

Efficacy And Safety Of Mini Percutaneous Nephrolithotomy And Open Pyelolithotomy For Renal Stones In Pediatric Population

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 DOI: 10.47750/pnr.2021.12.02.43

Abstract

Background: Pediatric renal stones may lead to pain, urinary obstruction, infection, and long-term renal damage. Although less common in children compared to adults, these stones remain a significant clinical problem.

Objective: To evaluate and compare the effectiveness and safety of Mini-PCNL versus open pyelolithotomy in pediatric patients.

Study design: A prospective study .

Duration and place of study. department of urology institute of kidney diseases Peshawar between 01-03-2021 and 31-06-2021

Methodology: This prospective analysis carried out at the Department of Urology, Khyber Teaching Hospital Peshawar, focused on pediatric patients diagnosed with kidney stones who had underwent either open pyelolithotomy or Mini percutaneous nephrolithotomy (Mini-PCNL) between 01-03-2021 and 31-06-2021 (study duration: 6 months). Patients of either gender aging 6 to 15 years with renal stones diagnosed on plain CT-KUB were enrolled. Efficacy and safety profile of both treatment modalities were compared.

Results: Of the 61 patients who required intervention for the identified kidney stones in the pediatric patients, 40 underwent mini-PCNL while 21 underwent open pyelolithotomy. Age profile in mini-PCNL group averaged 11. 3 years and open pyelolithotomy group was 10. 8 years on average. The mini-PCNL group consisted of 25 patients of which 62. 5% were male patients while the open pyelolithotomy group had a total of 3 patients of which 66. 7% were male patients. The results obtained from the present study showed that the mini-PCNL group had a higher stone clearance rate of 95% as compared to the open pyelolithotomy group having a clearance rate of 90. 5%. Also, the cases that had mini-PCNL experienced fewer complication rates including haematuria, postoperative urinary tract infection, and fever than those who underwent open pyelolithotomy.

Conclusion: Mini PCNL is a secure and efficient therapy substitute to open pyelolithotomy patients of paediatric age group diagnosed with renal calculi.

Keywords: Renal Stones, Mini Percutaneous Nephrolithotomy, Open Pyelolithotomy, Paediatric Population.

Introduction

Renal stones in children may result in pain, obstruction to the urinary system, infections and long-term complications of renal damage. Despite the frequency being lower in children than adults for these stones, it continues to be a clinical issue[1]. In recent decades, pediatric renal stones have become increasingly common, and various factors have been established to be linked to kidney stone development including diet, reduced physical activity, and metabolic disorders[2,3,4]. One unique aspect of treating renal stones in children is that the patient volume is relatively low, thus formulating different treatment plans that will not be detrimental to the developing system is challenging[5,6].Surgery is by far the ultimate and widely considered optimal choice in the management of P-KS when NIFTPM, medical management, and hydration, pain relief and MET cannot be implemented or have failed[7, 8]. Mini percutaneous nephrolithotomy (Mini-PCNL) and open pyelolithotomy, therefore, being most frequently employed surgical modalities for the treatment of stones in children[9].Mini-PCNL is a technique where small instruments are used to

fragment and retrieve the renal stones from the collecting system through a percutaneous track with the help of a small access sheath or a channel diameter <20 F under the fluoroscopic control[10]. A characteristic of this less invasive approach includes reduced tissue stress time, early hospital discharge and thus faster healing time [11,12]. Conversely, open pyelolithotomy involves making an incision to take direct access on to the renal pelvis or minor calyces in order to remove tunneled stones[13]. In instances where the stone is large or Units of Measure in Economics: CURRENT & FUTURE VALUE of money Units of Measure in Economics: CURRENT & FUTURE VALUE of money Impact of Information Technology on Consumer Behavior Impact of Information Technology on Consumer Behavior Factors affecting the growth of the hotel industry in Japan Factors affecting the growth of the hotel industry in Japan The Prevention and Management of Violence The Prevention and Management of Violence Marketing of BANK Although Mini-PCNL and open pyelolithotomy have been performed in pediatric patients, with increased popularity in children, comparative study exploring the safety and effectiveness of the procedures in pediatric patients, particularly our population, is scarce. For the purpose of patient care enhancement and to better understand how and which of these two methods should be applied, it is necessary to know more about their outcome differences. How much effective and safe is Mini-PCNL and open pyelolithotomy in pediatric renal stones treatment? This proposal plans to evaluate the data for 61 pediatric patients from prospectively.

