

Comparison between ‘Three in One Femoral Nerve Block’ and Psoas Compartment Block for Post-Operative Pain Relief Following Lower Limb Surgical Procedures

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Abstract

Introduction: Peripheral nerve blocks are suitable substitutes for parenteral analgesics for post-operative analgesia in lower limb surgery. Lumbar plexus block can provide good analgesia after hip, femur and knee surgery.

Aims: To compare the efficacy of ‘3 in 1’ block with psoas compartment block in relieving the post-operative pain in the patients, operated for unilateral hip, femur, or knee surgery under spinal anaesthesia

Materials and Methods: The A randomized, prospective, single blinded comparative study was conducted among the patients undergoing lower limb surgical procedures for 18 months from January 2021 – June 2022. 60 patients of age 15-50 years of ASA 1 to 2 undergoing lower limb surgery in orthopaedics OT, were included in the study.

Results: Majority (33.3%) of study participants in group 1 and 2 belonged to age category 21 to 30 years. In both the groups, majority (26/30) participants were males. There is no significant difference between the mean weights, height, BMI in the participants of two groups. The mean time taken for nerve block in group 1 & 2 is 328 ± 40 seconds and 329.5 ± 57.6 seconds. There is no significant difference between the mean time taken for nerve block in the participants of two groups. The mean time taken for onset for analgesia in group 1 is 294 ± 33.7 seconds and 298 ± 36.8 seconds. There is no significant difference between the mean time taken for onset of analgesia in the participants of two groups. No significant difference between the systolic, diastolic and mean arterial pressures and pulse rate among the two groups before and after the nerve blocks. No significant difference between the Times to First dose analgesia of both groups is noted. No significant difference is noticed between the two groups in verbal rating scale at any given points. Majority (76%) of the study participants were satisfied with analgesia produced by nerve blocks of either type.

Conclusion: 3 in 1’ block and psoas compartment block are equally efficacious in relieving the post-operative pain in lower limb surgeries under spinal anaesthesia.

Keywords: Psoas compartment block, 3 in 1 femoral nerve block, Postoperative analgesia.

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Introduction

Peripheral nerve blocks are used for performing surgeries and also for post-operative analgesia, depending upon the concentration of local anaesthetics used, Peripheral nerve blocks are suitable alternatives for parenteral analgesics for post-operative analgesia in lower limb surgery. Lumbar plexus block is advanced regional anaesthesia technique, has been used for number of lower limb procedures particularly for femur shaft and femur neck fractures. The inguinal perivascular

technique of lumbar plexus commonly known as ‘3 in 1’ block provides effective analgesia in hip and knee surgeries and surgeries on femur. [1,2,3] Efficacy of 3 in 1 block is limited due to incomplete block of obturator nerve, as it is mainly a motor nerve and gives few sensory branches. Incomplete analgesia after hip surgery if complete nerve block is not attained. Alternative technique for lumbar plexus analgesia is psoas compartment block. The present study was done to compare the

efficacy of “3 in 1” versus psoas compartmental block in relieving post-operative pain for lower limb surgeries[4,5,6].

Materials and Methods

The current study was conducted among the patients undergoing lower limb surgical procedures in the Department of Anaesthesia, Siddhartha Medical College, Vijayawada.

Study period: 18 months from January 2021 – June 2022.

Type of study: A randomized, prospective, single blinded comparative study

Source of data

After getting approval from the Institutional Ethics Committee, patients of age 15-50 years of ASA 1 to 2 undergoing lower limb surgery in orthopaedics OT, were included in the study.

Sample size calculation:

Nearly 5% of the surgeries performed in our tertiary care hospital were done on lower limb

$$N = Z^2 PQ / E^2$$

N-sample size P-Prevalence- 5%

$$Q = 1 - P$$

E-Error: 5%,

Z-Constant number for 90% confidence levels
N=54.

54 is the minimum sample size. Hence in our study 60 patients planned for lower limb surgery are included in the study. All 60 patients provided consent for the study.

Inclusion Criteria

Patients posted for lower limb surgery and who satisfy the following criteria are included in the study Age 15-50 years, BMI<30 and ASA physical status I and II . Those with normal clinical, biochemical, radiological and hematological parameters were selected.

Exclusion Criteria

History of allergy to local anesthetics, bleeding diathesis , neurological disorders , local sepsis and other contraindications for spinal anesthesia and obesity.

