Proceedings S.Z.M.C. Vol: 35(2): pp. 47-51, 2021. PSZMC-792-35-2-2021

Is Upper Pole Puncture for Percutaneous Nephrolithotomy (PCNL) Safe and Effective?

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ABSTRACT

Introduction: During this modern era of surgery, where miniaturization has taken a front row seat, endo-urology is flourishing like never before. PCNL has become the chosen tool for treating Staghorn stones, large renal calculi and complex upper ureteric calculi. The renal collecting system can be accessed by upper or lower pole puncture. Lower pole access is considered safer with fewer complications; however the benefits of upper pole access for PCNL also stands tall due to direct access to the most of renal calyxes system, renal pelvis and upper ureter. A lot of debate and confusion is recorded worldwide with respect to both methods. **Aims & Objectives:** To determine the outcome of upper pole access for removal of renal stones in patients undergoing Percutaneous Nephrolithotomy. **Place and duration of study:** A descriptive study, conducted in Department of Urology, SIMS/SHL, in 2 year period i.e. 1-02-2018 to 31-01-2020. **Material & Methods:** A Total of 62 patients fulfilling selection criteria were included in the study. All of these cases were operated under general anesthesia. Post-operatively, patients X-ray K.U.B were performed for presence or absence of stone. If there was no stone found in x-ray, then efficacy was labeled as high. Regarding complications, patients were evaluated for presence of hydrothorax and bleeding. If there was no complication, then safety was labeled as adequate. All this information was recorded on proforma. **Results:** The mean age of patients was 32.58±9.41 years. There were 29 (46.8%) males and 33 (53.2%) females. The mean size of stone was 2.50±0.50mm. In this study, 20 (32.3%) patients had one stone, 25 (40.3%) had two stones and 17 (27.4%) had three stones. High Efficacy of PCNL was achieved in 50 (80.6%) patients while PCNL was adequately safe in 45 (72.6%) cases while 17 (27.4%) patients had complications. **Conclusion:** This study showed that PCNL with upper pole approach was found to be highly effective in renal stone removal and is also safe in more than 70 % of cases.

Key words: Upper pole access, renal stones, Percutaneous Nephrolithotomy (PCNL)

INTRODUCTION

Renal calculi are made up of solid crystals or concretions containing dietary minerals that precipitate in the kidneys.[1] Staghorn calculi are a type of renal calculi that have hard deposits of minerals. These are more commonly known asstruvite or infection stones. Staghorn stones are very nefarious type of renal calculi as they develop into very large size without severe clinical presentation, although less frequent as other type of calculi. These stones require a surgical removal, as they usually carry a huge bulk, making it hard for body to pass out via urination. Routine therapy includes extracorporeal shock wave lithotripsy or surgery for removal of staghorn stones.[2]

The introduction of percutaneous nephrolithotomy (PCNL) has made renal stone removal more safe. During new millennium, PCNL has become the most preferable treatment of choice for upper urinary tract calculi. The PCNL procedure refers to the removal of calculi from renal collecting system through percutaneous access tracts with the nephroscope. The upper pole is sometime used because it provides "Direct Access".[3]

In last two decades, PCNL has emerged as the preferred surgical method for treating Staghorn stones, large renal stones and some upper ureteric stones.[4] In most published literature, puncture accessed from lower pole as this approach is considered safer with fewer complications; however some authors have safely employed upper pole access for PCNL. Most frequently, the upper pole is cannulated through supra-costal route above twelfth rib, or less frequently through above eleventh rib. It is crucial to determine the anatomy of kidney, with regard to lungs, pleura and diaphragm to develop a safe tract.[5]

The advantages of upper pole PCNL are mainly the direct access to "upper-pole calyx, pelvi-ureteric junction, proximal ureter and help to do ante-grade endo-pyelotomy for pelvi-ureteric junction obstruction". Inupper pole access less movement of nephroscope is needed, which decreases the chances of trauma and bleeding.[6]

One latest study showed that the efficacy (stone free rate) of upper pole PCNL was 100% with 100% safety.[7] While another latest study showed that the efficacy (stone free rate) of upper pole PCNL was 64.5% with 87.5% safety (12.5% had complications).[8]

Rationale of this study was to determine the outcome of upper pole access for removal of renal stones in patients undergoing PCNL. To the authors best knowledge no such study has been performed on a sample size of this magnitude in Pakistan in last 5 years. This leads to paucity of local data regarding safety and efficacy of upper pole PCNL puncture. So, we conducted this study to attain the evidence regarding its efficacy and safety in local population.

