

## **Lumbar Plexus Block for Post-Operative Analgesia following lower limb Orthopedic Surgery: A Comparison of '3 in 1' and psoas compartment block**

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### **ABSTRACT**

**Background:** Pain is the most common symptom for which patient seeks medical care. Severe postoperative pain is common following orthopaedic surgery. There are a variety of methods used to address orthopedic postoperative pain like Opioids, epidural analgesia, patient-controlled analgesia, nerve blocks, Opioids-sparing NSAIDs, such as ketorolac and Lumbar Plexus Block. Here in this study two approaches of Lumbar plexus Block method used to provide postoperative analgesia following lower limb orthopedic surgery. **Aims & Objectives:** to compare efficacy for post operative analgesia by two different methods of lumbar plexus block namely Psoas compartment block and "3 in 1 block". **Materials and Methods:** The study was conducted in 60 adult patients. In pre-operative room pulse rate, blood pressure, respiratory rate and Verbal Rating Scale (VRS) for pain at rest and at movement were noted. Patients were divided into 2 groups in group 'A' patients received '3 in 1' block following spinal anaesthesia at the end of surgery, in group 'B' Patient received Psoas Compartment Block following spinal anaesthesia at the end of surgery. In the postoperative period, patients were assessed at 1, 2, 4, 6, 12 and 24 hours after operation regarding the pain at operative site using four points verbal rating scale (none, mild, moderate or severe) both during rest and mobilization. The time of first analgesic, total doses of analgesics and any side effects were also recorded. **Results:** In group A (SA+'3 in 1' block) mean duration of analgesia was 11.83 hours whereas in group B duration of analgesia was 12.56 hours. There was no difference between two groups in respect of supplemental analgesia. **Conclusion:** Both approaches of single shot lumbar plexus block were effective in providing post operative analgesia after lower limb orthopedic surgery.

**Key words:** comparison of “3 in1” block, Lower limb orthopedic surgery, Lumbar plexus block, Postoperative analgesia, Psoas compartment block

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## **INTRODUCTION**

Major lower limb surgery is often painful and requires aggressive management. Poorly treated pain can have negative impact on recovery especially owing to disruption in physiotherapy resulting in stiffness of joints and slow progress in mobility.

Peripheral nerve blocks e.g. lumbar plexus block, sciatic nerve block, lateral femoral cutaneous nerve, tibial nerve block etc. are suitable substitutes for analgesia after lower limb surgery which provide better pain relief, greater patient satisfaction, more cost effective analgesia, more favorable post operative recovery and rehabilitation profile.<sup>1,2,3</sup>

Postoperative pain relief can be achieved by a variety of techniques

including peripheral nerve block, parenteral NSAIDS, epidural analgesia, neuraxial local analgesics and narcotics, wound infiltration and patient controlled IV analgesia with opioids.<sup>4,5</sup>

Proper management of postoperative pain is essential in delivering quality care to orthopedic surgery patients.<sup>6</sup> In orthopedics, pain management is of paramount importance, as it affects surgical outcome, hospital stay and time to patient remobilization in elderly, debilitated and patient having multiple diseases.<sup>6</sup>

The present study was conducted to compare the efficacy of '3 in 1' block and psoas compartment block in relieving post operative pain and facilitating physiotherapy in a patient with lower limb fracture operated under spinal anaesthesia.

### **AIMS & OBJECTIVES**

Aim of study is to compare post operative analgesia by two different methods of lumbar plexus block namely Psoas compartment block and "3 in 1 block" in effectiveness, onset of analgesia, duration of analgesia and compare side effects.

