

Comparison of Quadratus Lumborum Block and Peritubal Infiltration for Post-Operative Analgesia in Patients Undergoing PCNL under General Anaesthesia

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Abstract:

Background: Percutaneous nephrolithotomy (PCNL) is a minimally invasive and standard Endourological procedure for management of patients with renal calculi more than 2cm in size. Postoperative pain was managed using multiple blocks like Quadratus Lumborum block, Paravertebral block and also local infiltration.

Objective: To compare and study the effects of Quadratus Lumborum (QL) block and Peritubal infiltration (PTB).

Methods: This double-blinded study is conducted on all patients undergoing PCNL under General Anaesthesia. Based on the group assigned, Urologist performed Peritubal infiltration with 10ml of 0.5% bupivacaine and Anaesthesiologist performed Quadratus lumborum block with 20ml of 0.25% Bupivacaine. VAS score at rest and motion was assessed in both groups and also the cumulative dosage of rescue analgesia was analysed using Independent T test.

Results : VAS SCORE at rest and movement, over all need for analgesics over 24hr were less in group Q compare with group P. Time to rescue Analgesia was increased in group Q compared to group P.

Conclusion: QL block was more effective than Peritubal infiltration for, postoperative VAS score both at rest and movement and lower analgesic consumption In post-operative period and more satisfaction in patients undergoing PCNL surgery.

Keywords: PCNL, Quadratus Lumborum, Local infiltration, Post-operative pain, Urologic procedures, Minimal invasive surgery.

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Introduction

Urolithiasis is a common disease affecting individuals with obesity, diabetes and metabolic syndrome and changes in nutritional habits, sanitary conditions, and environmental factors have increased the risk. Treatment options include extracorporeal lithotripsy (ECL), Endourological techniques with flexible and rigid ureteroscopy and percutaneous nephrolithotomy (PCNL), and laparoscopic and rarely open surgeries [1].

PCNL remains the treatment of choice for several forms of stone disease including large stones, many cystine and struvite calculi, lower pole calyceal calculi, stones associated with morbidly obese patients and anomalous anatomy [2]. It is a minimally invasive and standard endourological procedure for the management of patients with

renal calculi more than 2cm in size associated with severe postoperative pain due to dilatation of renal capsule and parenchymal tract and is related to intra-renal handling as intrapelvic pressures do not increase significantly [3]. Effective pain management helps in early ambulation and recovery of the patient.

Postoperative pain management in patients undergoing PCNL is managed by various peripheral nerve blocks like paravertebral block, quadratus lumborum (QL) block and peritubular infiltration of local anaesthetic. Analgesia for both visceral and somatic pain can be managed by blocking, renal innervation T10-L1, ureter innervation by T10-L2 and the incision site is most commonly subcostal area or 10th -11th intercostal

space innervated by T10-T12 [5]. Peritubal infiltration involves anesthetizing the local port site, hence providing adequate postoperative pain relief. The paravertebral block requires injection at multiple levels to block the specific nerve roots, whereas QL block is single injection technique and known to block both somatic and visceral pain, hence is preferred for our study.

In this study, we would like to compare the efficacy of postoperative analgesia with peritubular infiltration vs quadratus lumborum block in patients posted for PCNL surgeries. VAS scores at rest and movement are monitored and compared between these two blocks and cumulative rescue analgesics required are calculated for 24 hours post-surgery.

Methods

This study will be conducted on adult patients at Vydehi institute of Medical sciences and Research Centre Bangalore. Vydehi ethical committee clearance was obtained [as per Helsinki declaration 2013] and CTRI registration is obtained. This prospective, double-blinded, randomized study was conducted from July 2022 to Dec 2022 on patients meeting the inclusion criteria after written informed consent is obtained. Inclusion criteria include all patients aged 20-65 years, belonging to the American Society of Anaesthesiologists physical status I, II and undergoing Percutaneous Nephrolithotomy. Patients with existing coagulopathy, allergic to bupivacaine and pregnant women were excluded from the study. Cost of study drugs will be borne by investigator.

On the day of surgery, patients were randomly assigned into groups by envelope method before induction of GA. The study subjects are blinded in the study. The Anesthesiologist in the Operating room (OR) picks up the envelope and allocates the patients to group. After the patient is shifted to OR, standard ASA monitors - ECG, NIBP and SpO₂ are attached and baseline values are recorded. Intravenous access was secured.

The patients were pre oxygenated with 5L/min oxygen for 3mins. Patients were premedicated with Injection Ondansetron 0.15 mg/kg, Injection Glycopyrrolate 0.005 mg/kg and Injection Midazolam 0.02 mg/kg.

