International Journal of Research in Medical Sciences
Reddy BCS et al. Int J Res Med Sci. 2023 Sep;11(9):xxx-xxx
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20232497

Original Research Article

Efficacy of ultrasound guided single level thoracic paravertebral block for post-operative analgesia in patients undergoing percutaneous nephrolithotomy: a randomized controlled study

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Received: 25 July 2023
Revised: 06 August 2023
Accepted: 07 August 2023

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ABSTRACT

Background: Percutaneous nephrolithotomy (PCNL) is a common surgical method used for the treatment of renal calculi. Post-operative pain is due to dilatation of the renal capsule, the parenchymal tract and peritubal distressing of the nephrostomy tube. Addition of ultrasound guided paravertebral block to the multimodal postoperative analgesic regimen after general anaesthesia can achieve adequate somatic and visceral sensory blockade to provide post op analgesic cover for PCNL.
Methods: It was a randomized controlled study where 60 ASA I and II patients scheduled for elective PCNL surgery were divided into 2 groups of 30 each, group P and group N. Both groups underwent PCNL under general anaesthesia. After the conclusion of surgery, group P were given ultrasound guided single level paravertebral block at T9-T10 level on the operated side using 10 ml 0.25% bupivacaine while group N did not receive paravertebral block after the conclusion of surgery.
Results: VAS score, time for first rescue analgesic, number of rescue analgesics in post-operative period were significant in group P compared to group N.
Conclusions: Addition of thoracic para vertebral block to multimodal analgesic regimen significantly provides effective analgesia, reduces requirements of intravenous opioids, maintains stable postoperative hemodynamics, improves respiratory mechanics and lowers the incidence of chronic postoperative pain.

Keywords: Para vertebral block, PCNL, Ultrasound guidance

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) has emerged as a highly effective and widely accepted approach for the treatment of complex and large renal stones. While PCNL offers numerous advantages, such as high stone clearance rates and minimal invasiveness, postoperative pain management remains an important aspect to address for improved patient comfort and recovery. Post-operative pain after PCNL is due to dilatation of the renal capsule, the parenchymal tract and peritubal distressing of the nephrostomy tube.

Traditionally, postoperative pain control in PCNL has been achieved using systemic analgesics, such as opioids. However, these medications are associated with various side effects and may not always provide optimal pain relief. In recent years, regional anesthesia techniques, such as paravertebral block, have gained attention as adjuncts to systemic analgesia for better pain control and reduced opioid consumption. The technique of combining PCNL with paravertebral block involves performing the block either preoperatively or intraoperatively, under ultrasound or fluoroscopic guidance.

Multimodal analgesia is based on combining different forms of analgesia with the addition of local or regional anesthesia to maximize effectiveness and minimize the risk of side effects.[1,2] Regional anesthetic techniques are particularly useful and have a well-established safety profile.[3] One such regional anesthesia technique is thoracic paravertebral block. Paravertebral block involves the injection of local anesthetic around the thoracic nerves, providing segmental anesthesia to the corresponding dermatomes. It has the unique property of causing strong afferent blockade, which eliminates somatosensory potentials and can have anticipatory analgesic effects.[4,5] These may be related to the effect of thoracic para vertebral block not only on acute but also on chronic pain.[6] Three randomized trials evaluated the effectiveness of PVB in PCNL, concluding that para vertebral block reduces intraoperative and postoperative pain and improves the quality of recovery after PCNL.[7-9]

METHODS

The above randomized controlled study was conducted in our institute from January 2018 December 2018. 60 ASA I and II patients scheduled to undergo PCNL surgery were included in our study.

Patients who met the inclusion criteria were explained regarding the procedure and informed and written consent was obtained. The patients were randomized into two groups of 30 each, with one group receiving thoracic paravertebral block (group P) and one group which did not receive the block at the end of surgery (group N).

Both groups received standard general anesthesia with propofol, atracurium and fentanyl and airway was secured with an appropriate size ET tube. The patient was then turned into prone position and PCNL surgery was done. Intraoperatively both groups received injection paracetamol 1-gram IV. At the end of procedure, patients in group P received ultrasound guided thoracic paravertebral block at T9-T10 level.

With the patient still in prone position, the skin was cleaned with antiseptic solution and sterile drapes were applied. A high frequency (5-10 MHz) linear probe was selected in the ultrasound machine and used to identify the superior costotransverse ligament and paravertebral space at the level of T9-T10 thoracic vertebra.

After visualizing the landmarks on the USG machine, a 25G Quincke spinal needle was used to perform the block. After piercing the costotransverse ligament and entering the paravertebral space, 10 ml of 0.25% bupivacaine was given after negative aspiration to blood (Figure 1).

The patients are then turned to supine position and extubated after complete reversal from neuromuscular blockade.

The patients were assessed for: pain relief by using visual analogue scale (VAS) score, time for first rescue analgesia (injection fentanyl 1 mcg/kg IV), number of rescue analgesic doses in the first 24 hours of post-operative period, hemodynamic parameters in the post-operative period, and any adverse events in the post-operative period.

