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Original Article

Comparison of Efficacy of Percutaneous Nephrolithotomy between Supracostal and Subcostal Access in Patients with Renal Stone

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ABSTRACT

Background: Percutaneous Nephrolithotomy (PCNL) is a prevalent surgical procedure for the treatment of large renal stones. The choice between supra-costal and sub-costal access is pivotal in optimizing patient outcomes. This study provides an in-depth comparison of these two approaches, contributing to the evolving discourse in urological surgery.

Objective: To compare the efficacy and safety of supra-costal and sub-costal access in PCNL for the treatment of renal stones.

Methods: A randomized controlled trial was conducted at the Department of Urology, Pakistan Institute of Medical Sciences, from May to October 2023. Sixty-four patients with renal stones larger than 2cm were enrolled and divided into two groups based on the access point: supra-costal (Group A) and sub-costal (Group B). Variables such as age, gender, duration of surgery, stone size, clearance rate, and complications were analyzed using Statistical Package for the Social Sciences (SPSS) Version 25.

Results: The average age of participants was 37.20 ± 13.0 years, with surgery duration averaging 45.75 ± 4.98 minutes. The majority of participants were male (59.4%). Stone clearance rates were high in both groups (93.8% in Group A and 90.6% in Group B), with no statistically significant difference (P-value > 0.05). Complication rates were 9.4% in Group A and 15.6% in Group B, also showing no significant difference.

Conclusion: Both supra-costal and sub-costal accesses in PCNL are effective for renal stone clearance, with comparable success rates and complication profiles. The choice between these approaches can be based on individual patient anatomy and surgeon preference. Further research could explore long-term outcomes and patient-specific factors influencing the choice of access point.

Keywords: Percutaneous Nephrolithotomy, Renal Stones, Supra-costal Access, Sub-costal Access, Urology, Kidney Stone Treatment.

INTRODUCTION

Urolithiasis, also known as kidney stones, is a condition that has challenged human health for centuries (1). Historical evidence and archaeological findings have documented the presence of urolithiasis across different cultures, illustrating its long-standing impact on human health. The development of kidney stones is influenced by a combination of dietary, genetic, and environmental factors. Contributing factors include dehydration, excessive intake of certain minerals, and a lack of dietary fiber (2-5). The prevalence of kidney stones varies globally, influenced by regional and demographic factors, but it remains a significant health concern. Specifically, in Pakistan, the occurrence of kidney stone disease is estimated to be around 16% (6-8), emphasizing its relevance in the region.

The management of renal stone disease has evolved substantially over the years. The field has shifted from invasive open surgeries to less invasive techniques, significantly reducing patient morbidity, shortening recovery periods, and improving overall outcomes. The introduction of Percutaneous Nephrolithotomy (PCNL) in 1976 was a landmark advancement in urology, revolutionizing the treatment of renal stones (9). Prior to PCNL, large kidney stones were primarily treated through open surgery, which required extensive incisions and lengthy recovery times. PCNL introduced a minimally invasive approach, marking a paradigm shift in kidney stone treatment (10). This technique has become the preferred surgical intervention for large and complex renal stones (11). Both the American Urological Association (AUA) and the European Association of Urology (EAU) endorse PCNL as the first-line surgical treatment for certain types of kidney stones (12-15).

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In PCNL, the choice between supracostal and subcostal access is critical and depends on various factors, including stone size, location, and the surgeon's expertise. Each approach has its own advantages and limitations. Comparing the efficacy of supracostal and subcostal access in PCNL is essential for identifying the most effective and safest method for renal stone treatment, contributing to evidence-based clinical decision-making and the refinement of urological guidelines. This research aims to compare the efficacy of these two access points in PCNL for patients with renal stones, providing valuable insights into optimal treatment strategies.

MATERIAL AND METHODS

This randomized controlled trial (RCT) was conducted at the Department of Urology, Pakistan Institute of Medical Sciences over a six-month period from May to October 2023. The study utilized a non-probability purposive sampling technique for the recruitment of patients, ensuring a focused and specific participant selection.

Participants included in the study were individuals aged between 18 and 65 years, diagnosed with renal stones. Eligible patients were those with a renal stone larger than 2cm, as confirmed by X-ray KUB, encompassing both genders (16). The study, however, excluded patients with renal stone sizes less than 2 cm, those undergoing two surgical procedures simultaneously, patients with a positive urine culture, a history of Extracorporeal Shock Wave Lithotripsy (ESWL), multiple stones within the renal calyces, a single functional kidney, or a clotting disorder (17).

Upon receiving approval from the hospital's ethical committee, the study commenced. A total of 64 patients, meeting the inclusion criteria, were enrolled in the study. Prior to participation, informed consent was obtained from each participant, with explanations provided in the native language to ensure comprehension. The patients were then divided into two groups using block randomization: Group A, receiving supra-costal access treatment, and Group B, receiving sub-costal access treatment.

