DOI: 10.7860/JCDR/2023/62663.18236

Original Article

Anaesthesia Section

Efficacy of Ultrasound Guided Single Level Paravertebral Block vs Transmuscular Quadratus Lumborum Block (III) for Postoperative Analgesia after Percutaneous Nephrolithotomy Surgeries- A Randomised Clinical Study

VIJETHA DEVARAM[1], A SHINY PRIYADARSHINI[2], KANDUKURU KRISHNA CHAITHANYA[3], SUKANYA MALLELA[4], CHAITANYA GUNAPATI[5], PRABHAVATHI RAVIPATI[6]

ABSTRACT

Introduction: Pain control forms an essential component of enhanced recovery after surgery. Regional nerve blocks forms the mainstay of pain relief now-a-days. Pain after Percutaneous Nephrolithotomy (PCNL) surgeries is always distressing to the patient due to injury to the renal capsule.

Aim: To compare the efficacy of Ultrasonography (USG) guided Paravertebral Block (PVB) versus Quadratus Lumborum Block (QLB) for postoperative analgesia following PCNL surgeries.

Materials and Methods: This randomised clinical study was done between February 2021 to August 2022 at Narayana Medical College and Hospitals, Nellore, Andhra Pradesh, India. Sixty patients of American Society of Anaesthesiology (ASA) I and II between 30-60 years age group undergoing PCNL surgeries were divided into two groups. Group P received USG guided PVB at T9-T10 level with 20 mL of 0.25% Levobupivacaine with 8 mg Dexamethasone whereas group Q received QLB (III) with 20 mL of 0.25% Levobupivacaine with 8 mg Dexamethasone. Visual Analogue Score (VAS), time for first rescue analgesic and number of patients requiring rescue analgesic in first 24 hours were measured. The unpaired t-test was used to compare continuous variables whereas the Chi-square test was used to compare the categorical variables.

Results: There was no statistical difference in terms of sex, age, weight, height or American Society of Anaesthesiology (ASA) grade (p>0.05). The mean time required for rescue analgesia in group P was around 478 minutes compared to group Q with 346 minutes which was statistically significant (p=0.001). Mean tramadol consumption in group Q was significantly high (155 mg) compared to group P (125 mg). VAS was significantly better in group P.

Conclusion: The USG guided single level PVB provides superior analgesia compared to transmuscular QLB for postoperative analgesia after PCNL surgeries which helps in enhanced recovery after surgery.

Keywords: Dexamethasone, Levobupivacaine, Tramadol, Visual analogue scale

INTRODUCTION

Good pain control is an essential component of Enhanced Recovery After Surgery protocols (ERAS) [1]. PCNL surgeries are one of the commonly performed procedures for renal stones which involve dilatation of renal capsule and insertion of nephrostomy tube. Pain due to the surgical procedure is often limiting factor for early ambulation and recovery [2]. Pain due to PCNL surgeries can be managed with systemic opioids, epidural analgesia and peripheral nerve blocks like intercoastal nerve block, paraverterbral block, QLB. Opoids in higher doses can cause respiratory depression, nausea, vomiting, constipation and pruritis. Ultrasound guided regional nerve blocks like PVB has been one of the modalities being practised for many years for postoperative pain relief after PCNL surgeries [3]. This block provides somatic and visceral analgesia and PVB rarely causes hypotension, urinary retention, nausea and vomiting following surgery.