### **METHODOLOGY:**

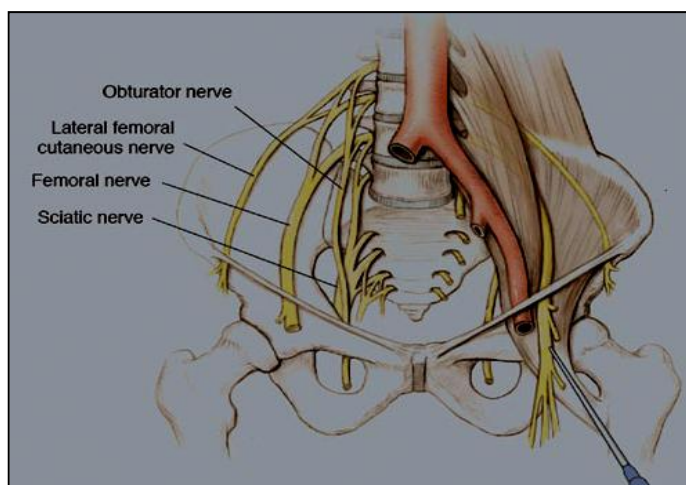
After approval by ethical committee and informed consent from patients, the study was carried out on sixty ASA grade I, II and III patients of either sex, aged between fifty to eighty years, taken up for elective lower limb orthopaedic surgery were divided into two small fixed and equal size groups (n=30 each group) by simple random sampling.

Patient giving negative consent, inability to follow study protocol because of language barrier, allergic to amide local anaesthetics and midazolam, contraindication of local anaesthesia (local infection at the site of needle insertion or systemic infection, neurological disease affecting lower limb and acquired or congenital coagulopathy), patient having

psychiatric illness, ulceration at the groin or in back or inability to understand the use of Verbal Rating Scale and history of epilepsy were excluded from study.

All patients had undergone through preoperative assessment for evaluation of the patient's medical status. Preoperatively, patients were inquired about the NBM status. All patients were explained about the procedure and Verbal Rating Scale before taking written informed consent. In pre-operative room pulse rate, blood pressure, respiratory rate and Verbal Rating Scale (VRS) for pain at rest and at movement were noted. Verbal rating scale was graded as nil, mild, moderate and severe.<sup>7</sup>

After securing intravenous line and preloading with Inj. Ringer Lactate 10 – 15 ml/kg I.V. Patients were premedicated with either inj. Atropine 10 µgm/kg or inj. Glycopyrrolate 5 µgm/kg and inj. Midazolam (30 µgm/kg) I.M. half an hour before operation. On operation table baseline pulse, blood pressure and saturation of oxygen were recorded



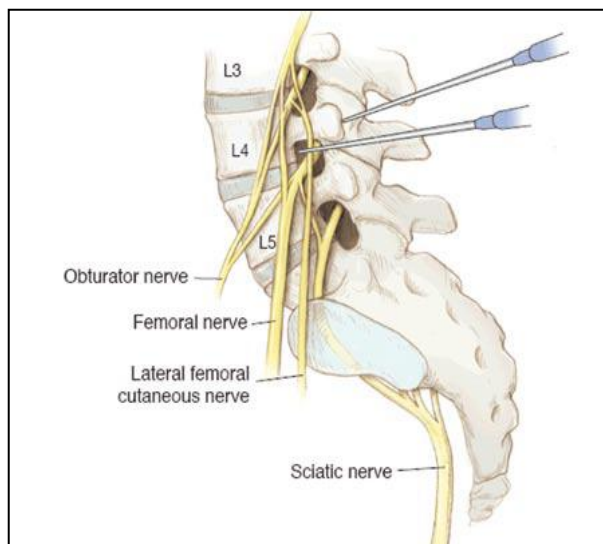
Patients were divided into 2 groups in group 'A' patients received '3 in 1' block following spinal anaesthesia at the end of surgery, in group 'B' Patient received Psoas Compartment Block following spinal anaesthesia at the end of surgery.

Spinal anaesthesia was given with 25 gauge spinal needle with 3.5-4.0 ml (0.4mg/kg) Bupivacaine Heavy 0.5% at L2–L3 or L3–L4 vertebral interspace. Intravenous midazolam was used for intraoperative sedation in increments of 0.5 mg, if needed. Routine monitoring included heart rate, noninvasive blood pressure,

electrocardiography and peripheral oxygen saturation.

