

Mini percutaneous nephrolithotomy for renal calculi in paediatric patients: A review of twenty cases

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Abstract

Objective: The objective was to report our initial experience of mini percutaneous nephrolithotomy (mPCNL) performed on patients in the pediatric age group (<18 years) using a miniature nephroscope (12F).

Subjects and Methods: A total of 20 children underwent mPCNL for renal stone extraction in the Department of Urology, Yenepoya Medical College, Mangalore, India, from February 2013 to January 2014. The patients were evaluated on the basis of parameters viz. age at the time of surgery, size and number of stones, duration of surgery, stone clearance, and postoperative complications.

Results: A total of 20 mPCNLs were performed on children, with age ranging from 8 to 16 years. Three children had three stones each, six children had two stones each, eight children had one stone each, and three had multiple. The median stone burden was 1.36 cm. The procedure was via single puncture in 15 cases, and two punctures in five cases. Punctures were upper calyceal in seven cases, lower calyceal in seven cases, and combined upper and lower calyceal in six cases. The calculi were accessed by a 12F mini nephroscope, laser lithotripsy was used in 12 cases and pneumatic lithotripsy used for the rest. Total clearance was achieved in 18 out of 20 cases (90%). Postoperative complications developed in one child, in the form of sepsis.

Conclusion: Our initial experience concludes that mPCNL is a safe and efficacious tool for the management of renal calculi in the pediatric population.

Key Words: Mini, nephrolithotomy, pediatric, percutaneous, renal calculi

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INTRODUCTION

Urolithiasis in the pediatric age group is a relatively rare condition with a prevalence of around 2%.^[1] The prevalence and treatment of stone disease have increased of late, especially in children <15 years.^[1-4] Though long considered safe in

adults, percutaneous nephrolithotomy (PCNL) was reluctantly performed in children, attributed primarily to the dangers of using large instruments in smaller kidneys leading to extensive parenchymal damage and the associated effects on renal function, excessive radiation exposure intra-op, and risks of postoperative sepsis, hemorrhage, hydrothorax, and hypothermia.^[3]

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During the past decade, several authors have described the use of pediatric “mini-perc” with track sizes as small as 11F with reasonable stone clearance rates.^[5] Advantages of the mini-perc technique include reduced pain, hemorrhage and sepsis, and shorter hospital stay. However, this is limited by a longer operative procedure (as a greater number of fragments are needed to be removed through a smaller track) and need for specific miniature instruments. We report our initial experience of mini PCNL (mPCNL) in 20 patients, the youngest being 8 years old, and the oldest being 16 years old, using a 12F nephroscope. The study was done to compare existing literature with the results we attain, as, at present, the dictum for pediatric patients in our part of India (Southern states) is to perform PCNL with adult nephroscopes.

SUBJECTS AND METHODS

Twenty patients, ranging from 8 to 16 years old, admitted to the Urology Department, were treated for renal stones using the mPCNL technique. The initial evaluation consisted of routine hematological investigations and radiological procedures (ultrasonography of the abdomen focusing primarily on the renal system) and computed tomography urogram. Routine coagulation profiles were obtained before the procedure. All the procedures were performed under general anesthesia in a dedicated pediatric operating room. Prophylactic antibiotics and postprocedural antibiotics were duly administered. Postprocedural radiological screening (ultrasonography and radiographs) was done to evaluate the extent of clearance. Patients' demographic details, procedural information (PCNL puncture site, stone burden, number of stones, screening, total procedural time), and posttreatment outcomes (PCNL stone clearance rate, duration of postoperative stay, chemical composition of stones, and postoperative complications) were prospectively documented. The study comprised a period of 12 months, from February 2013 to January 2014.

Mini percutaneous nephrolithotomy technique

The dilators, dilator sheaths, trocar, graspers, and mini nephroscope were all of make Richard Wolf, Germany. The patients were placed in lithotomy position, and a 5F retrograde end flushing ureteric catheter was placed into the pelvi-calyceal system. The position of the tip of the catheter was confirmed by fluoroscopy using a C-arm (inserting a small amount of radiographic contrast medium – urografin into the pelvi-calyceal system). This was followed by the insertion of a 10–14 Fr Foley's catheter (the size depending on the patient's age and diameter of the urethra) and taped to the ureteric catheter. This prevented accidental displacement of the ureteric catheter during the procedure. The patient was then repositioned (turned prone) with appropriate

