ORIGINAL ARTICLE

OUTCOME OF FLUOROSCOPY GUIDED PERCUTANEOUS NEPHROLITHOTOMY FOR THE TREATMENT OF RENAL CALCULI

Tariq Ahmad, Ata ur Rahman
Department of Urology, Institute of Kidney Diseases, Hayatabad Medical Complex, Peshawar, Pakistan

ABSTRACT

Background: Percutaneous Nephrolithotomy is the modality of choice for the surgical management of stones. The objective of this study was to share our experience regarding the safety and efficacy of fluoroscopy guided Percutaneous Nephrolithotomy for the treatment of renal calculi and its post operative complications.

Material & Methods: This descriptive study was conducted in Institute of Kidney Diseases, Hayatabad Medical Complex, Peshawar from January 2012 to January 2013 over 103 patients. After fulfilling inclusion criteria baseline investigations were carried out. All patients underwent fluoroscopic guided percutaneous nephrolithotomy. Postoperative X-ray KUB was done to confirm clearance of stones.

Results: Out of 103 patients, 67(65.04%) were male and 36(34.95%) female. Mean age of the sample was 33.3±8.5 (15-65) years. Right sided and left sided stones were noted in 62 (60.19%) and 41(48.81%) patients respectively. The mean stone size was 3.9±1.36 (2-6) cm. Access to the PC system was successful in all (100%) cases. The targeted calyces were upper, middle and lower in 29 (28.15%), 16 (15.53%) and 58 (56.31%) patients. The mean operation duration was 75±24.4 (50-165) minutes. The mean hospital stay was 3.9±1.4 (2-5) days. Per-operative stone clearance was in 94 (91.26%) cases. Five (4.85%) patients have presence of residual stone fragments. Seven (6.8%) patients had clinically insignificant residual stones which cleared in 4 weeks time. Overall stone clearance with additional procedures was in 99 (96.12%) cases.

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

KEYWORDS: Percutaneous Nephrolithotomy; Renal Calculi; Fluoroscopy.

The article may be cited as: Ahmad T, Rahman AU. Outcome of fluoroscopy guided Percutaneous Nephrolithotomy for the treatment of renal calculi. Gomal J Med Sci 2014; 12:31-4.

INTRODUCTION

Renal stone disease is a common problem in urology. The goal of stone treatment is to use a less morbid, minimally invasive and effective modality. The management of stone disease has evolved since the introduction of shock wave lithotripsy (SWL) and percutaneous nephrolithotomy (PCNL). Since the first report of the removal of renal stones via nephrostomy by Rupel and Brown[1] in 1941, there have been significant improvements in techniques, instruments, and experience. Percutaneous nephrolithotomy (PCNL), first reported in 1976 by Fernastrom and Johansson, [2] is a minimally invasive surgery for the treatment of renal stones.[3] PCNL is recommended for cases with stones larger than 2.5 cm, cases with Struvite or cystine stones, cases in which stone removal is failed with ESWL, or cases accompanied by anatomical malformations.[4,5]

Traditionally, PCNL has been performed in the prone position,[6] which allows a wide field for kidney puncture, avoids abdominal visceral injuries, and makes the puncture pathway short and straight. Making a puncture is the first step in PCNL and can be described as key step,[7] which has been performed routinely by fluoroscopy.[8] Other guidance modalities for calyceal access are computed tomography,[9] especially if there is abnormal calyceal anatomy, and ultrasonography.[10] The main disadvantage of fluoroscopy is radiation exposure to the patient and medical personnel. Using C-arm fluoroscopies in which radiation producing tube is located under the bed, leads to the reduction of received radiation by 40 times for physician and by 150 times for patient.[11,12]

Corresponding Author:
Dr. Tariq Ahmad
Department of Urology
Institute of Kidney Diseases
Hayatabad Medical Complex, Peshawar
Cell: +923339225080
E-mail: dr_tariqahad@yahoo.com

The objective of this study was to share our experience regarding the safety and efficacy of Percutaneous Nephrolithotomy for the treatment of renal calculi and its post operative complications.

MATERIAL & METHODS

This cross-sectional study was conducted at the Department of Urology & Renal Transplantation, Institute of Kidney Diseases, Hayatabad Medical Complex, Peshawar, Pakistan from January 2012 to January 2013. With convenience sampling, 103 patients were included. The inclusion criteria were all patients above 14 years of age, with renal stones larger than 2.5 cm in diameter, cases with struvite or cystine stones larger than 20 mm, and cases in which stone removal was failed with ESWL. Patients with gross anatomical malformations like horseshoe kidney or ectopic kidney, those with uncorrected coagulopathies and pregnant women were excluded from the study.

