PERCUTANEOUS NEPHROLITHOTOMY FOR THE TREATMENT OF RENAL STONES LARGER THAN 2.5 CM

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Objectives: *To share our experience regarding the safety and efficacy of Percutaneous Nephrolithotomy for the treatment of renal stones of larger than 2.5 cm and to study the frequency of any postoperative complications associated with this procedure.*

Methodology: *This is a descriptive study conducted during the period from June 2007 to December 2009. Using non-probability convenient sampling, total 88 patients with renal stones of more than 2.5 cm were selected for PCNL. Data was analyzed on SPSS version 10 for windows XP.*

Results: *In a cohort of 88 patients (57 male and, 31 female) PCNL was performed for renal stone treatment. The mean age was 33.5 (9 – 65) years. The mean operative time was 85 (60 – 180) minutes and the mean stone size was 3.2 cm range (2.5-4.8) cm. There were 37 staghorn and 51 non staghorn stone. PCNL via a single access tract was accomplished in 86% (76/88) of procedures, with upper pole calyx in 30, middle calyx in 27 and lower pole calyx in 19 procedures, while multiple tracts were used in 14% of procedures (12/88) with 09 procedures using the upper and middle calyxes and 05 procedures using lower and middle calyxes. The stone-free rates for staghorn stone at discharge and at 3 months were 83.7% and 90.8% respectively, while for non staghorn stone the figures were 85.8% and 92.5% respectively. Postoperative complications were observed in 9% of the procedures (8/88), the commonest of which was bleeding necessitating blood transfusion in 4 patients.*

Conclusion: *PCNL is safe and Effective treatment for renal calculi associated with less morbidity, shorter hospital stay and is cost effective.*

Key Words: *Renal Stones, Percutaneous Nephrolithotomy (PCNL), Effectiveness, Complications.*

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INTRODUCTION

The surgical management of urinary calculus has evolved considerably over the past few decades especially with the introduction of minimal invasive procedures and shock wave lithotripsy (SWL) and percutaneous nephrolithotomy (PCNL)[1]. Percutaneous nephrostomy was a procedure known since 1955[2]. However, it was not until 1976 when the first percutaneous nephrostomy for the specific purpose of removing a kidney stone was performed by Fernstrom and Johannson[3]. The practice of PCNL, having been refined over time, continues to evolve and has largely replaced open stone surgery for the treatment of complex upper tract stones unsuitable for SWL or ureterorenoscopy. This has been aided by advances in technology and equipment resulting in stone removal with less morbidity, shorter convalescence, and reduced cost compared with open surgery[4].

The success of PCNL for treatment of symptomatic renal stones does not depend on the

anatomic factors that usually affect the outcome of SWL and retrograde intrarenal surgery (RIRS), and is also independent of stone size and location[5]. Larger the stone the more efficient is its percutaneous removal. The efficacy of SWL and RIRS is better for mid pole pelvicaliceal stone and upper pole stone as compared to lower pole stone because of the better drainage of residual fragments in the former case due to the effect of gravity[6]. Similarly anatomic factors influence the outcome of SWL and the efficacy of SWL is lower for caliceal stone with infundibular width less than 5 mm or infundibulopelvic angle less than 90^{o} [7]. In this study we report our experience of PCNL in the management of renal stones more than 2.5cm with the aim of assessing the safety and efficacy of PCNL and identifying any technical modifications that will reduce morbidity and mortality.

METHODOLOGY

The study was conducted in the department of urology and renal transplantation, Institute of Kidney Diseases, Hayatabad Medical Complex Peshawar from June 2007 to December 2009. A total of 88 patients who underwent PCNL for symptomatic renal stones more than 2.5 cm at our institute in this period were selected for this study through the technique of non-probability convenient sampling. All patients irrespective of the age and gender, who were having symptomatic renal stones of more than 2.5 cm were included in this study, while those patients having stone size less than 2.5 cm or having some anatomic renal tract abnormalities or sever associated co-morbid conditions, were excluded from the study. All the procedures were carried out by a single surgeon, under general anesthesia and in prone position. In those patients who were left with significant residual stones (more than 5 mm) were followed by ESWL for the residual stones[8].

Preoperative Evaluation: In addition to history, clinical examination and routine laboratory investigations, radiological evaluation included plain abdominal radiography (KUB) and ultrasonography (US). Excretory urography (IVP) was performed if serum creatinine was 1.5 mg/dl or less. In patients with higher serum creatinine the configuration of the upper tract was evaluated with magnetic resonance urography. Split renal function was assessed using DTPA scan through measurement of the glomerular filtration rate (GFR) of both kidneys in selected cases of impaired renal functions. Urinary tract infection (UTI) was treated in all patients according to urine culture sensitivity. Stone analysis was done in 23 cases with x-ray diffraction[9].

Operative Technique: A standard PCNL was performed in prone position with the patient under general anesthesia. Visualization of the renal tract was done through a fluoroscope by placing an open ended ureteric catheter with the help of rigid cystoscope and injecting a contrast medium (urograffin) into the ureteric catheter.

