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A prospective randomised double blinded study- to evaluate the analgesic efficacy of transmuscular quadratus lumborum block in percutaneous Nephrolithotomy via VAS score

Abstract

Introduction: Before the advent of ultrasound guided regional anaesthesia, post-operative pain in percutaneous nephrolithotomy was mainly confined to opioid consumption and other analgesics. The use of Ultrasound in regional anaesthesia has facilitated the visualization of anatomical structures, needle advancement and the spread of local anaesthetic. This has led to the development and refinement of fascial plane blocks. Quadratus Lumborum block (QLB) facilitates early postoperative ambulation and reduction in length of hospital stay by effective postoperative analgesia.

Methods: In this prospective, randomised, double blinded study, 66 patients scheduled for elective percutaneous nephrolithotomy (PCNL) between 2021 and 2022 were randomised, 33 patients to receive ultrasound guided QLB with 20 ml of 0.25% bupivacaine and 33 patients receive 20 ml of normal saline post intubation. During the postoperative period, each patient's pain level was assessed by the *Visual analog scale(VAS) score* for pain: range 0-10 (0=no pain,10=worst pain ever).The VAS score at 15 mins,1hr, 2hr, 6hr,12hr, 24hr intervals, should be monitored.

Results: VAS Score in Group A was less as compared to Group B. The difference was statistically significant at 15 min, 1h, 2h, 4h, 6h, 8h, 14h.

Conclusion: Hence, ultrasound guided Transmuscular QLB had better analgesic efficacy in post PCNL surgery.

Keywords: PCNL, Ultrasound guided transmuscular Quadratus Lumborum block, VAS Score, 0.25%Bupivacaine, Postoperative analgesia

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Abbreviations: PCNL, Percutaneous Nephrolithotomy; QL block, Quadratus Lumborum block; LA, Local Anaesthesia; USG, Ultrasound guidance; ASA, American Society of Anaesthesiology; IV, Intravenous; VAS, Visual Analogue Scale; ml, Millimetre; Kg, Kilogram; Mcg, Microgram; Mg, Milligram; Hr;h, Hour; SpO2, Oxygen saturation; HR, Heart rate; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; MHz, Millihertz; mmHg, Millimetres of mercury; PACU, Post Anaesthesia Care Unit

Introduction

Pain is an unpleasant sensory and emotional experience and has been associated with tissue damage.[1-4] Urinary system calculi are commonly treated with PCNL, a minimally invasive procedure that also improves patient quality of life and shortens hospital stays. However, it is challenging to manage postoperative pain in PCNL surgery. In PCNL surgery, postoperative pain develops as a result of tissue damage-related nociceptive stimuli, renal capsule and renal parenchyma dilatation, and nephrostomy tube placement. Systemic opioids, Patient controlled analgesia(PCA) with opioids, NSAIDs, neuraxial methods such as epidural analgesia, paravertebral block, QLB, TAP block, or local anesthetic infiltration along the nephrostomy tube can be employed to prevent postoperative pain caused by PCNL.[5-11]

Better pain relief and patient satisfaction are achieved with patient controlled analgesia (PCA). However, opioids even used in PCA for postoperative pain management has unwanted side effects like sedation, nausea, vomiting, and pruritus which remains a unique concern in this population.[12] Multimodal analgesia is considered the standard practice for postoperative pain management with the goal of optimizing analgesia, minimising side effects, and providing opioid sparing. In recent years, ultrasound guided regional anaesthesia has become more useful for the accurate deposition of local anaesthetic because it allows faster action and low complications with high success rates. The use of ultrasound in regional anaesthesia has made it easier to visualise anatomical structures, needle advancement, and spread of local anaesthetic. As a result, fascial plane blocks have been developed and refined. Ultrasound-guided quadratus lumborum plane block was developed by Rafael Blanco in 2007 as a variation of the Trasversus Abdominus plane block (TAP).Blanco introduced the lateral approach QLB. Transmuscular QLB (anterior approach) defined by Borglum et al in 2015, has gained broader acceptance due to its opioid sparing effect and wider dermatomal distribution resulting in a large area of sensory inhibition of T7 through L1. As a result, it can be used as postoperative analgesia for abdominal and pelvic surgeries. In this study, we aimed to investigate the analgesic efficacy of ultrasound guided transmuscular QLB on postoperative patient's pain intensity using the Visual Analog Scale (VAS), which has a score range of 0 to 10, with 0 indicating no pain and 10 indicating the worst imaginable pain. We hypothesised that the patients who received QLB with Bupivacaine would have lower postoperative visual analog scale (VAS) value than the control group.