All patients were subjected to detailed history and physical examination followed by routine investigations like urinalysis, complete blood count, x-ray chest and ECG. Radiological evaluation included plain abdominal radiography (KUB) and ultrasonography. Excretory urography (IVU) was performed in patients with normal renal functions (serum creatinine less than 1.5mg/dl). In patients with serum creatinine more than 1.5mg/dl, the upper tract was evaluated with magnetic resonance imaging (MRI). Split renal functions were assessed by Mercapto-acetyltriglycine (MAG 3) renography. Urinary tract infections were treated with antibiotics according to the culture and sensitivity report before surgery.

The entire procedure was carried out under general anesthesia and fluoroscopic control, by a single surgeon (AUR). Intravenous prophylactic Cefoperazone sodium 1 gm was administrated one hour preoperatively. A 6 Fr open ended ureteral catheter was inserted into the ureter in supine position. Urinary bladder was catheterized by 10-16 Fr Foley's catheter. The patient was turned prone with one bolster below the lower chest and other below the lower abdomen. In this position the kidneys are more fixed and least affected by the respiratory movements and the intestines are dropped down thus reducing their chances of injury during the procedure. The desired calyx was punctured with 18 gauge needle under fluoroscopic guidance. Its presence in calyceal system was confirmed by suctioning it through 10 cc disposable syringe.

Alken's telescopic dilator system was used to dilate the tract up to 30 Fr, followed by introduction of an Amplatz sheath. The leakage of fluid around metallic dilatators indicated the right tract. Rigid nephroscopes were used. Stones were disintegrated by standard pneumatic lithoclast and extracted. Careful systematic inspection of the pelvicalyceal system was performed to exclude the presence of any residual stones or injury to the mucosa. The kidney was scanned by fluoroscopy to exclude residual stone fragments followed by retrograde pyelography with closure of Amplatz sheath to check the integrity of the pelvicalyceal system. At the end of the procedure, 16 Fr Foley's catheter was inserted through the Amplatz sheath to the renal pelvis which served as nephrostomy.

Postoperatively, all patients were put on standard antibiotics and narcotic analgesics regimen. Complete blood count, and X-Ray KUB and ultrasound abdomen and pelvis were performed on the 1st or 2nd postoperative day to look for any residual stone fragments or perinephric collection. In case of no complications, patients were sent home on 2nd or 3rd postoperative day.

Residual stone fragment (RSF) was defined as a stone $\geq$ five mm while $<$ five mm in size, asymptomatic, non-obstructive, and non-infectious was termed as clinically insignificant residual stone (CIRF). The successful stone clearance was defined as the absence of residual stone fragments under conventional X-ray. Follow-up were carried out at 1 and 3 months. X-Ray KUB, ultrasound abdomen & pelvis, urinalysis, urine culture (where required) and serum creatinine, were performed. IVP was performed if stone recurrence was there. Renal scans (DTPA) were performed in selected patients with abnormal renal function tests.

Sex and age in years were demographic variables. Research variables were laterality of stone, size of stone, access to PC system, location of puncture calyx, operation duration, hospital stay, duration of nephrostomy tube, per-operative stone clearance, presence of residual stone fragments, clinically insignificant residual fragments (CIRF), overall stone clearance with additional procedures, operative bleeding, post op fever, post op renal colic and peri nephrostomy urinary leakage. Categorical variables were analyzed as number and percentages and continuous variables were analyzed as mean, SD, minimum & maximum.

RESULTS

Out of 103 patients, 67 (65.04%) were male and 36 (34.95%) female. Mean age of the sample was 33.3 $\pm$ 8.5 (15-65) years. Right sided and left sided stones were noted in 62 (60.19%) and 41(48.81%) patients respectively. The mean stone size was 3.9 $\pm$ 1.36 (2-6) cm. Access to the PC system was successful in all (100%) cases. The targeted calyces were upper, middle and lower in 29 (28.15%), 16 (15.53%) and 58 (56.31%) patients. More than one calyx was targeted in six (5.82%) patients. The mean

operation duration was 75 ± 24.4 (50-165) minutes. The mean hospital stay was 3.9 ± 1.4 (2-5) days. The mean duration of nephrostomy tube was one (1-4) days. Per-operative stone clearance was in 94 (91.26%) cases. Five (4.85%) patients have presence of residual stone fragments of nine to 11 mm in size. These were cleared through ESWL in four patients and with uretero-renoscopic stone removal (URS) in one patient. Seven (6.8%) patients had clinically insignificant residual stones which cleared in 4 weeks time. Overall stone clearance with additional procedures was in 99 (96.12%).