Access to the kidney was achieved through 1 puncture in 76 patients and 2 punctures in 12 patients. Pneumatic lithotripsy was used for stone fragmentation in all cases. Rigid nephroscope was used in all cases for visualization and extraction of stones. At the end of the procedure JJ stent and 16Fr - 18Fr nephrostomy tube was placed. Mean operative time was 85 minutes (range 60 to 180 minutes). Radiological evaluation for residual stones was done by X - Ray KUB with or without nephrostogram. In faint opaque and lucent stones ultrasound was performed. Postoperative course, stone-free rate at discharge home and hospital stay were recorded. Patients who were completely cleared of stones were considered stone-free. Patients with clinically insignificant residual fragments (CIRFs) were those with non-symptomatic, non-obstructing and non-infected fragments of less than 5 mm in diameter.

Evaluation at follow up and data collection: All patients were followed up at outpatient clinic 1 to 3 months postoperatively. At each visit patients were asked about the time required to return to normal activities. Urinalysis, urine culture (if required), serum creatinine, X-Ray KUB and abdominal Ultrasound were performed. If stone recurrence was diagnosed, IVP was performed. Renal scans (DTPA) for selective determination of GFR was performed in selected patients with deranged renal function tests.

Data was collected on paper and then saved in the computer including pictures of the pre and post operative radiological investigations and was processed using SPSS version 10.

RESULTS

A total of 88 patients (57 male and 31 female) underwent PCNL at our centre. Mean age was 33.5 years (range 9-65 yrs). The average procedure time was 85 minutes (range 60–180 minutes) defined as the period from cystoscope insertion to placement of the flank dressing. The mean size of the stone was 3.2 cm (range 2.5-4.8 cm) with 37 staghorn stone and 51 non-staghorn stone (Figure 1). A partial staghorn, defined as a renal pelvic stone branching into one calyx, was encountered in 22 kidney units compared with 15 stones branching into more than one calyx, classified as complete staghorn stones[10].

Single session of PCNL was accomplished in 84 patients (95.4%) while only 4 patients (4.6%) required more than one session of PCNL

which was done within 24 to 48 hours. PCNL via a single access tract was accomplished in 86% (76/88) of procedures, with upper pole calyx in 30, middle calyx in 27 and lower pole calyx in 19 procedures, while multiple tracts were used in 14% of procedures (12/88) with 07 procedures using the upper and middle calyx and 05 procedures using lower and middle calyx. The mean hospital stay was 3 days, with a range of 2 to 7 days and nephrostomy tube was kept for 2 days (range 1-4 days). The stone-free rates for staghorn stone at discharge and at 3 months were 83.1% and 90.8%, respectively, while for non staghorn stone the figure were 85.8% and 92.5% respectively. Those patients who were left with significant residual fragments (>5mm) were treated with ESWL post operatively. The stone clearance after PCNL is shown in Table 1.

Significant post operative complications were observed in 8 patients (9 %). A greater than the typical amount of bleeding, necessitating blood transfusion was reported in 4 patients, representing 4.8% of all procedures. Indications for transfusion included symptomatic anemia or hemoglobin level falling below 8.0 g/l. For those patients needing transfusion, the preoperative mean hemoglobin was 12.0 g/l range 10.0 - 13.5 g/l, and 1 to 3 units were transfused. No patient needed open surgical intervention or nephrectomy. Among this series, only one (1.2%) patients had thoracic complications (pneumothorax), which was successfully treated by a thoracostomy drain; Urosepsis in one patient who received a course of broad-spectrum intravenous antibiotics and Adynamic Illius intwo patients who were successfully treated conservatively. There was no death in the series (Figure 2).