The '3 in 1' block (Group A) was given using the technique described by Winnie et al (1973).<sup>8</sup> With patient in the supine position femoral artery was palpated below the inguinal ligament. A 3.5 cm, short bevel 23 gauge needle was advanced lateral to the artery in the cephalad direction till a 'double pop' was felt after piercing fascia iliaca and pectineal fascia, and 30-40 ml of 0.25% bupivacaine was injected after negative aspiration for blood. Distal pressure was applied with the thumb at the site of

injection, to the femoral sheath for ten minutes, to facilitate proximal spread.



**Psoas compartment block**(Group B) was achieved by the technique described by Xavier Capdevila.<sup>9</sup> With the patient in lateral position, the operative leg uppermost, a line was drawn to connect the iliac crests (intercristal line) identifying the 4th lumbar spine. The spinous process was marked and Posterior Superior Iliac Spine (PSIS) was identified. A line through the PSIS was drawn parallel to the line joining the spinal processes. The site of needle insertion was at the junction of the lateral third and medial

two thirds of a line between the spinous process and the PSIS and 1 cm cephalic to the intercristal line (L4).

The needle was inserted perpendicular to all planes. An 18 gauge toothy needle was then advanced perpendicular to the skin until it contacted the 4th lumbar transverse process. The needle was slightly withdrawn and redirected caudad to walk off the transverse process and advanced no further than 15–20 mm. At this point, a 10 ml syringe filled

with air was attached; the needle was slowly advanced until a loss of resistance was detected. This was psoas compartment and its depth was 5-7 cm from the skin.

When the needle was in the psoas compartment, 20 ml of air was injected to distend the compartment and then 30-40 ml of 0.25% bupivacaine was injected slowly in increments of 5 ml after negative aspiration for blood and cerebrospinal fluid.

In the postoperative period, on the first demand of analgesia, inj. diclofenac 1.5

to 2.0 mg/kg IV was given. The patients were assessed at 1, 2, 4, 6, 12 and 24 hours after operation regarding the pain at operative site using four points verbal rating scale (none, mild, moderate or severe).<sup>10</sup> The time of first analgesic, total doses of analgesics and any side effects were also recorded.

*Statistical analysis:* Data were entered and analysed using Epi Info software and also applied Chi-square and unpaired "t" test. Simple proportions were calculated.

### **OBSERVATION & RESULTS:**

Statistical analysis was done by using Epi Info programme. P value <0.05 was considered as statistically significant. P value >0.05 was considered as statistically insignificant.

**Table 1: Demographic details (Group A & B)**

Characteristics	Group A	Group B	P value
Age in years (Mean±SD)	60.73±8.72	59.33±8.55	0.53
Sex (Male/Female)	18/12	20/10	0.59
Weight	51 ± 7.0	52 ± 6.0	0.78
ASA grade I, II & III	2, 17, 11	7, 21, 2	-
Duration of Operation	143 ± 17 minutes	137 ± 32 minutes	-

**Table 2: Types of lower limb surgery:**

Site of surgery	SA+'3 in 1' block	SA+PCB
Femur	29	30
Tibia	1	0

In Table 2, In Group A there were 56.7% patients of intertrochanteric femur fracture, 26.7% patients of fracture neck femur, 6.7% patients of shaft femur fracture, 3.3% patient of subtrochanteric femur fracture, 3.3% patient of tibial condylar fracture and 3.3% patient of avascular

necrosis of femur whereas in group B there were 53.3% patients of intertrochanteric femur fracture, 36.7% patients of fracture neck femur, 3.3% patients of shaft femur fracture, 3.3% patient of sub-trochanteric femur fracture and 3.3% patient of avascular necrosis of femur.

**Table 3: Preoperative Pain Scale by VRS Scale**

Verbal Rating Scale	VRS at rest		VRS during movement	
	Group A	Group B	Group A	Group B
Nil	0	0	0	0
Mild	6	3	0	0
Moderate	22	25	6	6
Severe	2	2	24	24

In both groups, none of the patients complained about pain at rest upto twelve hours postoperatively but mild to moderate pain during movement. At the time of moderate pain at rest (Verbal Rating Scale – Moderate), patients were given supplemental dose of analgesic in the form of inj. Diclofenac 75 mg IV.

