



Original Article

Analgesic Efficacy of Ropivacaine Infiltration in Puncture Site of Mini Percutaneous Nephrolithotomy Tract

Asif Khan¹, Tauheed Fareed^{2*}, Sayed Ghaffar Shah⁴, Muhammad Shoaib³, Qudrat Ullah⁵ and Naqib Ullah⁶¹Department of Urology Saidu Teaching Hospital, Swat, Pakistan²Department of Urology, Peshawar Institute of Medical Sciences Hayatabad, Peshawar, Pakistan³Department of Urology, PAF hospital, Islamabad, Pakistan⁴Department of Pediatric Urology, Children Hospital, Lahore, Pakistan⁵Department of Urology, Institute of Kidney Diseases, Hayatabad, Peshawar, Pakistan⁶Department of Urology, Rehman Medical Institute, Peshawar, Pakistan

ARTICLE INFO

Key Words:

Percutaneous Nephrolithotomy, Ropivacaine Infiltration, Post-Operative Pain

How to Cite:

Khan, A. ., Fareed, T. ., Shah, S. G. ., Shoaib, M. ., Ullah, Q. ., & Ullah, N. . (2022). Analgesic Efficacy of Ropivacaine Infiltration in Puncture Site of Mini Percutaneous Nephrolithotomy Tract. Pakistan BioMedical Journal, 5(1).

<https://doi.org/10.54393/pbmj.v5i1.334>

*Corresponding Author:

Tauheed Fareed,

Department of Urology Peshawar institute of medical sciences Hayatabad Peshawar, Pakistan
tauheedfareed786@gmail.com

ABSTRACT

Kidney stone is recurrent disease and about 50% of patients had to experience kidney in 10 years. Therefore, kidney stone is a disease with great burden on the health budget of countries and have a big influence on the quality of life. Open kidney surgery has been largely replaced by minimal invasive endoscopic surgery like extracorporeal shockwave lithotripsy (ESWL), retrograde intrarenal surgery (RIRS), percutaneous nephrolithotomy (PCNL), and mini percutaneous nephrolithotomy (mini PCNL). PCNL is the gold standard modality for all kidney stones irrespective of size, type, and location of the stone in the kidney with minimal damage to the kidney, small scar and less bleeding. **Objective:** To compare the mean postoperative pain score in patients with ropivacaine infiltration in the access track with placebo in patients undergoing mini PCNL. **Methods:** A total of 82 adult patients of either gender undergoing mini PCNL, between 9 and 63 years of age were included in the study. The patients were randomly allocated into two groups by lottery method. Patients in group A were given 20ml of 0.25% ropivacaine in the access tract while patients in group B were given 20ml of normal saline as a placebo at the beginning of surgery at the nephrostomy site. Postoperatively all patients were carefully followed at 2, 4, and finally at 6 hours. All patients were examined to determine the pain scores at the mini PCNL puncture site using visual analogue scale. **Results:** The mean age of patients in group A was 40.60 ± 11.62 years and in group B was 40.26 ± 13.15 years. Out of 82 patients, 43(51.43%) patients were male and 39(48.57%) were female with a male to female ratio of 1.1:1. The mean postoperative pain score in patients with preoperative ropivacaine infiltration (group A) of the nephrostomy tract was 3.2 ± 1.2 and in placebo (group B) was 5.60 ± 1.64 with a p-value of 0.0001. **Conclusions:** This study concluded that mean postoperative pain score of ropivacaine infiltration in the PCNL tract is less than the placebo in patients undergoing mini PCNL.