Technique of psoas compartment block (Figure-1)

Patient is placed in lateral decubitus position with the side to be blocked uppermost. The skin over the area to be injected is prepared with antiseptic

solution. A line is drawn between the iliac crests and midpoint at the fourth lumbar spine is marked. A second line is drawn 5cms para sagittally to the midline. This identifies the injection site, at the intersecting point of these two lines. A 22 gauge, four inches, Teflon coated, needle is inserted. The transverse process of lumbar fifth vertebrae is located with the needle. The needle is then slightly withdrawn and redirected cephalad until it slips past the transverse process. Now the nerve locator is set to deliver a current of 1-2 mA at a frequency of 1 Hz. Needle is advanced until the lumbar plexus is located by quadriceps contraction. Once the lumbar plexus is located, twitch strength is decreased to 0.4 - 0.6 mA while adjusting the needle to maintain quadriceps contraction (patellar twitch). The needle is then held in place and after negative aspiration for blood; 30 ml of 0.25% bupivacaine is injected with aspiration attempted after each 5 milliliters.

Technique of three-in-one nerve block

Patient is positioned supine with 15° abduction of thigh on a flat surface. The inguinal region is thoroughly cleaned with povidone iodine solution and sterile drapes are placed around the site. Anterior superior iliac spine, pubic tubercle and femoral artery are identified. A line is drawn between the anterior superior iliac spine and pubic tubercle. Femoral artery is located at the midpoint of inguinal ligament. Femoral nerve lies lateral to the artery. Conductive patches are attached on the ipsilateral thoracic wall and connected to the nerve locator. The site of puncture for entry into the perineural space of the femoral nerve is located approximately 1.5cm below the inguinal ligament and 1.5 cm lateral to the femoral artery. A 2inch, 22 G, short bevelled, Teflon coated, nerve locator with attached stimulator is advanced slowly at an angle of 45° to skin, parallel to the femoral artery in a cranio-dorsal direction. Once the needle is through the skin the nerve stimulation output is adjusted to 1 - 2 mA with a frequency of 1 Hz. A motor evoked response of movement of patella indicates stimulation of femoral nerve. Once the nerve is located, the needle position is optimized and the stimulus intensity is reduced until a patellar twitch is present at an output of 0.4 - 0.6 mA. After negative aspiration for the blood, a volume of 30ml of 0.25% bupivacaine was given with distal pressure to push the local anaesthetic upwards. With this volume, local anaesthetic tracks along the facial sheath to block the lumbar plexus i.e., the obturator nerve, lateral femoral cutaneous nerve and the femoral nerve.



Figure 1: PSOAS compartment block

Pain Score

- 0 - No Pain
- 1 - Mild Pain
- 2 - Moderate Pain
- 3 - Severe & Intolerable Pain

Premedication

All patients were premedicated with Tab. Diazepam 10mg the previous night. On arrival of the patient in the operating room, ECG, Pulse oximetry and blood pressure base line values were recorded. After explaining the procedure to the patient an intravenous access was obtained in the dorsum of the hand and intravenous infusion of Ringer lactate was started. Injection midazolam 0.05mg / kg given to all the patients. Patients will receive final anaesthesia for surgical procedure, after the completion of surgery and regression spinal anaesthesia below T12 level.

Then they were given either 3 in 1 block (group 1) or psoas compartmental block (group 2) as per their randomization which is generated by a software.

After completion of blocks, patients were placed in supine and checked for loss of cold sensation using spirit in a cotton, every 30 seconds.

Lack of sensation for cold is taken as the time for onset of block. After evaluating the onset time, both groups were evaluated for pain using 4-point verbal rating scale.

- 0 - no pain
- 1 - Mild pain
- 2 - Moderate pain
- 3 - Severe pain

They were assessed at 0 hour, at 6 hours and time of onset of severe pain noted. If the patients have a

pain score of 3 at 0 hour considered as block failure and excluded from study. If the VRS score is equal to 2, they will receive a dose of Diclofenac sodium.

VRS > 2 will receive opioids (Pentazocine / Promethazine) and the time noted.

Local anaesthetic toxic reactions including subjective and objective manifestations like circumoral numbness, tinnitus, twitching, convulsion etc., if any were looked for and appropriate measure were planned. Any other complications like hematoma (or) bleeding were noted.

Statistical Analysis

The following assumption on the data was made: Dependent variables are normally distributed. The data collected was entered in MS Excel 2019 and analysis was carried out using Microsoft excel and statistical software called Epi Info version 26. Frequencies, percentages were used to describe the data. Continuous variables were assessed using mean and SD. Categorical findings were assessed using chi square test. T test was used for numerical parameters.