In Group A 26.7% whereas in group B 50.0% patients had mild pain at rest after twenty four hours post operatively. In group A 66.7% whereas in group B 50.0% patients had moderate pain. In Group A 6.7

% patients whereas none had severe pain in group B during rest. In group A 40.0% patients had moderate pain whereas in group B 60.0% patients had moderate pain during movement twenty four hours after operation. In group A 60.0% patients had severe pain during movement whereas in group B 40.0% patients had severe pain during movement (P value 0.19). So both groups were comparable.

**Table 4: Duration of analgesia in hours**

Technique of Anesthesia	No. of patients	Mean
SA+'3 in 1' block	30	11.83 ± 3.84
SA+PCB	30	12.56 ± 3.91

In group A (SA+'3 in 1' block) mean duration of analgesia was 11.83 hours whereas in group B duration of analgesia was 12.56 hours. (P value 0.46). In group A 56.7% patients whereas 73.3% patients in group B required single dose of inj.diclofenac for supplemental analgesia within twenty four hours. In group A 43.3% patients whereas in group B 26.7% patients required two analgesic doses within twenty four hours. (P value 0.18). Thus there was no difference between two groups in respect of supplemental analgesia.



**Table 5: Patient's Acceptance as Quality of Analgesia**

Patient's Acceptance	SA+'3 in 1' block	SA+PCB
<b>Excellent</b>	16 (53.3%)	19 (63.3%)
<b>Good</b>	13 (43.3%)	9 (30.0%)
<b>Poor</b>	1 (3.3%)	2 (6.7%)

At the end of study, patients were asked about the quality of postoperative analgesia. In group A quality of analgesia was rated as excellent by 53.3%, good by 43.3% and poor by 3.3% of the patients. In group B quality of analgesia was excellent in 63.3%, good in 30.0% patients and poor in 6.7%. Thus both the block provide effective analgesia postoperatively.

In Group A, no complications was observed whereas in group B only one patient had hypotension probably due to epidural spread of the drug. Patient was treated with 100% oxygen, IV fluids and inj. Mephenteramine 6mg IV stat.

### **DISCUSSION**

Lower limb orthopaedic surgery generates significant postoperative pain that may be treated using regional anaesthesia.

When compared with other regimens, regional anesthesia provides superior pain relief and may favourably influence outcomes such as reduced blood loss and low incidence of thromboembolic events. Blocks are appreciated for the superlative and long lasting analgesia they provide. Moreover when compared with other types of anaesthesia, nerve block may enhance intraoperative hemodynamic stability.<sup>5</sup>

Following lower limb orthopedic surgery three branches of lumbar plexus need to be blocked namely lateral femoral cutaneous nerve of thigh, obturator nerve and femoral nerve. These are the branches of lumbar plexus. There are two different method of lumbar plexus block. One is anterior approach which is known as '3 in 1' block or inguinal paravascular block or

femoral nerve sheath block technique. Second is posterior approach which is known as psoas compartment block.

**Ismail Kaloul et al. (2004)** compared the efficacy of a continuous posterior lumbar plexus (PSOAS) block to a continuous three-in-one femoral nerve (FEM) block in patients undergoing primary total knee replacement (TKR). They concluded that both continuous PSOAS block and continuous three in one FEM block provided better analgesia than PCA but no differences were seen between the two regional techniques.<sup>11</sup>

**O Tokat et al. (2002)** evaluated the extent of inguinal paravascular blockade and psoas compartment blockade with sciatic nerve block in 60 patients. The study suggests that the psoas compartment block is effective in blocking the femoral, lateral femoral cutaneous and obturator nerves, but the inguinal paravascular block is only effective in blocking the femoral nerve.<sup>12</sup>