INTRODUCTION

Kidney stone is a common disease that affects about 10% of the population worldwide¹ affects about 12 to 15 % of people in central Asia [1]. The male to female ratio is getting close due to sedentary lifestyles and the westernization of diet. Kidney stones have affected mankind since antiquity and it has been identified in Egyptian Mummies [2-4]. The treatment of renal stones has passed through many phases of advancement during the last half-century from conventional stone removal through open surgery to

minimally invasive treatment options including percutaneous stone removal, shock wave lithotripsy and laser surgeries [5]. Kidney stone is a recurrent disease and about 50% of patients had to experience kidney in 10 years [6]. Therefore, kidney stones is a disease with great burden on the health budget of countries and has big influence on quality of life. With the advances in technology and modification in instruments now kidney stones have been treated with less postoperative pain, short hospital stay,

early return to work, and minimal morbidity. Open kidney surgery has been largely replaced by minimal invasive endoscopic surgery like extracorporeal shockwave lithotripsy (ESWL), retrograde intrarenal surgery (RIRS), percutaneous nephrolithotomy (PCNL) and mini percutaneous nephrolithotomy (mini PCNL) [7]. PCNL is the gold standard modality for all kidney stones irrespective of size, type, and location of stone in kidney with minimal damage to kidney, small scar, and less bleeding [8,9]. It is natural phenomenon that the smaller the incision, less will be the pain and the larger the incision, more will be the pain. Forestrom and Johnson for the first time performed PCNL in 1976 with 30Fr am Platz sheath with the intention to clear kidney stone with small incision with minimal morbidity and maximal stone clearance [10,11]. Pain score after PCNL is lower when smaller access sheath is used for stone removal [12]. Similarly, the administration of local anesthetics in the access tract, blocking the subcostal nerves, or the infiltration of local anesthetics in the renal capsule has been quite effective in reducing postoperative pain after various surgical procedures [13,14]. After PCNL, the mean postoperative pain score is significantly lower ($P \leq 0.001$ and 0.026) on visual analogue scale at 1 and 4 hours in patients with ropivacaine infiltration of the nephrostomy tract and control group respectively [15]. However, some research study shows that preoperative ropivacaine infiltration of the nephrostomy tract does not significantly decrease the postoperative pain [16]. In most studies bupivacaine has been used for Peritubal infiltration for reducing pain postoperatively but we have selected ropivacaine as it is less cardiac and central nervous system toxic in comparison to bupivacaine [17]. The local analgesia given in the beginning of procedure in the access tract pre-induction of anesthesia results less pain post operatively and requires less analgesia [18,19]. The purpose of this study is to know whether the mean postoperative pain score after preoperative ropivacaine infiltration of the nephrostomy tract is less than placebo in patients undergoing mini PCNL for kidney stones.

METHODS

This study is conducted in urology department of Saidu Teaching Hospital Swat from January 2018 to December 2020 after approval from the hospital ethical committee. All patients presenting to urology OPD with symptoms of kidney stones after evaluation and with detailed history, general physical and specific urological examination baseline performed on all patients to make a diagnosis, and a proper plan of management for stone clearance. Patients were counseled regarding the study and explained in detail the advantages and complications of the drug used for

infiltration in the access tract, and for all patients who agreed to participate in the study, written informed consent was obtained. The sample was collected by randomized control trial, and inclusion and exclusion criteria were applied for sample selection. All adult patients undergoing PCNL for renal calculus with a size more than 2 cm through single puncture for access and age between 14 years and 70 years were included because extreme of age may alter results due to misinterpreting of pain score on visual analogue scale. Age less than 14 year and more than 70 years, patients with multiple tracts for access, and patients with diagnosed medical conditions like diabetes mellitus, hypertension, cirrhosis, and other major medical disorders were excluded. The patients were randomly allocated into two groups by lottery method. There were 41 patients in each group, patients in group A were given 20ml of 0.25% ropivacaine in the access tract while patients in group B were given 20ml of normal saline as a placebo at the beginning of surgery at the desired puncture site. Patients were admitted on the day of surgery and during induction of anesthesia, all patients were given opioid (tramadol) analgesics to control for potential variability in drug. All procedures were performed under general anesthesia by a single experienced urologist with a special interest in endourology. The instruments used in PCNL were Karl Storz nephroscope 18Fr, swiss lithoclast, and puncture performed under fluoroscopic guidance. Postoperatively patients were carefully followed at 2, 4, and finally at 6 hours. All patients were examined to determine the pain score at the PCNL wound site using a visual analogue scale. Pre-designed performa was used for recording patients' name, age, and gender, and strictly exclusion criteria was followed to control confounders. Descriptive statistics for data was computed using (SPSS) version 19. Mean \pm S.D was calculated for continuous variables (age, postoperative pain, and duration of procedure) and gender differences were described in terms of frequency and percentages, and the male to female ratio was calculated. The student t-test was used to determine the statistical significance of differences in the level of pain between groups A and B. Mean postoperative pain was stratified among age, gender, and duration of surgery. P-value <0.05 was considered significant and all results were presented in the form of tables.