Materials and methodology

Protocol

Aim: This study evaluates the analgesic effect of transmuscular quadratus lumborum plane block in patients undergoing percutaneous nephrolithotomy.

Objectives: To assess analgesic efficacy of quadratus lumborum plane block postoperatively using Visual analogue scale (VAS).

Materials and methods

This study is a prospective, randomised, double blinded study conducted in Department of Anaesthesiology, Critical care and Pain medicine, Sri Ramachandra Institute of Higher Education and Research over a period of 12 months from December 2021 to December 2022. Ethical approval for this study was provided by the Institutional Ethics Committee at Sri Ramachandra Institute of Higher Education and Research (IEC/21/JUN/163/36).

Inclusion criteria:

i. Patients >18 yrs of age

ii. ASA 1 to 2

iii. Elective percutaneous nephrolithotomy

Exclusion criteria:

i. Patient's refusal to give consent

ii. Allergy to local anaesthetics

iii. Local infection of the site of injection

iv. Emergency cases

v. Patients on anticoagulants and with coagulation disorders

vi. Pregnancy

vii. ASA 4 ; ASA 5

viii. unconscious or mentally incompetent

ix. hemodynamic instability.

Patients who met the inclusion criteria were enrolled in the study, and written and informed consent was obtained after explaining the block, the drugs administered in the block, and their benefits and drawbacks. The previous day, a preoperative assessment was performed, and baseline investigations were recorded. For solids, patients were kept Nil per oral for 8 hours.

Randomization and blinding:

The patients enrolled in the study were randomly assigned to one of two groups using computer-generated randomization and were kept anonymous by using the sealed opaque envelope technique with sequential numbers numbered 1 to 66. Two anaesthesia nurses opened the randomization envelope and prepared 20 mL of syringe based on the allocation specified in the sealed envelope. All other investigators, staff, and patients were unaware of the group assignment.

Group A received an ultrasound-guided Transmuscular Quadratus Lumborum block with 20 ml of 0.25% Bupivacaine.

Transmuscular QLB with 20 mL of normal saline was performed on **Group B.**

Intraoperative

On the day of surgery, the patients were wheeled into the operating room and baseline monitors -Electrocardiography, Non invasive blood pressure and pulse oximetry were connected.

Baseline vitals – heart rate, oxygen saturation, blood pressure were noted.

Patients were Preoxygenated with 100%oxygen at 6 liter flow for 3 minutes and then induced with intravenous Fentanyl at 2mcg/kg and after 2 minutes intravenous propofol at 2 mg/kg was given. Once there was loss of response to verbal commands inj. Vecuronium IV at 0.1 mg/kg was given. After three minutes of vecuronium administration, laryngoscopy and endotracheal intubation was performed. Endotracheal tube size of 7.5 cuffed in female patients and 8.5 size cuffed was used in male patients. After confirmation of the position of the endotracheal tube and its fixation maintenance of general anaesthesia was with sevoflurane (2%) and air-oxygen mixture (3L/min).

Group A: Under strict aseptic precautions, the patient was placed in the lateral decubitus position with the surgical side up, and the low frequency curvilinear ultrasound probe was placed in the axial plane cranial to the iliac crest in the posterior axillary line. Once the shamrock sign was identified, a 23G Quincke spinal needle with a 10cm extension connector was inserted from the posterior end of the probe through the quadratus lumborum muscle using an in-plane technique. Following hydrodissection and multiple negative blood aspirations, 20 ml of 0.25%bupivacaine was injected into the fascial plane between the quadratus lumborum and the psoas major muscle. Successful injectate spread was confirmed by turning the transducer 90 degrees into the longitudinal sagittal plane and cephalad injectate spread from the iliac crest towards the openings in the diaphragm.

