



EFFICACY AND SAFETY OF "MINI-PERC" IN UPPER URETERIC AND PYELOCALYCEAL STONES.

Urology

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ABSTRACT

Objective To assess the efficacy and safety of a "mini-perc" technique of percutaneous nephrolithotomy for the removal of pyelocalyceal stones and upper ureteric calculi.

Materials and Methods Data of 94 patients who underwent mini-perc, were reviewed with relation to clinical presentation, stone characteristics, operative time, need for transfusion, stenting, nephrostomy placement, stone free rate, complications and hospital stay. The effect of stone diameter, stone burden, relation of primary vs secondary tract and placement of dj stent with respect to analgesic requirement and hospital stay were analysed. Also relationship of operative time with stone burden, placement of dj stent and presence of secondary tract were studied.

Results The immediate and at 1 month stone free rate was 100%, in all stone locations which was not influenced by stone diameter or stone burden. The mean hospital stay after the procedure was 2.09±0.39 days.

Conclusion In experienced hands miniperc provides a very good option for treatment of renal stones in all locations and upper ureteric calculi with low complication rates.

KEYWORDS

INTRODUCTION:

Renal stone disease has afflicted mankind since ancient times and has elaborated in connate with human civilization. Worldwide renal stone disease incidence is on rise. Often associated with considerable morbidity, nephrolithiasis has a lifetime prevalence of 5-10%.[1] Many a times presents as a recurring disorder, with recurrence rates peaking to 50%.[2] Advancement in technology has improved the outcome of kidney stones considerably and minimally invasive techniques such as extracorporeal shock wave lithotripsy (ESWL), retrograde intra-renal surgery (RIRS), percutaneous nephrolithotomy (PCNL) and laparoscopic ureterolithotomy, have now largely replaced open surgery which is now an event of past only[3]. PCNL is considered as treatment of choice for large renal calculi (>20 mm) and also for smaller stones (10–20 mm) of the lower renal pole when unfavourable factors for ESWL exist [3]. Excellent stone-free rates following PCNL have been reported, which range from 76% to 98%. [4] However, PCNL is still a challenging surgical technique and can be associated at times with significant complications. In order to decrease morbidity associated with larger instruments like blood loss, postoperative pain and potential renal damage, a modification of the technique of standard PCNL has been developed. This is performed with a miniature endoscope via a small percutaneous tract (11–20 F) and was named as minimally invasive PCNL or mini-PCNL or mini perc. Ever since Helal *et al.* reported percutaneous nephrolithotomy in a 2 year female child who had unsuccessful outcome at ESWL therapy for kidney stone developed due to loop diuretic therapy.[5] The method involved sequential dilation up to 16F with introduction of 10F pediatric cystoscope and grasper which were used to remove the stones. 12F catheter was placed after removing the peel away sheath. This seminal case laid a foundation for miniaturization of PCNL. However, mini-PCNL technique was first developed and further accomplished by Jackman *et al.* in the pediatric population with the use of an 11 F access tract. [6] He reported a series of 11 patients in age of 2-6 years who underwent mini-PCNL with 85% of stone clearance. Since then, the prospects of this method have been explored as a treatment option for adults as well.[7,8,9] Usually, the term mini-PCNL is used for access sheaths below 20 F, though the terminology has not been standardized yet.

MATERIALS AND METHODS

A total of 94 patients who underwent mini-perc in consecutive 6 months were included in this study excluding only complete staghorn calculi or patients with high stone burden involving more than two calyces. Besides these exclusion criteria included uncorrected

coagulopathy, pyonephrosis, any comorbidity increasing surgical risk in prone position or stage III-IV renal failure with creatinine clearance <15-30 ml/min. The clinical details of all the successive 94 patients who underwent the "mini-perc" technique of percutaneous nephrolithotomy, were reviewed studying clinical details, stone characteristics, operative time, need for transfusion, stenting, nephrostomy placement, immediate and final stone free rate after any additional procedures, complications and hospital stay.