Statistical analysis

Statistical analysis was performed using IBM statistical package for the social sciences (SPSS) software. The demographic data, time to first request for analgesic were analysed using student's t-test. Normally distributed data were presented as mean±standard deviation (SD), non-normally distributed data were presented as median (interquartile range). Visual analogue scores were analysed with analysis of variance (ANOVA) using general linear model for repeated measures (SPSS 9) and by student's t-test. Number of rescue analgesia, haemodynamic parameters and complications were analysed using Chi-square test, $p<0.05$ was considered statistically significant.

RESULTS

A total of 60 patients were included in this study and none of them was excluded from the final analysis. No statistically significant differences were found with respect to age, ASA grading, and duration of surgery between the two groups (Table 1). Stone position (most of the stones were in the upper calyx) and size, access tract and success rate were comparable between the two groups.

Table 1: Demographic variables between two groups.

Categories	Group P	Group N	P value
Age (years)	37.6	38.8	0.329
ASA (I: II)	18: 12	19: 11	0.324
Mean duration of surgery (min)	48±1.9	46±2.2	0.7

VAS scores

VAS scores at 0, 2, 4, 8 hours were found to be significantly lower in group P than group N (Table 2).

Table 2: VAS scores between the group.

VAS score (hours)	Group P	Group N	P value
0	0.5±0.2	1.7±1.1	0.006
2	1.4±0.9	3±0.9	0.006
4	2.2±0.8	4.2±0.9	0.005
8	4.3±0.8	5.2±0.9	0.005
12	4.2±0.8	4.8±0.7	0.7
24	4.7±0.4	4.7±0.5	0.9

Time for first rescue analgesic (fentanyl 1 mcg/kg IV)

In group P, the mean duration of first rescue analgesic was around 486 minutes when compared with group N where it was around 144 minutes which was statistically significant (Table 3).

Table 3: Time for first rescue analgesic requirement (minute).

Group	Group P	Group N	P value
Mean duration of first analgesic requirement (minute)	486±75	144±67	0.007

Table 4: Number of rescue analgesics in first 24 hours.

Group	Group P	Group N	P value
Number of rescue analgesics in first 24 hours	3±0.5	4±0.9	0.005

Number of rescue analgesics in first 24 hours

In group P, the mean number of rescue analgesics in first 24 hours was 3±0.5 when compared with group N where it was 4±0.9 which was statistically significant (Table 4).

Hemodynamic parameters

There was no significant change in the SBP, DBP and HR in both groups. But SBP, DBP and HR values were on the higher side in both groups.

Side effects

Group N experienced a few cases of mild postoperative nausea and vomiting, which are common side effects associated with opioids-based analgesia. No other side effects reported in other group.

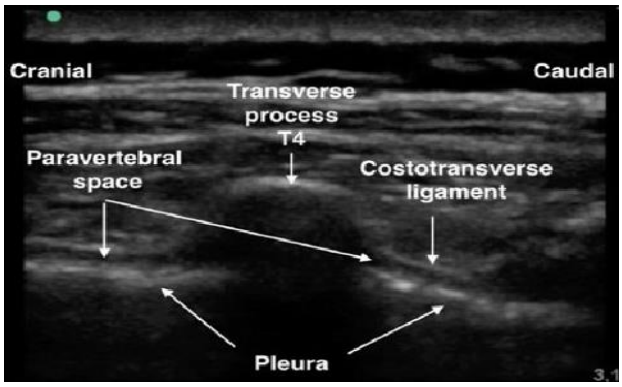

Figure 1: Ultrasound guided paravertebral block.

DISCUSSION

The present research study aimed to compare the effectiveness of two pain management techniques, paravertebral block (group P) and PCNL alone (group N), in patients undergoing PCNL for kidney stone removal. TPVB is an accurate, simple, and safe method with significant advantages over neuroaxial or intercostal blocks.[10]

Another advantage of PVB in comparison to epidural anaesthesia is having comparable analgesia effect and less side effects.[11] Several parameters, including pain intensity (VAS score), time to first rescue analgesia, number of rescue analgesia doses, hemodynamic parameters, and side effects, were evaluated between the two groups.

The primary outcome measure, the VAS score, revealed a statistically significant difference between group P and group N. Patients in group P reported lower VAS scores throughout the postoperative period, indicating superior pain control compared to the standard pain management in group N. These results are consistent with previous studies that have demonstrated the analgesic efficacy of paravertebral block in various surgical procedures.[12,13] The targeted approach of para vertebral block likely contributed to its effectiveness in providing localized pain relief.

