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Research Article

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

Aim of this study was to compare anterior approach ('three in one block') and posterior approach (psoas compartment block) of lumbar plexus block in relieving the post-operative pain in patients operated for unilateral hip, femur or knee surgery under spinal anaesthesia. 40 patients undergoing elective orthopedic procedure in hip, femur or knee were randomized into group A and group B. Surgery was done under spinal anaesthesia. At the end of the surgery, single shot lumbar plexus block was given by anterior approach (3 in 1 block) in group A and by posterior approach (psoas compartment block) in group-B patients with 30 ml of 0.25% of bupivacaine. Pain was assessed using verbal rating scale. The time for first rescue analgesic, need of additional analgesic and overall satisfaction of post-operative pain relief were noted. Both the groups were comparable in age, sex, weight, height, vital signs, duration and type of surgery. There is no significant difference in pain level between two groups. The mean time for first rescue analgesia was 9.10 (± 1.52) and 9.90 (± 1.21) hours in group A and group B respectively ($p>0.05$ not significant). Requirement of additional analgesic was reduced in both groups. More than 90% of patients expressed overall satisfaction of post-operative pain relief in both groups. Both approaches of lumbar plexus block by Three in one femoral nerve block (Group A) and psoas compartment block (Group B) were effective in providing post-operative analgesia after hip, femur, or knee surgery.

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

INTRODUCTION

Post operative pain following major lower limb surgery is often troublesome and requires aggressive management. Post operative pain relief can be achieved by a variety of techniques including parenteral NSAIDS, epidural analgesia or intravenous analgesia with opioids.

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. Lumbar plexus block can be achieved by two techniques viz (i) Inguinal perivascular technique (Anterior approach) or (ii) Psoas compartment block (Posterior approach).

The inguinal perivascular technique of lumbar plexus block, commonly known as '3 in 1' block has been shown to provide effective analgesia following hip and knee surgery. Some investigators have questioned its efficacy due to incomplete block of obturator nerve.[1,2] Failure to achieve block of this nerve may cause incomplete analgesia after hip surgery.

Psoas compartment block (PSB) has been reported to be more effective in producing complete block providing

better analgesia after hip operation.[2] The present study was done to compare the efficacy of "3 in 1"block versus psoas compartmental block in relieving post-operative pain for orthopedic procedures in hip, femur and knee surgeries.

Aim of the study

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 ,in terms of time of first rescue analgesia administration, additional analgesia requirement and satisfaction of post-operative analgesia.

METHODS

It is a prospective, randomized, controlled, single blinded study. Forty patients (n=40) belonging to ASA I & II who were to undergo elective orthopedic hip, femur and knee surgeries were chosen. All the patients were assessed preoperatively. Patients of physical status ASA I & II with a BMI <30 and those with normal clinical, biochemical, radiological and hematological parameters were selected. Exclusion criteria were history of allergy to local anaesthetics, bleeding diathesis, neurological disorders, local sepsis, patient refusal and other contraindications for spinal anaesthesia and obesity. Procedure was explained to the patients and written informed consent was obtained from all the patients. They were assessed with particular attention for any contraindication. Exact weight was recorded. Overnight fasting was advised. Assessment of pain using modified 4 point verbal rating scale (vide infra) was explained to the patients pre-operatively.

Patients were randomly allocated into one of the two groups.

Group A (n=20): Three in one nerve block

Received 30ml of 0.25% bupivacaine for 3 in 1 nerve block

Group B (n=20): Psoas compartment block

Received 30ml of 0.25% bupivacaine for psoas compartment block

All patients were premedicated with Tab. diazepam 5mg two hours before surgery. In the operating room, patient was connected to ECG, pulse oximetry and automatic non-invasive blood pressure monitor and base line values were recorded. An intravenous access was obtained and preloaded with 15ml/kg Ringer lactate 15 minutes prior to subarachnoid blockade. Under strict aseptic precaution, spinal anaesthesia was given with 3ml of 0.5 % bupivacaine heavy at L3 – L4 interspace. Intraoperatively heart rate, non-invasive blood pressure, ECG and peripheral oxygen saturation were monitored. Total duration of surgery was noted. At the end of surgery, when sensory level regressed to T12, lumbar plexus block was performed, either three in one block or psoas compartment block based on the randomization.

