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ORIGINAL ARTICLE

Comparison between Additive Doses of Fentanyl and Clonidine to Lignocaine with Adrenaline in Lower Limb Surgeries under Lumbar Plexus/Sciatic Block

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ABSTRACT

Introduction: There are situations in which block anesthesia would be the technique of choice, if the technique or techniques of blocking the lumbar and sacral plexus could be simplified, as they have been for brachial plexus.

Aims and objectives: Aim of the study is to evaluate the effect of adding fentanyl and clonidine to Lignocaine with adrenaline in lumbar/sciatic block with regard to the following parameters: onset of complete motor and sensory block, duration of motor and sensory block, duration of analgesia, sedative effect of fentanyl and clonidine, hemodynamic changes, complications due to adjuvants and to compare both these adjuvants.

Method study design: Patients were randomly allocated into 2 groups of 30 each.

Groups: Groups L and C (lignocaine with adrenaline + clonidine)—30 patients received 35 ml lignocaine with adrenaline + 10 ml distilled water diluted clonidine containing 100 µg + 5 ml distilled water, and groups L and F (lignocaine with adrenaline + fentanyl)—30 patients received 35 ml lignocaine with adrenaline + 10 ml distilled water diluted fentanyl containing 100 µg + 5 ml distilled water.

Results: From present study, it can be concluded that Clonidine appears to be better adjuvant for prolongation of anesthesia and analgesia in lower limb surgeries under lumbar plexus/sciatic block.

Keywords: Clonidine, Fentanyl, Lumbar/sciatic block.

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INTRODUCTION

Regional anesthesia is abolition of painful impulses from any region of the body by temporarily interrupting the sensory nerve conductivity with or without involving motor function. Halsted[1] in the year 1884 introduced the concept of nerve blocking and later with Hall[2] evolved the principles of nerve blocking. Despite tremendous advances in techniques of nerve block we are yet to find out how lower limb can be definitely and individually be blocked by one, or two pricks as are being done for the upper limb (*viz* brachial plexus block).

Nerve block anesthesia assumes great importance in poor risk patients who cannot tolerate the stress imposed by general, spinal, or epidural anesthesia. Also, as nerve blocks provide adequate postoperative analgesia, it is definitely advantageous. Bridenbaugh[3] (1963) has stated categorically in a review of regional anesthesia that peripheral nerve block is the anesthesia of choice for operation of the lower leg and foot. There are situations in which block anesthesia would be the technique of choice, if the technique or techniques of blocking the lumbar and sacral plexus could be simplified, as they have been for brachial plexus. In 1973 Winnie[4-7] described the inguinal paravascular approach of lumbar plexus, the '3 in 1 block' to block all the three nerves *viz* femoral, lateral cutaneous nerve of thigh and obturator simultaneously by single injection, he indicated that if an anesthesiologist is able to provide anesthesia for operations on lower leg and foot with combination of sciatic and femoral block, then he can also provide anesthesia of entire leg by the same combination of blocks if he simply modifies his technique of femoral block by not injecting without paresthesia and by increasing the volume of anesthetic injected. He also suggested the possibility of lumbar paravertebral method of injecting the lumbar plexus. In 1976, Chayen et al[8] described the method of Psoas compartment block where the lumbar and sacral plexuses can be blocked by single

injection. There is some evidence for a small number of opioid receptors on axons of peripheral nerves, and addition of different opioids enhance peripheral nerve block from local anesthetics in some studies.[9]

AIMS AND OBJECTIVES

Aim of the study is to evaluate the effect of adding fentanyl and clonidine to Lignocaine with adrenaline in lumbar/sciatic block with regard to the following parameters: onset of complete motor and sensory block, duration of motor and sensory block, duration of analgesia, sedative effect of fentanyl and clonidine, hemodynamic changes, complications due to adjuvants and to compare both these adjuvants.

MATERIALS AND METHODS

The present study was undertaken in indoor patient admitted in NSCB Medical College, Jabalpur.

Selection of Cases

An informed written consent was taken from all the patients in the two groups after the approval of institutional ethics committee. Sixty patients of ASA class I and II aged between 20 and 60 years scheduled for lower limb surgery under lumbar plexus/sciatic block were enrolled in a prospective double blind controlled trial.

