International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Safety and Efficacy of Combined Lumbar Plexus, Sciatic Nerve, Femoral Nerve Blocks in Failed Spinal Anaesthesia for Lower Limb Surgeries: A Prospective Clinical Study

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Abstract: ***Introduction: In patients with failed spinal anaesthesia for lower limb surgeries often carries high risk with General anaesthesia due to presence of high risk factors for General anaesthesia like severe Chronic obstructive pulmonary disease [COPD], Ischemic heart disease, cardiomyopathies, valvular heart disease, difficult intubation. In order to decrease the risk of anaesthesia for surgery, we have evaluated alternative technique of anaesthesia for lower limb surgeries in failed spinal anaesthesia cases. Aims & Objectives: The aim of the study was to evaluate safety and efficacy of combined Lumbar plexus, sciatic nerve, femoral nerve for lower limb surgeries and to assess efficacy of providing surgical anaesthesia, incidence of intraoperative complications, postoperative complications and benefits. Materials & Methods: In the present study, 50 patients of failed spinal anaesthesiaof age group between 20 - 80yrs of age were taken. In all the patients with failed spinal anaesthesia, Combined Lumbar plexus, Sciatic nerve, femoral nerve blocks were performed. Local anaesthetic solution of 40ml of 0.5% Ropivacaine is used for achieving combined nerve blocks.8mg Dexamethasone was added to local anaesthetic as an adjuvant to prolong the duration. . To allay anxiety, Inj 1mg midazolam was given intravenously prior to the block and intravenous Butorphanol Tartarate was given before starting of surgery as a opioid analgesic for intraoperative analgesia. A total of 24 patients were ASA group I, 16 patients were ASA group II, 6 patients were ASA group III. Results: Time of onset of block required for surgical anaesthesia was noted. Incidence of Regional nerve complications like unconsciousness, local anaesthetic systemic toxicity, respiratory arrest was noted. No patient reported about regional nerve block complications. Out of 50 patients 8 patients required intraoperative supplementation TIVA with propofol. There were no intraoperative complications noted during the study. Postoperatively patients had a longer pain free relief. Opioid analgesic were required in lower doses in postoperative period, due to prolonged duration of regional nerve blocks, which caused lower incidence of postoperative complications like nausea & vomiting. Conclusion: The study confirms combined lumbar plexus, sciatic nerve, femoral nerve block in failed spinal anaesthesia is a very good appropriate alternative technique to General anaesthesia in patients with failed spinal who are scheduled for lower limb surgeries. The study highlights advantages of combined lumbar plexus, sciatic nerve, femoral nerve having low morbidity and mortality over general Anaesthesia in patients with high risk factors in failed spinal anaesthesia.***

Keywords: Lumbar plexus block, sciatic nerve block, femoral nerve block, failed spinal anaesthesia, Ropivacaine.

1. Introduction

Lower limb surgeries are usually done under spinal or epidural anaesthesia which are considered as safe anaesthesia techniques. Achieving spinal or epidural anaesthesia may be difficult or impossible to achieve because of calcification of ligamentum flavum or severe skin infections at the site of puncture.

General anaesthesia is usually given as an alternative technique for failed spinalanaesthesia. Giving general anaesthesia to patients with high risk factors like severe Chronic obstructive pulmonary disease (COPD), Ischemic heart disease (IHD), Cardiomyopathies, valvular heart diseases may pose the risk to the life of the patient. In the present study, we have made efforts to know the efficacy and safety of combined lumbar plexus, sciatic nerve, femoral nerve blocksfor lower limb surgeries which has a lower morbidity and mortality.

We had combined lumbar plexus, sciatic nerve, femoral nerve blocks because single nerve block cannot produce anaesthesia of the whole lower limb. Combination of above 3 blocks will anaesthetize the complete lower limb, adequate surgical anaesthesia will be achieved with the above 3 blocks.

2. Materials and Methods

The present study was conducted at Government Medical College, Ananthapur in the Department of Anaesthesiology prior to the study, ethical clearance was obtained from Institutional Ethical Committee, with code number 1 - 2 - 23.

Inclusion criteria: Patients who are scheduled for lower limb surgeries, unable to achieve spinal/ epidural anaesthesia were included in the study.

Exclusion criteria: patients allergic to local anaesthetics, coagulopathies& patient refusal. Prior to the procedure, patients were informed about the details of the procedure and risks involved with the technique. Informed consent were taken from the patients prior to the starting of the procedure. All the patients were made well accustomized with visual analog scale (VAS) for postoperative pain assessment.