Group B: Under strict aseptic precautions, the patient was placed in the lateral decubitus position with the surgical side up, and the low frequency curvilinear ultrasound probe was placed in the axial plane cranial to the iliac crest in the posterior axillary line. Once the shamrock sign was identified, a 23G Quincke spinal needle with a 10cm extension connector was inserted from the posterior end of the probe through the quadratus lumborum muscle using an in-plane technique. Following hydrodissection and multiple negative blood aspirations, 20 ml of normal saline was injected into the fascial plane between the quadratus lumborum and the psoas major muscle. Successful injectate spread was confirmed by turning the transducer 90 degrees into the longitudinal sagittal plane and cephalad injectate spread from the iliac crest towards the openings in the diaphragm.

All blocks were administered by the same skilled anaesthesiologist.

After giving block, patient was supined and surgery was proceeded. At the end of surgery, neuromuscular blockade was reversed with intravenous Neostigmine at 0.05 mg/kg and intravenous Glycopyrrolate at 0.01 mg/kg. After ensuring adequacy of neuromuscular blockade reversal, patients were extubated. The time of extubation was taken as 0 hrs (Ohr Post EXtubation) (0 hrs PEX).

Patients were kept in head up position and shifted to PACU.

At 15 mins, 1hr, 2hr, 6h, 12h, and 24h postoperatively, each patient's pain intensity was assessed using the Visual analogue scale (VAS) score for pain: range 0-10 (0=no pain, 10=worst pain ever).

All patients received 6L/min of O2 via Hudson facemask and 15mg/kg TDS of intravenous paracetamol.

The VAS Score was monitored by a post-anesthesia care unit staff nurse who was not aware of the patient's group assignment and was not present in the operating room.

Observation and results

Age: Chi square test was used to compare age between both the groups, the difference between the age groups of both the study groups was not statistically significant (P value= 0.888).

Gender: The gender between the groups were compared using Pearson's Chi-square test with p value=0.113 which shows no statistical significant association between Gender and Groups.

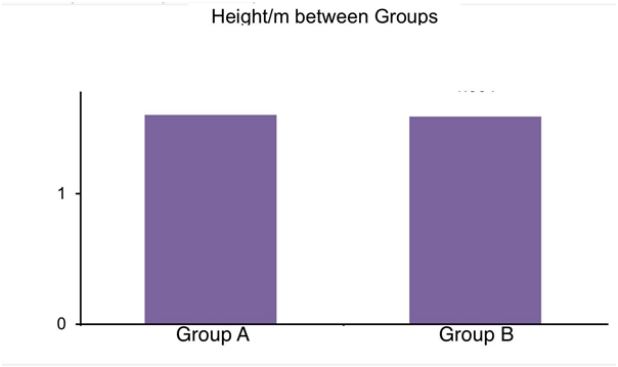
ASA physical status score: ASA class between two groups were compared by Pearson's Chi-square test with p value =0.336 which shows no statistical significant association between ASA class and the groups.

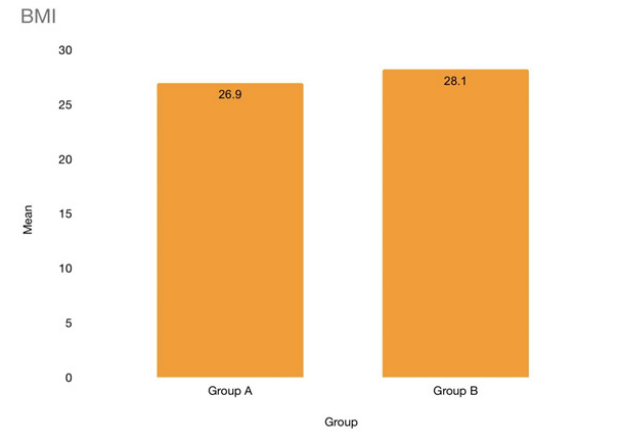
Weight: The weight between groups were compared by independent t test with p value =0.465 which shows no statistical significant association between Weight and the groups.

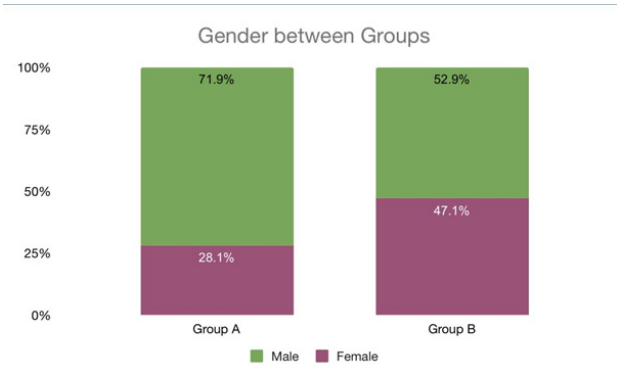
Height: The comparison between height between groups were compared by independent t test with p value =0.257 which shows no statistical significant association between height and the groups.