The induction of GA will be performed with intravenous Propofol 2mg/kg, Fentanyl 2mcg/kg and Atracurium 0.5 mg/kg. Orotracheal intubation will be performed using disposable cuffed PVC ETT of no-7.5 for female and size-8 for Male. Cuff inflated with air and bilateral air entry is confirmed. Maintenance of anaesthesia with mixture of 0.8-1% Isoflurane; Air and Oxygen of 2.5L/min with FiO₂ =40%.

All the surgical procedures were performed by the same surgical team using same surgical technique. The patient was first positioned in lithotomy position to place a ureteral catheter under the guidance of 22 French (F) rigid cystoscope. The patients were then positioned prone. Retrograde pyelography was performed by administering radio-opaque material through the ureteral catheter. Percutaneous entry into kidney was achieved using 18G needle and 0.032 Teremo guidewires. A 26-F sheath was placed after access was opened with an Amplatz dilator upto 27-F. Stones were fragmented using a pneumatic lithotripter. In the postoperative period, a nephrostomy tube was placed in the presence of residual stones, active bleeding and possible extravasation in the calyceal system. A 6-F double J ureteral stent was placed in patients who did not have a nephrostomy tube inserted.

After patient allocation, Group P- the Urologist performs peritubular infiltration, at 6 o'clock and 12 o'clock with 20ml of 0.25% bupivacaine along the nephrostomy tube.

Group Q - an Anesthesiologist performs Quadratus Lumborum block.

The patient's back is cleaned with 5% Betadine solution and draped. A Curvilinear probe (2-5Hz) is placed on the iliac crest of operated side. Traced upwards along the posterior axillary line, till shamrock sign is visible. Quadratus Lumborum (QL) appears as small triangular muscle, below which is psoa major (PM) muscle. 23G Quinke's needle is inserted in-plane in the plane between QL and PM and study drug is injected in real time with clear visualisation of tip of needle.

Following either of the procedure, the patient is turned supine, spontaneous respiratory efforts are observed and Reversal agent (Neostigmine 0.05mg/kg and Glycopyrrolate 0.01mg/kg) is given. The patient's endotracheal tube is removed. Vitals (HR, BP, SpO₂) recorded and VAS score at rest and movement is assessed at 0, 30min, 1st, 2nd, 4th, 6th, 12th and 24th hour in all patients. Duration of analgesia is documented – the time of onset of block to demand of first rescue analgesic. In patients with VAS > 5, Inj. Tramadol 50mg in 100ml Normal Saline stat is advised. Cumulative dosage of Tramadol used is documented after 24 hours.

Data will be entered into Microsoft excel data sheet and will be analyzed using SPSS 22 version software. Categorical data will be represented in the form of Frequencies and proportions. Chi-square will be the test of significance. Continuous data will be represented as mean and standard deviation. Independent t test will be the test of significance to identify the mean difference between two groups. p value <0.05 was considered as statistically significant.

Sample Size:

Was estimated by using the difference in Mean Patient satisfaction score(based on VAS score) between Peritubal group and Quadratus group from the study by Simon Halim Armanious et al as 3 ± 1.48 and 4 ± 0.74 .

Using these values at 95% Confidence limit and 80% power sample size of 20 was obtained in each group by using the below mentioned formula and Med calc sample size software. With 10% non-

response sample size of $20 + 2.2 \approx 23$ cases will be included in each group.

$$\text{Sample size (N)} = 2SD^2 (Z_{\alpha/2} + Z_{\beta})^2 / d^2$$

- SD – Standard deviation = From previous studies or pilot study
- $Z_{\alpha/2} = Z_{0.05/2} = Z_{0.025} = 1.96$ (From Z table) at type I error of 5%
- $Z_{\beta} = Z_{0.20} = 0.842$ (From Z table) at 80% power
- d = effect size = difference between mean values

	At 5% Error and 80% Power
Z_{α}	1.960
Z_{β}	0.840
$Z_{\alpha} + Z_{\beta}$	2.800
$(Z_{\alpha} + Z_{\beta})_{sq}$	7.840
sd1	1.48
sd2	0.74
$SD = sd1 + sd2/2$	1.110
SD2	1.232
Mean 1	3
Mean 2	4
d = Mean 1 - Mean 2	-1.000
d2	1.000
n	19.319

