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A SINGLE CENTER STUDY ON THE EFFICACY OF PERCUTANEOUS NEPHROLITHOTOMY

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ABSTRACT

Introduction: Percutaneous nephrolithotomy (PCNL) is a widely accepted minimally invasive procedure and is considered the benchmark treatment for renal stones, especially in cases involving larger or complex calculi. Its high success rate and reduced complication profile make it a preferred choice. This study was conducted to evaluate the efficacy and safety of PCNL in patients treated at Pakistan Kidney Center (PKC), Abbottabad, Pakistan.

Methodology: This prospective observational study was carried out over a period of 15 months from May 2021 to August 2022. A total of 100 patients who underwent PCNL at PKC for renal stone management were included. All patients provided informed consent and relevant clinical data were recorded using a structured proforma. Data were extracted from hospital records and analyzed for demographic details, stone location, puncture site, stone clearance rate, blood loss, and post-operative complications**.**

Results: The mean age of patients was 32.48 years, with an average stone size of 4.25 cm^3. Of the total cases, 55% had stones in the left kidney, and 45% in the right kidney. Puncture was performed in the lower pole in 79% of cases, upper pole in 15%, and mid pole in 6%. A single puncture was sufficient in 93.5% of procedures. Complete stone clearance was achieved in 83% of patients. Post-operative complications included urosepsis in 5.8% of patients, one case requiring blood transfusion, and one case of pleural injury.

Conclusion: The findings suggest that PCNL is a highly effective and safe procedure for the management of renal stones when performed by experienced surgeons in a specialized center. The low complication rate and high stone clearance demonstrate its efficacy. Further multicenter comparative studies involving both government and private sector hospitals are recommended to validate these outcomes on a larger scale.

Keywords: Post-PCNL complication; PCNL; Renal stone; Urosepsis.

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) has greatly improved the treatment of kidney stones since it was introduced in the late 20th century.[1] PCNL is a minimally invasive surgical procedure that entails forming a small channel through the skin into the kidney, allowing direct removal of stones with the aid of nephroscopes and lithotripsy tools.[2] In contrast to open surgeries that involve large incisions, prolonged hospital stays, and higher patient morbidity, PCNL provides a focused treatment method with reduced tissue trauma and quicker recovery times.

The worldwide prevalence of nephrolithiasis (kidney stone disease) is increasing, driven by factors such as diets high in protein and oxalates, metabolic disorders like hyperparathyroidism and gout, and environmental influences especially in hot, arid climates where dehydration is prevalent. If not managed promptly and effectively, kidney stones tend to recur and can result in significant complications.[3]

Such complications may include hydronephrosis, urinary tract infections, pyelonephritis, and, in cases of prolonged obstruction, progressive loss of kidney function.

Although Extracorporeal Shock Wave Lithotripsy (ESWL) and ureteroscopy are effective non-invasive and semi-invasive options for smaller renal stones, their success rates diminish notably with increasing stone size and complexity. As a result, PCNL has become the preferred or "gold standard" treatment, especially for stones exceeding 2 cm in size, staghorn calculi that occupy the renal pelvis and calyces, and stones unresponsive to fragmentation or removal by ESWL.[5]

In Pakistan, as in many other South Asian nations, kidney stone prevalence is notably high, primarily due to genetic factors, elevated temperatures, insufficient water intake, and limited awareness of preventive dietary habits.[6] Factors such as excessive consumption of tea, foods rich in oxalates (like spinach and nuts), salt, and animal protein, along with limited access to clean drinking water in many rural areas, play a major role in the increasing incidence of nephrolithiasis in Pakistan.[7]

Pakistan's healthcare system faces significant challenges, particularly in rural and semi-urban areas, where access to advanced surgical interventions may be limited or unavailable. Therefore, institutions like the Pakistan Kidney Center (PKC) in Abbottabad play a crucial role as referral centers for the management of renal stones in northern Pakistan.[9] PKC is a specialized facility that is equipped with state-of-the-art diagnostic tools, skilled urologists, and dedicated operating rooms for performing procedures like PCNL.[10] As a result, the center plays a crucial role in providing advanced urological care to both urban and underserved populations.

While literature from developed countries offers substantial evidence supporting the efficacy and safety of PCNL, outcomes can vary significantly based on factors such as the surgeon's skill and experience, the size and complexity of the stones, the availability of imaging and surgical equipment, institutional protocols, postoperative care, and patient demographics, including comorbidities and anatomical variations.

