

Mini-PCNL for complex staghorn stones in children

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Abstract

Objectives: To evaluate the safety and efficacy of percutaneous mini-nephrolithotomy (mini-PCNL) in children with complex staghorn stones.

Patients and Methods: We analyzed prospectively data of 28 children undergoing pediatric mini-PCNL during a period of 18 months. Stone complexity was defined according to the validated Guy's stone score (GSS). Our patients were GSS III and IV. All PCNL procedures were performed in the prone position, under fluoroscopic guidance, and in the same standardized fashion with F12 and F17 mini-nephroscopes.

Results: Eleven children were boys (total n=28). Mean age was 7.25 ± 3.27 (2-14) years. Mean stone burden was 36.89 ± 8.002 (30-60) mm. GSS was in 57% grade III and in 43% grade IV. The initial stone-free rate was 78%, which increased to 89% after few ancillary procedures. 17% of children had major complications (one hydrothorax, four blood transfusions). On statistical analysis, stone clearance rates were found inversely dependent on stone complexity (GSS) ($p < 0.025$). Stone burden, number of tracts, and procedure time were associated with stone complexity ($p < 0.000$). In turn, stone complexity ($p < 0.015$) and the number of tracts ($p < 0.049$) were significantly associated with complications.

Conclusion: Mini-PCNL is effective and safe for treating complex renal stones in pediatric patients. Complication rates are acceptable and predictably stable on comparison with the literature.

Introduction

Pediatric urolithiasis is a common problem globally (1). The incidence is 2% to 3% (2) with a 55 % recurrence rate within 5 years (3). Pediatric nephrolithiasis is more prevalent in developing countries (4).

Anatomical defects, metabolic and genetic aberrations, and urinary tract infections are risk factors for renal stone formation in children. In addition, any relevant genetic component has a more significant impact in children (5). In developing nations, hypercalciuria and hypocitraturia occur in 84 - 87% of children (6). And as in adults, gender, diet, obesity, season, physical activity and fluid intake all contribute to stone formation (7).

In 1977, percutaneous nephrolithotomy (PCNL) has first been described to treat pediatric nephrolithiasis (8). Today, pediatric PCNL has become routine and has widely replaced open surgery (4).

Because of small size and high mobility of the pediatric kidney, PCNL of staghorn calculi in children is most challenging (9). On the other hand, PCNL has become the treatment of choice for children with complex stone burden (10). Also, it is a successful salvage operation after failed SWL (11). PCNL is recommended in the American Urology Association guidelines as first line treatment for staghorn calculi (12). The reasons for a progressive shift towards PCNL for treating staghorn calculi in children are the high clearance rate of 80-90%, and avoiding multiple procedures and hospital visits (13, 14). PCNL in children as young as three months was reported as safe and efficacious (15).

Initially adult-size instruments (F22-30) were available too big for infants and preschool-aged children (16). In recent years, miniaturization of urological endoscopes has much progressed. Today, mini- (F14-22), ultramini- (F11-14), and micro-PCNL (F7-11) are available.

In this study, we prospectively assessed 28 children with complex staghorn stones that were treated with mini-PCNL as to efficacy and safety of the procedure.

Patients and Methods

Prospectively, 28 children were assessed who underwent mini-PCNL for staghorn stones from April 2016 to September 2017 in the Urology department of the Sulaymani Teaching Hospitals in Kurdistan/ Iraq. The study was approved by the scientific committee of the Iraqi Board for Medical Specialization. Excluded were children with congenital anomalies, associated comorbidities, coagulopathy, and sepsis. All children were evaluated with medical history, physical examination, urinalysis, urine culture, complete blood count, serum biochemistry, coagulation tests, IVU, abdominal ultrasonography, and computerized tomography. Personal data were recorded such as age, gender, presence of urinary tract infection, hemoglobin levels, serum creatinine, and history of previous renal stones and/or stone surgery. Stone data included stone size, location, number, complexity (according to Guy's stone score (GSS) (17)), side, and degree of hydronephrosis. All 28 cases had pre-operatively sterile urine. All procedures were performed in a single session, prone, under fluoroscopic access guidance, and antibiotic prophylaxis. The operation followed a standard protocol using 18-20F Amplatz sheaths and 12 or 17F nephroscopes (Karl Storz, Tuttlingen/ Germany) dependent on the age of the child, size of the kidney and anticipated width of the calyceal neck through which the access was planned. In cases of several accesses (branched staghorn stones), all accesses were established at the beginning of the operation. Lithotripsy was performed pneumatically. Flexible ureteroscopes or nephroscopes were not available. A JJ stent or a ureter catheter was left for 48 hours post-operatively. A Foley catheter F12 was used as nephrostomy and removed when producing clear urine.