Results: Forty patients were recruited in the study and monitored for 24 hours. The demographic data, duration of surgery were comparable in both groups. Pain scores (VAS) were analysed at rest and during deep breathing. Group P and Q were known to have mild pain – VAS (0-3) for 2 hours. After 4 hours, Group P had moderate pain on rest compared to Group Q [Table 1][Figure 1]

Table 1: Changes in VAS- at rest

Time period	Group P	Group Q	P - value
	Mean \pm SD	Mean \pm SD	
0 min	3.3 \pm 0.47	2.0 \pm 0.0	<0.001 (significant)
1 hour	3.4 \pm 0.50	2.65 \pm 0.64	<0.001 (significant)
2 hours	3.7 \pm 0.44	3.09 \pm 0.51	<0.001 (significant)
4 hours	4.1 \pm 0.38	3.09 \pm 0.28	<0.001 (significant)
6 hours	4.4 \pm 0.51	3.3 \pm 0.48	<0.001 (significant)
12 hours	4.8 \pm 0.38	4.6 \pm 0.49	0.10 (not significant)
24 hours	4.6 \pm 0.49	4.3 \pm 0.49	0.14 (not significant)

Pain scores (VAS) were analyzed at rest and during deep breathing. Group P and Q were known to have mild pain – VAS (0-3) for 2 hours. After 4 hours, Group P had moderate pain on rest compared to Group Q, which was overall statistically significant.

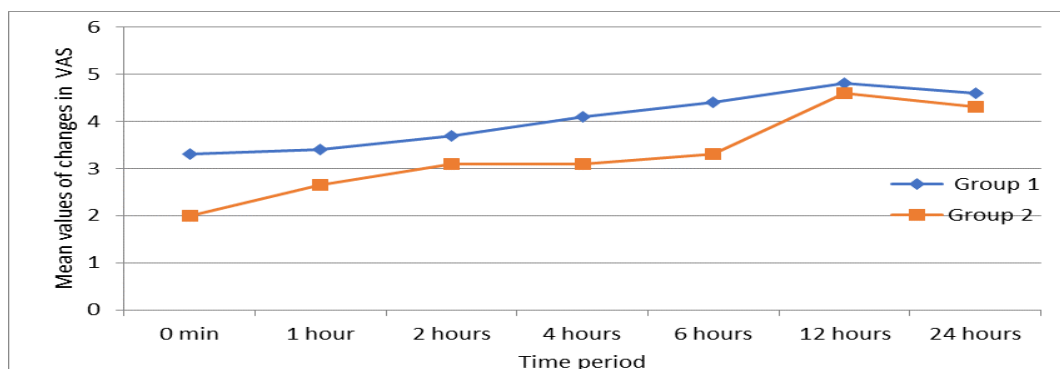


Figure 1: Mean values of changes in VAS in both group-at rest

VAS on movement was significantly low in Group Q compared to Group P at all-time intervals [Table 2][Figure 2].

Table 2: Changes in VAS-on movement

Time period	Group P	Group Q	P - value
	Mean ± SD	Mean ± SD	
0 min	4.0 ± 0.28	3.4 ± 0.50	<0.001 (significant)
1 hour	4.7 ± 0.44	3.2 ± 0.42	<0.001 (significant)
2 hours	4.6 ± 0.64	3.0 ± 0.00	<0.001 (significant)
4 hours	4.2 ± 0.44	3.4 ± 0.50	<0.001 (significant)
6 hours	4.6 ± 0.48	3.8 ± 0.38	<0.001 (significant)
12 hours	4.7 ± 0.61	3.9 ± 0.28	<0.001 (significant)
24 hours	4.4 ± 0.51	3.7 ± 0.85	0.002 (significant)

VAS on movement was significantly low in Group Q compared to Group P at all-time intervals