The permission from the Institutional ethical committee attached to Siddhartha Medical College & Hospital, Vijayawada was taken before conducting the study. Every patient was explained the whole process and advantages of availing their data for the study, without revealing the type of block. The patients were also told that their information will be kept confidential. After he/she accepts, an informed consent form was given in the local language or understandable language and the person was asked to sign it or put a thumb impression. They were assured that their doubts if any to be clarified at any time

Results

Table 1: Demographic details in present study

Age in mean	Group 1	Group 2
10 to 20	2 (6.7%)	3 (10%)
21 to 30	10 (33.33%)	11 (36.7%)
31 to 40	5 (16.7%)	7 (23.3%)
41 to 50	9 (30%)	2 (6.7%)
51 to 60	3 (10%)	5 (16.7%)
61 to 70	1 (3.3%)	2 (6.7%)
Total	30	30
Gender		
Males	26	26
Females	4	4
Mean height in cm	167.6±6.3	166.6±5.8
Mean weight (kg)	62±7.3	62.6±6.3
Mean BMI (kg/m ²)	22.1±1.8	22.5±2.0

All demographic details are comparable in present study.

Table 2: Mean time for nerve block and time taken for onset for analgesia in both groups

Mean time for nerve block(sec)		S D
1	328.0000	40.0990
2	329.5000	57.6606
P-value	0.9	
Mean time taken for onset for analgesia (sec)		SD
Group 1	294.0000	33.7945
Group 2	298.0000	36.8969
p-value	0.6	

The mean time taken for onset for analgesia in group 1 is 294 ± 33.7 seconds. The mean time taken for onset for analgesia in group 2 is 298 ± 36.8 seconds. Analgesia was attained at the earliest in 240 seconds in group 1. Analgesia was attained at the earliest in 240 seconds in group 2. The maximum time to attain the analgesia in group 1 is 360 seconds. The maximum time to attain the analgesia in group 2 is 360 seconds.

Table 3: Hemodynamic parameters comparison in both the groups

systolic blood pressure	Before block	After block	Intra group p-value
Group 1	118.2 ± 5.9	117.9 ± 6.09	0.27
Group 2	118 ± 6.5	120 ± 6.46	0.16
Inter group P value	0.8	0.18	
Diastolic blood pressure			
Group 1	80.3 ± 3.9	80.2 ± 3.6	0.3
Group 2	82.2 ± 4.4	82.0 ± 4.5	0.18
Inter group P value	0.08	0.09	
Mean diastolic blood pressure			
Group 1	79.4 ± 5.5	80.2 ± 3.6	0.6
Group 2	79.4 ± 3.2	82.0 ± 4.5	0.15
Inter group P value	0.08	0.09	
Mean Pulse rate			
Group 1	79.9 ± 4.9	80 ± 5.6	0.4
Group 2	79.3 ± 3.0	80.4 ± 4.12	0.3
Inter group P value	0.5	0.7	

Systolic blood pressure, diastolic blood pressure, mean diastolic BP and pulse rate are insignificant in both groups.

Table 4: Verbal rating scale in comparison in both the groups

VRS	Group 1	Group 2	P value
At 6 hours	0.4 ± 0.6	0.2 ± 0.4	0.2
At 8 hours	0.16 ± 0.3	0.16 ± 0.3	1.0

At 10 hours	0.16 ± 0.3	0.23 ± 0.5	0.56
At 12 hours	0.16 ± 0.37	0.23 ± 0.5	0.56
At 24 hours	0.16 ± 0.37	0.16 ± 0.37	1.0

No significant difference is noticed between the two groups in verbal rating scale at any given points (p>0.5)

Table 5: Comparison of patient satisfaction with either of the nerve blocks

Patient Satisfaction	1	2	Total
Excellent	5	4	9
Good	23	23	46
Poor	2	3	5
Total	30	30	60

Majority of the study participants were satisfied with analgesia produced by nerve blocks of either type.

Discussion

In present study majority (33.3%) of study participants in group 1 belonged to age category 21 to 30 years. Majority (36.6%) of study participants in group 2 belonged to age category 21 to 30 years. In both the groups, majority (26/30) participants were males. In group 1, female participants are

present. In-group 2, four female participants are observed in the present study.