cushioning placed at the pressure points to avoid pressure sores. Throughout the procedure, the anesthesiologist took care to keep the patient warm, as there is an increased risk of hypothermia in the pediatric population. The pelvi-calyceal system was opacified by injecting the radiographic contrast in a retrograde fashion through the ureteric catheter, mobile fluoroscopy C-arm was used to identify the specific calyx that needed to be punctured. This identification enabled the antero-gradual insertion of the initial procedure needle, through which a wire was passed, down the ureter. The puncture needle was removed. Using an 11F blade, the skin was incised. This was followed by dilation of the fascia using a rigid dilator, first 12F, and then 15F [Figure 1] for inserting the 12F nephroscopic sheath. Nephrostogram was performed to confirm the placement of the access sheath. The 12F nephroscope [Figure 2] was inserted into the sheath [Figure 3] and the collecting system examined. Continuous irrigation was performed using isotonic solution. The stones were localized, fragmented, and removed from the collecting system. For 12 cases, laser lithotripsy was used and in the remaining eight cases, the pneumatic lithotripter. Three children were initially subjected to extracorporeal shock wave lithotripsy (ESWL), but following shock wave lithotripsy (SWL) failure, they

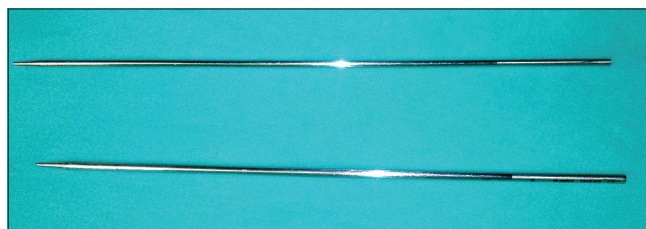


Figure 1: 12F and 15F dilators

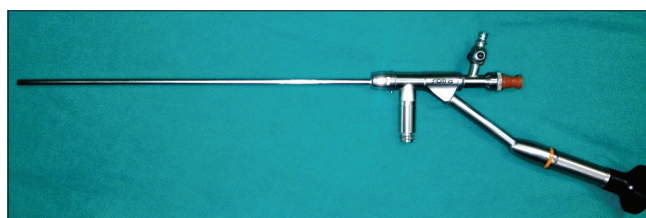


Figure 2: 12F nephroscope

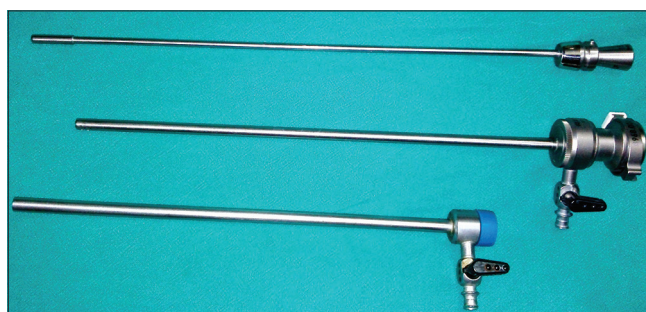


Figure 3: Outer and inner sheath and trocar

were subjected to laser lithotripsy subsequently. Semi-rigid grasper (4 Fr) [Figures 4 and 5] was used to remove the fragments. Reinspection was done to assess the extent of clearance through direct vision and fluoroscopy. Nephrostomy tubes were placed into the collecting system, and double-J stents were kept extending from the pelvis to the bladder.

RESULTS

A total of 20 mPCNLs were performed on patients whose ages ranged from 8 to 16 years. Mean age was 11.25 years. Three children had three stones each, six children had two stones each, eight children had one stone each, and three had multiple. Hypercalcemia was present in five patients and hyperuricemia in one patient. A single staghorn calculus was encountered (2.8 cm). The median stone burden was 1.36 cm. The access was primary in all the cases; via single puncture in 15 cases, and two punctures in five cases.