Patients were given 1mg midazolam slow IV, to allay anxiety before starting of combined nerve blocks.

On patient arrival to the operation theatre complex, patients were secured intravenous line with 18G IV cannula on dorsum of hand. Intravenous infusion of ringer lactate started before starting of spinal or epidural anaesthesia. All necessary resuscitated equipments were kept ready for giving general anaesthesia in case of combined nerve blocks failure and to deal with complications of combined nerve blocks. Spinal anaesthesia was performedand first attempted by senior resident, then followed by associate professor, assistant professor and professor. Attempts of spinal/ epidural anaesthesia was abolished after 6 - 8 attempts.

After failure of spinal anaesthesia, under strict aseptic precautions, lumbar plexus block was achieved with patient in nondependent lateral position.

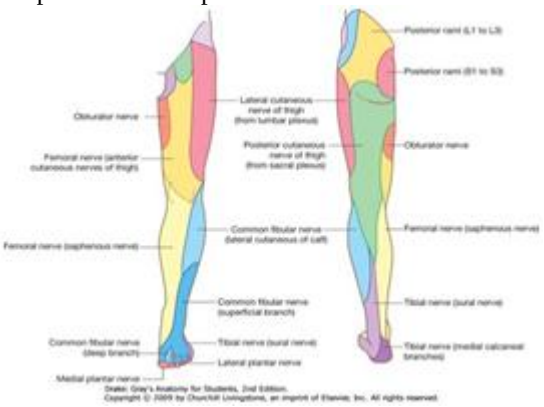

Image 1: Nerve supply of lower limbs

Image 2: dermatomal distribution

Lumbar Plexus Block: It consists of six nerves that supply lower abdomen and upper leg. Formed from ventral rami of L1 - L4 with variable contribution from T12 and L5. Peripheral branches of lumbar plexus include iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, femoral and obturator nerves. Lumbar plexus provides sensory innervation to abdomen, groin, anterior, lateral and medial aspects of thigh, knee joint and medial part of the calf.

Technique

A line is drawn from the top of posterior iliac crest down to the midline, known as "intercrisal line" which is positioned over L4 transverse process. Intersection of intercristal line with a line drawn parallel to the spine from the posterior superior iliac spine, determine initial needle insertion point and is 4cm lateral from the midline in most of the patients.23G spinal needle used for block. Once the transverse process of L4 is contacted, needle is drawn back to skin and directed caudally to "walk off" the transverse process. The plexus should be stimulated at the depth of not more than 2cm beyond the transverse process.15 ml of 0.5% Ropivacaine used. Muscle contracted is Quadriceps muscle. No complications were noted during the lumbar plexus block.

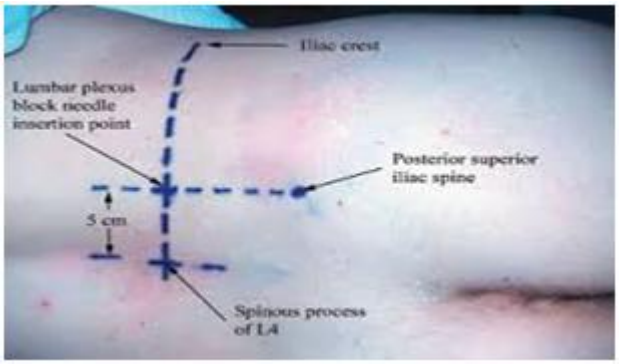

Image 3: Lumbar Plexus Block

After completion of lumbar plexus block, sciatic nerve block is achieved with the patient in same position.

Sciatic nerve block: Formed from anterior rami of spinal nerves L4 - S3. Sciatic nerve supplies sensory and motor innervation to the posterior aspect of thigh, as well as the entire lower linb except for medial compartment of leg.

Technique

Patient positioned in lateral decubitus position in nondependent with leg flexed at knee. Line1 is drawn from Greater trochanter to the sacral hiatus. Identify and mark midpoint of 1st line. Draw a line perpendicular to the midpoint of the 1st line, to its intersection with 2nd line which forms 3rd line.4th line drawn along the furrow formed by the medial edge of gluteus maximus and long head of biceps femoris muscle, which represents the course of the sciatic nerve towards the leg.23G spinal needle is used. Insert the 23G spinal needle perpendicular to the skin, stimulation of gluteus maximus muscle is often encountered just before the sciatic nerve stimulation. Successful needle placement in proximity to sciatic nerve is observed with plantar flexion/ inversion (Tibial nerve) or dorsiflexion/ eversion (common peroneal nerve).20ml of 0.5% Ropivacaine is used for achieving sciatic nerve block. Plantar flexion of foot is more

desirable than dorsiflexion. No complications were encountered during sciatic nerve block.