The primary evaluation of stone clearance in patients was conducted on the first postoperative day using X-ray KUB, specifically for identifying radiopaque stones. All procedures were performed under general anesthesia, with patients positioned in the prone position during PCNL. Post-procedure, patients were closely monitored in the recovery area for any signs of complications. Follow-up imaging, including X-ray KUB, was conducted to assess stone clearance. Patients were advised to maintain hydration and adhere to prescribed medications for pain management and infection prevention (18).

For the analysis of the collected data, the study employed Statistical Package for the Social Sciences (SPSS) Version 25. This software facilitated comprehensive statistical analysis, ensuring the rigor and accuracy of the study's findings.

RESULTS

The results of this study present a comprehensive overview of the efficacy of percutaneous nephrolithotomy (PCNL) with both supra-costal and sub-costal access in patients with renal stones. The study encompassed a diverse group of 64 patients, where the average age was observed to be 37.20 years, with a standard deviation of 13.0 years. This age distribution reflects the broad applicability of the procedure across a wide age range.

A critical aspect of the procedure, the duration of surgery, averaged at 45.75 minutes with a standard deviation of 4.98 minutes, indicating a relatively consistent surgical time across cases. This consistency in surgery duration is indicative of the standardized nature of the PCNL procedure. The average size of the renal stones treated was 3.39 cm, with a standard deviation of 0.71 cm, underscoring the study’s focus on relatively large renal stones.

The gender distribution among the patients was also noteworthy, with 59.4% (38 patients) being male and 40.6% (26 patients) female. This distribution provides insights into the prevalence of renal stones among different genders in the study population. In terms of the primary outcome, the clearance of renal stones, an impressive success rate was observed, with 92.2% (59 patients) achieving stone clearance. This high rate of success demonstrates the efficacy of the PCNL procedure in treating renal stones. However, there were complications in 12.5% (8 patients) of the cases, highlighting the importance of considering potential risks in such procedures.

When comparing the two techniques, supra-costal and sub-costal access, the study reported no significant differences in various parameters. The average age in Group A (supra-costal) was 36.37 years (±12.3), and in Group B (sub-costal) it was 38.03 years (±13.8), with a P-value of 0.61, indicating no significant age-related differences between the two groups. The duration of surgery was also comparable, with Group A averaging at 46.37 minutes (±5.35) and Group B at 45.12 minutes (±4.59), resulting in a P-value of 0.32. This similarity in surgery duration suggests that both approaches require a similar amount of operative time.

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Table 1 Overall Study Data (n=64)

Variable	Data
Age (Years)	37.20 ± 13.0
Duration of Surgery (minutes)	45.75 ± 4.98
Size of Renal Stones (cm)	3.39 ± 0.71
Gender	
Male	38 (59.4%)
Female	26 (40.6%)
Clearance of Renal Stones	
Yes	59 (92.2%)
No	5 (7.8%)
Complications	8 (12.5%)

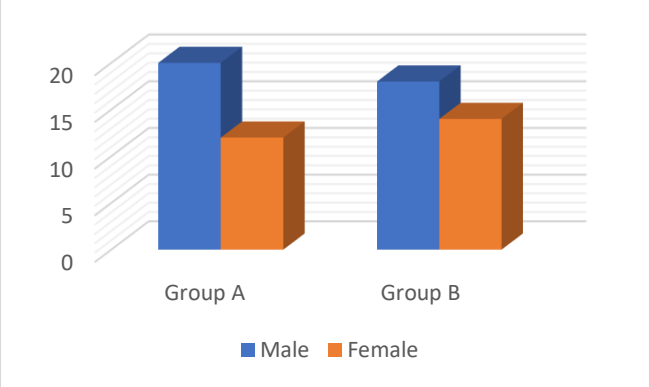

Figure 1 Bar graph showing gender distribution of both Groups.

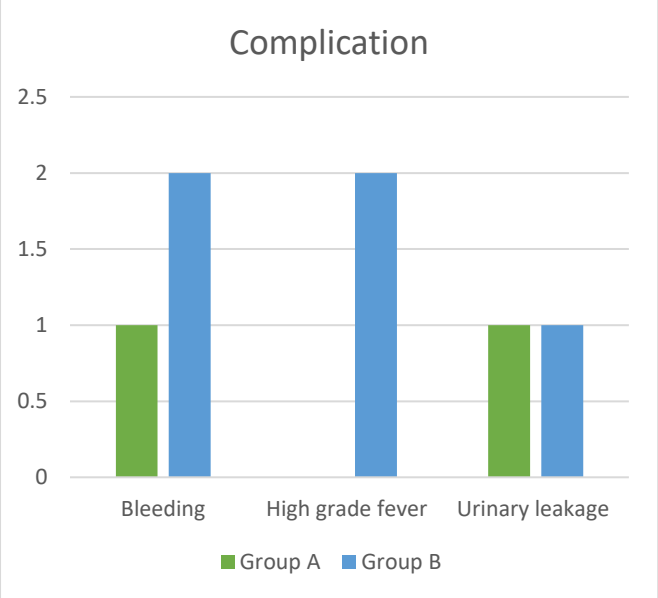

Figure 2 Bar graph showing gender distribution of both Groups.