Surgery data were recorded such as size, number and location of access, time, stone-free status (as established by fluoroscopy and endoscopy), Hb-drop, transfusions,

complications (according to Clavien classification), hospital stay, and ancillary procedures.

After 3 weeks, children were assessed with renal ultrasound and Xray KUB. Stone-free status was defined as residual fragments <4mm.

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 21). Chi square test of association was used to compare between proportions. Independent-Samples T Test was used to compare between means of two groups. A p value of ≤ 0.05 was considered statistically significant. Statistical analyses were performed to detect any significant association between each of the dependent and independent variables. The 95% confident interval was calculated.

Results

Twenty-eight children were included , thereof 11 (43%) boys. Mean age was 7.25 ± 3.27 years (range 2-14 years). 39% had had previous stone treatments. 25 (89%) had moderate to severe hydronephrosis. Hb and serum creatinine levels were in the normal range for all.

About one third of procedures were on the right kidney. Stone size was 36.89 ± 8 mm (range 30-60mm). Stone complexity (GSS) was 16 (57%) III, and 12 (43%) IV, respectively.

Median procedure time was 91 minutes (range 55-130 min). 43% of patients had two access tracts, and one had three. Tracts were placed in 28/4/10 children into the lower/ middle/ upper calyx, respectively.

Two (7%) children needed intra-OP blood transfusions, 2 (7%) post-operatively. One child needed drainage of a hydrothorax. Therefore, the rate of serious complications was 17%. Mean Hb-drop was 1.08 ± 0.48 g%.

JJ stents were used post-operatively in 24 (86%) children. No child reported serious stent-related symptoms. Mean hospital stay was 3.54 ± 1.47 days.

Initial stone clearance as assessed by fluoroscopy and endoscopy was achieved in 22 (78%) children. 6 (22%) had significant (> 4mm) residual fragments. Thereof one (4%) underwent 2nd-look PCNL, and 5 (18%) underwent extracorporeal shockwave lithotripsy (SWL). On follow-up, the stone-free rate rose to 89%.

Statistically, stone size, number of tracts, and mean operation time were significantly associated with GSS ($p < 0.000$). Stone clearance rates decreased significantly with increasing stone complexity ($p < 0.025$). Children with complete staghorn stones (as opposed to partial ones) had a significantly higher complication rate ($p < 0.015$), a greater Hb-drop ($p < 0.001$), and a longer hospital stay ($p < 0.001$)

Age, side, previous stone interventions, stone size, tract dilatation, and DJ stenting were not significantly associated with any complications ($p > 0.05$).

Discussion

PCNL is the treatment of choice for hard, complex, large staghorn stones in pediatric patients, either as monotherapy or in combination with SWL (18). It is highly effective as our results with an initial stone-free rate of 78%, and 89% on follow-up after few ancillary treatments show. This is in line with the literature with 58 - 94% (1, 13, 18-23).

Serious complications occurred in 17%. This corresponds with the literature where the complication rate is 13 - 42% (1, 13, 18-23). Blood transfusions are of most concern in

the pediatric age group. The transfusion rate has been reported as 24% (21). Our rate of 14% compares favorably.

The use of adult size instruments (F24-30) versus mini-PCNL in pediatric patients has been controversially discussed. It was reported that a smaller instrument diameter does not decrease the complication rate (24), whereas others reported just the opposite (25, 26). In adults, an advantage in reducing bleeding complication by reducing the scope and tract diameter has clearly been evidenced (27).

From our results, it appears that the overall complication rate is significantly associated with stone size and complexity, number of access tracts and procedure time. These findings compare with other authors (20, 24, 28).

Unfortunately, due to limited resources neither a flexible ureteroscope nor a flexible nephroscope suitable for children was available. The use of those might reduce the need of additional tracts.

In conclusion, mini-PCNL is efficient and safe [29]. Children are often treated initially with SWL since they are able to pass much larger fragments than adults. Consequently, children listed for primary PCNL often have a large and complex stone burden. That may be the reason that the transfusion rate in pediatric series (14-24%) is higher than in adults (7-8%) (30). Given the smallness and fragility of the pediatric kidneys, and the clearly established association between scope/ tract diameter and bleeding (26), mini-PCNL seems the way to go in children.

Compliance with Ethical Standards

No funding.

Conflict of Interest: No conflict of interest declared by any of the authors

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The study protocol was approved by the scientific committee of the Iraqi Board for Medical Specialization.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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