RESULTS

A total of 82 patients enrolled in the study, 43 (51.43%) patients were males and 39 (48.57%) were females. 56 (60.8%) had right side kidney stones while 36(39.2%) had left kidney stones. The age range in this study was from 9-63 years with a mean age of 39.3 ± 11.21 years. The mean age of patients in group A was 41.4 ± 12.26 years and in group B

was 41.36 ± 1121 years. The mean duration of the procedure in group A was 38.31 ± 8.16 minutes and in group B was 39.29 ± 4.20 minutes (Table 1). In this study, mean postoperative pain score in patients with ropivacaine infiltration (group A) in the PCNL tract was 3.2 ± 1.2 and in placebo (group B) was 5.60 ± 1.64 with a p-value of 0.0001 as shown in Table II. Stratification of postoperative pain scores with respect to age groups, sex, and duration of surgery is shown in Tables 2, 3, and 4 respectively.

Variable	Value
Age	9 to 63 years
Gender No (%)	
Male	43 (51.43%)
Female	39 (48.57%)
Laterality No (%)	
Right	56 (60.8%)
Left	36 (39.2%)
Size of stone	1.5 ± 0.7 cm
Duration of procedure	
Group A	38.31 ± 8.16 min
Group B	39.29 ± 4.20 min

Table 1: Demographics of patients in the sample

Age (years)	Group A (n=41)	Group B (n=41)	p-value
	Mean \pm SD	Mean \pm SD	
9-35	3.45 ± 1.14	5.19 ± 1.60	0.0001
36-63	2.27 ± 0.89	5.43 ± 1.54	0.0001

Table 2: Postoperative pain score comparison between two groups with respect to age groups

Gender	Group A (n=41)	Group B (n=41)	p-value
	Mean \pm SD	Mean \pm SD	
Male	3.31 ± 1.10	5.28 ± 1.31	0.0001
Female	3.42 ± 1.12	5.81 ± 1.21	0.0001

Table 3: Stratification of postoperative pain score between two groups with respect to gender

Duration of procedure (minutes)	Group A (n=41)	Group B (n=41)	p-value
	Mean \pm SD	Mean \pm SD	
≤ 35	3.42 ± 1.12	4.92 ± 1.44	0.0001
> 35	3.09 ± 0.92	5.91 ± 1.62	0.0001

Table 4: Stratification of postoperative pain score between two groups with respect to duration of surgery

DISCUSSION

For many decades it has been a tradition that postoperatively pain management is dependent on the use of opioid analgesics, there are many side effects of opioids both in the short and long term, in the early phase of administration opioid analgesics lead to nausea, vomiting, drowsiness, respiratory depression, ileus, and urinary retention [20,21]. In long term, it leads to drug addiction and constipation which affect the quality of life. The other common analgesics which have been in use after opioids