Figure 1: Graphic Presentations of type of Renal Stone Encountered in the Study

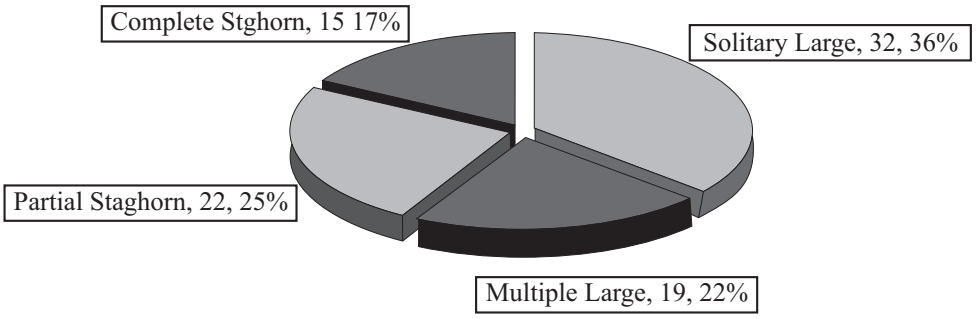

Figure 2: Graphic Presentation of Complications Occur During the Study

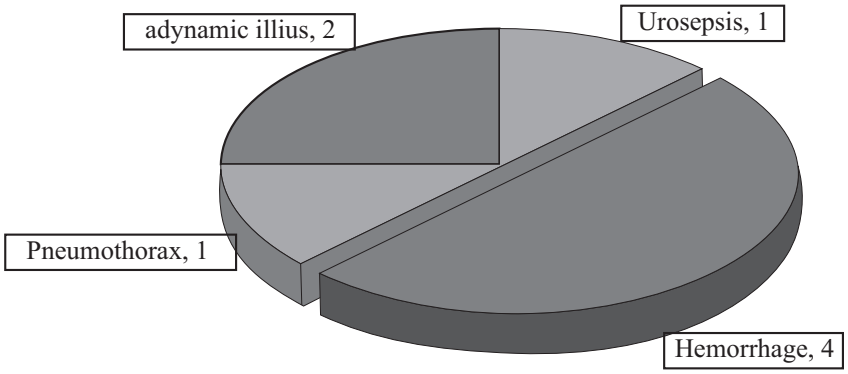

Table 1: Stone clearance after PCNL

Type of stones	No. of Cases (%)	Complete Clearance (%)	Residual fragments < 5mm (CIRFs)	Residual fragments >5mm
Solitary Large	32 (36%)	28 (87.5%)	3	1
Multiple Large	19 (22%)	16 (84.2%)	2	1
Partial Staghorn	22 (25%)	19 (86.3%)	3	0
Complete Staghorn	15 (17%)	12 (80.0%)	1	2

CIRFs; Clinically insignificant residual fragments.

DISCUSSION

Open surgical procedures were the cornerstone of treatment until the early 1980s. These procedures were associated with improvement in patient symptoms and renal function. However, with the introduction of PCNL by Fernstrom and Johansson in 1976[10], the indications for open surgery to remove these stones were dramatically reduced. Open surgical procedures are only recommended in patients with partial or complete staghorn stones associated with infundibular stenosis or severe distortion of intrarenal anatomy[11].

PCNL is currently the preferred first-line treatment for renal stones not amenable to extracorporeal shock wave lithotripsy (ESWL)[12]. The morbidity of PCNL is less than that of open surgery, with better stone clearance rates[13]. With increasing stone size and complexity, an inherent fear exists of greater bleeding and complication rates. PCNL has proved to be a less morbid procedure compared to open stone surgery[14]. Synder et al[15] compared the success rate, procedure duration, complications, and recovery time for percutaneous and anatrophic nephrolithotomy in patients with stag horn stones. They demonstrated a decreased cost, earlier return to activity, decreased requirement for either blood transfusion or narcotic drug, and shorter operative time in favor of patients undergoing PCNL. In the community setting approximately 90% of the renal stones can be successfully removed by percutaneous method successfully and in experienced hand this rate can approach to 98%[16].

In our study the success rate was 90.8% for staghorn and about 92.5% for non-staghorn stone which is comparable to different studies word wide[17,18]. Review of literature for ESWL monotherapy for similar stones reveals stone-free rates at 3 to 6 months that range from 33.5% to 78.6%. Gleeson et al[12] have stratified their results with ESWL monotherapy of stones larger than 3 cm into solitary (55.2%), multiple (39.5%), and staghorn (55.6%). These results are far below those achieved by most experienced operators with PCNL monotherapy. Similarly the success rate of open surgery may although be comparable to PCNL, it has the advantage of shorter hospital stay, associated with less morbidity and early return to work and is currently the preferred method of treatment for larger renal stone[11].

Although the failure rate of 3.8% to 5% for failed access and extraction had been reported by Jones et al[19] and Wickham et al[20]. In the present study no failure was reported and could be due to small sample size. However multiple tracts were formed in 14% (12/88) of the cases for more complex stone either because of difficult anatomy and/or larger stone burden. The mean operative time was 90 minutes in our study which is shorter than that of open surgery as reported by Falahatkar S et al[11].

Although PCNL is safe and effective treatment for renal calculi, significant potential complications does occurs sometime necessitating thoughtful planning and evaluation. The overall postoperative morbidity of PCNL ranges from 8% to 24% with the variability reflecting different surgical techniques used, experience of the operative surgeon and the diverse patient population[21,22]. In the present study significant post operative complications were observed in 8 patients (9%). Four patients (4.8 %) required blood transfusion due to primary hemorrhage. One patient developed pneumothorax which was successfully treated with thorocostomy tube. Singela et al has reported thoracic complications in about 4.7% of the patients[14]. One patient developed urosepsis which was treated conservatively with i.v antibiotics. Lahme S et al has reported the incidence of symptomatic UTI in 5.5% - 9.2% of patients[23]. The overall mortality of PCNL ranges from 0.5% to 1.5%, and is generally attributed to severe hemorrhage, urosepsis or pulmonary embolism[24].

However no mortality was recorded in the present study.

CONCLUSION

PCNL is the mainstay of treatment for renal calculi larger (2.5 cm). A well-planned and carefully executed PCNL in experience hands will achieve high stone clearance and is associated with less morbidity, shorter hospital stay, early return to normal activities and is cost effective**.**

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CONTRIBUTORS

AUR, AU, SK, MNK, MKK, MAJ and RUR, contributed equally to the research and preparation of the manuscript. All authors listed contributed significantly to the research that resulted in the submitted manuscript.

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None Declared