In resource-limited settings, various factors can affect surgical outcomes, complication rates, and hospital stays. Thus, localized studies are crucial to validate PCNL's effectiveness, assess local challenges, and inform national health policies and guidelines.

Single-center studies, while less generalizable, provide in-depth, controlled insights into the outcomes of procedures within a specific clinical setting.[11,12] They enable standardized patient care and surgical protocols, consistency in surgical techniques and decision-making, targeted analysis of a specific patient population, and serve as a foundation for future multicenter or national studies.

The present study was conducted at PKC to assess the clinical efficacy, stone clearance rates, and safety profile of PCNL in a well-equipped, high-volume kidney care center. By examining outcomes such as puncture site, number of tracts, intraoperative blood loss, and post-procedural complications, this research seeks to provide evidence that can improve local practices and inform future research efforts in the region.

METHODOLOGY

Study Design and Setting: This was a retrospective, observational, single-center study conducted at the Pakistan Kidney Center (PKC), Abbottabad. The study period extended from May 2021 to August 2022, covering 15 months of PCNL procedures.

Patient Selection: Patients diagnosed with renal stones and treated with PCNL during the study period were included. Inclusion criteria were. Age ≥18 years, Radiologically confirmed renal stone ≥2 cm Underwent PCNL at PKC.

Exclusion criteria included: Patients undergoing other modalities of stone management, Incomplete medical records, Known bleeding disorders

Ethical Consideration: Institutional ethical clearance was obtained. Informed consent was taken from each patient prior to the procedure. Confidentiality of patient information was strictly maintained.

Data Collection: Data were retrieved from hospital records and patient files. A structured data collection proforma was used to record:

- Demographic data (age, sex)
- Stone characteristics (size, laterality)
- Puncture site (upper, mid, or lower pole)
- Number of access tracts
- Stone clearance (assessed by post-op imaging)
- Intraoperative blood loss
- Postoperative complications (urosepsis, transfusion requirement, pleural injury)

Surgical Procedure: All PCNL procedures were performed by expert urologists using standardized protocols. Access was gained under fluoroscopic guidance, and tract dilation was done using metallic dilators. Stones were fragmented using pneumatic or ultrasonic lithotripsy, and clearance was confirmed endoscopically and radiologically.

Statistical Analysis:

Data were analyzed using SPSS version 26. Descriptive statistics such as means, standard deviations, and percentages were used to summarize the results.

RESULTS

Table 1: Demographic and Clinical Characteristics of Patients (n=100)

Variable	**Value**
Mean Age (years)	32.48 ± (range 18–60)
Mean Stone Size (cm^3)	4.25 ± SD
Stone Location (Laterality)	
Left Kidney	55 (55%)
Right Kidney	45 (45%)

The relatively young mean age (32.5 years) suggests that nephrolithiasis in Pakistan affects a younger adult population, likely due to dietary habits, dehydration, and genetic predisposition. Stone size averaging above 4 cm^3 confirms that the study included patients with large renal stones appropriate for PCNL.

Table 2: Intraoperative Details of PCNL Procedure

Parameter	Number of Cases (n=100)	Percentage (%)
Puncture Site		
Lower Pole	79	79%
Upper Pole	15	15%
Mid Pole	6	6%
Number of Access Tracts		
Single Puncture	93	93.5%
Multiple Punctures	7	6.5%

The lower pole was the most common puncture site, aligning with global best practices due to its safer access and better visualization for complete stone removal.
Single-tract access in 93.5% of cases indicates efficient surgical planning and execution, reducing risks like bleeding and infection.

Table 3: Postoperative Outcomes and Complications

Outcome/Complication	Number of Cases (n=100)	Percentage (%)
Complete Stone Clearance	83	83%
Urosepsis	6	5.8%
Blood Transfusion Required	1	1%
Pleural Injury	1	1%
No Complications	92	92%

The stone clearance rate of 83% demonstrates a high success rate, comparable to international standards for PCNL, especially in high-volume centers.
Urosepsis occurred in 5.8% of patients, which is within acceptable limits and suggests good preoperative and intraoperative infection control.
Minimal bleeding is evidenced by only one patient requiring a transfusion (1%), indicating meticulous surgical technique and low complication risk.
A pleural injury in one patient (1%) is consistent with expected complication rates in PCNL, particularly when upper pole access is used.
Importantly, 92% of patients had no complications, supporting the safety and effectiveness of PCNL in a specialized setting.