In addition to superior pain control, group P also exhibited a longer time to first rescue analgesia and a reduced number of rescue analgesia doses. This finding further supports the advantage of para-vertebral block over standard pain management in PCNL. Delayed requests for rescue analgesia and reduced analgesic consumption in group P suggest a sustained and prolonged analgesic effect, potentially contributing to better patient recovery and satisfaction.[14]

The study also monitored hemodynamic parameters to evaluate the impact of pain management techniques on cardiovascular stability. While both groups demonstrated stable hemodynamics throughout the postoperative period, group P showed slightly better control of blood pressure and heart rate. This finding aligns with a meta-analysis by Obek et al, which indicated that para-vertebral block could attenuate the stress response and reduce the release of stress hormones, thus positively influencing hemodynamic stability.[15]

Regarding side effects, both pain management techniques were well-tolerated by the patients. Group P did not report any serious complications related to the para-vertebral block. However, group N experienced a few cases of mild postoperative nausea and vomiting, which are common side effects associated with opioid-based analgesia. The absence of significant side effects in group P further supports the safety and feasibility of para-vertebral block for pain management in PCNL patients.[16]

Limitations

We felt that better pain relief and hemodynamics would have been achieved if given multiple levels of paravertebral block or more volume of local anaesthetics. Those having lower calyx stones would require a lower puncture, thus requiring multiple levels of paravertebral block. The sample size was relatively small, and a larger cohort may provide more robust conclusions.

CONCLUSION

This research study demonstrated that para-vertebral block is a superior pain management technique compared to standard pain management (PCNL alone) in patients undergoing PCNL for kidney stone removal. Group P experienced lower VAS scores, delayed requests for rescue analgesia, and reduced analgesic consumption, indicating enhanced pain control and patient satisfaction. Furthermore, para-vertebral block showed better hemodynamic stability and a favorable side effect profile. These findings suggest that para-vertebral block should be considered as a viable option for postoperative pain management in PCNL patients, potentially contributing to improved overall patient outcomes.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Kehlet H, Dahl JB. The value of 'multimodal' or 'balanced analgesia' in postoperative pain treatment. Anesth Analg. 1993;77:1048-56.
2. Misiołek H, Cettler M, Woroń J, Wordliczek J, Dobrogowski J, Mayzner-Zawadzka E. The 2014 guidelines for post-operative pain management. Anaesthesiol Intensive Ther. 2014;46(4):221-44.
3. Rawicz M. Acute postoperative pain in children. Anaesthesiol Intensive Ther. 2015;47:264-5.
4. Woolf CJ, Chong MS. Preemptive analgesia: treating postoperative pain by preventing the establishment of central sensitization. Anesth Analg. 1993;77:362-79.
5. Lonnqvist PA. Preemptive analgesia with thoracic paravertebral blockade? Br J Anaesth. 2005;95:727-8.
6. Richardson J Jones J Atkinson R. The effect of thoracic paravertebral blockade on intercostal somatosensory evoked potentials. Anesth Analg. 1998;87(2):373-6.
7. Elbealy E, Rashwan D, Kaasim SA, Abbas S. A comparison of the effects of epidural anesthesia, lumbar paravertebral block and general anesthesia in percutaneous nephrolithotomy. J Med Sci. 2008;8:170-6.
8. Ak K, Gursoy S, Duger C, Isbir AC, Kaygusuz K, Ozdemir Kol I, et al. Thoracic paravertebral block for postoperative pain management in percutaneous nephrolithotomy patients: a randomized controlled clinical trial. Med Princ Pract. 2013;22:229-33.
9. Borle AP, Chhabra A, Subramaniam R, Rewari V, Sinha R, Ramachandran R, et al. Analgesic efficacy of paravertebral bupivacaine during percutaneous nephrolithotomy: an observer blinded, randomized controlled trial. J Endourol. 2014;28:1085-90.
10. Batra RK, Krishnan K, Agarwal A. Paravertebral block. J Anaesthesiol Clin Pharmacol. 2011;27:5-11.
11. Davies RG, Myles PS, Graham JM. A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade. for thoracotomy-a systematic review and meta-analysis of randomized trials. Br J Anaesth. 2006;96(4):418-26.
12. Soto RG, Fu ES. Acute pain management for patients undergoing thoracotomy. Ann Thorac Surg. 2003;75(4):1349-57.
13. Marshall K, McLaughlin K. Pain Management in Thoracic Surgery. Thorac Surg Clin. 2020;30(3):339-46.
14. Myles PS, Myles DB, Galagher W, Boyd D, Chew C, MacDonald N, Dennis A. Measuring acute postoperative pain using the visual analog scale: the minimal clinically important difference and patient acceptable symptom state. Br J Anaesth. 2017;118(3):424-9.
15. Obek C, Ozkan B, Tunc B, Can G, Yalcin V, Solok V. Comparison of 3 different methods of anesthesia before transrectal prostate biopsy: a prospective randomized trial. J Urol. 2004;172(2):502-5.
16. Novak-Jankovic V. Update on thoracic paravertebral blocks. Coll Antropol. 2011;35(2):595-8.

Cite this article as: Reddy BCS, Tappa R, Ravula RK. Efficacy of ultrasound guided single level thoracic paravertebral block for post-operative analgesia in patients undergoing percutaneous nephrolithotomy: a randomized controlled study. Int J Res Med Sci 2023;11:xxx-xx.