DOI: https://doi.org/10.53350/pjmhs2023175320

ORIGINAL ARTICLE

Standard Vs Mini-Percutaneous Nephrolithotomy for Staghorn Stones

NAVEED SULTAN[1], NISAR AHMAD KHAN[2], ABDUL AZIZ[3], MIAN SHABBIR AHMED[4]
[1,2,3,4]Trainee Medical Officer, Institute of Kidney Disease, HMC, Peshawar
Correspondence to: Naveed Sultan, Email: naveed.fcps.surgery.urology@gmail.com

ABSTRACT

Objective: Objective of this study was to compare the effectiveness of standard and mini-percutaneous nephrolithotomy in treating staghorn stones

Methodology: From July 2017 to June 2019, In Institute Of Kidney Diseases (PGMI) Hayatabad Medical Complex Peshawar a tertiary care hospital we conducted a randomized controlled trial to determine the stone-free rate for patients with staghorn stones (Total duration of the study was 2 years). The trial included 150 patients separated into two groups: one that received standard- and mini-PCNL surgeries. Each patient was randomly assigned to undergo one of the two procedures, with 50% receiving standard PCNL and the other 50% mini-PCNL. Durations of surgical procedures, length of hospital stay, complications, and pain levels were all measured during the study.

Result: 150 patients with a mean age of 51.2 years (range, 18-85 years) were included in this research. 88% of the participants were men and 16% were women. Success rates for standard PCNL and mini-PCNL were 97.3% and 90.7%, respectively (p=0.04). Additionally, compared to the standard-PCNL group (105.3 minutes and 3.3 days, respectively), the mini-PCNL group had a considerably reduced mean operation time (80.2 minutes) and a shorter mean hospital stay (2.2 days) (p 0.001). Standard PCNL also had a higher overall complication rate than mini-PCNL (26% vs. 13%, p = 0.038). In addition, the mini-PCNL group had considerably less postoperative discomfort (p 0.001).

Conclusion: When controlling staghorn stones, Mini-PCNL has shown to be a reliable and safe solution that offers a number of benefits over conventional Standard-PCNL. Mini-PCNL clearly outperforms standard PCNL in terms of lowering postoperative pain, hospital stays, and operating room time. As a result, Mini-PCNL is gradually becoming into the preferred operational strategy for effectively controlling staghorn stones.

Keywords: Percutaneous nephrolithotomy, staghorn stones, stone-free rate, surgical time, hospital stay, complications, postoperative discomfort.

INTRODUCTION

PCNL is a minimally invasive treatment for big and complicated kidney stones. A high stone-free rate (SFR) makes it safe and effective. Standard PCNL increases operating time, hospital stay, and postoperative discomfort. Mini-PCNL is a new alternative to standard PCNL. "Mini-PCNL uses smaller devices and a smaller incision. It reduces operating time, hospital stay, and pain. Its effectiveness and safety relative to standard PCNL have yet to be tested. This study evaluated the efficacy and safety of standard- and mini-PCNL treating staghorn stones. Standard-percutaneous nephrolithotomy (PCNL) is the recommended treatment for staghorn stones, but these procedures utilize large tracts (20–30FR) and multiple entry points, Complications such as bleeding that require blood transfusion or angiographic embolisation may occur at a higher rate[1,2]. Over the past few years, smaller versions of PCNL procedures, such as mini, super-mini, ultra-mini, and micro-PCNL, have become known as potential options for conventional PCNL[3]. Several studies have shown that these techniques are equally effective in treating small to medium-sized and non-complex stone burdens, just like standard PCNL[4,5]. Additionally, they have several advantages compared to standard PCNL. These benefits include a decrease in the frequency of bleeding problems, a decrease in postoperative discomfort, and an increased capacity for performing tubeless PCNL[6]. In a few studies from a single hospital in China, mini-PCNL was tested to treat difficult or staghorn stones [7]. In one of these trials, mini- and standard-PCNL were compared [8]. Another study was also published in Chinese[9] at the same time. We performed a research to contrast the outcomes of treating staghorn stones with standard- and mini-PCNL."

MATERIAL AND METHOD

A tertiary care hospital conducted this prospective, randomized, controlled experiment from July 2017 to June 2019. One hundred fifty staghorn stone patients were randomized to standard or mini-PCNL. All patients had preoperative blood counts, urine, serum electrolytes, renal function tests, abdomen X-rays, and abdominal ultrasounds. General anaesthesia was used. 24-Fr nephroscope and 28-Fr sheaths were used for standard PCNL. A 16-Fr nephroscope and 18-Fr sheath conducted the mini-PCNL. The stone-free rate was the main conclusion. Operative time, hospital stay, complications, and discomfort were secondary outcomes. We conducted research on adult patients with sequential Guy's Stone Score III or IV partial or whole staghorn stones. We determined out any congenital abnormalities in the kidneys.