Off late QLB has gained popularity for postoperative analgesia for abdominal procedures which was described by Blanco R, [4]. Ultrasound guided transmuscular QLB or anterior approach of QLB which involves deposition of drug between QLB and Psoas major muscle has been used in an earlier study [5]. Though many authors have studied the efficacy of these two blocks individually for PCNL surgeries [3,6-8], literature is very limited comparing the efficacy of these two blocks for providing postoperative pain relief for PCNL surgeries. This study hypothesised that single level PVB provides better postsurgical analgesia and prolonged duration with reduced opioid consumption than QLB in PCNL surgeries as PVB blocks the spinal nerves emerging from intervertebral foramen. Hence, this study was designed to evaluate the efficacy of ultrasound guided single level PVB at T9-10 level and transmuscular QLB for postoperative pain relief after general anaesthesia given at the end of PCNL surgeries with VAS for 24 hours as primary outcome and time for first rescue analgesic dose, number of patients requiring rescue analgesia and total opioid consumption in first 24 hours as secondary outcomes were measured.

MATERIALS AND METHODS

This randomised double-blinded interventional clinical study was done at Narayana Medical College and Hospital, Nellore, Andhra Pradesh, India during February 2021 to August 2022. After obtaining the Institution Ethical Committee approval (NMC/ Adm/ Ethics/ approval/ Fac/ Anesthesia/ 004/ 01/ 2021), this study was registered at Clinical trial registry with no. (CTRI/2021/03/031742).

Sample size calculation: Mean total opioid consumption from previous study conducted by Hatipoglu Z et al., was taken to determine the sample size [7]. Sample size was calculated keeping two-sided alpha error at 5% and a power @ 80% by using the formula:

Sample size (n)=$2\times(Z\alpha+Z\beta)^2\ (\sigma)^2/(\mu1-\mu2)^2$

$Z\alpha=1.66$

$Z\beta=0.84$

$\mu1=142$

$\mu2=77$

$\sigma=60$

Thus, $n=2\times(1.66+0.84)^2\ (60)^2/(142-77)^2$

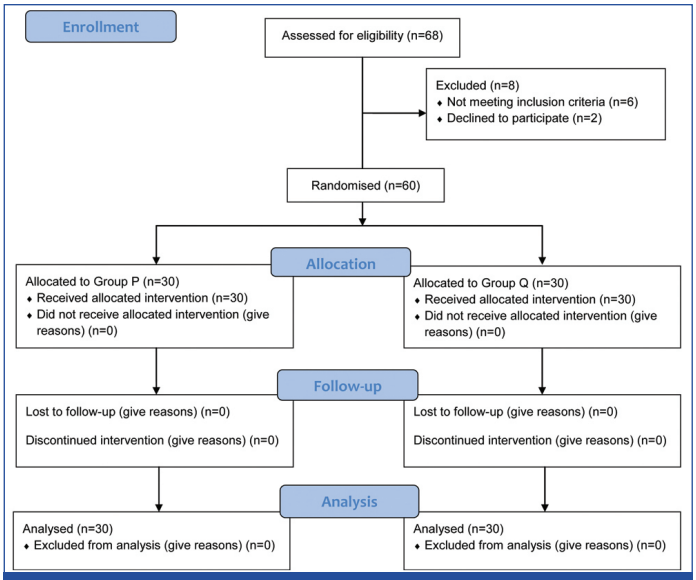
$n=11$

Minimum of 11 patients in each group were required. For better validation, 30 patients were selected in each group.

Inclusion criteria: Sixty patients of ASA I and II in the age group of 30-60 years were included. Informed written consent was taken from all the patients who participated in the study.

Exclusion criteria: Patients who refused to participate, hypertensives, with coronary artery disease were excluded from the study.

This study adheres to the CONSORT guidelines. This study was conducted on 60 patients undergoing PCNL surgeries under general anaesthesia. Computerised randomisation was done. Procedure was performed by a single anaesthesiologist. Both the patient and observer who records the parameters were blinded in the study. Group P received ultrasound guided unilateral single level PVB at T9-T10 level with 20 mL of 0.25% levobupivacaine with additive 8 mg dexamethasone. Group Q received unilateral transmuscular QLB (III) (anterior approach) with 20 mL of 0.25% levobupivacaine with additive 8 mg dexamethasone at the end of the surgery in prone position [Table/Fig-1].