**Uma Srivastva et al. (2007)** used a single shot lumbar plexus block by posterior approach (Psoas compartment block- PCB)

or anterior approach ('3in1' block) for postoperative analgesia in the patients of hip fractures operated under spinal anaesthesia. They concluded that both approaches of lumbar plexus block were effective in providing post operative analgesia after hip surgery.<sup>13</sup>

The examination of the anatomy would seem to indicate that three nerves of the leg arising from lumbar plexus can be blocked by single injection near femoral nerve sheath as the lumbar plexus arises in a fascial envelop, from which an extension accompanies the femoral nerve.<sup>8</sup>

A posterior approach to the lumbar plexus was first described by **Winnie (1973)** and colleagues.<sup>8</sup> They described an approach for 'lumbosacral' block but provided no data on the extent of neural block. The term 'psoas compartment block' was coined by **Chayen (1976)** and colleagues to describe a loss of resistance technique with injection of solution into the 'compartment' between the quadratus lumborum and psoas major muscles. There have been a number of other approaches described since, including an

approach by Capdevila and colleagues based on modifications to Winnie's landmarks using computed tomography.<sup>9</sup>

**Bernard Urbanek et al. (2003)** observed the duration of '3 in 1' block in group B (bupivacaine 0.5%) was 17.55 hours,<sup>1</sup> as compared to 11.83 hours in present study.

**Uma Shrivastav et al. (2007)** demonstrated the mean time of first demand of analgesic was  $10.7 \pm 6.4$  hours and  $12.4 \pm 7.5$  hours in '3 in 1' block and psoas compartment block respectively.<sup>13</sup> In our study also mean time of demand of first analgesic was around 12 hours (moderate pain on VRS) which is accordance to finding of their study.<sup>13</sup>

**Luiz Eduardo Imbelloni et al. (2008)** observed mean analgesia time of psoas compartment block was  $23.33 \pm 5.17$  hours, ranging from 16 to 36 hours.<sup>14</sup>

**Roxane Fournier et al. (1998)** noted that duration of postoperative analgesia for prosthetic hip surgery was  $298 \pm 39$  minutes in '3 in 1' femoral nerve block group which is in contrast to present study.<sup>4</sup>

**Huey Ping et al. (2001)** also demonstrated prolonged duration of postoperative analgesia with intraoperative single shot '3 in 1' block with ropivacaine 0.25%, ropivacaine 0.5% and bupivacaine 0.25% after unilateral total knee replacement.<sup>15</sup>

As such it is clear from above discussion that '3 in 1' block and psoas compartment block provide effective and prolonged postoperative analgesia following lower limb orthopedic surgery. Verbal Rating Scale for pain is rated as nil, mild, moderate and severe which is subjective so there may be variation in perception of pain rating by the patient.

Inj. Diclofenac sodium 1.5-2.0 mg/kg IV was administered as rescue analgesic when VRS was moderate. In group A 56.7% patients required one dose of diclofenac for supplemental analgesia whereas 73.3% patients in group B required single dose of analgesic within twenty four hours. In group A 43.3% patients required two doses of analgesics whereas in group B 26.7% patients required two analgesic doses

within twenty four hours. P value was 0.18( $P>0.05$ ). Thus there was no difference between two groups in respect of supplemental analgesics.

**Uma Srivastva (2007)** compared the '3 in 1' block with psoas compartment block for postoperative analgesia following hip surgery. They noted that 86% of patients in '3 in 1' block group required one injection in 24 hours whereas 82% of patients in psoas compartment block one injection in 24 hours.<sup>13</sup> In our study 57% patients of '3 in 1' block and 73% patients of psoas compartment block required one analgesic within twenty four hours.

**Huey Ping (2001)** observed that cumulative morphine consumption was significantly lower when femoral nerve block was given inj. Bupivacaine than saline after unilateral knee replacement,<sup>15</sup> which is in accordance to our study.

**Ismail Kaloul (2004)** noted that postoperative forty eight hours morphine consumption was reduced by 48% when FEM block was given after total knee replacement<sup>11</sup> which is in accordance to our

study having reduced requirement of analgesic.