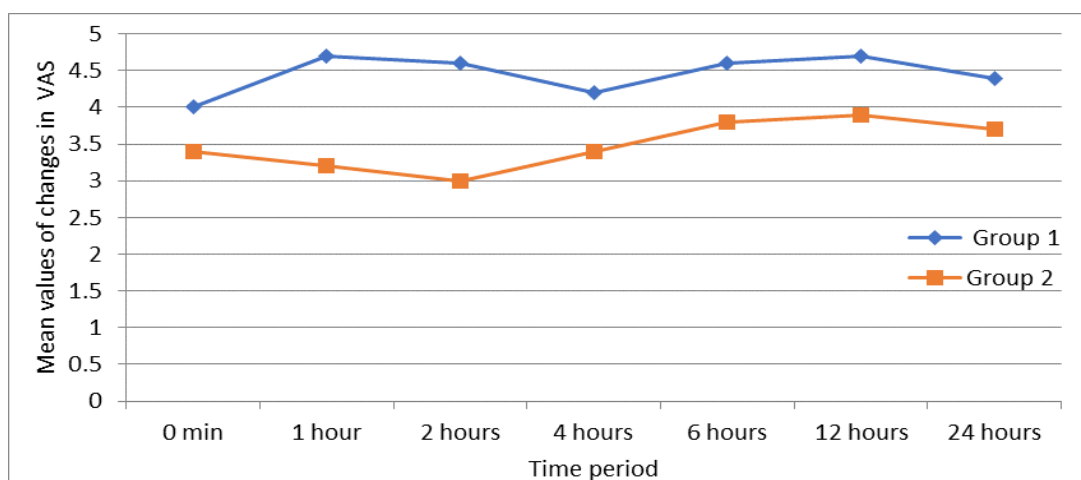


Figure 2: Mean values of changes in VAS in both groups -on movement

The total duration of analgesia in Group P was 255 ± 30 minutes and for Group Q was 600 minutes ± 25 minutes. When VAS was more than 5, Inj. Paracetamol 1g and Inj. Tramadol was given in 100ml Normal Saline, and the total consumption in 24 hours was calculated. In post-operative period, the cumulative dosage of Paracetamol consumed was 2.57 ± 0.5g in Group P and 1.17 ± 0.3 g in Group Q which was statistically significant. Inj. Tramadol dosage was 78.26 ± 25.3 mg in Group P and 58.70 ± 19.3mg in Group Q [Table 3].

Table 3: Time for rescue analgesia and total dose of analgesia

Variable	Group P	Group Q	P-Value
	Mean ±SD	Mean ± SD	
Time for rescue analgesia (in hours)	4.39 ± 0.6	10.09 ± 1.7	<0.001 (significant)
total dose of paracetamol (in g)	2.57 ± 0.5	1.17 ± 0.3	<0.001 (significant)
total dose of tramadol (in mg)	78.26 ± 25.3	58.70 ± 19.3	0.005 (significant)

Discussion

The major finding of the current study is significantly reduced pain scores in patients receiving Quadratus Lumborum block compared to Peritubal infiltration for Percutaneous Nephrolithotomy (PCNL)

Kidney Stone Disease (KSD) is prevalent, with an expectancy of 12% in a total population reported to be prone to urinary stones in India. Of this 12%, 50% of the population are severely affected by renal damage, which even leads to a loss of kidneys⁶. Various treatment options being endourological and laparoscopic surgery. Percutaneous Nephrolithotomy (PCNL) was introduced in 1976 by Fernström and Johannson [7]. PCNL is known to have 90% less chances of recurrence rate and increased duration of stone free period. It is indicated in patients with stone size upto 2cm, hard stone (containing calcium oxalate monohydrate, cystine, brushite), lower caliceal stone with infundibulo-pelvic angle less than 70 degrees and obstructive uropathy [6,8,9]. PCNL has advantages of reduced hospital stay, decreased morbidity and reduced hospital length of stay with good post-operative pain management. The pain is due to nephrostomy tube placement post dilatation of renal capsule and parenchymal tract [10,11,12]. As pain after PCNL is complex in nature, no analgesic technique is 100% effective and may require a multimodal approach. Inadequate pain relief can be associated with complications like delayed recovery, increased pulmonary and cardiac complications, Deep Vein Thrombosis (DVT), prolonged hospital stay and the development of chronic neuropathic pain¹³. The post-operative pain can be managed by non-steroidal anti-inflammatory drugs, narcotics, local/peritubular infiltration and regional anaesthesia techniques. Regional anaesthesia techniques include epidural morphine, intercostal block, paravertebral block (PVB), transversus abdominis plane block (TAP) and quadratus lumborum block [14,15]. The quadratus lumborum muscle runs along the posterior abdominal wall and is located lateral to the psoas major muscle.

This muscle starts from the inner part of the posterior part of the iliac wing and four small tendons attach this muscle to the lower medial of the 12th rib and the transverse processes of the L1-L4 lumbar vertebra. The subcostal nerve, iliohypogastric nerve, and ilioinguinal nerve run between the quadratus lumborum muscle and the transversalis fascia. Lateral branches of the thoracoabdominal nerves that receive sensation lateral to the thorax from the iliac wing, abdomen, and upper femoral nerve near the angle of the rib. The subcostal and iliohypogastric nerve pass through the anterior surface of the quadratus lumborum muscle [16]. Quadratus lumborum block (QLB) is

considered superior to TAP and PVB as it provides extensive abdominal analgesia involving the upper branches of lumbar plexus¹⁷. Several studies are conducted to study various approaches of QLB. It was concluded Trans muscular QLB, hence this approach was used in the study¹⁸. Dam et al [1], studied trans muscular QLB with 30ml 0.75% Ropivacaine vs Normal saline and observed that time to first opioid use was prolonged in the intervention group (678 [285-1020] vs 36 [19-55] min, $P < 0.0001$).