Criteria for Exclusion

Patient in whom regional anesthesia is contraindicated such as, who refuse, suffering from coagulopathy, blood dyscrasias and anticoagulant therapy, infection at the site of block, patient receiving adrenoreceptor agonist or antagonist therapy, patients with history of cardiac, respiratory, hepatic or renal failure and pregnant women.

Study Design

Patients were randomly allocated into two groups of 30 each.

Groups

Groups L and C (lignocaine with adrenaline + clonidine)—30 patients received 35 ml lignocaine with adrenaline + 10 ml distilled water diluted clonidine containing 100 µg + 5 ml distilled water.

Groups L and F (lignocaine with adrenaline + fentanyl)—30 patients received 35 ml lignocaine with adrenaline + 10 ml distilled water diluted fentanyl containing 100 µg + 5 ml distilled water.

Technique

Patients were not premedicated before block. After insertion of 20 gauge IV cannula in arm, 5 ml/kg/h infusion of 0.9% NaCl solution is given. After connecting standard anesthesia monitoring equipments, baseline measurement of heart rate (HR), noninvasive arterial blood pressure (NIBP), peripheral 02 saturation (SPO_2) and respiratory rate were recorded.

The patient was placed in Sim's position in which the patient lies on one side with the under arm behind the back and the upper thigh flexed. Also called lateral recumbent position with slight forward tilt. The foot on the side to be blocked should be positioned over the dependent leg so that twitches of the foot or toes can be easily noted (for sciatic nerve) (Fig. 1). The patient is placed in the lateral recumbent position with the operative side upper most.

Neural localization was achieved using a nerve stimulator (stimuplex, B. Braun, Germany) connected to 22 gauge 100 mm long stimulating needle. The position of the needle was judged adequately when an output current < 5 mA elicited a light distal motor response for lumbar plexus block (twitches of the quadriceps muscle) (Fig. 1). Once was obtained, 60% of total volume of drug mixture was injected slowly after repeated aspiration.

For sciatic plexus block, neural localization was achieved using a nerve stimulator (Stimuplex Braun) connected to 22 gauge 100 mm long stimulating needle. The position of the needle was judged adequately when an output current < 5 mA elicited a light distal motor response for sciatic block (toe twitches). Once it was obtained, 40% of total volume of drug mixture was injected slowly after repeated aspiration.

Evaluation was carried every minute after the completion of injection for onset of complete sensory and motor block using Hollman scale.

Hollman Scale[10,11]

Sensory Blockade (Grade)

- Normal sensation of pin prick.
- Pinprick felt as sharp pointed sensation but weaker when compared with the same area in the other lower limb.
- Pinprick felt as touch with blunt object.
- No perception of pinprick.

Complete sensory block means no perception to pinprick.

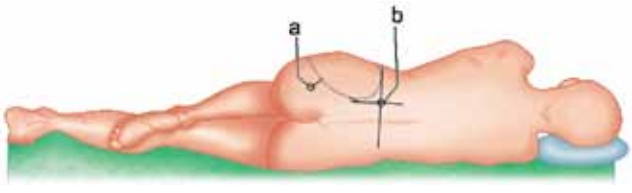

Fig. 1: Patient position and landmarks for sciatic nerve (a) and lumbar plexus (b) blocks

Motor Blockade (Grade)

- Normal muscle function.
- Slight weakness in muscle function.
- Very weak muscular action.
- Complete loss of muscle function.

Complete motor block means complete loss of muscular function.

Onset of complete sensory block is defined as time interval between the administration of drug and absence of sensation to pinprick.

Onset of complete motor block is defined as the time interval between administration of the drug and complete loss of muscle function.

Surgery was permitted only when complete blockade was achieved. General anesthesia was instituted whenever the block was inadequate.

Duration of sensory blockade is defined as the time interval between the onset of complete sensory block and the return to normal sensation to pinprick.

Duration of motor blockade is defined as time interval between the onset of complete motor block to recovery of normal muscle function.

Duration of analgesia is defined as the time interval between the onset of complete sensory block to the postoperative visual analog scale (VAS) score > 3.

Visual Analog Scale[12]

Pain intensity was evaluated using a 10 cm visual scale where 0 represents no pain and 10 represents worst possible pain.

Nursing staff administered intramuscular diclofenac 75 mg when the VAS > 3.

The time between the end of local anesthetic administration and the first analgesic request was recorded as duration of analgesia.