MATERIAL AND METHODS

A prospective descriptive study was done in Department of Urology, Services Hospital, Lahore. Duration of study was two years starting from 1-2-2018 to 31-1-2020, was approved by an Institutional Review Board. All patients who were fulfilling inclusion criteria i.e. Patients of age 18-50 years of either gender with renal stone disease on the basis of X-ray KUB showing Unilateral Stone size ≥2cm included in study. Exclusion criteria was ASA III or higher, Upper pole not dilated (on IVP examination), congenital anomaly (on clinical examination), bleeding diathesis (on medical record), untreated urinary tract infection.

Data collection procedure: A total of 62 patients fulfilling selection criteria were included in the study. Informed consent was obtained from each participant. Patient's data including name, age, gender, stone size, stone location and number of stones, was taken. All cases underwent surgery by a single surgical team with assistance of main researcher. All surgeries were carried out under general anesthesia. Post-operatively all patients were shifted in Urology ward and were followed-up there for 72 hours. After first 24 hours, patients underwent X-ray for assessment of presence or absence of stone. If there was no stone found in x-ray, then efficacy was labeled as high. With view of adverse outcomes, patients were evaluated for presence of hydrothorax (defined as dull percussion and no breath sound on auscultation of chest assessed 2 hourly till 24 hours and chest x ray). Bleeding was also determined in tract site, if there was >200ml bleeding internally from the puncture site assessed and on USGKUB after 24 hours. If there was no complication, then safety was labeled as adequate. The patients who developed complications, were managed as per hospital protocol. All this information was recorded on proforma.

Statistical analysis:

Statistical analysis was performed on SPSS version 21. Mean± Standard Deviation was calculated for age, size of stones and duration of renal stones. Frequency and percentage were calculated for gender, number of stones, efficacy and safety.

RESULTS

The mean age of patients was 32.58±9. 41 years. There were 29 (46.8%) males and 33 (53.2%) females. The mean size of stone was 2.50±0.50mm. In this study, 20 (32.3%) patients had 1 stone, 25 (40.3%) had 2 stones and 17 (27.4%) had 3 stones. In this study, 30 (48.4%) patients had stones in right kidney while 32 (51.6%) had stones in left kidney. In this study, stone was detected in pelvis in 7 (11.3%) cases, in upper pole in 16 (25.8%) patients, in middle pole in 11 (17.7%) patients, in lower pole in 18 (29.0%) patients, in stag horn in 10 (16.1%) patients. (Table-1)

Efficacy of PCNL was achieved in 50 (80.6%) patients. Hydrothorax was detected in 17 (27.4%) while bleeding occurred in 17 (27.4%) cases. PCNL was safe in 45 (72.6%) cases while 17 (27.4%) patients had complications. (Table-2)

n	62
Age (years)	32.58 ± 9.41
Male	29 (46.8%)
Female	33 (53.2%)
Size of Stone	2.50 ± 0.50
Number of stone	
1	20 (32.3%)
2	25 (40.3%)
3	17 (27.4%)
Side of Stone	
Right	30 (48.4%)
Left	32 (51.6%)
Site of Stone	
Pelvis	7 (11.3%)
Upper Pole	16 (25.8%)
Middle Pole	11 (17.7%)
Lower Pole	18 (29.0%)
Staghorn	10 (16.1%)

Table-1: Demographics of patients

	Frequency
Efficacy	50 (80.6%)
Complications	
Hydrothorax	17 (27.4%)
Bleeding	17 (27.4%)
Safety	45 (72.6%)