Technique of three-in-one nerve block (Figure 1)

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.

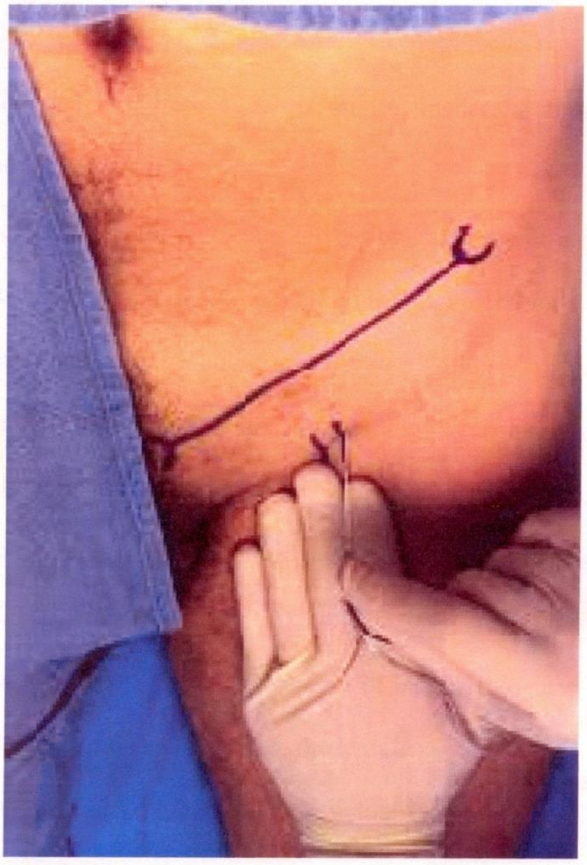

Figure 1: Three in one femoral nerve block.

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.

Technique of psoas compartment block (Figure 2)

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 sagitally to the midline. This identifies the injection site, at the intersecting point of these two lines.

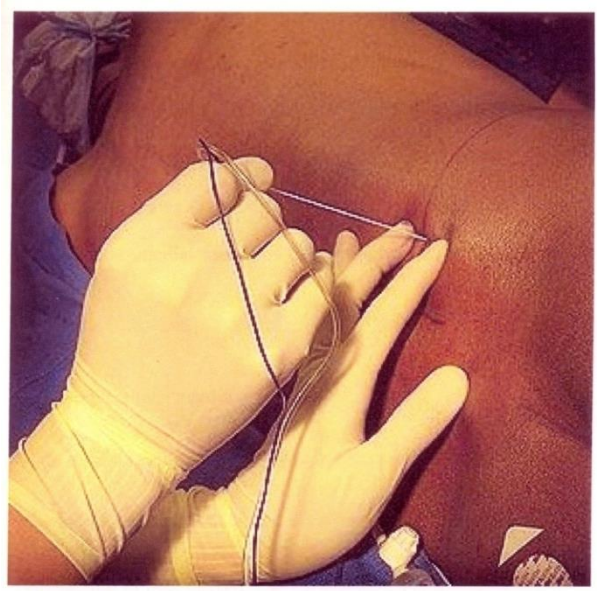

Figure 2: Psoas compartment block.

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.

They were assessed at zero hour (at the time of performing the block), 2 hours,4 hours, 6 hours, 8 hours, 10 hours, 12 hours, 24 hours and the time of onset of mild pain noted. Pain was evaluated using 4 point verbal rating scale (VRS)

0 - No pain

1 - Mild pain, pain reported in response to questioning only, without any behaviour signs

2 - Moderate pain, pain reported in response to questioning and accompanied by behavioural signs

3 - Severe pain, strong verbal response accompanied by facial grimacing, withdrawal of the hand or tears.

If the patient's pain score is 1 at 2 hours it is considered as block failure and excluded from the study.

If the VRS score is equal to 1, they received a dose of inj. Diclofenac sodium 75mg intramuscularly. Additional analgesic of inj. tramadol hydrochloride 100mg I.M. was given if the VRS score was greater than 2.

Local anaesthetic toxic reaction including subjective and objective manifestations like circumoral numbness, tinnitus, twitching, convulsion etc., was looked for and appropriate measures were planned. Any other complication like hematoma or bleeding was looked for and noted.