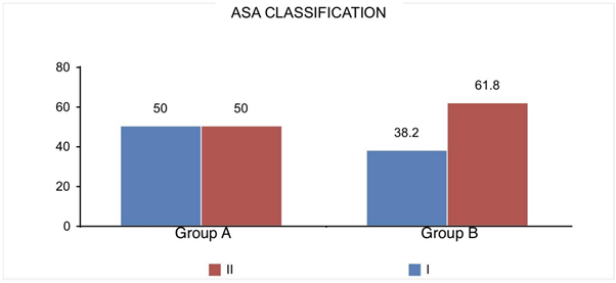
BMI: The comparison between BMI between groups were compared by independent t test with p value =0.223 which shows no statistical significant association between BMI and the groups.

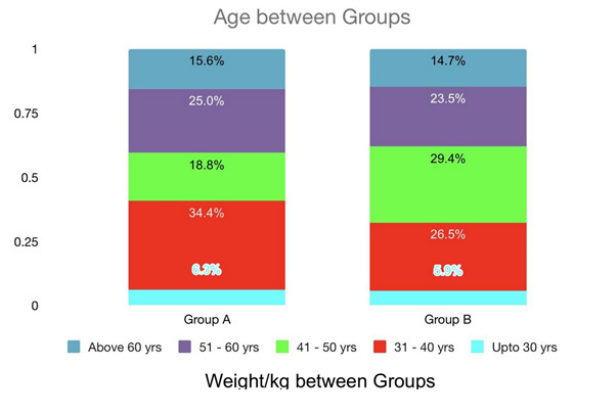
VAS at different time intervals: The VAS Score in Group A was less as compared to Group B. The difference was statistically significant ($p<0.05$) using Mann- Whitney U test at 15min, 1h, 2h, 4h, 6h, 8h (Figures) (Tables 1-7).

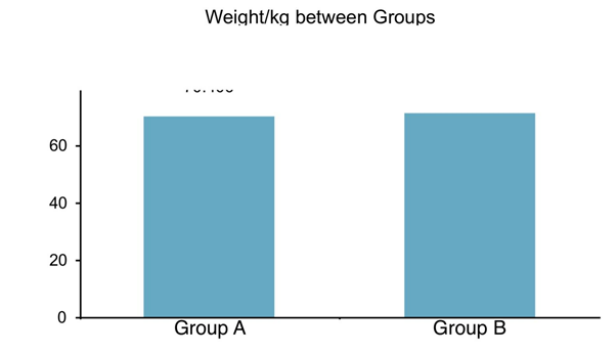












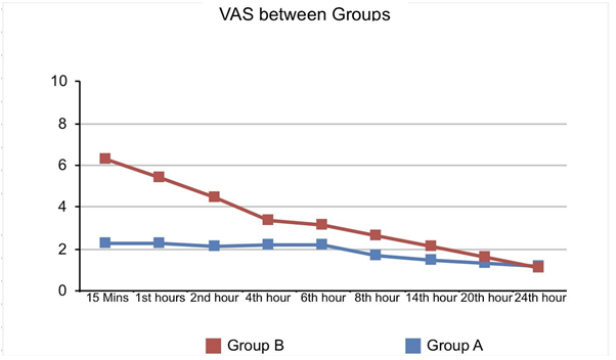


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Table 1 Description and mean comparison of study subjects according to their age category

Age		Groups		Total	p value
		Group A	Group B		
upto 30 yrs	count	2	2	4	0.888
	%	6.20%	5.90%	6.10%	
31 - 40 yrs	count	11	9	20	
	%	34.40%	26.50%	30.30%	
41 - 50 yrs	count	6	10	16	
	%	18.80%	29.40%	24.20%	
51 - 60 yrs	count	8	8	16	
	%	25.00%	23.50%	24.20%	
Above 60 yrs	count	5	5	10	
	%	15.60%	14.70%	15.20%	
Total	count	32	34	66	
	%	100.00%	100.00%	100.00%	