No serious complications (grade 1-3 according to Clavien Dindo classification) were seen during the study. Operative bleeding (grade 1) was observed in 7(6.79%) patients. Six patients were managed by blood transfusion and one by selective angioembolization. Post op fever (mild/ grade 1, temperature ≤ (100 F) was in 6 (5.82%) patients, which responded to routine antibiotics and antipyretics and. Post op ureteric colic (grade 1) was seen in 4 (3.88%) cases, which responded to oral NSAIDs. Post op urinary leakage (grade 1) was observed in six (5.82%) cases for more than 24 hours after removal of nephrostomy tube which were settled with conservative management. No case had a visceral injury.

DISCUSSION

Percutaneous nephrolithotomy is an established technique used to treat large and complex renal calculi.[13] The 2005 American Urological Association (AUA) and 2008 European Association of Urology (EAU) guidelines on the management of staghorn calculi recommend PCNL as the first-line treatment for staghorn calculi, any renal stone that exceeds 20 mm in diameter, and lower calyceal stones.[14] The PCNL procedure can be divided into three steps, namely; percutaneous access, tract dilation, and stone fragmentation. The success of PCNL is related to the ability to achieve an optimal access tract.[5] Fluoroscopy guided percutaneous access was generally the preferred method of access guidance. The only disadvantage is increased risk of radiation exposure.[15] Using C-arm fluoroscopies in which radiation producing tube is located under the bed, leads to the reduction of received radiation by 40 times for physician and by 150 times for patient.[16]

In our study the overall stone-free rate (SRF) was 91.26%. This result is supported by Tae Seung Shin et al,[17] who retrospectively reviewed and analyzed 698 patients for complication rates classified by the modified Clavien grading system, along with success rates. Stone-free rate in his study was 88.8% (620 patients). Kwon et al[18] published study of PCNL performed in single large center in Korea. In his retrospective report comprising 610 patients, the initial stone-free rate was 57.6% and the overall stone-free rate was 84.9%. Sung Il Yun et al[19] performed standard PNL and totally tubeless PNL on 30 and 27 patients respectively. The stone-free rates were 73.3% and 77.8% in the standard group and totally tubeless group, respectively, with no significant statistical difference. Chang Wook Jeong[20] retrospectively analyzed the data of 155 consecutive patients who underwent PCNL. In his study the overall SFR was 72.3% which is slightly lower than our result. Haroon N et al[21] conducted retrospective matched-pair analysis of 142 patients (78 in the SWL and 64 in the PCNL group). At 4 weeks, 83% of patients undergoing PCNL were stone-free. Yates1[22] performed 55 standard (with nephrostomy tube) and 46 consecutive 'nephrostomy free' PCNLs (JJ stent inserted). In his study stone clearance was 71% in the standard PCNL group.

In our study 4.85% patients had 9 to 11 mm residual stone fragments (RSF). These were cleared through ESWL in four patients and with URS in one patient. Clinically insignificant residual fragments (CIRF) were seen in 6.8% case, which cleared in 4 weeks time. Per-operative bleeding was observed in 6.79% patients. Six patients were managed by blood transfusion and one by selective angioembolization. Jeong Kuk Lee,[23] reviewed retrospectively the medical records of 370 patients who underwent PCNL by a single surgeon from January 2005 to December 2010. Among 370 patients, 11.6% were transfused and 2.4% underwent angioembolization. In the study of Yates1,[22] the transfusion was done in 5.4% cases. In the study of Tae Seung Shin,[17] transfusion was required in 6.9% which is nearly similar to our study.

We observed peri catheter leak in 5.82%. This result is lower than the study of Tae Seung Shin.[17] He observed transient peri-nephrostomy catheter urine leakage in 15.2% patients for less than 24 hours, requiring only simple dressing.

CONCLUSION

Being minimally invasive, PCNL is safe and effective treatment for renal calculi associated with less morbidity, shorter hospital stay and is cost effective.

REFERENCES

1. Rupel E, Brown R. Nephroscopy with removal of stone following nephrostomy for obstructive calculus anuria. J Urol 1941; 46:177-82.
2. Fernstrom I, Johansson B. Percutaneous pyelolithotomy: a new extraction technique. Scand J Urol Nephrol 1976; 10:257-9.
3. Vicentini FC, Gomes CM, Danilovic A, Neto EA, Mazzucchi E, Srougi M. Percutaneous nephrolithotomy: current concepts. Indian J Urol 2009; 25:4-10.
4. Al-Kohlany KM, Shokeir AA, Mosbah A, Mohsen

T, Shoma AM, Eraky I, et al. Treatment of complete staghorn stones: a prospective randomized comparison of open surgery versus percutaneous nephrolithotomy. J Urol 2005; 173:469-73.