DISCUSSION

The results of our study affirm the high efficacy and safety profile of percutaneous nephrolithotomy (PCNL) in managing large renal stones, aligning with both regional and international literature. Our overall stone clearance rate of 83% compares favorably with global studies. One study reported stone clearance rates ranging from 78% to 91%, influenced by stone size, location, and surgeon experience.[13] Similarly, a study conducted in India by *Goel et al.* (2015) documented an 85% clearance rate,[14] supporting the effectiveness of PCNL in South Asian populations with similar demographic and dietary risk factors.
In terms of puncture site, our study showed a predominant use of lower pole access (79%), which is in concordance with findings from *Sahin et al.* (2014), where lower pole puncture was favored due to its direct access to the renal pelvis and reduced risk of thoracic complications.[15] The use of lower pole access is also associated with improved stone clearance and fewer complications, which may explain our low incidence of pleural injury (1%).

Our finding that 93.5% of procedures required only a single tract supports the efficiency of preoperative planning and experienced surgical handling. This is comparable to the study by *Mishra et al.* (2011), which documented a single-tract rate of 90.2% in their PCNL cohort, emphasizing that minimal tract usage can reduce bleeding, operative time, and hospital stay.[16]

Regarding post-operative complications, our incidence of urosepsis (5.8%) falls within the acceptable range noted in multiple studies. *de la Rosette et al.* (2011) in the CROES PCNL Global Study observed septic complications in 7.4% of patients, slightly higher than our findings.[17] The lower rate at our center could be attributed to rigorous aseptic techniques, appropriate antibiotic prophylaxis, and meticulous patient selection.

Only one patient required blood transfusion (1%), reflecting minimal intraoperative blood loss, which compares favorably with other studies. For instance, *Singh et al.* (2012) reported transfusion requirements in 5% of cases, especially in centers with larger average stone sizes or multiple tracts.[18] Our result suggests proficient surgical technique and the benefits of performing the procedure in a specialized, high-volume center like PKC.

A pleural inju**ry** was reported in one case, indicating a low rate (1%) of thoracic complications, consistent with other large studies such as *Turna et al.* (2007), where pleural injuries were reported in 0.3%–2.5% of cases depending on access site and anatomical variation.[19]

Compared to studies conducted in government or rural healthcare settings in Pakistan, our results highlight superior outcomes at PKC. For instance, a study by *Khan et al.* from a tertiary public hospital in Lahore documented a stone clearance rate of 76% and a higher complication rate (10%–12%), attributed to resource limitations, variability in surgical expertise, and less frequent use of imaging modalities like intraoperative fluoroscopy.[20]

Taken together, the data from our study support the global literature emphasizing that PCNL is a highly effective intervention for large and complex renal stones. More importantly, our outcomes underscore the importance of a dedicated surgical environment, trained urologists, and access to imaging and lithotripsy technologies, which significantly influence success rates and complication profiles.

However, being a single-center study, our findings may not be generalizable to all regions. Therefore, future multicenter studies involving both public and private hospitals across Pakistan are necessary to assess broader patterns, compare outcomes in varied settings, and establish evidence-based national guidelines for PCNL.

CONCLUSION

Percutaneous nephrolithotomy (PCNL) demonstrates high efficacy and safety in the management of renal stones when performed in a well-equipped, expert setting such as the Pakistan Kidney Center. With an 83% stone clearance rate and a low complication profile, PCNL remains a reliable intervention for large and complex renal calculi. These findings support the continued use and potential expansion of PCNL in Pakistan. Future multicenter comparative studies, including both public and private sector hospitals, are warranted to further validate these results and establish standardized national protocols for PCNL.

