PERCUTANEOUS NEPHROLITHOTOMY: A MINIMAL INVASIVE SURGICAL OPTION FOR THE TREATMENT OF STAGHORN RENAL CALCULI

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ABSTRACT

Objectives: *To see the safety and efficacy of percutaneous nephrolithotomy (PCNL) for the treatment of staghorn renal stone.*

Methodology: *This descriptive study was conducted in Department of Urology and Renal Transplantation, Institute of Kidney Diseases Hayatabad Medical Complex Peshawar, Pakistan from June 2010 to May 2012. A total of 52 patients who underwent PCNL for staghorn renal stones irrespective of the age and gender were selected for this study through the technique of non-probability consecutive sampling. All the procedures were carried out by a single surgeon, under general anesthesia and in prone position. Data was analyzed on a computer using SPSS version 10 for windows XP.*

Results: *Mean age was 35.9±14.5 years (range 7-59 yrs). The average procedure time was 105±19.3 minutes (range 75–180 minutes). The mean size of the stone was 3.9±1.2 cm (range 3.1-5.8 cm). In 41 of 52 (78.84%) patients, complete stone clearance was achieved after a single session of PCNL. The procedure was staged in 04 (7.7%) patients and a repeat PCNL was performed. Complete clearance (including second stage PCNL) was achieved in 44 of 52 (84.61%) patients. With dual therapy (PCNL + shock wave lithotripsy), stone clearance was achieved in 48 of 52 (92.3%) patients. The commonest complication encountered was bleeding in 4/52 (7.7%) patients necessitating blood transfusion. The mean hospital stay was 3±0.9 days and nephrostomy tube was kept for 2 days.*

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

Key Words: *Staghorn stone, Percutaneous Nephrolithotomy (PCNL), Efficacy.*

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INTRODUCTION

Urolithiasis is a major public health problem and is the commonest urologic disease in Pakistan. The estimated prevalence in the country is 10-15% in the population but only 1-2% symptomatic patients come to the tertiary care hospitals for treatment.[1] The term staghorn calculi refer to branched stones that occupy the renal pelvis and contain one or more calyceal extensions.[2] The risk of obstructive nephropathy leading to chronic renal failure and life-threatening urosepsis are well-known complications of staghorn stones.[3] If left untreated the mortality rate at 10 years is estimated to be 28% due to complications of staghorn calculi.[4]

The goal of stone treatment is to use less morbid, minimal invasive and effective modality.[5] 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).[6] The practice of PCNL, having been refined over time, continues to evolve and has largely replaced open stone surgery for the treatment of staghorn renal stones. This has been complemented by advances in technology and equipment resulting in stone removal with less morbidity, shorter convalescence, and reduced cost compared with open surgery.[7]

The purpose of this study was to evaluate the outcome and complications in patients who were undergoing Percutaneous Nephrolithotomy for staghorn renal calculi at a single, tertiary referral stone center.

METHODOLOGY

Between June 2010 and May 2012, all patients who underwent PCNL for staghorn stones at the Institute of

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Kidney Diseases, Hayatabad Medical Complex Peshawar were included in the study. A total of 52 patients who underwent PCNL for staghorn renal stones irrespective of the age and gender were selected for this study through the technique of non-probability consecutive sampling. Patient having anatomic renal tract abnormalities like associated pelvi-ureteric junction obstruction, or severe co-morbidities were excluded from the study. All the procedures were carried out by a single surgeon, under general anesthesia and in prone position.

After induction of general anesthesia patients were put in lithotomy position and a 6Fr open ended ureteric catheter was placed with the help of rigid cystoscope to allow injection of contrast material to delineate the intrarenal collecting system. A 16Fr Foley catheter is inserted into the bladder to provide drainage during the procedure. Patients were then shifted to prone position. After standard preparation and draping, visualization of the renal tract was done with the help of fluoroscope after injecting contrast (urograffin) into ureteric catheter. Percutaneous access was made with the help of 18G diamond tip needle (Cook Urological) and the tract was dilated with metallic Alken dilators up to 30 Fr and a 28Fr working sheath (Amplatz Sheath) was advanced into the collecting system. Rigid nephroscope (Storz) 26Fr was used in all cases for visualization and extraction of stones and lithotripsy was performed by Swiss Pneumatic Lithoclast. Control Fluoroscopic images were taken to determine about the stone clearance and residual fragments. At the end of procedure 12-16 Fr nephrostomy tube was placed which was removed after 24 - 48 hours.

Postoperatively all patients received standard dose of narcotic analgesics and antibiotics for the first 24 hrs and then analgesia on demand basis. X Ray KUB and Ultrasound abdomen and pelvis were performed on the 1st or 2nd postoperative day to look for stone clearance or any residual fragments which if larger than 5mm were treated with ESWL. In the absence of any complications patient were discharged on 2nd or 3rd postoperative day.