Methodology

This cross-sectional study conducted in the Department of Urology Unit Pediatric Urology at KTH Peshawar base on pediatric stone patients who have undergone open pyelolithomy or Mini-PCNL from between 01-03-2021 and 31-08-2021. Children of either gender admitted with the diagnosis of renal stones and aged 6 to 15 years of age were included in the study. All presented patients with renal stones were examined using an ultrasound or a plain CT KUB. Patients with prior history of surgical intervention, altered anatomy (congenital) and syndromic patients were excluded. Sample size was calculated using WHO sample size formula and patients were recruited using non-probability consecutive sampling technique. Before collecting and analyzing data, the required ethical approval was obtained from the institutional review board.

The age, gender, and medical history of each patient were properly documented. Before surgery, imaging exams (such as computed tomography and ultrasound) were used to capture specific characteristics such as size, location, and composition of the stones. Duration of operation, the technique (open/mini PCNL), quantity of stone extracted, and incidence of any surgical complications were carefully documented. In addition, we recorded the outcomes after the surgery, including the proportion of patients who achieved stone-free status, the mean length of hospitalization, and any further occurrences that took place post-procedure. The selection between Mini-PCNL and open pyelolithotomy was determined after a thorough evaluation of the patient's symptoms, the surgeon's preference, and the clinical indication. The defined protocol for mini-PCNL involves percutaneously accessing the renal collecting system under fluoroscopic guidance, followed by the use of tiny instruments for fragmentation and extraction of the stones. Open pyelolithotomy was performed to extract the stone which included making an incision in either the lower abdomen or flank to get direct access to the calyces or renal pelvis. The primary outcome was the stone clearance defined by the absence of renal stones confirmed on ultrasound/CT KUB carried out within 24 hours after the procedure. Aside from the main outcome, supplementary measures included surgical complications, length of hospital stay, and intervention needs.

Descriptive statistics were used to examine the data, specifically focusing on demographic and clinical characteristics. Continuous data was represented using mean \pm standard deviation or median (interquartile range), whereas categorical variables were conveyed using frequencies and percentages. We used chi-square tests or Fisher's exact tests to analyze categorical data, and independent t-tests or Mann-Whitney U tests to analyze continuous variables. Statistical significance was established based on a p-value \leq 0.05.

Results

Out of 61 pediatric patients who had kidney stones, 40 had mini-PCNL and 21 had open pyelolithotomy. In the mini-PCNL group, patients' mean age was 11.3 years, while in the open pyelolithotomy group, it was 10.8 years. The proportion of male patients was high in both the mini-PCNL group (62.5%) and the Open Pyelolithotomy group (66.7%). Both groups had comparable preoperative features and stone properties. Stones in the open pyelolithotomy group averaged 3.2 cm in size, whereas those with mini-PCNL averaged 2.8 cm. The renal pelvis was the most prevalent site for stones in both groups, with the lower calyx coming in second. The two groups' stone compositions were ranked by the frequency of calcium oxalate and uric acid, respectively. Both groups had their intraoperative factors and surgery outcomes compared. In comparison to the open pyelolithotomy group, which had an average operating duration of 93.2 minutes, the mini-PCNL group had a far shorter time (75.6 minutes). Additionally, the

mini-PCNL group had a greater stone clearance rate (95%) than the open pyelolithotomy group (90.5%). Both groups had few intraoperative problems; however, bleeding was the most prevalent event in both groups. Mini-PCNL achieved a stone-free rate of 90%, which was greater than the open pyelolithotomy group's rate of 81%. In comparison to the open pyelolithotomy group, which had a longer average hospital stay of 3.1 days, the mini-PCNL group had a shorter one of 2.5 days. Likewise, patients who underwent mini-PCNL encountered fewer complications than patients who underwent open pyelolithotomy. A more serious complication of postoperative bleeding has been observed, and this was present in 5% of the patient who underwent mini-PCNL while 17% of the patient who had open Pyelolithotomy. In addition, fevery rates and urinary tract infections in mini-PCNL group (2. 5%) were less compared with open pyelolithotomy group (9. 5%). Therefore, this research concluded that mini-PCNL was safe and effective in managing pediatric renal stone disease. It is a less invasive procedure with less postoperative morbidity and quicker recovery than OP and has a higher stone clearance rate than LAP. ASF and LEEP were found to have similar complications. Therefore Mini-PCNL could be the optimal therapy for pediatric renal stones particularly in those with abnormalities or small stones.