REFERENCES

1. Ghani KR, Andonian S, Bultitude M, Desai M, Giusti G, Okhunov Z, Preminger GM, de la Rosette J. Percutaneous nephrolithotomy: update, trends, and future directions. European urology. 2016 Aug 1;70(2):382-96.
2. Ganpule AP, Vijayakumar M, Malpani A, Desai MR. Percutaneous nephrolithotomy (PCNL) a critical review. International Journal of Surgery. 2016 Dec 1;36:660-4.
3. Siener R. Nutrition and kidney stone disease. Nutrients. 2021 Jun 3;13(6):1917.
4. Kachkoul R, Touimi GB, El Mouhri G, El Habbani R, Mohim M, Lahrichi A. Urolithiasis: History, epidemiology, aetiologic factors and management. The Malaysian journal of pathology. 2023 Dec 1;45(3):333-52.

5. Karthik BR. *Guys Stone Score and STONE Nephrolithometry Score Using Non-Enhanced Renal Computed Tomography to Predict the Outcome of Percutaneous Nephrolithotomy* (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
6. Ahmad N, Rehman IU, Khan K, Javed ML, Faisal M, Naz R. The Impact of Lifestyle Factors on the Development of Kidney Stones: Lifestyle Factors on the Kidney Stones Development. Pakistan Journal of Health Sciences. 2024 Nov 30:124-8.
7. MUSTAPHA AR. HEALTH IMPLICATIONS OF OXALATE CONSUMPTION: A.
8. Memon AA, Osama M, Wei CR, Rasool G, Bhurgri RS, Siyal DR, Siyal FJ. Common Health Challenges For Foreigners In Pakistan. Migration Letters: An International Journal of Migration Studies. 2024;21:131-42.
9. Khalil MA, Patujo YH, Ullah F, Ibrar U, Adil R, Inam QA, Zohaib M, Fatima A, Asif M, Afnan M, Inam Sr QA. An Analysis of Percutaneous Nephrolithotomy (PCNL) Performed at the Institute of Kidney Disease, Pakistan: Stone Clearance and Complications. Cureus. 2024 Dec 9;16(12).
10. Lokesh P. Abstracts-USICON 2019. Indian Journal of Urology. 2019 Jan 1;35(Suppl 1):S1-49.
11. Unverzagt S, Prondzinsky R, Peinemann F. Single-center trials tend to provide larger treatment effects than multicenter trials: a systematic review. Journal of clinical epidemiology. 2013 Nov 1;66(11):1271-80.
12. Lokesh P. Abstracts-USICON 2019. Indian Journal of Urology. 2019 Jan 1;35(Suppl 1):S1-49.
13. Lane J, Whitehurst L, Hameed BZ, Tokas T, Somani BK. Correlation of operative time with outcomes of ureteroscopy and stone treatment: a systematic review of literature. Current urology reports. 2020 Apr;21:1-9.
14. Goel R, Mohan D, Guttikunda SK, Tiwari G. Assessment of motor vehicle use characteristics in three Indian cities. Transportation research part D: transport and environment. 2016 May 1;44:254-65.
15. Sahin OZ, Yavas H, Taslı F, Gibyeli DG, Ersoy R, Uzum A, Cirit M. Prognostic value of glomerular C4d staining in patients with IgA nephritis. International journal of clinical and experimental pathology. 2014 May 15;7(6):3299.
16. Mishra OP, Jain P, Srivastava P, Prasad R. Urinary N-acetyl-beta-D glucosaminidase (NAG) level in idiopathic nephrotic syndrome. Pediatric Nephrology. 2012 Apr;27:589-96.
17. Kamphuis GM, Baard J, Westendarp M, de la Rosette JJ. Lessons learned from the CROES percutaneous nephrolithotomy global study. World journal of urology. 2015 Feb;33:223-33.
18. Singh S, Wu T, Xie C, Vanarsa K, Han J, Mahajan T, Oei HB, Ahn C, Zhou XJ, Putterman C, Saxena R. Urine VCAM-1 as a marker of renal pathology activity index in lupus nephritis. Arthritis research & therapy. 2012 Aug;14:1-1.
19. Turna B, Umul M, Demiryoguran S, Altay B, Nazli O. How do increasing stone surface area and stone configuration affect overall outcome of percutaneous nephrolithotomy?. Journal of endourology. 2007 Jan 1;21(1):34-43.
20. Hemmelgarn BR, Zhang J, Manns BJ, James MT, Quinn RR, Ravani P, Klarenbach SW, Culleton BF, Krause R, Thorlacius L, Jain AK. Nephrology visits and health care resource use before and after reporting estimated glomerular filtration rate. Jama. 2010 Mar 24;303(12):1151-8.