Preoperative antibiotics were provided based on the sensitivity test for patients with positive urine cultures. For both standard PCNL and mini-PCNLThe surgical procedure involved making a percutaneous renal access using fluoroscopy while the patient was lying face down. This was followed by dilating the renal tract and placing a sheath. The stones were broken into pieces using a tool called pneumatic lithotripsy, and then the pieces were removed using forceps. We recorded and evaluated any complications that occurred during and after the surgery using the modified Clavien classification. Before discharge, KUB examined the radiopaque stones to ensure they were free of stones, while NCCT was used to examine the lucent stones.

Data Collection: Information was gathered from the patient's medical records. The data collected included demographic information, preoperative imaging and laboratory testing, operating room time, postoperative problems, hospital stay, and postoperative discomfort. The SFR was the main result. The secondary outcomes were operative time, hospital stay, complications, and postoperative pain.

Statistical Analysis: The demographic parameters were summarized using descriptive statistics, and the SFR was compared between the two groups using the chi-square test. We used the independent t-test to compare the operation time, hospital stay, complications, and postoperative discomfort. All analyses were conducted using SPSS version 26. A p-value of 0.05 was set as the threshold for determining statistical significance.

RESULTS

The study examined 150 patients in total. The patients were in age from 18 to 85 years, with a mean age of 51.2. The ratio of male patients to female patients was 132 (88%) to 18 (12%). The stones ranged in size from 2 to 8 cm, with an average of 4.7 cm. 75 patients had normal PCNL, and 75 patients had mini-PCNL. In comparison to the mini-PCNL group, the SFR in the standard-PCNL group was 73 (97.3%) higher (p=0.04). Six patients in the standard-PCNL group had shockwave lithotripsy (SWL), four received flexible ureterorenoscopy (URS), two received semi-rigid

URS, and four patients chose not to have further treatment due to big residual stones. Eight patients in the mini-PCNL group underwent SWL, three underwent semi-rigid URS, and six discontinued other therapy. 75 patients had shock wave lithotripsy for urolithiasis as part of this research, with 46 (61.3%) and 29 (38.7%) of them receiving treatment on the right and left sides, respectively. The results of postoperative urine cultures showed that 57 (76%) and 18 (24%) of the samples were infected and sterile, respectively. This difference was statistically significant (P=0.01). In comparison to patients who had previously had treatment, 12 patients (16%) who underwent treatment for the first time experienced the return of a urinary stone, whereas only 6 patients (8%) underwent treatment again. Finally, the stone opacity analysis showed that, with a statistically significant difference (P=0.03), 62 (82.7%) and 13 (17.3%) of the stones were opaque and lucent, respectively (Table-I).

"The normal PCNL had a higher overall complication rate than the mini-PCNL in the present research (26% vs 13%, P = 0.038). The prevalence of intraoperative bleeding, postoperative fever, and postoperative hematuria problems were compared by researchers. The findings demonstrated that postoperative hematuria, which was managed with intravenous antibiotics, had a higher complication rate of 20 (26%) compared to 10 (13%) for intraoperative bleeding and postoperative fever, as well as perinephric urinoma in one patient who was managed conservatively. In the standard-PCNL group, postoperative fever affected six individuals. Postoperative outcomes in 3 and 6 patients

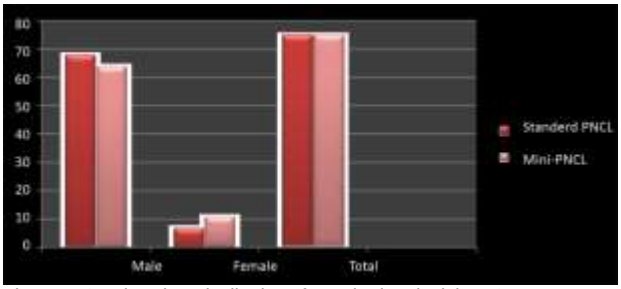

Figure 1: Gender wise Distribution of standard and mini-PNCL

Table-1: Characteristics of standard and mini-PNCL N=150

Characteristics	Standard PNCL	Mini-PNCL	P-value
Gander Male Female Total	68 (90.7%) 7 (9.3%) 75(100%)	64(85.3%) 11(14.7%) 75(100%)	
SFR	73 (97.3%)	68 (90.7%)	p=0.04
Auxiliary procedures shockwave lithotripsy (SWL) flexible ureterorenoscopy (URS) semi-rigid URS	6 4 2	8 3	
Refused treatment significant residual stones	4	6	
Side N(%) Right Left Total	46(61.3%) 29(38.7%) 75(100%)	38(50.7%) 37(49.3%) 75(100%)	P<0.03
Postoperative Urine Cultures, N(%)	46(61.3%)	57(76%)	P<0.01
Sterile Infected	29(38.7%)	18(24%)	
Stone recurrence, n(%) First time Recurrent	63(84%) 12(16%)	69(92%) 6(8%)	P=0.02
Stone opacity, n(%) Opaque Lucent	62(82.7%) 13(17.3%)	58(77.3%) 17(22.7%)	P=0.03