are NSAIDS, the main side effect of its use is gastritis and it affects kidney functions as well, especially in compromised patients [22]. So, several techniques have been adopted in order to overcome these problems such as combinations of different classes of analgesics PCNL with small nephroscope, tubeless PCNL, local infiltration of bupivacaine or ropivacaine and renal capsule analgesics infiltration. Among these, the easiest way to subside pain postoperatively without compromising patient outcomes is infiltration of long-acting local anesthetics along the access tract like bupivacaine and ropivacaine after PCNL [23]. In this study, we have compared the mean postoperative pain score in patients with ropivacaine infiltration in the PCNL tract with placebo in patients undergoing mini PCNL. In this study, the mean postoperative pain score in patients with ropivacaine infiltration (group A) in the nephrostomy tract was 3.2 ± 1.2 and in placebo (group B) was 5.60 ± 1.64 with a p-value of 0.0001. The mean postoperative pain score after PCNL is significantly lower ($P \leq 0.001$ and 0.026) on visual analogue scale at 2, 4, and 6 hours in patients with ropivacaine infiltration of the nephrostomy tract and control group respectively. However, some research study shows that preoperative Bupivacaine infiltration of the nephrostomy tract does not significantly decrease postoperative pain. [Mean time for first rescue dose (h), 6.71 ± 1.82 , for Bupivacaine group, 10.22 ± 2.12 for other analgesic group, (P -value < 0.0001)]. Jonnavithola et al., randomly divided patients treated with PCNL for kidney stones into two groups control and block group. In the block group, 0.25% bupivacaine was given in the puncture site, and control group no bupivacaine was given in the puncture site. There was a significant difference between the start of pain-controlling medicine and the need of total analgesia. The pain-free period and average consumption of tramadol following operation of the control group and block group were 4.6 ± 5.4 hours and 105 ± 85 mg and 14.7 ± 9.6 hours and 31 ± 44 mg, respectively. Their study has shown that Peritubal infiltration of 0.25% bupivacaine reduces VAS/DVAS pain scores, reduces pain doses, and is safe without risk to the patient health [24]. Ugras et al., in their study, observed the positive effect on postoperative pain-free intervals and ventilator function following ropivacaine infiltration of the skin, nephrostomy tract, and renal puncture site in combination with parenteral analgesia (metamizole). Combination treatment for postoperative pain control leads to better pain management, which resulted in better patient ventilation and less need for analgesia [25]. Dalela et al., performed PCNL in 11 patients by blocking renal capsule innervations with 2% lignocaine under ultrasound-guided. For quantification of pain, they used a numerical rating scale (NRS) and during the initial 5

hours, the NRS scores were less than 3 in all patients. In 2 patients in whom procedures extend beyond 1.5 hours the NRS scores were 6 and 7. They have concluded that the main reason of pain in patients who had undergone PCNL is due to dilatation of the renal capsule and parenchyma which can be easily controlled by blocking renal capsule innervations with local anesthetics [26]. Geeta P Parikh et al., in their prospective randomized double-blind study conducted in 60 patients who were treated with PCNL for kidney stones. Patients were grouped of 30 into group S which will receive 20ml of 0.25% bupivacaine and group C who will 20 ml normal saline along the nephrostomy tube under fluoroscopic guidance. Pain scores at rest and during coughing were significantly less in the bupivacaine group than those with group C. Rescue analgesics was significantly less in the bupivacaine group and 1st demand for analgesia was around 9 hours in group S and it was 2.6 hours in C group [27]. According to the results of this study, local ropivacaine infiltration along the puncture site is an effective method of management of postoperative pain after mini PCNL regardless of age, sex, and duration of the procedure. The limitations of our study are the patients who were excluded from this study, such as the pediatric patients and patients with severe co-morbid such as cardiac dysfunction and respiratory insufficiency/distress which could have affected the pain scores.

CONCLUSION

This study concluded that the mean postoperative pain score of ropivacaine infiltration in the PCNL tract is less than placebo in patients undergoing mini percutaneous nephrolithotomy (PCNL).