Table-2: Outcome during first 24 hours after PCNL

DISCUSSION

PCNL is the most preferable method for removal of large stag horn stones for both pediatric and adult population. PCNL has less post-procedural complications, reduce procedural cost and short hospital stay as compared to the open surgery. Complete stone removal is goal of PCNL.[9] In our study, the mean age of patients was 32.58±9. 41years. There were 29 (46.8%) males and 33 (53.2%) females. The mean size of stone was 2.50±0.50mm. In our study, 20 (32.3%) patients had 1 stone, 25 (40.3%) had 2 stones and 17 (27.4%) had 3 stones. Efficacy of PCNL was achieved in 50 (80.6%) patients. PCNL was safe in 45 (72.6%) cases i.e. hydrothorax was detected in 17 (27.4%) while bleeding occurred in 17 (27.4%) cases.

Oner et al., found that that upper pole PCNL was effective with 100% stone free rate and 0% complication.[7] While Patel et al., found that upper pole PCNL was effective in 64.5% cases while 12.5% developed post-PCNL complications.[8]

Also in a study conducted by Peyene et al., the success rate was 100% stone free status and no residual stone was observed in 93% cases of stag horn calculi with PCNL.[10] Denby, reported that the complete clearance of large stones was achieved in 91% cases with PCNL.[11] Rana et al., found that PCNL was performed in 110 patients with large renal calculi, the success rate was achieved in 80% cases after using the PCNL as a monotherapy, without significant complication.[12] Aron et al., also found that about 89% patients had complete stone clearance with PCNL that was carried outon pre-school children having complete staghorn calculi while Jou et al., reported the success in 82.8% cases with PCNL.[13,14]

A systematic review included 5 studies in which upper pole approach used in 176 cases in comparison with 208 cases lower pole approach. It showed no significant difference between these approaches, with 74.4% in UP approach and 71.1% lower pole approach considered stone-free. The thoracic complications rate (hydrothorax and pneumothorax) reported not differ significantly.[15]

A study conducted by Raza et al., showed overall stone-free rate 78% with upper-pole puncture or in combination with lower pole. Thoracic complication rate was 3% in upper pole punctures, with overall complication rate of 30% for thoracic versus non-thoracic complications.[17]

Surgical treatment of renal calculi has been modified after introduction of minimally invasive techniques, including retrograde intrarenal surgery(RIRS)and PCNL.[18] PCNL is the more suitable and method of choice for removal of renal calculi.[19]

PCNL is a safe and effective way to remove kidney stones.[18] It has been reported that about 90% of large calculi can be removed effectively and with more procedural expertise and better equipped operation theatres, efficacy can be achieved in 100% cases.[20] Recent improvement in PCNL methodology has significantly reduced the post-procedural complications.[21] Stone-free rates achieved with PCNL and laparoscopic retroperitoneal pyelolithotomy are equal, although the complications rate is less with PCNL.[16] But another study which showed that PCNL was superior in removal of large size renal stone as compared with laparoscopic retroperitoneal pyelolithotomy with reference to procedural time, bleeding rate and hospital stay.[22,23]

Smaldone et al., found that the PCNL is still a highly effective mode for removal of larger upper tract stones. They observed many reports regarding laparoscopic and robotic-assisted laparoscopic pyelolithotomy.[24] In 1st study on robotic-assisted laparoscopic pyelolithotomy, Lee et al., presented their experience in 5 cases; 4 case had cystine stag horn calculi stubborn to the PCNL &SWL while 1 case had calcium oxalate stone and simultaneous obstruction in ureteropelvic junction.[25]

This study has few limitations as it is single centered study with small data, more studied are required in Pakistan to support this approach. Procedure selection bias may be there as only upper pole approach is done without comparison to middle or lower puncture approach. So more prospective, randomized -controlled trials are still need of hour.

CONCLUSION

Thus, upper pole PCNL puncture was found to be highly effective and viable option in renal stone removal with maximum clearance rate. Upper pole PCNL puncture was found to be relatively safe with fewer complications which can be overcome with surgical expertise. In future, we will be able to apply

upper pole PCNL puncture for renal stones in local setting.

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