Even though cobined lumbar plexus and sciatic nerve block completely anaesthetizes the lower limb, we have opted for femoral nerve block because lumbar plexus, sciatic nerve blocks were achieved with conventional techniques, without use of peripheral nerve stimulator (PNS) / ultrasound guided techniques.

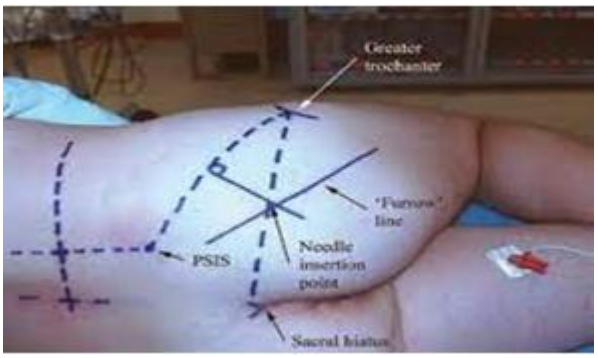

Image 4: Sciatic Nerve Block

Femoral Nerve Block

Femoral nerve is the largest branch of lumbar plexus. It is created from contributions of L2, L3, L4. It enters into thigh under the inguinal ligament between psoas and iliacus muscle covered by iliopsoas fascia. The psoas fascia separates the nerve from the femoral artery. The femoral nerve lies lateral to the artery deep to the inguinal ligament. Femoral block results in anaesthesia of the entire anterior thigh and most of femur and knee joint. The block confers anaesthesia of the skin on the medial aspect of the leg below knee joint (saphenous nerve)

Technique

Patient placed in supine position. A line is drawn between the anterior superior iliac spine and pubic tubercle, identifying the inguinal ligament. Palpate and mark femoral artery at the level of inguinal ligament. Mark a point 1cm lateral to the pulsation and 1 - 2cm distal to the ligament. Insert a 22G 50cm needle at 45^0 to the skin in a cephalad direction. Two distinct pops may be felt as the needle passes through fascia lata then fascia iliaca respectively. Paraesthesia in knee or stimulation of quadratus femoris "dancing patella" indicates correct location of the needle.5ml of 0.5% Ropivacaine is used. No complications seen during femoral block.

Image 5: femoral nerve block

Strict vigilance was kept on the patients for the complications of lumbar plexus, sciatic nerve, femoral nerve blocks like loss of consciousness, local anaesthetic systemic toxicity, seizures, respiratory arrest, cardiac arrest.1mg Butorphanol tartarate was administered as intraoperative opioid analgesic. Time of onset of surgical anaesthesia was noted after completion of combined nerve blocks. Patients were monitored with Multichannel monitor for SpO2, pulse rate, NIBP, Temperature, 6 lead ECG. Induction time is the time gap between completion of combined nerve blocks with pinprick discrimination. Monitoring was continued through out the procedure and patients were shifted to recovery room and were kept for 24hrs. Patients were noted for pain and postoperative complications like nausea, vomiting, hypotension and bradycardia in recovery room.

Data was collected at 1, 2, 3, 4, 6, 8, 10, 12, 18, 24 hrs respectively and calculated from the time of block. Postoperative pain assessed with VAS of 0 - 10.0 indicates no pain, 10 indicates worst unbearable pain. VAS >4 were treated with rescue analgesic of NSAIDS. If not relieved by rescue analgesic, opioid analgesics were administered. Total administered doses of rescue analgesic and opioid analgesic during first 24hrs were noted. Time taken for rescue analgesic requirement was noted. Duration of postoperative analgesia was defined as the time gap between last suture application and requirement of 1^{st} rescue analgesic at VAS score of 4. At the end of the surgery, surgeon was asked about to assess the quality of anesthesia following Numeric Ranking scale (NRS) of 0 - 100. At the time of discharge, were also asked about satisfaction score following NRS (0 - 100).

3. Results

The study was conducted in Government general hospital, Anantapur, Andhra Pradesh over 2 years period. All the patients who were scheduled for lower limb surgeries with failed spinal anaesthesia undergoing lower limb surgery procedure went under lumbar plexus, sciatic nerve, femoral nerve block except for 8 patients out of 50 patients in the study who required small total intravenous anesthesia dose of propofol during surgery. The mean supplementation of propofol for these 8 patients were 80mg.