REFERENCES

- [1] Pearle MS and Lotan Y. Urinary lithiasis: etiology, epidemiology, and pathogenesis. In: Wein AJ, Kavoussi LR, Norvick AC, Partin AW, Peters CA, editors. *Campbell's Urology*. 10th ed. Philadelphia: ElsevierSaunders; 2012:1257-86.
- [2] Scales CD Jr, Smith AC, Hanley JM and Saigal CS. Urologic Diseases in America Project. Prevalence of kidney stones in the United States. *Eur Urol*. 2012;62(1):160-165. doi:10.1016/j.eururo.2012.03.052.
- [3] Ferakis N and Stavropoulos M. Mini percutaneous nephrolithotomy in the treatment of renal and upper ureteral stones: Lessons learned from a review of the literature. *Urol Ann*. 2015;7(2):141-8. doi:10.4103/0974-7796.152927.
- [4] Prezioso D, Di Martino M, Galasso R and Iapicca G. Laboratory assessment. *Urol Int*. 2007;79 Suppl 1:20-5. doi: 10.1159/000104437.
- [5] Skolarikos A, Straub M, Knoll T, Sarica K, Seitz C and Petřík A et al. Metabolic evaluation and recurrence prevention for urinary stone patients: EAU guidelines. *Eur Urol*. 2015;67(4):750-63. doi: 10.1016/j.eururo.2014.10.029.
- [6] Michel MS, Trojan L and Rassweiler JJ. Complications in percutaneous nephrolithotomy. *Eur Urol*. 2007;51(4):899-906. doi:10.1016/j.eururo.2006.10.020.
- [7] Patel SR and Nakada SY. The modern history and evolution of percutaneous nephrolithotomy. *J Endourol*. 2015; 29(2):153-7. doi: 10.1089/end.2014.0287.
- [8] Ozgor F, Kucuktopcu O and Ucpinar B et al. The effects of previous open renal stone surgery types on PNL outcomes. *Can Urol Assoc J*. 2016;10(7-8):E246-E250. doi:10.5489/cuaj.3687.
- [9] Lee LC, Violette PD, Tailly T, Dave S, Denstedt JD and Razvi H. A comparison of outcomes after percutaneous nephrolithotomy in children and adults: a matched cohort study. *J Pediatr Urol*. 2015;11(5):250.e1-6. doi: 10.1016/j.jpuro.2015.04.002.
- [10] Shah K, Agrawal MS and Mishra DK. Superperc: A new technique in minimally-invasive percutaneous nephrolithotomy. *Indian J Urol*. 2017;33(1):48-52. doi:10.4103/0970-1591.194784.
- [11] Choi SW, Cho SJ, Moon HW, Lee KW, Lee SH and Hong SH et al. Effect of Intercostal Nerve Block and Nephrostomy Tract Infiltration With Ropivacaine on Postoperative Pain Control After Tubeless Percutaneous Nephrolithotomy: A Prospective, Randomized, and Case-controlled Trial. *Urology*. 2018;114:49-55. doi: 10.1016/j.urology.2017.12.004.
- [12] Luo J and Min S. Postoperative pain management in the postanesthesia care unit: an update. *J Pain Res*. 2017;10:2687-2698. doi: 10.2147/JPR.S142889.
- [13] Parikh GP, Shah VR, Vora KS, Parikh BK, Modi MP and Kumari P. Ultrasound guided peritubal infiltration of 0.25% Bupivacaine versus 0.25% Ropivacaine for postoperative pain relief after percutaneous nephrolithotomy: A prospective double blind randomized study. *Indian J Anaesth*. 2014;58(3):293-7. doi: 10.4103/0019-5049.135040.
- [14] Lojanapiwat B, Chureemas T and Kittirattarakarn P. The efficacy of peritubal analgesic infiltration in postoperative pain following percutaneous nephrolithotomy - A prospective randomized controlled study. *Int Braz J Urol*. 2015;41(5):945-952. doi:10.1590/S1677-5538.IBJU.2014.0471.
- [15] Shimazu Y, Shibuya E, Takehana S, Sekiguchi K, Oshima K and Kamata H et al. Local administration of resveratrol inhibits excitability of nociceptive wide-dynamic range neurons in rat trigeminal spinal