Both the groups were evaluated for (i) Time of first rescue analgesic drug administration: (When the VRS score is 1) (ii) Any additional analgesic required or not: (VRS score of >2 after first rescue analgesic administration) (iii) Satisfaction post-operative analgesia: excellent/good/poor. (iv) Side effects: Hemodynamic instability, bradycardia, hypotension, nausea, vomiting, accidental intravascular injection etc.

Data was expressed as mean +/- standard deviation. Quantitative analysis was compared with independent sample student's t-test for continuous variables and chi-square test with Yates Correction was used for discrete variables. When using the above statistical tests to compare the mean among the two groups, a p-value of less than 0.05 was taken as significant. All values were rounded off to a maximum of 2 decimals.

RESULTS

The patients in each group were comparable in distribution in terms of age, weight, height and sex.

Average duration of surgery in Group A was 130.25 minutes with standard deviation of 12.77 and in Group B it was 130 minutes with, SD 12.77 (P value = 0.95: not significant).

There was no significant difference between two groups in terms of hemodynamic parameters like heart rate, systolic pressure, diastolic pressure and mean arterial pressure before and after the block.

Mean time at which first rescue analgesic was required

The average time of getting first rescue analgesia in group A was 9.10 hours with standard deviation of 1.52 hours whereas in group B it was 9.90 hours with standard deviation of 1.21 hours (P value = 0.07: not significant) (Table 1).

Table 1: Mean time at which first rescue analgesia was required.

FRA hours	Group A			Group B			P-value
	N	Mean	SD	N	Mean	SD	
	20	9.10	1.52	20	9.90	1.21	0.07*

Not significant

Various times at which first rescue analgesia was required

At the end of 6 hours in group A one patient (5%) received first rescue analgesiawhereas in group B none (0%) of them required first rescue analgesia.At the end of 8 hours in group A nine patients (45%) received first rescue analgesia whereas in group - B it was four patients (20%). At the end of 10 hours, eight patients (40%) in group A andthirteen patients (65%) in group B received first rescue analgesia.

At the end of 12 hours in group A two patients (10%) required first rescue analgesia and in group B it was three patients (15%) (Table 2).

Table 2: Various times at which first rescue analgesia was required.

Time	Group I		Group II		Total	
	N	%	N	%	N	%
6 hours	1	5	-	-	1	2.5
8 hours	9	45	4	20	13	32.5
10 hours	8	40	13	65	21	52.5
12 hours	2	10	3	15	5	12.5
Total	20	100	20	100	20	100

Chi-square 4.13 diff=3 significant value = 0.23 (not significant).

Mean value of verbal rating scale

Among both groups, mean value of verbal rating scale was not statistically different (Table 3).

Overall satisfaction of post-operative analgesia

There was no significant difference in two groups in terms of satisfaction of pain relief at 24 hours (Table 4).

Table 3: Mean value of verbal rating scale.

Time	Group A			Group B			P-value
	N	Mean	SD	N	Mean	SD	
(6 hours)	20	0.05	0.22	20	0.02	0.01	0.32
(8 hours)	20	0.45	0.51	20	0.20	0.41	0.10
(10 hours)	20	0.40	0.50	20	0.65	0.49	0.12
(12 hours)	20	0.15	0.37	20	0.15	0.37	1.00
(24 hours)	20	1.10	0.72	20	0.80	0.70	0.19

Table 4: Overall satisfaction of post-operative analgesia.

	Group A		Group B		Total	
	N	%	N	%	N	%
Poor	01	05	0	0	03	2.5
Good	11	55	11	55	22	55.0
Excellent	08	40	09	45	17	42.5
Total	20	100	20	100	40	100

Chi-square 0.92 difference = 1 significant value = 0.34 (not significant)

Additional analgesia requirement

Only one patient in group A received additional analgesia, injection Tramadol 100 mg intramuscularly where as in group B none of them received additional analgesia.

Side effects

In this study, no side effect was observed in both the groups.