Similar gender distribution is observed between the two studies. There is no significant difference between the mean heights in the participants of two groups (P=0.5). This is in similarity to the study done by Arul. [8]

Table 6: Comparison of variables with other studies

Age categories	Present study	Study by Arul[8]
0-25	33.3 % vs 16.6%	20% vs 20%
26-35	16.6 % vs 46.6 %	28% vs 44%
36-45	13.3 % vs 10 %	20% vs 12%
46-55	26.6% vs 16%	20% vs 16%
≥56	10 % vs 26.6%	12% vs 8%
Gender		
Males	86% vs 86 %	92% vs 88%
Females	13.3% vs 13.3%	8% vs 12%
Mean height (cm)		
Group 1	167.60 ± 6.3	167.5 ± 1.2
Group 2	166.70 ± 5.8	166.8 ± 1.2
P value	(P=0.5)	P= 0.7
Mean weight (kg)		
Group 1	62.0 ± 7.3	62.44 ± 1.3
Group 2	62.6 ± 6.3	62.52 ± 1.29
P value	0.7	0.9
Mean BMI (kg/m2)		
1	22.1 ± 1.8	22.8 ± 1.7
2	22.5 ± 2.0	22.4 ± 2.1
P value	(P=0.4)	P=0.07
Mean time for nerve block(sec)		
1	328 ± 40	327.2 ± 7.7
2	329.5 ± 57.6	333.8 ± 11.04
P value	(p=0.9)	P=0.6
Mean time taken for onset for analgesia (sec)		
Group1	294 ± 33.7	292.8 ± 7.2
Group 2	298 ± 36.8	292.8 ± 6.9
P value	0.6	0.0
Mean Time to First dose analgesia (sec)		
Group1	7.4 ± 0.6	9.10 ± 1.52
Group 2	7.46 ± 0.62	9.90 ± 1.21
P value	0.68	0.07

The mean Weight of the study participants in group 1 is 62 ± 7.3 kg. The mean Weight of the study participants in group 2 is 62.6 ± 6.3 kg. The study participants Weight ranged from 56 kg to 75 kg in group 1. The study participants Weight ranged from 58 kg to 75 kg in group 2. There is no significant difference between the mean weight in the participants of two groups ($P=0.7$). This is in similarity to the study done by Arul [8]. There is no significant difference between the mean BMI in the participants of two groups ($P=0.4$). This is in similarity to the study done by Arul [8]. The mean time taken for nerve block in group 1 is 328 ± 40 seconds. The mean time taken for nerve block in group 2 is 329.5 ± 57.6 seconds. The nerve block was attained at the earliest in 270 seconds in group 1. The nerve block was attained at the earliest in 240 seconds in group 2. The maximum time to attain the nerve block in group 1 is 400 seconds. The maximum time to attain the nerve block in group 2 is 420 seconds. There is no significant difference between the mean time taken for nerve block in the participants of two groups ($P=0.4$). This is in similarity to the study done by Arul [8]. Analgesia was attained at the earliest in 240 seconds in group 2. The maximum time to attain the analgesia in group 1 is 360 seconds. The maximum time to attain the analgesia in group 2 is 360 seconds. There is no significant difference between the mean time taken for onset of analgesia in the participants of two groups ($P=0.4$). But this is not in concordance with the study done by Arul [8]. ($p=0.0$). No significant difference between the systolic blood pressures before the nerve block of both groups is noted in our study ($p=0.8$). No significant difference between the systolic blood pressures after the nerve block of both groups is noted ($p=0.18$). No significant difference between the systolic blood pressures before and after the nerve block in group 1 is noted ($p=0.27$) No significant difference between the systolic blood pressures before and after the nerve block in group 2 is noted ($p=0.16$).

No significant difference between the Diastolic blood pressures after the nerve block of both groups is noted ($p=0.09$). No significant difference between the Diastolic blood pressures before and after the nerve block in group 1 is noted ($p=0.3$) No significant difference between the Diastolic blood pressures before and after the nerve block in group 2 is noted ($p=0.18$).

No significant difference between the Mean Arterial blood pressures before the nerve block of both groups is noted ($p=1.0$). No significant difference between the Mean Arterial blood pressures after the nerve block of both groups is noted ($p=0.09$). No significant difference between the Mean Arterial blood pressures before and after the nerve block in group 1 is noted ($p=0.6$) No

significant difference between the Mean Arterial blood pressures before and after the nerve block in group 2 is noted ($p=0.15$)