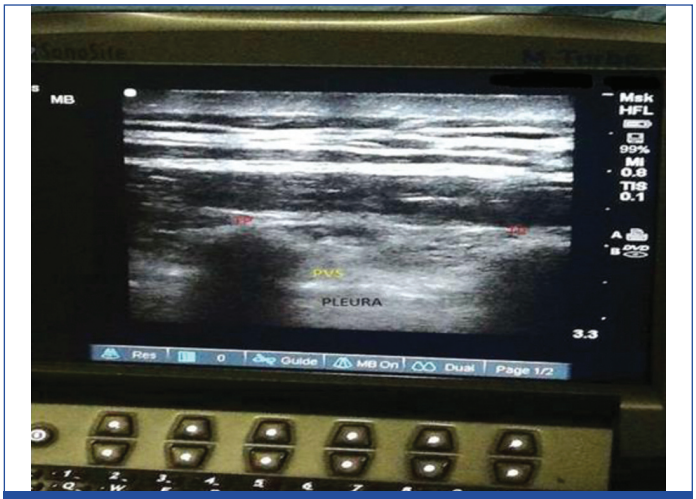


[Table/Fig-1]: CONSORT flow diagram.

Study Procedure

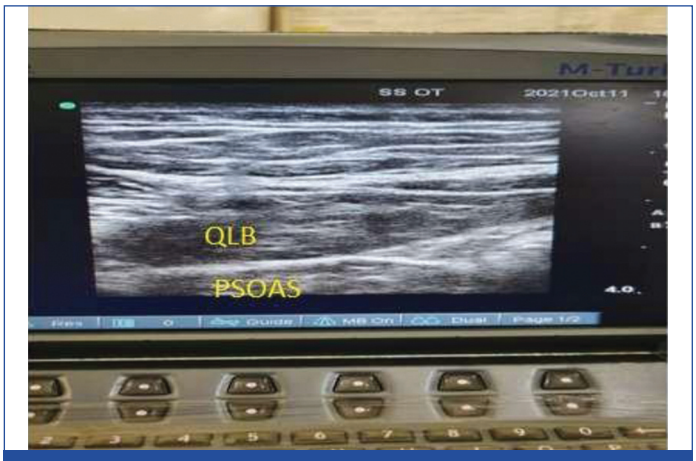
Standard general anaesthesia protocol was followed with injection (inj.) Propofol (2 mg/kg), Inj Cisatracurium (0.15 mg/kg as bolus and 0.01 mg/kg as maintenance), Inj Fentanyl (2 mics/kg) with O_2 (50%)+air (50%)+Sevoflurane (2MAC) for all the patients posted for PCNL. Standard ASA monitors were connected. Ringer lactate was used as intraoperative fluid. At the end of surgery before extubation, under strict aseptic conditions, ultrasound guided single level PVB and transmuscular QLB were given in respective study groups. Sonosite M-turbo Ultrasound machine with high frequency linear probe (13-6 Hz) covered with sterile cover and 20 G i.v. cannula stylet needle was used for the blocks.

In Group P with patient in prone position at the end of the surgery, PVB was performed with linear ultrasound probe placed in a caudo-cranial orientation about 5 cms from midline at the T9-T10 level. After identifying the paravertebral space between costo transverse ligament, pleura and transverse process, 20 G i.v. canula stylet needle was introduced in a caudo-cranial direction in-plane approach and placed in the paravertebral space [3]. Negative aspiration was confirmed and 20 mL of 0.25% levobupivacaine with additive 8 mg dexamethasone was injected into the paravertebral space [Table/Fig-2].



[Table/Fig-2]: Paravertebral block.