TABLE 1

Age in years (mean±sd)	35.55±17.08
Range in years	(4-63)
Renal stone	33
Ureteric stone	25
Calyceal stone	44
Stone size surface area	271.95±108.3mm ²

Preoperatively patients were evaluated by a urine routine test and urine culture. Plain radiography of kidneys, ureters and bladder (KUB), and intravenous urography, ultrasonography or unenhanced computed tomography, computed tomography urography (CTU) and radionuclide imaging were performed as per individual case basis. Third generation cephalosporins were administered prophylactically to all patients. Calculus clearance was assessed on postoperative day 1 with a plain film of KUB and USG after 1 month. 'Stone-free' was defined as no residual stones or fragments <4 mm detected on KUB/USG, as fragments <4 mm have a likelihood of spontaneous passage.[10]. Postoperative hemorrhage was defined as continued heavy bleeding which needed transfusion, embolism or nephrectomy. The operative time was calculated from performing the puncture to placing of the nephrostomy tube. The time from insertion of the ureteric catheter to the turn in the prone position was not included. The mini-PCNL procedure was performed under general anaesthesia. It began with the placement of an open-ended 5-Fr ureteric catheter by cystoscopy with the patient in the lithotomy position. After the catheter was secured over contralateral side of abdomen with dynaplast adhesive, the patient was turned into prone position. Percutaneous access was obtained by the placement of an 18-gauge access needle into the intended calyx (most often the middle calyx, sometimes the upper calyx) under fluoroscopy guidance with the help of retrograde pyelography. It was commonly done through a middle posterior calyx. A 0.035-inch floppy-tipped terumo guide wire was passed through the needle into the collecting system. The access needle was then removed and the skin and fascia were incised with 11 no blade. Nephrostomy tract dilation was

performed with serial dilators (Cook) over the guide wire up to 10F followed by dilatation with metal dilators 15F/16F. A 12-Fr Karl Storz rigid nephroscope was used. Holmium laser utilizing SureFlex 550 μm fiber, 10 to 20 Hz frequency, and 0.5 to 1 J power lithotripsy fiber of innova quartz Phoenix, AZ for lithotripsy was used for fragmenting stones with stone fragments flushed out with irrigation under gravity through ureteric catheter utilizing Bernoulli's principle, while the remaining larger fragments were extracted with stone forceps. At the end of the procedure, a 12/14Fr nephrostomy tube was routinely placed to drain the kidney and in cases where there was significant edema around the pelvic and upper ureter area 5.5F DJ stent was placed in antegrade fashion. Unless the plain film of KUB suggested significant residual calculi, the tube was removed 1-3 days after the operation. The postoperative course was followed and any complication developing was graded according Dindo modification of Clavien grading. [11]

RESULTS

All the 94 patients with total of 102 calculi underwent single session of percutaneous surgery and one of the patients required creation of two tracts. The average stone size was 271.95±108.3mm2. (Table 1) Eight patients had percutaneous tract already created as they have presented previously with calcular pyonephrosis. (Table 2) None of the patients required any auxiliary procedure for residual stone clearance. Besides also none of the patients underwent any stone removing procedure on the contralateral side in the same sitting.

Table 2

Access Tract	
Primary	86
Secondary	8

Table 3

Operating time (Min)	58.11±14.12
DJ stenting	
Yes	12
No	82
Nephrostomy	
Yes	94
No	0
Transfusion	
No	94
Yes	0

The stone-free rates in ureteric and renal calculi patients were (100%). The average operating time was 58.11±14.12min. (Table 3) Though minimal amount of bleeding did occur during the process of gaining access to renal pelvicalyceal system. None of the cases experienced severe hemorrhage during procedure resulting in loss of vision or conversion to standard PCNL. After completion of the procedure in none of the cases PCN was clamped for stopping bleeding. The mean postoperative hospital stay was 2.09±0.39 days. (Table 4)

TABLE 4

Hospital stay (Days)	2.09±0.39
Stone clearance	
Complete	94
Residual	0

There were no significant complications such as hemorrhage necessitating transfusion, urinary tract perforation, or visceral injury that occurred during the procedure. In twelve patients who had placement of double-J stent which was usually removed by cystoscope within 1 month after the operation. Stone analysis revealed 83.8% of the calculi were mixed stones (the main component was calcium oxalate), 9.5% calcium oxalate, 5% carbonated apatite and 1.7% uric acid composition.