Table 2 Factors Associated with Supra-costal and Sub-costal Access (n=64)

Variable	Group A (Supra-costal)	Group B (Sub-costal)	P-Value
Age (Years)	36.37 ± 12.3	38.03 ± 13.8	0.61
Duration of Surgery (minutes)	46.37 ± 5.35	45.12 ± 4.59	0.32
Size of Renal Stones (cm)	3.45 ± 0.74	3.34 ± 0.68	0.56

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Variable	Group A (Supra-costal)	Group B (Sub-costal)	P-Value
Gender			
Male	20 (62.5%)	18 (56.3%)	0.61
Female	12 (37.5%)	14 (43.8%)	
Clearance of Renal Stones			
Yes	30 (93.8%)	29 (90.6%)	0.64
No	2 (6.3%)	3 (9.4%)	
Complications	3 (9.4%)	5 (15.6%)	0.45

The size of renal stones treated in both groups was quite close, with Group A having an average stone size of 3.45 cm (±0.74) and Group B 3.34 cm (±0.68), yielding a P-value of 0.56. Gender distribution across the two groups was also comparable, with 62.5% males and 37.5% females in Group A, and 56.3% males and 43.8% females in Group B. The clearance rate of renal stones was slightly higher in Group A (93.8%) compared to Group B (90.6%), but this difference was not statistically significant (P-value of 0.64). The rate of complications was 9.4% in Group A and 15.6% in Group B, with a P-value of 0.45, suggesting no significant difference in the risk of complications between the two methods.

Overall, these results indicate that both supra-costal and sub-costal access in PCNL are effective and comparable in terms of age, duration of surgery, size of renal stones treated, gender distribution, clearance of renal stones, and complication rates. The lack of significant differences in these parameters suggests that the choice between supra-costal and sub-costal access can be made based on other factors such as surgeon preference and individual patient anatomy.

DISCUSSION

The discussion of this study centers around the comparative effectiveness of supra-costal and sub-costal access techniques used in percutaneous nephrolithotomy (PCNL) for treating renal stones. Both approaches, distinguished by the location of the instrument's entry point into the kidney, have unique advantages. Supra-costal access, involving entry above the rib, is often preferred for its direct approach to the renal pelvis, upper ureter, and lower-pole calyces (19). This study aimed to empirically evaluate these methods in a clinical setting.

A notable demographic finding was the higher prevalence of renal stones in males compared to females, aligning with previous research (20, 21). In our study, 62.5% of patients in Group A (supra-costal) and 56.3% in Group B (sub-costal) were male. This gender disparity in renal stone prevalence is a well-documented phenomenon, suggesting underlying biological and lifestyle differences influencing stone formation.

The duration of the surgery, another critical aspect of this study, showed no significant difference between the two groups, with times averaging around 46.37±5.35 and 45.12±4.59 minutes for Groups A and B, respectively. This finding is particularly interesting as it contrasts with the limited data available in existing literature, where only one study has previously compared these durations (22). The consistency in operative times across both groups implies that the choice of access point may not significantly impact the length of the procedure.

Renal stone clearance, a primary indicator of PCNL success, was high in both groups – 93.8% in Group A and 90.6% in Group B – with no statistically significant difference (19, 20). These rates are consistent with other studies, indicating that both access techniques are effective in stone removal (23, 24, 25). This high success rate in stone clearance is crucial for patient recovery and long-term health outcomes.

Complications such as bleeding, high-grade fever, and urinary leakage were observed, with an overall incidence of 9.4% in Group A and 15.6% in Group B. These rates are consistent with prior research (19, 20) and underscore the importance of careful technique and vigilant postoperative monitoring. Significant bleeding, when encountered, necessitates prompt intervention, including the placement of a nephrostomy tube and potentially secondary procedures. High-grade fever and urinary leakage, while less common, are also critical complications that require immediate attention.

CONCLUSION

In conclusion, the findings of this study indicate that supra-costal access in PCNL is as effective as sub-costal access for renal stone clearance, with an acceptable complication rate. Despite the slightly higher success rate in stone clearance in the supra-costal group, the differences were not statistically significant, suggesting that either approach can be effectively utilized depending on specific patient circumstances and surgeon preference. The study contributes valuable insights to the ongoing discourse in urology regarding

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optimal techniques for renal stone management, underscoring the need for individualized patient care and consideration of various access points in PCNL. Future research should continue to explore these techniques in different patient populations and settings to further validate these findings and potentially uncover nuances in procedural efficacy and safety.

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