Sedation was assessed using sedation score described by Culebras et al[13] which was graded as follows:

- Awake and alert.
- Sedated, responding to verbal stimulus.
- Sedated, responding to mild physical stimulus.
- Sedated responding to moderate or severe physical stimulus.
- Not arousable.

Monitoring

Heart rate systolic arterial blood pressure and diastolic arterial blood pressure were recorded at 0, 5, 10, 15, 30, 45, 60, 90, 120 minutes. Adverse events comprises hypotension (a 30% decrease in relation to the baseline value), bradycardia (HR < 50 beat per minute) hypoxemia (SPO_2 < 90%) or nausea and vomiting.

OBSERVATIONS AND RESULTS

Table 1 shows the sexwise distribution of all patients in both groups. Majority of patients were male in both groups as compared to females. However the distribution of both male and female in each group was comparable ($p < 0.05$).

Table 2 shows the mean age of patients (in year) in various groups which are almost comparable ($p < 0.05$).

Table 3 shows the mean weight of patients (in kg) in both groups and both are comparable ($p < 0.05$).

The onset time of complete sensory block in group LC and LF which were 3.5 ± 0.6 and 2.5 ± 0.6 minutes respectively. On statistical analysis, this difference was found to be just significant ($p < 0.05$) (Table 4).

The onset time of complete motor block in group LC and LF which were 7 ± 0.9 and 5.3 ± 0.4 minutes respectively. On statistical analysis, this difference was found to be just significant ($p < 0.05$) (Table 5).

The mean duration of sensory block in group LC and LF which were 161.3 ± 22.7 and 120.66 ± 18.9 respectively. The difference in duration of sensory block between both groups was found to be statistically significant ($p < 0.05$) (Table 6).

The mean duration of motor block in group LC and LF which were 125 ± 18.5 and 92.33 ± 15 respectively. The difference in duration of motor block between both groups was found to be statistically significant ($p < 0.05$) (Table 7).

The mean duration of first rescue analgesia in group LC and LF were 208.33 ± 24 and 152.33 ± 25.2 respectively. The difference in duration of first rescue analgesia between both groups was found to be statistically significant ($p < 0.05$) (Table 8).

The mean BP in mm Hg in both the groups was comparable ($p > 0.05$). No patient in both group developed hypotension (Table 9).

Table 10 shows the mean pulse rate in study groups. Mean pulse rate in both groups were comparable ($p > 0.05$).

Table 11 shows the mean respiratory rate in study groups. Mean respiratory rate in both groups were comparable ($p > 0.05$).

Table 1: Sexwise distribution of patients in study groups

Group	*LC*	*LF*
Male	27	26
Female	3	4
Total	30	30

Table 2: Agewise distribution of patients in study groups

Age category (years)	*LC*	*LF*
<35 years	9	7
36–45 years	12	11
>45 years	9	12

Table 3: Weightwise distribution of patients in study groups

Weight category	*LC*	*LF*
< 55 kg	13	9
55–64 kg	12	14
> 65 kg	5	7

Table 4: Onset time of complete sensory block in study groups

Group	*LC*	*LF*
Mean value (minutes) ± SD	3.5 ± 0.6	2.5 ± 0.6

Table 5: Onset time of complete motor block in study groups

Group	*LC*	*LF*
Mean value (minutes) ± SD	7 ± 0.9	5.3 ± 0.4

Table 6: Duration of sensory block in study groups

Group	*LC*	*LF*
Mean value (minutes) ± SD	161.3 ± 22.7	120.66 ± 18.9

Table 7: Duration of motor block in study groups

Group	*LC*	*LF*
Mean value (minutes) ± SD	125 ± 18.5	92.33 ± 15

Table 8: Time for first rescue analgesia in study groups or duration of analgesia in study groups

Group	*LC*	*LF*
Mean value (minutes) ± SD	208.33 ± 24	152.33 ± 25.2

Table 9: Changes in mean blood pressure in study groups (in mm Hg)

Group	*Baseline*	*10 minutes*	*20 minutes*	*30 minutes*	*1 hour*	*2 hours*	*4 hours*	*6 hours*	*12 hours*
LC	92.9 ± 5.1	92.5 ± 4.2	90.5 ± 4.0	91.9 ± 4.0	82.7 ± 3.3	87.6 ± 4.1	95.5 ± 4.5	92.3 ± 4.3	92.8 ± 4.1
LF	92.9 ± 5.1	92.5 ± 4.2	90.5 ± 4.0	91.9 ± 4.0	89.1 ± 2.9	87.6 ± 4.1	92.5 ± 4.5	92.3 ± 4.3	92.8 ± 4.1