Discussion

The minimally invasive modalities including PCNL, ESWL and RIRS have completely replaced open surgeries in the treatment of stone diseases. Ever since Goodwin reported needle decompression of hydronephrotic kidney, PCNL has become the modality of choice for large renal stones and in stones with unfavorable characteristics for ESWL.[12] The complications with standard PCNL have been quite variable with studies reporting up to 80% complication rates though most include febrile illness and insignificant bleeding which settle with conservative management.[13],[14],[15],[16],[17] About <8%

rate of significant bleeding has been reported in various studies with about 5-18% requirement of transfusions rates. [17], [18], [19], [20], [21] There has been quite debate about the renal parenchymal injury after PCNL especially when multiple tracts are created it has been shown in various studies that PCNL brings along it the risk of parenchymal loss following creation of nephrostomy tracts up to 30F.[22],[23] Hegarty NJ studied complication rate between single vs multiple tracts with results showing almost similar hemoglobin drop. It was inferred that need for transfusion correlated with lower preoperative Hb levels and increased baseline Sr creatinine. Further it was seen that with multiple access tracts Sr creatinine levels increased and also the creatinine clearance decreased. However blood loss and complications were comparable between single tract and aggressive approach. [24] The inciting trauma due to large tracts in PCNL served as an impetus for exploration of miniaturization of tracts especially in childhood age group because of disproportionation in instruments and the childhood kidney. The basic denominator in mini-PCNL has been miniaturization of instruments thereby reducing tract diameter with less chances of bleeding, less pain, and less no of days of hospital stay. Knoll T studied the benefits of miniaturized PCNL and supported shorter hospital stay, lesser degree of pain with comparable stone free rates. [25] However many presumed that his results could be because of low stone burden. Since now mini PCNL has been extended to adults and even tried for large stone burden. Controversy exists regarding role of mini PCNL in large calculi, Zhong et al compared mini PCNL and standard PCNL in large calculi, theorizing little tracts will bring less tissue trauma. Patients with comparable stone parameters were randomized to mini and standard PCNL. It was seen that mini PCNL has higher stone clearance rate (89.7% vs 68% p= 0.049). Also it was reported by the authors that need for adjunctive procedures for stone clearance was 24.1% vs 60%.[26] Studies conducted by Lahme and Monga have revealed quite encouraging results however in our study the successful outcomes with 100% clearance of stones have been reproduced from pediatric age group up to adult group.[9],[27] Further our study achieved 100% success rates for renal vis a vis calyceal, pelvic and also for upper ureteric calculi thereby being an only study which has reached such successful results over substantial varied ages of patients and also varied stone locations. To our knowledge there has not been any study in the literature which has reproduced such results in all ages and all stone locations. In the management of inferior calyceal calculus with poor parameters for ESWL and for upper ureteric calculus mini PCNL has been gaining a strong foothold even in era of RIRS. Though RIRS being a non invasive procedure associated with low morbidity both have comparable stone free rates with longer operating times for RIRS. [28] For upper ureteric calculus as the size increases >10mm the efficacy of ESWL falls to about 42% while as for URSL success rate are in the range of 35-87%. [29],[30],[31] The minimal invasiveness of URSL is accompanied by relatively low stone clearance rate and also there are stone migration chances amounting to 32% which result in eventual need for an auxiliary procedure in 16-32% of cases.[32],[33] Yang Z et al also compared mini PCNL with URSL for upper ureteric calculus. Mini PCNL was associated with shorter operating time, greater stone clearance, lower rate for auxiliary procedures and lower incidence of post operative fever at the cost of bleeding rates which were higher with mini PCNL. [34] Our study included 21 patients with inferior calyceal calculi and 25 with upper ureteric calculi; complete stone clearance was achieved in all these patients with no complications. As the stone size increased the need for analgesia also increased however there was no statistical correlation found (Table 5). Furthermore the average hospital stay in our study was 2.09±0.39 days. Though it was found that as the number and size of stone increased there was increase in the duration of hospital stay but it was not significant statistically. (Table 6)