**Luiz Eduardo Imbelloni (2008)** observed 52.5% of patients did not require rescue analgesic in first twenty four hours following psoas compartment block in lower limb orthopedic surgery<sup>12</sup> which is in accordance to our study.

**Roxane Fournier (1998)** noted that when femoral nerve block was given with general anaesthesia and compared to control group for prosthetic hip surgery, there was no difference in requirement of morphine or diclofenac sodium and analgesic intervention, which is in contrast to our study.<sup>4</sup>

The result of present study indicate that '3 in 1' block and psoas compartment block for postoperative analgesia reduces requirement of total analgesic requirement when monitored for 24 hours. The explanation for reduces requirement of analgesics is good and effective analgesia which reduces VRS for pain. Effective '3 in 1' block and psoas compartment block also

abolish quadriceps muscle spasm which further reduces pain.

In this study, patients were observed for side effects like nausea, vomiting, hypotension, respiratory depression, hematoma, infection at the '3 in1' block site or psoas compartment block site.

**Roxane Fournier (1998)** noted no side effects when when studied postoperative analgesia with '3 in 1' femoral nerve block after prosthetic hip surgery<sup>4</sup> which is in accordance to our study.

**Luiz Eduardo Imbelloni (2008)** noted no side effects when studied postoperative analgesia with psoas compartment block following lower limb surgery.<sup>14</sup> In our study, one patient developed hypotension after giving psoas compartment block which may be due to epidural spread of drug while rest of the patient did not have complications.

At the end of study patients were asked about the quality of postoperative analgesia.

**Ismail Kaloul et al. (2004)** noted patient satisfaction was high in all three groups<sup>11</sup> which is in accordance to our study while **Uma Srivastva (2007)** also observed

excellent or good quality of analgesia in more than 90% patients in '3 in1' block and psoas compartment block following hip surgery<sup>13</sup> which is similar as in our study.

Thus it was concluded that '3 in 1' block and psoas compartment block provide prolonged duration and good quality of postoperative analgesia following lower limb orthopedic surgery with minimal side effects.

#### CONCLUSION

Thus, it was concluded that '3 in 1' block and psoas compartment block are safe, effective, inexpensive technique of postoperative pain relief in elderly patients undergoing unilateral lower limb orthopedic surgery.

Both the approaches of Lumbar Plexus Block provides low VRS for pain for 24 hours and reduces total analgesic requirement in 24 hours.

#### SUMMARY

Old, debilitated and patient with multiple systemic diseases benefited from providing regional block in post operative period. These techniques were better than

sole spinal anaesthesia and general anaesthesia.

Orthopedic cases provide a maximum number of opportunities for utilization of regional anaesthesia techniques in all age groups for anesthesia as well as post operative pain relief. In recent years, importance of providing pain relief in the immediate postoperative period is a welcome trend. '3 in 1' block and psoas compartment block are excellent methods to achieve pain relief for lower limb orthopedic surgery. They are safe, effective, simple and devoid of serious complications.

At the end of surgery patients were randomly divided to receive '3 in 1' block or psoas compartment block using 0.25% bupivacaine 35-40 ml. All patients were assessed in postoperative period. VRS for pain at 1, 2, 4, 6, 12 and 24 hours were compared between two groups. SA+'3 in 1' block mean duration of analgesia was 11.83 hours whereas in SA+PCB mean duration of analgesia was 12.56 hours.

Inj. Diclofenac sodium 75 mg IV was given as rescue analgesia when patients

complained of moderate pain (VRS scale) at rest and requirement of supplemental analgesia was observed in first twenty four hours. All patients were observed for side effects like nausea, vomiting, sedation, respiratory depression, hematoma and infection at puncture site. In this study, only one patient had developed hypotension following psoas compartment block which may be due to epidural spread of drug. At the end of twenty four hours patients were asked about quality of postoperative analgesia in which >95% experienced excellent or good quality of analgesia.

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