Table 2 Description and comparison of study subjects according to their gender

Gender		Group A	Group B	Total	p-value
Male	Count	23	18	41	0.113
	% within Group	71.90%	52.90%	62.10%	
Female	count	9	16	25	
	% within Group	28.10%	47.10%	37.90%	
Total	count	32	34	66	
	% within Group	100.00%	100.00%	100.00%	

Table 3 Description and comparison of study subjects according to their ASA category

ASA		Group A	Group B	Total	p-value
I	Count	16	13	29	0.336
	% within Group	50.00%	38.20%	43.90%	
II	count	16	21	37	
	% within Group	50.00%	61.80%	56.10%	
Total	count	32	34	66	
	% within Group	100.00%	100.00%	100.00%	

Table 4 Description and comparison of study subjects according to their weight

Group	Mean	SD	P value
Group A	70.4	7.4	0.465
Group B	71.9	9.1	

Table 5 Description and comparison of study subjects according to their BMI

Group	Mean	SD	p value
Group A	26.9	3.1	0.223
Group B	28.1	4.7	

Table 6 Description and comparison of study subjects according to their height

Group	Mean	SD	p value
Group A	1.6	0	0.257
Group B	1.6	0.1	

VAS at different time intervals

Table 7 Comparison of VAS Score between two groups

VAS	Group	Mean	p-value
15minutes	Group A	2.16	0.000*
	Group B	6.26	
1 hour	Group A	2.28	0.000*
	Group B	5.32	
2 hour	Group A	2.09	0.000*
	Group B	4.44	
4 hour	Group A	2.22	0.011*
	Group B	3.26	
6 hour	Group A	2.25	0.022*
	Group B	3.12	
8 hour	Group A	1.66	0.003*
	Group B	2.62	
14 hour	Group A	1.47	0.018*
	Group B	2.12	
20 hour	Group A	1.31	0.283
	Group B	1.62	
24 hour	Group A	1.16	0.845
	Group B	1.09	

Discussion

In this study we conducted a prospective, randomized, double blinded study and we evaluated the postoperative analgesic efficacy of ultrasound guided transmuscular quadratus lumborum block in patients undergoing elective PCNL surgery under general anaesthesia.66 patients completed the study with 33 patients in each group. Group A underwent unilateral ultrasound guided transmuscular Quadratus Lumborum block with 20 ml of 0.25% bupivacaine. Group B received unilateral ultrasound guided infiltration with 20 ml of normal saline into the same fascial plane as Group A .All the demographic parameters were insignificant between the two groups . The mean VAS scores recorded at 15 minutes, 1, 2, 4, 6, 8, 14 h postoperatively between the two groups were less in the ultrasound guided transmuscular QLB group when compared to the control group and this variation was statistically significant (P<0.05) and the mean VAS Score was statistically insignificant at 20 and 24 h between the interventional and control group .According to our findings, ultrasound-guided QLB significantly resulted in lower postoperative pain scores.

M Dam et al.[12] performed a single center randomized controlled double blinded study. The study was done in 60 patients undergoing PCNL surgery who were randomly assigned into two groups. Patients in one group received 30 ml of 0.75% Ropivacaine, while the control group received 30ml of normal saline .It was found that the interventional group had lower postoperative morphine consumption at 6h [7.2mg vs 90.6mg] (p<0.001), oral morphine equivalents 6 to 12h [5.4mg vs 14.42 mg] (p<0.009), and oral morphine equivalents 12 to 18h [16.8 mg vs 10.38 mg] (p<0.04), total morphine equivalents 0 to 24h [54 mg vs 126 mg] (p<0.0011*), time to first opioid requirement [678 min vs 36 min] (p<0.0001*) was longer in interventional group , NRS Score [1.36 vs 1.85] (p<o.2) was statistically insignificant, time to first ambulation [302 min vs 595 min] (p<0.004*).The study suggested that ultrasound guided QLB reduces postoperative opioid requirement and better postoperative VAS Score in PCNL surgery. The outcomes measured were consistent with our study. E kilic et al.[13] conducted a prospective randomized double blinded study. 44 patients undergoing elective PCNL under spinal anesthesia were randomly allocated into two groups. Patients in one group received