Morphine consumption was lower in the intervention group at 6 h after surgery (7.2 [8.7] vs 90.6 [69.9] mg OME-oral morphine equivalent, $P < 0.001$) and at 24 h (54.0 [36.7] vs 126.2 [85.5] mg OME, $P < 0.001$). Hence concluded that QLB reduced morphine consumption in post-operative period [19]. Another study conducted by Peksoz U et al, found that opioid consumption was significantly lower in Group QLB compared to Group C (no intervention was done). Postoperative visual analog scale (VAS) scores during the movement and rest were significantly lower in Group QLB compared to Group C at all times in patients undergoing PCNL [20].

Peritubular infiltration (PTI) is infiltrating local anesthetic along the tract beside nephrostomy tube, from skin to renal capsule at 6 o'clock and 12 o'clock position. Local anesthetics (LA) acts by blocking impulses generated by injured nerve fibres at surgical site and decreases level of inflammatory mediators like prostaglandins, endothelin-1, nerve growth factor and cytokines.

LA can inhibit inflammatory and local sensitising responses by directly suppressing some phases of inflammation like neutrophil priming and by blocking some of the neuronal pathways, which are activated by inflammation involving protein kinase C and G protein-coupled receptors [21]. Jonnavithalu et al, compared PTB with 20ml of 0.25% bupivacaine in one group with no intervention in other group, observed that bupivacaine infiltration provided good postoperative analgesia and significantly reduced analgesic requirement after standard PCNL. The mean analgesic (inj. Tramadol) consumption was 33mg in the block group and 105mg in the control group. The number of analgesic demands was also significantly reduced in the block group²². Another study conducted by Parikh et al concluded PTI with local anaesthetics ropivacaine and bupivacaine under ultrasound guidance provides effective pain relief in the initial post-operative period and duration of analgesia as denoted by demand to first rescue analgesic is prolonged with Ropivacaine (10.54h) as compared with bupivacaine (7.91 hr) [23].

Yayik et al compared PVB with 20ml 0.25% Bupivacaine vs PTI with 10ml 0.25% bupivacaine each at 6 and 12 o'clock position vs control and observed that fentanyl consumption in PVB and PTI was significantly lower compared to control, total of 24 h (197.50 ± 133.74 and 368.75 ± 116.66 respectively) with $p < 0.05$. The dynamic VAS scores analyzed at the 1st and 2nd hours were significantly lower in PVB than PTB ($p < 0.05$). Eight patients in Group C, two patients in Group PTI and 1 patient in Group PVB required additional analgesics and the difference was significant ($p < 0.05$). Hence proving that PVB achieved more effective analgesia by reducing postoperative opioid consumption and VAS scores comparison to the control and PTI groups in patients undergoing percutaneous nephrolithotomy [24].

Simon et al compared QLB and PTI with 20ml 0.25% bupivacaine, observed VAS scores were low in QL block at 6th – 12th hour compared to PTI and QL block significantly lower mean 24hour morphine consumption than Peritubal infiltration (10mg versus 17mg, respectively). Our study showed that VAS scores were lower in both Group P and Q for 2 hours. After 4th and 6th hour, Group Q had significantly lower VAS score compared to Group P. Group P experienced pain with VAS of 5, rescue analgesics Injection. Paracetamol 1 g and Inj. Tramadol 50mg in 100ml Normal Saline was given. The cumulative requirements of both analgesics was calculated over 24 hours. Paracetamol consumption was 2.57 ± 0.5 g in Group P and 1.17 ± 0.3 g in Group Q which was statistically significant. Tramadol consumption was 78.26 ± 25.3 mg in Group P and 58.70 ± 19.3 mg in Group Q. Group receiving Quadratus lumborum was known to have better VAS scores at rest and movement with comparatively lesser dosage of rescue analgesics. It was superior to PTB as it provides both visceral and somatic analgesia Quadratus Lumborum Block is a advanced truncal block to be performed by experts, is known to provide superior analgesia compared to Peritubular Infiltration due to involved of dermatomes from T6-L1, is good option for Percutaneous Nephrolithomy for post-operative analgesia.

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