Initial postoperative stone-free rates were determined by patient assessment at time of hospital discharge with KUB or IVU radiography, or abdominal ultrasound examination. Follow-up stone-free rates were determined in an outpatient clinic setting at 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, IVU was performed. Renal scans (DTPA) for selective determination of GFR was performed in selected patients with deranged renal function tests.

Preoperative data, including patient demographics, stone location, and whether it was an incomplete or complete staghorn, were prospectively collected from the patient charts and entered into a database. Intraoperative data included the procedure duration, number of tracts used, and intraoperative complications. Postoperative data included length of hospitalization, postoperative complications, need for secondary procedures, blood transfusion requirements, and stone-free rates. All this data was collected on designed proforma and then saved in the computer including pictures of the pre and post operative radiological investigations and was analyzed using SPSS version 10 for Windows XP.

RESULTS

Over the period of 2 years total of 52 patients (34 male and 18 female) underwent PCNL at our centre for staghorn renal stones. Mean age was 35.9±14.5 years (range 7-59 yrs). The average procedure time was 105±19.35 minutes (range 75–180 minutes) defined as the period from cystoscope insertion to the placement of flank dressing. The mean hospital stay was 3±0.9 days, with a range of 2 to 7 days and nephrostomy tube was kept for 2 days (range 1-4 days). The mean size of the stone was 3.9±1.2 cm (range 3.1-5.8 cm). A partial staghorn, defined as a renal pelvic stone branching into few calyces, was encountered in 29 (55.8%) kidney units compared with 23 (44.2%) stones branching into almost all calyces, classified as complete staghorn stones.[2] The stone was on right side in 35 (67.3%) patients and on the left side in 17 (32.7%) patients. (Table No: I)

The most common presenting symptom was flank pain in 48 of 52 (92.30%) patients. The other common symptoms were hematuria in 25 of 52 (48.07%) patients and fever with chills in 11 of 52 (21.15%) patients. Sixteen of 52 (30.76%) patients had a previous history of renal stone surgery. Seventeen of 52 (32.7%) patients had urinary-tract infection (UTI) at presentation, confirmed by urine culture and sensitivity. The most common organism isolated was beta-lactamase–producing Escherichia coli. All patients were treated with antibiotics according to urine culture and sensitivity report before PCNL.

A single tract was made in 45 (86.5%) patients, with upper pole calyx in 15 (28.8%), middle calyx in 21(40.38%) and lower pole calyx in 9(17.30%) procedures, while multiple tracts were used in 7 procedures (13.5%) with 04 procedures using the upper and middle calyx, 02 procedures using lower and middle calyx and only 1 procedure using upper and lower calyx. infracostal approach was used in 49 (94.2%) patients and the supracostal approach in 3 (5.8%) patients. (Table No: II)

In 41 out of 52 (78.84%) patients, complete stone clearance was achieved after a single session of PCNL. The procedure was staged in 04 patients and a repeated PCNL was performed after 24 to 48 hours. The reason for the staged procedure in these patients was large stone bulk or bleeding. Complete clearance (including second stage PCNL) was achieved in 44 out of 52 (84.61%) patients at discharge. With dual therapy (PCNL + SWL), stone clearance was achieved in 48 out of 52 (92.3%) patients at 3 months follow up.

There were no deaths in our series. Significant post

operative complications were observed in 9 patients (17.3 %). A greater than the typical amount of bleeding, necessitating blood transfusion was reported in 4(7.4%) patients. 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. One patient ended up in left nephrectomy due to severe bleeding not control by conservative measures. Among this series, only one 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 in two patients who were successfully treated conservatively. (Figure No: I)

COMPLICATIONS OBSERVED DURING THE STUDY

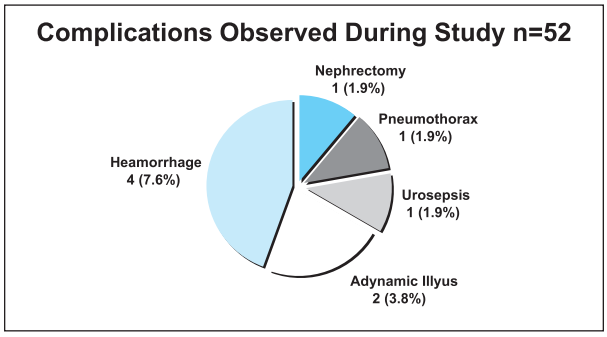

Figure 1

PREOPERATIVE CHARACTERISTICS (N=52)

Characteristics		No of patients
Total no. of patients		52
Mean age of the Patients		35.9±14.5 years (range 7-59 yrs)
Mean size of the stone		3.9±1.2 cm (range 3.1-5.8 cm)
Sex	Male	34
	Female	18
Type of stone	Partial Staghorn	29 (55.8%)
	Complete Staghorn	23 (44.2%)
Side of Stone	Right	35 (67.3%)
	Left	17 (32.7%)
Presenting Symptoms	Flank pain	48 of 52 (92.30%)
	Hematuria	25 of 52 (48.07%)
	Fever and chills	11 of 52 (21.15%)
Nature of stones	Denovo	36 of 52 (69.24 %)
	Recurrent	16 of 52 (30.76%)
No. of patients with UTI		17 of 52 (32.7%)

Table I

TYPES OF ACCESS TRACT FORMED DURING PROCEDURE (N=52).