The different types of surgeries performed during this study, 1) Intertrochanteric femur# with DHS fixation - 16 cases.2) intracapsular femur # with Bipolar prosthesis - 12 cases.3) femur plating – 8 cases.4) tibial shaft# with tibia interlocking – 4 cases.5) tibial condyle# with tibial plating - 10 cases. The mean onset of combined nerve blocks adequate for surgical anaesthesia is 16.20± 2.4 SD. The mean duration of surgery was 76± 21.68 min. The patient hemodynamics were stable throughout the procedure without any intraoperative complications. We have not had any incidence of combined nerve block complications like convulsions, loss of consciousness, respiratory arrest, cardiovascular collapse, cardiac arrest. Complications like no abdominal /visceral injury noted during lumbar plexus block.

Only 8 patients out of 50 patients in the study had discomfort during surgery which was managed by

intermittent dose of propofol, which made these patients comfortable throughout intraoperative procedure. The time taken for onset of pain in the postoperative period is 412± 52.6 hrs. Mean time of administration of rescue analgesic is 412± 52.6 hrs. only 10% of the patients required received rescue analgesic with inj diclofenac sodium (20%). Total dose of opioid analgesic administered in the postoperative period butorphanol tartarate 3.51± 0.68 during 1st 24hrs after surgery. Incidence of postoperative nausea and vomiting requiring treatment is 10patients (20%). Surgeon satisfaction score was 72.67± 6.50. Patient satisfaction score was 78.69± 8.13. There was no incidence of postoperative complications. Average stay of the patients in the hospital were 6±0.9 days. There was no mortality in our study.

Table 1: Demographic and preoperative parameters

Parameters	value
Age (yrs)	53.4± 12.74
Weight (kg)	56.76± 8.36
Height (cm)	158.96± 6.32
BMI (kg/m^2)	20.62± 0.04
ASA I/II/III	14/16/20
Preoperative PR	82.34± 8.34
Preoperative MAP	76± 8.24
Preoperative SpO2	98.6 ± 0.46

Table 2: Intraoperative characteristics

Parameters	value
Induction time	16.20± 2.4 SD
Duration of surgery	76± 21.68 min
Total operation theatre time	96.68± 18.54
Intraoperative PR	98.86± 9.24
Intraoperative SpO2	98.68± 0.64
Intraoperative MAP	82.68± 5.24
Surgeon satisfaction score (0 - 100)	72.67± 6.50

Table 3: Postoperative analgesia and PONV

Parameters	value
Time to 1st analgesic at VAS > 4 (mins)	412± 52.6 hrs
Total butorphanol dosage in 1st 24 hrs	3.51± 0.68
% patients received rescue analgesic diclofenac sodium	10%
VAS score in immediate postop	0
VAS at 2hrs	0
VAS at 4hrs	1.68± 0.26
VAS at 6hrs	3.88± 0.86
VAS at 12hrs	2.96± 0.84
VAS at 24hrs	2.32± 0.36
VAS score at 1st rescue analgesic administration	4.38± 0.69
Maximum VAS score in 24hrs	4.76± 6.8
% patients requiring PONV treatment	10%
Patient satisfaction score (0 - 100)	78.69± 8.13

Table 4: Incidence of complications of lumbar plexus, sciatic nerve, femoral nerve blocks

Parameters	value
Intravascular injection injury	0
convulsions	0
Respiratory arrest	0
Cardiovascular collapse	0
Cardiac arrest	0
Epidural/subarachnoid (total spinal)	0
Permanent nerve damage	0

4. Discussion

Combined lumbar plexus, sciatic nerve, femoral nerve blocks has been used as a safe and ideal alternative technique to general anaesthesia for patients scheduled for lower limb surgeries with failed spinalanaesthesia. We have selected 0.5% Ropivacaine as a local anaesthetic because of its cardiovascular stability and duration of action. Dexamethasone 8mg was added to Local anaesthetic as an adjuvant to prolong the duration of local anaesthetic, increased quality of block, postoperative analgesia and reduced incidence of PONV, reduction in dosage of opioid analgesic in first 24hrs. Reduced ICU stay and decreased postoperative pulmonary complications and patients were ambulated early. The method used to assess postoperative pain by VAS which was explained to the patient. Patients experienced prolonged postoperative pain relief and we had very good surgeon score 72.67±6.50 and patient satisfaction score 78.69±8.13. To conclude combined lumbar plexus block, sciatic nerve, femoral nerve blocks had produced good intraoperative surgical anaesthesia, excellent intraoperative hemodynamic stability, and good postoperative analgesia, reduced incidence of opioid and decreased PONV.