No significant difference between the Mean Pulse Rate after the nerve block of both groups is noted ($p=0.7$). No significant difference between the Mean Pulse Rate before and after the nerve block in group 1 is noted ($p=0.4$) No significant difference between the Mean Pulse Rate before and after the nerve block in group 2 is noted ($p=0.3$). The vital parameters like systolic, diastolic and mean arterial blood pressures and pulse rate were not studied in previous studies. The present study tried to look into these parameters in both the groups before and after the nerve block. In a study done by Gould et al [10] that the primary anaesthetic technique (MAC, regional, central neuraxial, general) had a significant effect on intraoperative blood pressure in hypertensive patients' hypothesis is tested. Patients receiving MAC or regional anaesthetics had less dramatic BP declines compared to central neuraxial and general techniques. The primary anaesthetic technique is a highly significant predictor of intraoperative blood pressure change: central neuraxial and general anaesthetics have the largest effect on blood pressure. The observation that patients with higher initial blood pressures have larger drops intraoperatively indicates that severe hypertension regardless of preoperative treatment places patients at increased risk for blood pressure lability intraoperatively, regardless of technique. If good control of BP is a goal in hypertensive patients, regional anaesthesia (when appropriate) is the technique of choice. Hence these parameters were studied and no significant difference in these above-mentioned parameters in both the groups before and after nerve block was observed.

No significant difference between the Time to First dose analgesia of both groups is noted ($p=0.68$). Mean time taken for first dose analgesia between two studies. The mean Verbal Rating Scale at 6 hours after the block in group 1 is 0.4 ± 0.6 . The mean Verbal Rating Scale at 6 hours after the block in group 2 is 0.2 ± 0.4 . The verbal rating scale in group 1 ranged from 0 to 2 at 6 hours after the block. The verbal rating scale in group 2 ranged from 0 to 1 at 6 hours after the block. The mean Verbal Rating Scale at 8 hours after the block in group 1 is 0.16 ± 0.3 . The mean Verbal Rating Scale at 8 hours after the block in group 2 is 0.16 ± 0.3 the verbal rating scale in both the groups ranged from 0 to 1 at 8 hours after the block. The mean Verbal Rating Scale at 10 hours after the block in group 1 is 0.16 ± 0.37 . The mean Verbal Rating Scale at 10 hours after the block in group 1 is 0.23 ± 0.5 . The mean Verbal Rating Scale at 12 hours after the block in group 1 is 0.16 ± 0.37 . The mean Verbal Rating Scale at 12 hours after the block in

group 2 is 0.23 ± 0.5 . The verbal rating scale in group 1 ranged from 0 to 1 at 10, 12 and 24 hours after the block. The verbal rating scale in group 2 ranged from 0 to 2 at 10 and 12 hours after the block. The mean Verbal Rating Scale at 24 hours after the block in group 1 is 0.16 ± 0.37 . The mean Verbal Rating Scale at 24 hours after the block in

group 2 is 0.16 ± 0.37 . The verbal rating scale in group 2 ranged from 0 to 1 at 24 hours after the block. No significant difference is noticed between the two groups in verbal rating scale at any given points ($p > 0.5$). The result of this study was comparable with different studies done previously [12, 13]

Table 7: Mean verbal rating scale comparison between two studies

Verbal Rating Scale Group 1 vs group 2 (p value)	Present study	Study by Ponnambala[11]
At 6 hours	0.4 ± 0.6 vs 0.2 ± 0.4 ($p = 0.2$)	0.05 ± 0.22 vs 0.02 ± 0.01 ($p = 0.32$)
At 8 hours	0.16 ± 0.3 vs 0.16 ± 0.3 ($p = 1.0$)	0.45 ± 0.51 vs 0.20 ± 0.41 ($p = 0.10$)
At 10 hours	0.16 ± 0.3 vs 0.23 ± 0.5 ($p = 0.56$)	0.40 ± 0.5 vs 0.65 ± 0.49 ($p = 0.12$)
At 12 hours	0.16 ± 0.37 vs 0.23 ± 0.5 ($p = 0.56$)	0.15 ± 0.37 vs 0.15 ± 0.37 ($p = 1$)
At 24 hours	0.16 ± 0.37 vs 0.16 ± 0.37 ($p = 1.0$)	1.10 ± 0.72 vs 0.80 ± 0.7 ($p = 0.19$)

Majority of the study participants were satisfied with analgesia produced by nerve blocks of either type.

Table 8: Comparison of patient satisfaction between two studies

Patient Satisfaction	Present study		Study by Ponnambala[11]	
	Group 1	Group 2	Group 1	Group 2
Excellent	16.6 %	13.3%	40 %	42.5%
Good	76.6%	76.6%	55%	55%
Poor	6.6%	10%	5%	2.5%

Conclusion

Hence it is concluded from the present study that 3 in 1 block and psoas compartment block are equally efficacious in relieving the post-operative pain in lower limb surgeries under spinal anaesthesia.

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