Traditionally, QLB was done in lateral position but in this study, the block was performed in prone position. In Group Q with patient in prone position, following strict aseptic precautions, the linear ultrasound probe was placed over the mid-axillary line between costal margin and iliac crest at the level of T10. The three abdominal muscle layers (externa oblique, internal oblique, transverse abdominis) were identified and traced posteriorly towards the paraspinal region to identify the thoraco lumbar fascia and back muscles- Quadratus lumborum, Psoas major, Erector Spinae and Lattismus dorsi. The needle was inserted in in-plane approach from medial to lateral side i.e., the needle was passed from the paraspinal side and was placed between QLB and psoas major muscle which was described as transmuscular approach [5]. Once negative aspiration was confirmed, 20 mL of 0.25% levobupivacaine with 8 mg dexamethasone was injected [Table/Fig-3,4].



[Table/Fig-3]: Quadratus lumborum block (QLB).

Patients were extubated after the block. Primary outcome measured was VAS on a scale of 1-10 for first 24 hours after extubation at 30 minutes, 2 hours, 4, 6, 12 and 24 hours postoperatively. Rescue analgesic used was Inj.Tramadol 50 mg. Secondary outcomes were time for first rescue analgesic dose which was given when VAS score exceeded four, total number of patients requiring rescue analgesic in both the groups and total amount of tramadol consumption in the first 24 hours.

[Table/Fig-4]: Quadratus lumborum block depicted with patient case.

STATISTICAL ANALYSIS

Data was collected and entered in Microsoft (MS) Excel sheet. Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 25.0. Continuous variables were presented as Mean and standard deviation. Statistical difference was assessed with student t-test. Categorical data were presented as proportions and compared with Chi-square test. The p-value <0.05 was considered as significant.

RESULTS

Initially, 68 patients were analysed, out of which six were excluded as they didn't meet the criteria and two refused to participate. Thus, 60 patients were randomised into two groups by computerised randomisation and analysed. No statistically significant differences were observed between the two groups with regards to demographic profile like age, sex, weight, and height [Table/Fig-5].

Demographics	Group P (N=30)	Group Q (N=30)	p-value
Age (in Year)	34.18±12.13	34.87±10.12	0.964
Height (in cm)	168.88±6.6	164.32±2.10	0.53
Weight (in kg)	60.45+3.26	63.32+7.22	0.43
Sex (M/F)	14/16	12/18	0.34
ASA (I/II)	23/7	20/10	0.30

[Table/Fig-5]: Demographics of the study population.
Chi-square test has been employed and p<0.05 is considered as significant
ASA: American society of anaesthesiology

Primary outcome VAS score was significantly lower in group P compared to group Q (p=0.001) in first 24 hours postoperatively. The mean VAS scores did not exceed 4.4 in 24 hours in group P whereas the mean VAS scores in group Q exceeded 4 after four hours [Table/Fig-6]. Mean time for rescue analgesia was 478 minutes in group P vs 346 minutes in group Q which was statistically significant (p<0.05). As 18 patients requested for rescue analgesia in group P, 27 out of 30 required analgesia in group Q. Mean total dose of tramadol consumption was 125 mg in group P vs 155 mg in group Q in 24 hours which was statistically significant (p<0.05) [Table/Fig-7]. None of the patients in both the groups had any technique related complications like pneumothorax etc.

VAS	Group P (N=30)	Group Q (N=30)	p-value
30 min	2.4±0.24	3.3±0.67	**0.001***
2 hours	2.3±0.68	3.4±0.44	**0.001***
4 hours	2.7±0.56	4.2±0.75	**0.001***
6 hours	3.06±0.43	5.25±0.85	**0.001***
12 hours	3.46±0.46	5.69±0.44	**0.001***
24 hours	4.42±0.24	6.3±0.67	**0.001***

[Table/Fig-6]: Visual analogue scale.
Chi-square test has been employed and p<0.05 is considered as significant

Parameters	Group P	Group Q	p-value
Time for first rescue analgesia (min)	478±75	346±67	**0.001***
No. of patients required analgesia in 24 hour of postoperative	18 (60%)	27 (90%)	**0.0078***
Total dose of tramadol consumption (mg)	125±40.46	155±64.89	**0.03***

[Table/Fig-7]: Secondary outcomes.
Chi-square test has been employed and p<0.05 is considered as significant

DISCUSSION

Literature is very limited comparing paravertebral and QLB for PCNL surgeries as none of the authors have studied the superiority of each block over the other. Many databases were searched but studies were not available. Many authors have studied either thoracic paravertebral or QLB individually for PCNL surgeries [3,6-8]. This study was conceived to compare these two blocks for postoperative analgesia after PCNL surgeries.