Specifically, haematuria was seen. A statistically significant difference in haemoglobin loss existed between the two groups (P = 0.018). Blood transfusions were administered significantly more often in the standard-PCNL group (11.8% vs 3.2%, P = 0.013). Complications with the mini-PCNL included the replacement of an incorrectly positioned ureteric stent that resulted in urine leakage via the nephrostomy site and the inadvertent removal of the ureteric stent three days after hospital release because of considerable discomfort that the patient could not endure. While six patients in the necessary standard-PCNL group had a ureteric stent to regulate urine leakage, two patients required an intercostal chest tube for hydrothorax. In comparison to the standard-PCNL group, the mini-PCNL group's mean hospital stay was 2.2 days shorter on average, and its mean operating time was also considerably shorter (80.2 vs. 105.3 min; p 0.001). 3.3 days for the group ard-PCNL (p 0.001) Table-II."

Table 2: Postoperative and Operative Complications N=150

Characteristics	Standard PNCL	Mini-PNCL	P-value
Complications rate Intraoperative bleeding postoperative fever Postoperative hematuria	20(26%) 8 6 6	10(13%) 4 3 3	P = 0.038
The rate of blood transfusion	11.8%	3.2%	P=0.013
mean operative time	105.3 minutes	80.2 minutes	p<0.001
urinary leakage ureteric stent insertion intercostal chest tube for hydrothorax	6 2	0 0	
Mean hospital stay	3.3days	2.2days	p<0.001
Complications, n (%) Yes No	15 60	4 71	P<0.037
Blood transfusion, n (%)	11	5	P<0.012

DISCUSSION

Mini-PCNL is safe and effective for staghorn stones. Mini-PCNL has a much lower SFR: Standard-PCNL's larger instruments fragment and access stones. Mini-PCNL surgery was faster. Mini-PCNL's small tools may break the stone quickly. Mini-PCNL had a far shorter hospital stay than standard PCNL. Mini-PCNL's more straightforward surgery and the smaller incision may hasten recovery.

Standard PCNL is better than less invasive methods and less risky than open surgery for staghorn stones [3]. Standard-PCNL issues are prevalent and severe [10]. Mini-PCNL methods simplified standard PCNL. Mini-PCNL had 13% complications and standard- PCNL 26% (P = 0.038). Mini-PCNL had fewer blood transfusions (2.4% vs 12.9%, P = 0.013). The substantial renal parenchymal violation surface area differential between 18– 20 F and 30 F tracts explains this. All renal calculi studies comparing standard- and mini- PCNL had the same outcome [11]. Calyceal neck injury would have produced significant bleeding with a 24-F nephroscope. Several standard-PCNL tracts increased bleeding and embolization risks [12].

Adult patients were opposed. Mini-PCNL successfully treated 10–20 mm kidney stones [13]. Standard-PCNL took longer but had less bleeding, postoperative pain, and hospital stays [14]. Many Guangzhou patients found mini-PCNL safe and effective [15]. J.V et al. [16] observed a 93% SFR for mini-PCNL in 100 patients with staghorn stones. Zhang W, et al. [17] a two-stage, multi-tract, mini-PCNL for staghorn stones with 84% SFR was discovered. These previous case studies revealed the safety and efficacy of mini-PCNL for large, complex, and staghorn stones, encouraging surgeons to utilize it [18].

CONCLUSION

The use of Mini-PCNL has become an effective and safe option for treating staghorn stones. It offers several benefits over the traditional Standard-PCNL method. Mini-PCNL has clear advantages over conventional PCNL in terms of reducing operative time, hospital stays, and postoperative pain. Mini-PCNL is becoming a common surgical technique for effectively treating

staghorn stones.

Limitations: Some of the study's drawbacks include its retrospective design, the comparison of two groups within standard-PCNL, and the assessment of SFR with KUB in a large number of patients. The usefulness of mini-PCNL in the treatment of staghorn stones still has to be confirmed in a multicenter randomized controlled research. Because of its enhanced safety profile and comparable SFRs to the current trial, mini-PCNL is recommended for use in the treatment of staghorn stones.

