis, ٢٥(٥٩.٥٪) had moderate degree of hydronephrosis, and ٣(٧.١٪) had a severe degree of hydronephrosis. Number of stones ranged from a single stone to ٨ stones per patient with a mean of ٢.٢٦ stones per patient. In this study, ٢٤ cases (٥٧.٢٪) had stones in their renal pelvis, ١٨ cases (٤٢.٨٪) had their stones in both renal pelvis and calyces. All cases enrolled in this study were managed through a single puncture and tract into the pelvicalyceal system except one patient who had ٢ punctures. There were two techniques of dilatation used in this study; dilatation with telescopic metal Alkan dilators and serial Amplatz dilators. ١٧ patients (٤٠.٤٪) underwent dilatation using the Alkan dilators and ٢٥ patients (٥٩.٥٪) underwent dilatation using Amplatz dilators. Significant bleeding was defined as bleeding compromising the patients' hemodynamics, necessitating blood transfusion, and impending clarity of vision. According to these criteria, significant bleeding was encountered intraoperatively in ٥ patients (١١.٩٪). In ٢ cases, the source of bleeding was the neck of the access calyx while it was from the parenchyma around the working sheath in another ٣ cases. Residual stones were encountered in ٩ cases (٢١.٤٪), all having either complex or multiple stones. In ٥ cases (١١.٩٪).

Table ١: Relation between initial puncture and intraoperative bleeding.

Variable	Total	-ve Bleeding		+ve Bleeding		P-value
		No	%	No	%	
Post. Inf. calyx	٢٩	٢٩	٧٨.٤	٠	٠	٠.٠٥
Other locations	١٣	٨	٢١.٦	٥	١٠٠	

From the table shown above, all the cases that experienced bleeding were through other than the lower posterior calyx through our series.

Table ٢: Relation between duration of procedure and intraoperative bleeding.

Variable	-ve Bleeding	+ve Bleeding	P-value
	Mean ± SD	Mean ± SD	
Duration in minutes	٧٣.٩٣ ±٣٤.٣٣	١٠٩.٠٠ ± ٤٢.٥٩	٠.٠٥

From the table shown above, the cases that had intraoperative bleeding, as previously defined had a longer mean operative time

Discussion

The technique of percutaneous renal surgery has revolutionized the way renal stones are treated. It has become increasingly clear in the last several years that the percutaneous approach is ideal for many patients. In designing the present study, it was focused upon the minimally invasive techniques for percutaneous renal surgery in the pediatric population**.** The surgeon's experience is paramount to facilitate complete stone clearance and minimize re-treatment rates. The decision regarding the most efficacious primary treatment modality must be individualized per child based on age, anatomy, location, and composition of the stone burden [٧].

In the Desai et al. series published in ١٩٩٩ [٨], their number of cases was ٤٠ patients with an age range from ١ lms-١٥yrs. In the Zeren et al. series published in ٢٠٠٢ [٩], their number of cases was ٥٣ patients with an age range of ١٠m-١٤yrs. In review, our series showed a lower total number of patients but still was comparable to these series and more than other published series. Our age range of patients was relatively the same with no major differences. In comparison to the Rutter et al series [٩], they used renal access sheaths of ١١-١٦Fr diameters in comparison to our ١٤Fr sheaths that were used in our series. Only ٩ patients were included in their series while ٤٢ patients were included in our work. Their stone free rate was ١٠٠٪ but this is influenced by their small number of patients included in their series. No stone size range was reported in the Rutter series. Also, in study of Nischith et al, they show their experience on a series of ٢٠ patient had miniperc for renal calculi. Children were with age ranging from ٨ to ١٦ years which is much older than age range in our study and The calculi were accessed by a ١٢F mini nephroscope with ٩٠٪ stone free rate.

The method of dilatation and its impact on the outcome of the miniaturized PCNL in children was not reviewed in many similar works in the literature. However, the present work showed that although there was not much of a difference between creating the nephrostomy tract with either the Alkan dilators or the Amplatz dilators in relation to their impact on stone clearance at the end of the procedure, still our work showed an advantage for the Amplatz dilators over the Alkan dilators in creating the nephrostomy tract when it comes in relation with causing a significant intraoperative bleeding. The total number of cases that had a significant intraoperative bleeding was too low to create a statistical significance, but the advantage of the Amplatz dilators was apparent.

Conclusion

Miniaturized percutaneous renal surgery in pediatric patients is a safe and effective procedure that provides an alternative to the standard percutaneous renal surgery with the same indications, limitations and outcome. It also provides a high patient satisfaction with significant decrease in postoperative analgesia requirements, shorter hospital stay compared to standard PCNL in children. This would have a definitive impact on the overall cost reduction. So, the Miniperc technique is believed to have several advantages, including decreased blood loss, increased maneuverability, and shorter hospital stays. As the risk for bleeding complications is related to the number and caliber of tracts used, limited transfusion rates have been reported with this technique.

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