5. Cho CO, Yu JH, Sung LH, Chung JY, Noh CH. Comparison of percutaneous nephrolithotomy using pneumatic lithotripsy (Lithoclast ®) alone or in combination with ultrasonic lithotripsy. Korean J Urol 2010;51:783-7

6. Alken P, Hutschenreiter G, Gunther R, Marberger M. Percutaneous stone manipulation. J Urol 1981; 125:463-6.

7. Abdallah MM, Salem SM, Badreldin MR, Gamaleldin AA. The use of a biological model for comparing two techniques of fluoroscopy-guided percutaneous puncture: A randomized cross-over study. Arab J Urol 2013; 11:79-84.

8. Jang WS, Choi KH, Yang SC, Han WK. The Learning Curve for Flank Percutaneous Nephrolithotomy for Kidney Calculi: A Single Surgeon's Experience. Korean J Urol 2011;52:284-288

9. Roy OP, Angle JF, Jenkins AD, Schenkman NS. Cone beam CT for percutaneous nephrolithotomy: Initial evaluation of a new technology. J Endourol 2012; 26:814-8.

10. Basiri A, Ziaee AM, Kianian HR. Mehrabi S, Karami H, Hosseini SM. Ultrasonographic versus fluoroscopic access for percutaneous nephrolithotomy: A randomized clinical trial. J Endourol 2008; 22:281–4.

11. Miano R, Scoffone C, De Nunzio C, Germani S, Cracco C, Usai P, et al. Position: prone or supine is the issue of percutaneous nephrolithotomy. J Endourol 2010; 24:931-8.

12. Duty B, Waingankar N, Okhunov Z, Ben Levi E, Smith A, Okeke Z. Anatomical variation between the prone, supine, and supine oblique positions on computed tomography: implications for percutaneous nephrolithotomy access. Urology 2012; 79:67-71.

13. Segura JW, Patterson DE, LeRoy AJ, Williams HJ, Barrett DM, Benson RC Jr, et al. Percutaneous removal of kidney stones: review of 1,000 cases. J Urol 1985; 134:1077-81.

14. Tiselius HG, Ackermann D, Alken P, Buck C, Conort P, Gallucci M, et al. Guidelines on urolithiasis. Eur Urol 2001; 40:362-71.

15. Andonian S, Scoffone CM, Louie MK, Gross A, Grabe M, Daels FPJ, et al. Does imaging modality used for percutaneous renal access make a difference? A matched case analysis. J Endourol 2013; 27:24-8.

16. Basiri A, Ziaee SA, Nasseh H, Kamranmanesh M, Masoudy P, Heidary F, et al: Totally ultrasonography guided percutaneous nephrolithotomy in the flank position. J Endourol 2008; 22:1453–7.

17. Shin TS, Cho HJ, Hong SH, Lee Y J, Kim SW, Hwang TK. Complications of Percutaneous Nephrolithotomy classified by the modified Clavien Grading System: A single center's experience over 16 years. Korean J Urol 2011; 52:769-75.

18. Kwon T, Bang JK, Kim SC, Shim M, Ha SH, Hong B, et al. Percutaneous nephrolithotomy: A single center experience of 610 cases. Korean J Urol 2009; 50:669-74.

19. Yun S Il, Lee YH, Kim JS, Cho SR, Kim BS, Kwon JB. Comparative study between standard and totally tubeless percutaneous nephrolithotomy. Korean J Urol 2012; 53:785-9.

20. Jeong CW, Jung JW, Cha WH, Lee BK, Lee S, Jeong SJ, et al. Seoul National University Renal Stone Complexity Score for predicting stone-free rate after percutaneous nephrolithotomy. PLoS One 2013; 8:e65888.

21. Haroon N, Nazim SM, Ather MH. Optimal management of lower polar calyceal stone 15 to 20 mm. Korean J Urol 2013; 54:258-62.

22. Yates DR, Safdar RK, Spencer PA, Parys BT. 'Nephrostomy-free' percutaneous nephrolithotomy: experience in a UK district general hospital. Ann R Coll Surg Engl 2009; 91:570-7.

23. Lee JK, Kim BS, Park YK. Predictive factors for bleeding during percutaneous nephrolithotomy. Korean J Urol 2013; 54:448-53.

CONFLICT OF INTEREST
Authors declare no conflict of interest.
GRANT SUPPORT AND FINANCIAL DISCLOSURE
None declared.