SINGLE TRACK 45 (86.5%)		SINGLE TRACK 45 (86.5%)	
Upper Calyx	15 (28.8%)	Upper + Middle Calyx	04 (7.8%)
Middle Calyx	21 (40.38%)	Lower + Middle Calyx	02 (3.9%)
Lower Calyx	9 (17.30%)	Upper + Lower Calyx	01 (1.95%)

Table II

DISCUSSION

Urolithiasis is a major public health problem and is the commonest urologic disease in Pakistan.[1] It not only causes recurrent pain and physical suffering, hematuria and infection, but can also lead to the loss of one or both kidneys.[1] Of all types of renal stones, Staghorn Stones represent the most troublesome therapeutic challenge to urologists.[7] The most current version of the American Urological Association guideline on staghorn calculi recommends PCNL as the treatment of choice.[8]

Despite the widespread appeal of PCNL in the management of large-volume renal stones, its application in patients with staghorn calculi is one of the more challenging endourologic procedures, requiring the surgeon to strive for a balance between complete stone clearance with acceptable patient morbidity.[9] However improvement of endourologic instruments and lithotripsy devices has yielded greater success rates and lower complications rates for percutaneous renal surgery.[10] Proper access is a prerequisite for complete clearance of renal calculi by PCNL. The ideal tract is one that provides the shortest and straightest access to all calculi.[11] This is in agreement with the general principle for access site selection stated by Lingeman et al., that percutaneous access to the kidney should allow maximal stone removal using a rigid nephroscope.[12]

In our study the stone-free rate after a single session of PCNL was 78.84%. This rate is higher than that reported by Ziaee SA et al. and Singla et al. after a single session (59.4% and 70.7% respectively) [13,14] and lower than that reported by Holman et al. and Jou et al. (96% and 82.8% respectively).[15,16] The procedure was staged in 4/52 patients (7.6%) which is higher than that reported by El-Nahas AR et al. (3.4% for the PCNL group)[17] and less than that reported by Monahar T et al. (11.9 % second look PCNL).[18] The reason for the staged procedure in these patients was large stone bulk or bleeding. Complete clearance (including second stage PCNL) was achieved in 44 of 52 (84.61%) patients at discharge. With dual therapy (PCNL + SWL), stone clearance was achieved in 48 of 52 (92.3%) patients at 3 months follow up. This is higher

than that achieved by Al-Kohany et al (82 %), [7] and lower than that reported by Davol PE et al (95.7 %).[19]

Review of literature for SWL monotherapy for similar stones reveals stone-free rates at 3 to 6 months that range from 33.5% to 78.6%. Gleeson et al[20] have stratified their results with SWL 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.[3]

PCNL remains an operation with potential significant morbidity and necessitates thoughtful planning considerations. Hemorrhage resulting in blood transfusion, renal artery embolization, or need for an emergent nephrectomy remains a concern but is uncommon. The blood transfusion rates reported in the literature specifically for PCNL of staghorn stones vary from 06 to 18%,[21]with the variability likely due to different surgical techniques used, diverse patient populations, strict indications for transfusion overall, and the individual surgeon's preference to transfuse. Excessive bleeding necessitating transfusion in our series was low compared with the literature. Only 7.4% of cases were reported to have excessive bleeding during surgery or in the recovery room and were transfused 1-2 pints of blood. One patient ended up in left nephrectomy due to severe bleeding not control by conservative measures and the facilities of selective angio-ambulization are not available at our institute. Other postoperative complications reported in our series were; Pneumothorax in one patient due to very highly placed kidney under the rib cage, which was successfully treated by a thoracostomy drain; Urosepsis in one patient who received a course of broad-spectrum intravenous antibiotics and Adynamic Illius in two patients who were successfully treated conservatively.

CONCLUSION

PCNL is a safe and effective procedure for the management of staghorn renal stones, with outcomes similar to those reported for percutaneous management of smaller volume, nonstaghorn stones. The risks of clinically significant bleeding and other complications remain low.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

AU: Conception and design, acquisition of data and analysis, Drafting the manuscript

MK: acquisition of data; Drafting the manuscript

AUR: Critical revision, Final Approval of the manuscript

RUR: acquisition of data, Analysis and interpretation of data

CONFLICT OF INTEREST

Authors declare no conflict of interest

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NONE DECLARED

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