A study by Baldea KG et al., who has compared PVB vs placebo has observed that PVB group had lower intraoperative and postoperative use of opioid consumtion [6]. In their study, they have given PVB at the start of surgery whereas in this study, the block was given at the end of the surgery. In this study also, PVB group had less consumption of opioid in PVB group.

Hatipoglu Z et al., compared multiple level PVB with i.v. tramadol and observed that PVB provided superior analgesia with reduced opioid consumption [7]. In their study, multiple level PVB was given at T10-L1 whereas in this study, PVB was given at T9-10 level. But the results regarding duration and opioid consumption were similar to this study group.

Ak K et al., compared PVB vs Placebo for postoperative pain management in patients undergoing PCNL [8]. They observed that Thoracic PVB using Levobupivacaine was an effective regional technique with low morphine consumption, high patient satisfaction, and no side-effects for postoperative pain management of patients undergoing PCNL.

The OLB is a myofascial plane block which provides analgesia for abdominal surgery including caesarean section [9], laparoscopy, PCNL, colostomy, pyeloplasty and hernia repair surgeries. Zhu Q et al., conducted studies in detail about the anatomy and techniques of QLB [10]. Four approaches for QLB were described. The authors here have used transmuscular QLB (III) where the drug will be injected between quadratus lumborum and psoas major muscle. This approach is also called anterior or transmuscular approach. Though the exact mechanism for analgesia is not yet defined, spread of drug to paravertebral space is explained. Few authors have compared QLB with PVB for renal surgeries like nephrectomise but none has compared for PCNL surgeries. Most of the authors have performed QLB in lateral position which was well explained in the literature whereas in the present study, the authors have done QLB in prone position which was not well established. The authors here didn't find much difficulty in identifying transmuscular plane in prone position.

Yuan Q et al., compared Transmuscular Quadrates Lumborum (TMQLB) block versus thoracic PVB for acute pain and quality of recovery after laparoscopic renal surgery [11]. They observed that the analgesic efficacy of TMQLB in laparoscopic renal surgery is not inferior to that of TPVB. Okmen K and Okmen BM have studied the efficacy of QLB (III) for postoperative pain relief in PCNL surgeries [12]. They have observed that QLB was an effective postoperative option for PCNL surgeries.

In this study, it was observed that single level PVB at T9-10 level provided superior postoperative analgesia with VAS scores less than four till 12 hours whereas in QLB group the VAS scores exceeded four after four hours. Patients in PVB group required analgesia after 478 minutes in PVB group whereas patients in QLB group, required analgesia after 346 minutes which was quite earlier in this group.

Reduced opioid consumption was observed in PVB group with a mean of 125 mg vs 155 mg in QLB group.

Effective pain relief is an important constituent of enhanced recovery after surgery which helps in early ambulation, hastens recovery and reduces the morbidity. Both the regional blocks will improve the postoperative recovery of the patients after PCNL surgeries.

Limitation(s)

The lack of low frequency curvilinear probe could have been very helpful in performing these blocks.

CONCLUSION(S)

Ultrasound-guided PVB level is superior to transmuscular QLB in terms of alleviating postoperative pain, reduced opioid consumption and better outcome after PCNL surgeries which aids in enhanced recovery after surgery.