Table 5: Comparison

Variables	Painkiller		
	50mg (group 1)	100mg (group 2)	150mg (group 3)
Surface area	262.89±103.19	275.99±116.87	276.68±118.09
p value*	0.79		
Bonferroni Post-hoc Test...			
Group 1 vs Group 2:	Diff=13.1, 95%CI=-87.57 to 110.51, p=0.18		
Group 1 vs Group 3:	Diff=13.79, 95%CI=-143.76 to 170.73, p=0.13		
Group 2 vs Group 3:	Diff=0.69, 95%CI=-149.29 to 153.19, p=0.98		
Hospital stay	1.78±0.44	2.09±0.47	2.41±0.45
p value*	0.0866		
Bonferroni Post-hoc Test...			
Group 1 vs Group 2:	Diff=0.31, 95%CI=-0.17 to 0.59, p=0.39		
Group 1 vs Group 3:	Diff=0.63, 95%CI=-0.089 to 1.21, p=0.09		
Group 2 vs Group 3:	Diff=0.32, 95%CI=-0.22 to 0.92, p=0.24		

*: Kruskal Wallis test

Table 5

TABLE 6: Comparison according to hospital stay

Variables	Hospital stay	Wilcoxon-Mann-Whitney	p value
SINGLE STONE	1.8±0.49	1.26	0.14
MULTIPLE STONE	2.38±0.53		
PRIMARY TRACT	1.96±0.46	0.94	0.39
SECONDARY TRACT	2.22±0.83		
DJ STENTING YES	2.25±0.22	4.21	0.01*
DJ STENTING NO	1.93±0.29		

*: statistically significant **Table 6****TABLE 7: Comparison according to operating time**

Variables	Operating time	Wilcoxon-Mann-Whitney	p value
SINGLE STONE	51.67±14.27	1.87	0.06
MULTIPLE STONE	64.55±17.18		
PRIMARY TRACT	66.53±16.28	1.73	0.08
SECONDARY TRACT	49.69±14.76		
DJ STENTING YES	61.3±17.25	0.68	0.44
DJ STENTING NO	54.92±15.87		

Table 7

The average hospital stay in our study was 2.09±0.39 days which was quite less as compared with the study by Knoll T who reported 3.8±2.8 days. [25] Patients who underwent DJ stenting also during procedure had increase in the duration of hospital stay to 2.25±0.22 days with respect to non stented ones with 1.93±0.29 days, this had significant correlation statistically, the reason for this could be the explained because of increased incidence of stent related symptoms in such patients. (Table 6) The morbidity of DJ-stents however can be significant. Stent related discomfort is reported in 39% of patients. [35] Pain, nausea, vomiting, minimal amount of hematuria, dysuria, frequency, episodes of fever and epigastric discomfort were most common complications which were assigned grade according to Dindo modification of Clavien classification which has been validated for its use in mini PCNL in order to decrease interrater variability. [11] The complications seen were only Grade I according to clavien system of grading with no requirement of transfusion, endoscopic, radiological or surgical intervention. The patients were evaluated for residual fragments using X-ray though NCCT has highest sensitivity for diagnosing residual calculi. CT shouldn't be used routinely for assessing residual calculi as it doesn't yield valuable increase in diagnosing significant residual stone with respect to plain X ray. With high success rate and low complication rates seen in our study it seems mini PCNL can be an effective and safe technique for removing renal in all locations and upper ureteric calculi in experienced hands. Further studies are needed in order to reproduce and prove our validation.

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