transmuscular QLB with 0.9% saline, while the patients in the other group received transmuscular QLB with 0.0125% isobaric bupivacaine with ultrasound guided transmuscular QLB. The results of the study for the postoperative morphine consumption at 4h [Group S=1.63mg vs Group Q=0.59mg] (p<0.001*), 8h [Group S=8.68 mg vs Group Q=1.27mg] (p<0.00*), 12h Group S=13.8 mg vs Group Q=7.86mg] (p<0.00*), 24h[Group S=28.5mg vs Group Q=10.22mg] (p<0.00*), 48h [Group S=5.4mg vs Group Q=4.45mg (p<0.13) These results show that morphine consumption was less till 24 hours postoperatively in the group which received transmuscular QLB in PCNL surgery. VAS score 4h [Group S=1.59±0.73 vs Group Q=1.27±O.7] (p<0.14), 8h [Group S=6±1.66 vs Group Q=0.54±0.5] (p<0.0001*), 12h Group S=4.59±1.09 vs Group Q=0.77±0.75](p<0.0001*), 24h [Group S=3.45±1.01 vs Group Q=0.95±0.84] (p<0.0001*). It was found that the VAS score was significantly lesser at the 8th, 12th, and 24th hour in the interventional group (p<0.05) whereas in our study the score was found to be less in the transmuscular quadratus lumborum group till the 14th hour post operatively. These results support our study.

R Raman et al.[14] conducted a prospective randomized double blinded study on 40 patients undergoing PCNL surgery under spinal anesthesia. Patients were divided into two groups at random. Patients in one of the two groups were given 30 ml of 0.2% ropivacaine as an ultrasound-guided posterior QLB, while patients in the other group were given normal saline. The primary goal of the study was to track the duration of analgesia, with secondary goals including postoperative VAS score, total dose of paracetamol consumed, and total dose of tramadol required. The duration of analgesia [290 minutes in the control group and 167 minutes in the QLB group] (p=0.001) was significantly longer in the QLB group than in the control group. VAS score was significantly lower in the QLB group until 20 hours postoperatively, as was total analgesic consumption [Tramadol consumption in the QLB group=84.70mg vs 175 mg in the control group; Paracetamol dose required in the QLB group=1585mg vs. 3428 mg] (p<0.001) was also lower in the QLB group. The study concluded that the postoperative analgesic effect of ultrasound guided posterior QLB on PCNL surgery was significant.

L Chen et al.[15] performed a retrospective study in which they compared the analgesic effect of ultrasound guided QLB via lateral approach and transmuscular QLB approach with a control group for patients undergoing percutaneous nephrolithotomy (PCNL) and discovered that patients who received QLB in either approach had a lower cumulative intraoperative opioid consumption and a lower VAS score at rest and 24 hours after surgery, but there was no significant difference between the two approaches. In our study, however, we discovered that the VAS score was significantly lower until 14 hours after surgery.

Dose and volume of drug used:

There is no previous study stating the appropriate concentration and volume of local anaesthetic to be injected in ultrasound guided QLB. Carney et al.[16] used 0.3 to 0.6 mL/kg of LA along with contrast to study the anatomical distribution of contrast in thoracic paravertebral space. Considering the previous study, we used 20 ml of 0.25% Bupivacaine in our study as at least 20 mL of the LA is required for a unilateral block. Murouchi et al.[17] after giving QLB using 20 mL per side from 0.375% ropivacaine measured the plasma LA concentration and found that it was less than the toxic threshold. Ropivacaine at a dose of 4 mg/kg have been used for single shot blocks. In our study we used 20 ml of 0.25% bupivacaine and at this dose we observed no signs of Local anesthetic systemic toxicity. In Future, further studies have to be done to find the minimal dosage of LA required for its maximum efficacy with minimal risk of Local anesthetic systemic toxicity (LAST). The ultrasound guided transmuscular QLB is still used as a part of multimodal analgesia and it has not been used as a sole anaesthetic technique and its role in completely alleviating somatic and visceral pain is yet to be studied.

Conclusion

In this prospective, randomised, double blinded study, we evaluated the analgesic efficacy of transmuscular quadratus lumborum block in patients aged between 18 and 65 years undergoing elective PCNL surgery under general anaesthesia with ASA physical status I and II. From our study we conclude that Transmuscular Quadratus block with Bupivacaine provide effective analgesia in postoperative period with lesser postoperative pain Score (VAS Scale) in patients undergoing elective PCNL surgery under general anaesthesia.

Acknowledgments

None.

Conflicts of interest

None.

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