Punctures were upper calyceal in seven cases, lower calyceal in seven cases, and combined upper and lower calyceal in six cases. The calculi were accessed by a 12F mini nephroscope. Holmium YAG laser was used in 12 cases; for the rest of the cases, pneumatic lithotripsy used. Of the 12 cases subjected to holmium YAG laser, three were after short wave lithotripsy failure. The total clearance rate was achieved in 18 out of 20 cases (a success rate of 90%). The patients with residual stones were treated with ESWL for one and retrograde intrarenal surgery for the other. The mean operating time was 58 min. Of the patients operated, one child developed postoperative sepsis. She was managed with vigorous intravenous antibiotic therapy in a pediatric intensive care setup. Two children had fall in hemoglobin (10%), one developed fever. The mean postoperative stay was 3 days. Six stones were calcium oxalate stones; four were calcium phosphate, five mixed two uric acid, two ammonium urate, and one struvite. Blood was transfused for the two children who developed postoperative fall in Hb.

DISCUSSION

The incidence of nephrolithiasis in children has increased at an annual rate of about 6–10% and is currently 50 per 100,000.^[6] An effective modality of pediatric urolithiasis management has become a highly sought-after topic for discussion among urologists world over. Open surgery was the primary treatment

of choice, till the advent of SWL in the 1980's that paved the way for the revolution in pediatric stone management.^[3,7] This is currently the procedure of choice in treating most upper urinary tract calculi in children <1.5 cm,^[8] open surgery being confined only to complex stones.^[9] However, the stone-free rates of SWL are low, with only 37–52% of children stone-free at discharge according to a large-scale study.^[10] There is also some data that suggests a possible increase in the risks of hypertension, diabetes mellitus, arteriosclerosis, and long-term renal tubular injury in children treated with SWL.^[11] According to world literature, PCNL is generally used for the treatment of large stone burdens >1.5 cm in children, with efficacy and complication rates similar to the adult population.^[7,8] In fact, PCNL has now replaced open surgery as the treatment of choice for large stone burdens in children of all ages.^[3] However, the dangers of using large instruments in smaller kidneys leading to hemorrhage and lower tolerance of blood loss, extensive parenchymal damage, and the associated effects on renal function have been a deterrent to its widespread usage. There are few reported series of mPCNL in children. The first one was by Jackman *et al.*, who developed the novel percutaneous access technique (“mini-perc”) using a 13 Fr peel-away vascular access sheath and reported a 85% stone-free rate for 11 procedures in seven children with a mean age of 3.4 years.^[5] The authors of various small series have declared mPCNL as safe and effective for the management of renal stones in children, with mean stone burden of 1.5 cm in most studies, and stone-free rate of 70–95%.^[12–14] The advantages are the short treatment time, the high stone-free rate and the accessibility of lower pole stones.^[15] In our initial experience with mini PCNL, the median stone burden was 1.36 cm; the largest stone encountered was a staghorn calculus measuring 2.8 cm in diameter. Guidelines for pediatric PCNL direct it to be used for stones >2 cm or >1.5 cm, however, we could use the mini-perc safely for stones smaller than that. Application of the mPCNL technique for retrieval of stones more than 1.5 cm in diameter was not associated with any significant difficulty in achieving clearance because of stone dusting settings used during Laser (increased frequency and lower wattage); the resultant being a high clearance rate of 90%, with only two cases out of 20 in which total clearance was not achieved. A major complication occurred in one patient, and the complication rates of mPCNL, as per our initial experience, are acceptable. Thus, to conclude, mPCNL, especially with laser dusting is a safe and efficacious tool for the management of renal

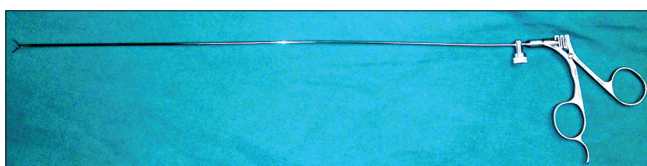


Figure 4: Two pronged grasper

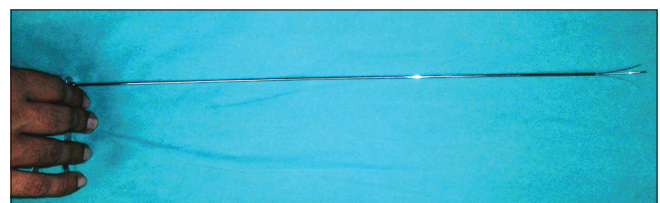


Figure 5: Three pronged grasper

calculi in the pediatric population. Mini-perc should be done in select experienced high volume centers dedicated to pediatric urology. A large population under the purview of this study would give a greater insight into this disease entity and enable its effective management. Furthermore, comparative trials with regular PCNL should be performed to determine its effectivity.

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Conflicts of interest

There are no conflicts of interest.

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