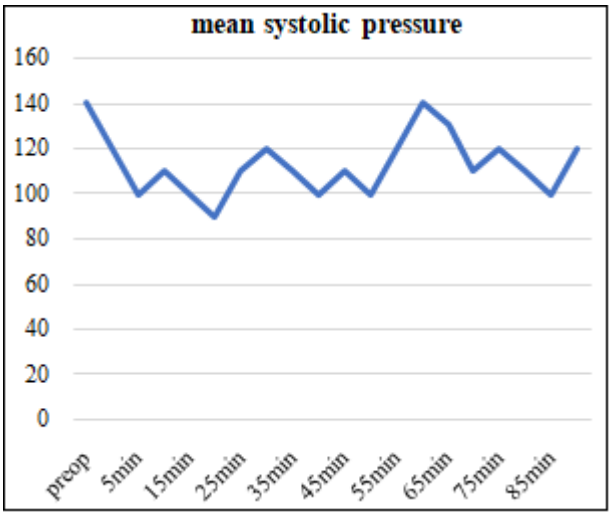

Figure 1: Mean Systolic Pressure

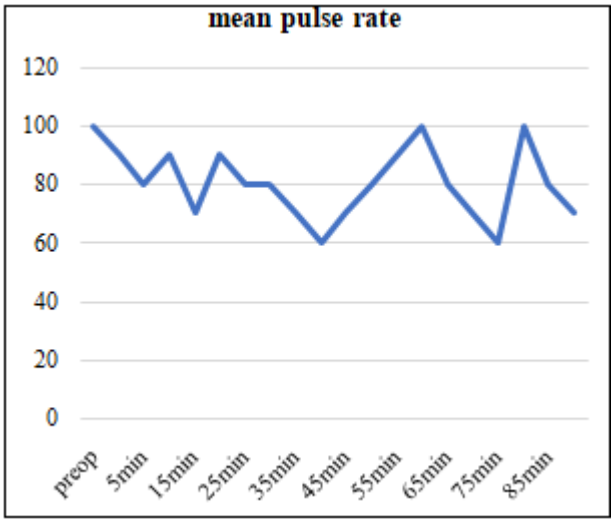

Figure 2: Mean Pulse Rate

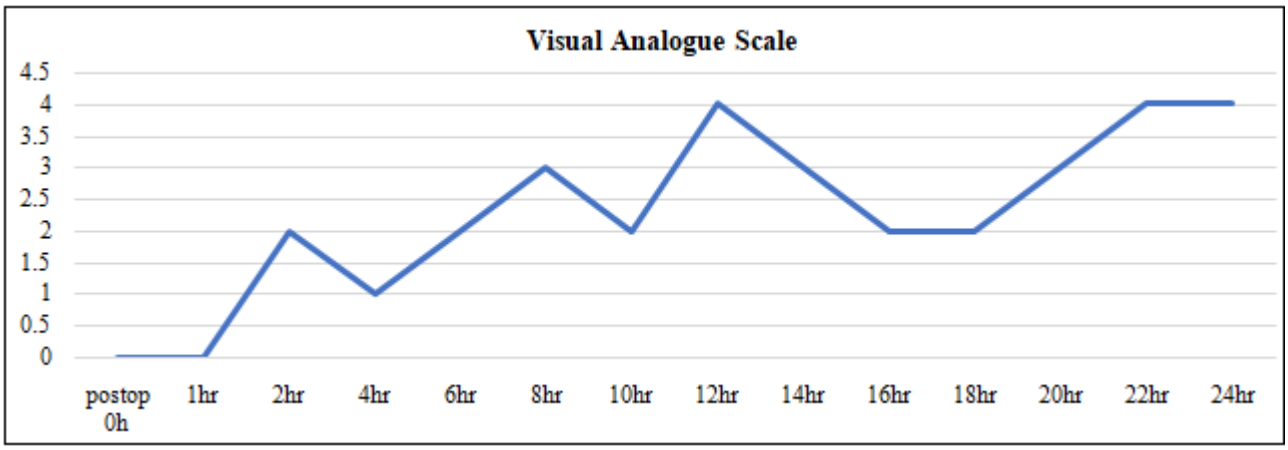

Figure 3: Visual Analogue Scale

5. Conclusion

Combined lumbar plexus, sciatic nerve, femoral nerve blocks is an excellent and ideal anaesthetic technique of choice with failed spinalanaesthesia who are scheduled for lower limb surgeries with high risk factors. Good intraoperative and postoperative analgesia, good hemodynamic stability, is an additional advantage of technique which can be practiced in peripheral institutions, where gadgets like PNS/ Ultrasound is not available.

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