DISCUSSION

Lower limb is innervated by two major nerve plexuses namely (i) Lumbar plexus and (ii) Lumbo-sacral plexus. Lumbar plexus supplies anterior, medial and lateral aspects of thigh, hip joint, knee joint and antero medial aspects of thigh. Lumbosacral plexus supplies posterior part of thigh, knee joint, lateral and posterior portions of leg and whole foot. Lumbar plexus is formed from L1, L2, L3, and L4. The main branches of Lumbar plexus are iliohypogastric nerve, ilioinguinal nerve, genitor femoral nerve, lateral cutaneous nerve of thigh, femoral nerve, and obturator nerve. Lumbo sacral plexus is formed from L4, L5, S1, S2, S3 and S4. Lumbo sacral plexus forms the sciatic nerve which splits into tibial nerve and common peroneal nerve. Cutaneous distribution of lower limb nerves show considerable overlapping between

adjacent territories. Muscles and bones are supplied by the same nerves as the skin overlying them. Joints receive innervations from all the nerves supplying structures around them. However, Lumbar plexus block is usually sufficient to provide postoperative analgesia following hip, femur and knee.

At the level of lumbar segments four and five (L4-L5), the nerves of the lumbar plexus lie in a fascial sheath between the psoas and the quadratuslumborum muscles. Anesthetic injected into the sheath will bath the three main nerves femoral nerve, lateral cutaneous nerve of thigh, obturator nerve and possibly the sciatic nerve.[3] This is how the psoas compartment block works.

Three in one nerve block is similar to femoral nerve block except for the distal pressure. The distal pressure applied in three in one block pushes the local anaesthetic upwards. With this volume of 30 ml, the 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.

A sample size of 20 per group was taken in each group. One patient in each group developed block failure (VRS of one at 2 hours) and these patients were excluded from the study. Randomization of subjects to the two groups was done by allotting random numbers to patients that was generated by computer generated randomization table.

In all the patients, block was performed by a single anaesthesiologist. The outcome measures were evaluated by a person who is unaware of the type of block.

In our study surgery was performed under sub-arachnoid block and the lumbar plexus block was performed at the end of the surgery (when sensory level regressed to T12).

The mean duration of post operative analgesia was around 9.1 hours in three in block whereas in psoas compartment block around 9.9 hours. Uma Srivastava et al. has showed a mean duration of around 10.7 hour and 12.4 hours in three in one femoral nerve block and psoas compartment block.

Very few studies have examined the analgesic efficacy of single shot "3 in 1" or psoas compartment block following hip surgery. Fournier et al had reported prolongation of post operative analgesia with three in one nerve block,[5] whereas Stevens et al. and others demonstrated effective post-operative analgesia following psoas compartment block.[6]

Biboulet et al. compared the efficacy of single shot 3 in 1 and psoas compartment with that of I.V PCA with morphine after total hip arthroplasty under general anaesthesia. They concluded that the blocks were effective only for the first four hours of post operatively and thereafter no difference existed between the three groups regarding pain scores and morphine use.[7] Kaloul et al. showed both continuous femoral block and psoas compartment block result in similar morphine consumption and pain scores up to 48 hours after TKA.[8]

In a study by Jankowski and colleagues, patients undergoing knee arthroscopy with psoas compartment block had less post-operative pain, greater satisfaction and less post operative recovery room admission rates compared with general anaesthesia.[9]

Ganidagli and colleagues found that psoas compartment block with sciatic nerve block for knee arthroscopy resulted in patients having less pain, lower 24 h opioid requirements, and greater satisfaction compared with sciatic nerve block.[10]

Contrary to previous studies we demonstrated longer duration of analgesia, even longer than the expected duration of bupivacaine. We postulated the longer duration of analgesia in the present study to be due to summative effects of pre-emptive analgesic effect of spinal anaesthesia, prevention of spasm of quadriceps muscle due to plexus block and the analgesic action of intramuscular diclofenac, which was given to majority of patients.

The concern of sparing of obturator nerve in "three in one" femoral nerve block is not seen in our study. Sparing of obturator nerve in some cases could be due to inadequate spreading of local anaesthetic up in the neural sheath.

In this study no side effects were observed in both groups. However, accidental intra vascular injection, local anaesthetic toxicity etc are possible complications.

CONCLUSION

Both three in one femoral nerve block and psoas compartment block provide effective and longer duration of post-operative analgesia after hip, femur or knee surgery done under spinal anaesthesia.

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Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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