Table 1: Demographic Characteristics of Pediatric Patients with Renal Stones

Characteristic	Mini-PCNL Group (n=40)	Open Pyelolithotomy Group (n=21)
Age (years)		
Mean \pm SD	11.3 \pm 3.5	10.8 \pm 2.9
Range	6 – 15	6 - 15
Gender		
Male (%)	25 (62.5%)	14 (66.7%)
Female (%)	15 (37.5%)	7 (33.3%)

Table 2: Preoperative Characteristics and Stone Parameters

Parameter	Mini-PCNL Group (n=40)	Open Pyelolithotomy Group (n=21)
Stone Size (cm)		
Mean \pm SD	2.8 \pm 0.9	3.2 \pm 1.1
Range	1.5 - 4.5	2.0 - 5.0
Stone Location		
Renal Pelvis	20 (50.0%)	10 (47.6%)
Lower Calyx	12 (30.0%)	7 (33.3%)
Upper Calyx	8 (20.0%)	4 (19.0%)
Stone Composition		
Calcium Oxalate	22 (55.0%)	15 (71.4%)
Uric Acid	12 (30.0%)	4 (19.0%)
Struvite	4 (10.0%)	2 (9.5%)
Cystine	2 (5.0%)	0

Table 3: Intraoperative Variables and Surgical Outcomes

Variable	Mini-PCNL Group (n=40)	Open Pyelolithotomy Group (n=21)
Operative Time (min)		
Mean \pm SD	75.6 \pm 12.4	93.2 \pm 18.7
Range	55 – 100	70 - 130
Stone Clearance Rate		
Successful (%)	38 (95.0%)	19 (90.5%)
Unsuccessful (%)	2 (5.0%)	2 (9.5%)

Table 4: Postoperative Outcomes

Outcome	Mini-PCNL Group (n=40)	Open Pyelolithotomy Group (n=21)
Stone-free Rate (%)		
Successful	36 (90.0%)	17 (81.0%)
Unsuccessful	4 (10.0%)	4 (19.0%)
Length of Hospital Stay (days)		
Mean \pm SD	2.5 \pm 0.8	3.1 \pm 1.2
Range	2 - 4	2 - 5
Postoperative Complications		
Bleeding	2 (5.0%)	3 (14.3%)
Urinary Tract Infection	1 (2.5%)	2 (9.5%)
Fever	0	1 (4.8%)

DISCUSSION

This paper presented the fact that mPCNL is slightly superior to open pyelolithotomy concerning the SFR as well as postoperative complications in the management of renal calculi in pediatric age group patients. The findings are comparable with another study that has compared the efficiency of mini-PCNL with open pyelolithotomy in children who underwent treatment of renal stone diseases, and stated that mini-PCNL has better success rate in terms of stone clearance and also shortened operative time as compared with open pyelolithotomy in young patients[16]. As for dysfunctional issue emergence, there was no significant disparity between the two strategies. In the same manner, Young patients with renal stones which was evidenced done by ElSheemy et al[17] have also been benefited from mini-PCNL. (2019). This study demonstrated that more number of patients in the study had their stones cleared by mini-PCNL than open pyelolithotomy in addition to spending a shorter hospital stay.

However, a study conducted by Galal et al. [18] in analyzing the clinical outcomes of patients with HF taking Saxagliptin in a large scale phase III trial found out that Saxagliptin improved outcomes and reduced the risk of HHF. The comparative analysis of mini-PCNL abilities and open pyelolithotomy in children done in 2019 showed that effective stone clearance was similar in both approaches. The researchers concluded that mini-PCNL was less invasive in the procedure and the patients were discharged early after the operation in comparison to those who underwent open Pyelolithotomy. ElSheemy et al. [19] mini-PCNL which was described in the study by (2020) disclosed the fact that the duration of surgery and hospital stay was significantly shorter than that. Nonetheless, they could not observe a significantly higher rate of stone elimination either in the ECC therapy.

Altogether, the three articles contribute strong testimonials to the optimum efficacy and safety profile of the mini-PCNL as a treatment modality in children with renal stones. However, several benefits are enjoyed with L. O. A compared to open pyelolithotomy for example the duration of the surgery and the rate of removal of stones besides, the period spent in the hospital. It is necessary to underline that those studies involved rather limited number of participants and short-term follow-up. Presumably, further research with greater issues of study participants and longer tracking periods will be required to confirm these observations.

Conclusion

Mini-PCNL comes out as a rather safe and effective approach to the individuals with kidney stones of a pediatric age. As opposed to open pyelolithotomy, several advantages include; shorter time on surgery operation table, high efficiency on removal of the stone and shortest hospital stay. But it is need of the hour to perform more research with large sample size and report the effects of mini-PCNL on pediatrics, especially over large follow up period. The selection of proper patients and gentle approach in the procedure ensures that paediatric patients undergo smooth and successful mPCNL procedures. Mini-PCNL is ideal as a treatment for pediatric nephrolithiasis especially in patients with various associated diseases or smaller stones.

Disclaimer: Nil

Conflict of Interest: Nil

Funding Disclosure: Nil

Authors Contribution

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