- nucleus caudalis. *Brain Res Bull.* 2016;124:262-8. doi: 10.1016/j.brainresbull.2016.06.001.
- [16] Bektas F, Eken C, Karadeniz O, Goksu E, Cubuk M and Cete Y. Intravenous paracetamol or morphine for the treatment of renal colic: a randomized, placebo-controlled trial. *Ann Emerg Med.* 2009;54(4):568-74. doi: 10.1016/j.annemergmed.2009.06.501.
- [17] Memis D, Inal MT, Kavalci G, Sezer A and Sut N. Intravenous paracetamol reduced the use of opioids, extubation time, and opioid-related adverse effects after major surgery in intensive care unit. *J Crit Care.* 2010;25(3):458-62. doi: 10.1016/j.jcrc.2009.12.012.
- [18] Desai MR, Kukreja RA, Desai MM, Mhaskar SS, Wani KA and Patel SH et al. A prospective randomized comparison of type of nephrostomy drainage following percutaneous nephrostolithotomy: large bore versus small bore versus tubeless. *J Urol.* 2004;172(2):565-7. doi: 10.1097/01.ju.0000130752.97414.c8.
- [19] Bellman GC, Davidoff R, Candela J, Gerspach J, Kurtz S and Stout L. Tubeless percutaneous renal surgery. *J Urol.* 1997;157(5):1578-82.
- [20] Kehlet H, Rung GW and Callesen T. Postoperative opioid analgesia: time for a reconsideration? *J Clin Anesth.* 1996;8(6):441-5. doi: 10.1016/0952-8180(96)00131-6.
- [21] Papic JC, Finnell SM, Howenstein AM, Breckler F and Leys CM. Postoperative opioid analgesic use after Nuss versus Ravitch pectus excavatum repair. *J Pediatr Surg.* 2014;49(6):919-23. doi: 10.1016/j.jpedsurg.2014.01.025.
- [22] Gupta A and Bah M. NSAIDs in the Treatment of Postoperative Pain. *Curr Pain Headache Rep.* 2016;20(11):62. doi: 10.1007/s11916-016-0591-7.
- [23] Haleblan GE, Sur RL, Albala DM and Preminger GM. Subcutaneous bupivacaine infiltration and postoperative pain perception after percutaneous nephrolithotomy. *J Urol.* 2007;178(3 Pt 1):925-8. doi: 10.1016/j.juro.2007.05.025.
- [24] Jonnavithula N, Pisapati MV, Durga P, Krishnamurthy V, Chilumu R and Reddy B. Efficacy of peritubal local anesthetic infiltration in alleviating postoperative pain in percutaneous nephrolithotomy. *J Endourol.* 2009;23(5):857-60. doi: 10.1089/end.2008.0634.
- [25] Ugras MY, Toprak HI, Gunen H, Yucel A and Gunes A. Instillation of skin, nephrostomy tract, and renal puncture site with ropivacaine decreases pain and improves ventilatory function after percutaneous nephrolithotomy. *J Endourol.* 2007;21(5):499-503. doi: 10.1089/end.2006.0335.
- [26] Dalela D, Goel A, Singh P and Shankhwar SN. Renal capsular block: a novel method for performing percutaneous nephrolithotomy under local anesthesia. *J Endourol.* 2004;18(6):544-6. doi: 10.1089/end.2004.18.544.
- [27] Parikh GP, Shah VR, Modi MP and Chauhan NC. The analgesic efficacy of peritubal infiltration of 0.25% bupivacaine in percutaneous nephrolithotomy - A prospective randomized study. *J Anaesthesiol Clin Pharmacol.* 2011;27(4):481-4. doi: 10.4103/0970-9185.86591.