REFERENCES

[1] Nimmo SM, Foo ITH, Paterson HM. Enhanced recovery after surgery: Pain management. J Surg Oncol. 2017;116(5):583-91.
[2] Wang J, Zhang C, Tan D, Tan G, Yang B, Chen W, et al. The effect of local anesthetic infiltration aroun nephrostomy tract on postoperative pain control after percutaneous nephrolithotomy: A sistemik review and meta-analysis. Urol Int. 2016;97(2):125-33.
[3] Yaman F, Tuglu D. Analgesic efficacy of ultrasound guided paravertebral block in percutaneous nephrolithotomy patients: A randomized controlled clinical study. BMC Anesthesiol. 2020;20(1):250.
[4] Blanco R. TAP block under ultrasound guidance: The description of a 'no pops trechnique'. Regional Anesthesia and Pain Medicine- Region Anesth Pain Med. 2007;32(5):130-30.
[5] Ueshima H, Otake H, Lin JA. Ultrasound-guided quadratus lumborum block: An updated review of anatomy and techniques. Biomed Res Int. 2017;2017:2752876. Doi: 10.1155/2017/2752876. Epub 2017 Jan 3.
[6] Baldea KG, Patel PM, Delos Santos G, Ellimoottil C, Farooq A, Mueller ER, et al. Paravertebral block for percutaneous nephrolithotomy: A prospective, randomized, double-blind placebo-controlled study. World J Urol. 2020;38(11):2963-69.
[7] Hatipoglu Z, Gulec E, Turktan M, Izol V, Andogan A, Gunes Y, et al. Comparative study of ultrasound-guided paravertebral block versus intravenous tramadol for postoperative pain control in percutaneous nephrolithotomy. BMC Anesthesiolgy. 2018;18(1):01-06.
[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. Medical Principles and Practice. 2012;22(3):229-33.
[9] Blanco R, Ansari T, Girgis E. Quadratus lumborum block for postoperative pain after caesarean section: A randomised controlled trial. Eur J Anaesthesiol. 2015;32:812-18.
[10] Zhu Q, Li L, Yang Z, Shen J, Zhu R, Wen Y, et al. Ultrasound guided continuous Quadratus Lumborum block hastened recovery in patients undergoing open liver resection: A randomized controlled, open-label trial. BMC Anesthesiol. 2019;19(1):23.
[11] Yuan Q, Cui X, Fei Y, Xu Z, Huang Y. Transmuscular quadratus lumborum block versus thoracic paravertebral block for acute pain and quality of recovery after laparoscopic renal surgery: Study protocol for a randomized controlled trial. Trials. 2019;20(1):01-07.
[12] Okmen K, Okmen BM. Ultrasound-guided anterior quadratus lumborum block for postoperative pain after percutaneous nephrolithotomy: A randomized controlled trial. Korean J Anesthesiol. 2020;73(1):44-50.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Anaesthesiology, Narayana Medical College, Nellore, Andhra Pradesh, India.
2. Assistant Professor, Department of Anaesthesiology, Narayana Medical College, Nellore, Andhra Pradesh, India.
3. Professor, Department of Anaesthesiology, Narayana Medical College, Nellore, Andhra Pradesh, India.
4. Postgraduate, Department of Anaesthesiology, Narayana Medical College, Nellore, Andhra Pradesh, India.
5. Assistant Professor, Department of Anaesthesiology, Narayana Medical College, Nellore, Andhra Pradesh, India.
6. Professor, Department of Anaesthesiology, Narayana Medical College, Nellore, Andhra Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Sukanya Mallela,
120/1, Baba Nagar, Nellore-524003, Andhra Pradesh, India.
E-mail: surya.sukanya93@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Jan 06, 2023
- Manual Googling: Mar 09, 2023
- iThenticate Software: Apr 27, 2023 (16%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Jan 05, 2023**
Date of Peer Review: **Mar 29, 2023**
Date of Acceptance: **May 02, 2023**
Date of Publishing: **Jul 01, 2023**