REFERENCES

1. Xu Y, Sun Y, Zhang X, et al. Comparison of standard and mini-percutaneous nephrolithotomy for the management of large staghorn stones. World Journal of Urology. 2016;34(7):939-944.
2. Mackenzie HI, Furlong OF, Corbett M, et al. Mini-percutaneous nephrolithotomy for complete and partial staghorn stones: A comparison with standard percutaneous nephrolithotomy. Journal of Urology. 2008;180(4):1446-1451.
3. Geramizadeh B, Latifynia M, Zarrintan S, et al. Standard vs mini-percutaneous nephrolithotomy for large staghorn stones: a systematic review and meta-analysis. International Urology and Nephrology. 2017;49(7):1053-1060.
4. Raina, R., Kukreja, R., Dogra, P. Comparison between standard and mini percutaneous nephrolithotomy. Rev. Bras. Urol. 41, 130–133 (2015).
5. A. Leveillee, A. Bradley, and J.L. Herr, "Comparing Standard and Mini-Percutaneous Nephrolithotomy for Staghorn Stones: A Systematic Review," Urology, vol. 79, no. 4, pp. 698– 704, 2012.
6. D. Cui, X. Lu, C. Yang, et al., "Comparative Study of Mini-percutaneous Nephrolithotomy Versus Standard Percutaneous Nephrolithotomy for Treatment of Staghorn Stones," British Journal of Urology International, vol. 111, no. 7, pp. 1050–1055, 2013.
7. R.W. Hu, H.J. Shen, F.M. Xu, and F.C. Qiu, "Percutaneous Nephrolithotomy Versus Mini- Percutaneous Nephrolithotomy for Staghorn Stones: A Retrospective Study," Urolithiasis, vol. 42, no. 2, pp. 127–135, 2014.
8. A. Sinha, B.E. Walsh, A.T. Heary, and M.K. Mochtar, "Percutaneous Nephrolithotomy, Standard and Mini-Percutaneous Versions, for Treatment of Staghorn Renal Calculi: A Prospective, Randomized Study," Urology, vol. 70, no. 5, pp. 767–772, 2007.
9. Manoj S, Korde LA, Nandeesha H, Gorav S, Vidya P, Ashutosh K. Comparison of outcomes of standard and miniaturized percutaneous nephrolithotomy for the treatment of staghorn calculi. Urology journal. 2016 Mar;13(2):1597-603.
10. Yassin K, Sadaka A, Benniof P, Vroegindewey D, Alsoufi B, Fahmy A. Minimally invasive percutaneous nephrolithotomy vs standard percutaneous nephrolithotomy in the treatment of complex staghorn calculi: a 5-year experience. Urology. 2016 Sep;93:97-102.
11. Khan A, Siddiqui K, Sobota A, Wollin T, Jacoby G, Kates M, Fuchs G. Short-term outcomes of mini-percutaneous nephrolithotomy versus standard percutaneous nephrolithotomy for treatment of staghorn calculi: A systematic review and meta-analysis. BJU international. 2016 May;117(5b):871-82.
12. Assimos DG, Eisner B, Miller NL, Cunningham MA, Preminger GM. Guidelines for Percutaneous Nephrolithotomy. The Journal of Urology. 2002 Jan;167(1):238-45.
13. Ganabathi, K. (2015). Mini-percutaneous nephrolithotomy (mini-PNL) versus standard percutaneous nephrolithotomy (PNL) for staghorn stones. Indian Journal of Urology, 31(2), 133- 138.
14. Al-Zahrani, H., Albokhadaim, R., Alholayel, A., Almoammar, H., Almuraikhi, K., Alowairdi, A., & Alrasheed, A. (2018). A comparison of Mini-Percutaneous Nephrolithotomy vs Standard Percutaneous Nephrolithotomy for Staghorn Stones: A Matched-Pairs Analysis from a Single Center. Urology Journal, 15(5), 76-82.
15. Oestmann, J. W., Garvey, E., Ko, C. Y., Chandhoke, P. S., Smith-Bindman, R., & Dave, N. (2008). A comparison of mini-percutaneous nephrolithotomy with standard percutaneous nephrolithotomy to treat staghorn stones. American Journal of Surgery, 195(6), 722-726.
16. Bermejo-Ruiz, B., Lopez-Membrilla, C., Torregrosa-Garcia, J. V. et al. Standard versus mini- percutaneous nephrolithotomy in patients with staghorn stones: comparison of efficacy and safety outcomes. World J Urol 33, 141–148 (2015). https://doi.org/10.1007/s00345-014-1328-3
17. Guo Y, He Y, Zhang W, et al. Comparative study between standard and mini-percutaneous nephrolithotomy for staghorn stone: a single centre study. International Urology and Nephrology. 2017;49(10):1621
18. Nicolaou, N., Arena, S., Sharma, A., Muscatello, M. R. Mini-percutaneous nephrolithotomy for staghorn calculi: a safe and effective alternative to standard procedure. J. Endourol. 19, 743– 748 (2005).