Table 10: Changes in mean pulse rate in study groups (per minute)

Group	*Baseline*	*10 minutes*	*20 minutes*	*30 minutes*	*1 hour*	*2 hours*	*4 hours*	*6 hours*	*12 hours*
LC	82.9 ± 6.9	80.9 ± 6.4	81.7 ± 4.6	81.7 ± 4.8	80.9 ± 5.7	90.9 ± 5.7	92.4 ± 6.6	81.3 ± 4.6	82.3 ± 5.2
LF	81.7 ± 4.6	81.7 ± 4.8	80.9 ± 5.7	90.9 ± 5.7	80.9 ± 6.4	81.7 ± 4.6	81.7 ± 4.8	80.9 ± 6.4	81.7 ± 4.6

Table 11: Changes in mean respiratory rate in study groups

Group	*Baseline*	*10 minutes*	*20 minutes*	*30 minutes*	*1 hour*	*2 hours*	*4 hours*	*6 hours*	*12 hours*
LC	16.2 ± 1.1	15.8 ± 1.3	15.9 ± 1.1	15.6 ± 1.1	15.9 ± 1.2	16.2 ± 1.2	15.9 ± 1.0	16.2 ± 1.4	15.4 ± 1.1
LF	15.6 ± 1.1	15.9 ± 1.2	16.2 ± 1.2	15.9 ± 1.0	16.2 ± 1.4	15.8 ± 1.3	15.9 ± 1.1	15.6 ± 1.1	15.9 ± 1.2

DISCUSSION

The present study was carried out to evaluate the effect of adding clonidine and fentanyl to lignocaine and adrenaline in lumbar plexus and sciatic block.

Winnie AP et al (1974) described the combined lumbosacral plexus block through posterior approach and claimed that this is effective for blocking both lumbar and sacral plexus by single injection and described the depth of needle insertion around 5 to 6 cm.

Dalens et al (1988)[14] studied Lumbar plexus blocks in children; a comparison of Winnies technique and Chayens technique in 50 patients undergoing surgeries in the hip region. Group 1 (n = 25) and group 2 (n = 25) in whom variant of psoas compartment and the classic technique were used respectively. Procedures were carried out under light general anesthesia with patients in lateral position using insulated needles and nerve stimulator. It was found that both procedures were effective, allowing completion of surgery without additional treatment and concluded that the procedure described by Winnie et al was more suitable for providing unilateral blockade than 'psoas compartment block.'

Farny et al[15,16] described the relation of the lumbar plexus with psoas major and with the superficial and deep landmarks close to it in the year 1994. They dissected four cadavers and studied 22 computed tomography films of lumbosacral region. They found that the lumbar plexus at the level of L5 is within the substance of the psoas major muscle rather than between this muscle and quadratus lumborum. Lateral femoral cutaneous nerve is in the same plane as the femoral nerve, obturator nerve is found in the same plane as the two nerves or in its own muscular fold.

Through radiological data they found that the femoral nerve at a depth of 9.01 ± 2.43 cm, the psoas major medial border at 2.73 ± 0.64 cm from the median sagittal plane and the lateral border at 6.41 ± 1.61 cm from the same plane. And concluded that the lumbar plexus lies within the psoas major while the obturator nerve localization within the psoas major varies and that computed tomography data define precisely the relationship of the lumbar plexus with superficial and deep landmarks.

Farny et al (1994) examined clinical characteristic of posterior approach to lumbar plexus combined with a sciatic nerve block using lignocaine and measured the serum lignocaine concentrations. They selected 45 patients undergoing lower extremity surgery. Sciatic nerve and lumbar plexus blocks were made with lignocaine 680 mg with adrenaline 0.3 mg. For each patient

following data were collected, weight, age, sex, site of surgery, time to perform each block, needle depth, speed of onset of sensory and motor blockade in the territories of the sciatic, femoral, obturator and lateral cutaneous nerves and postoperative analgesic requirements. They found that the analgesia was complete in 88% of the patients, and despite high doses of lignocaine the serum concentrations were within safe limits; only one patient had a concentration > 5 μg/ml and was associated with contralateral extension of block. They concluded that this combination of blocks is a valuable alternative for unilateral lower extremity anesthesia.

In present study onset of complete motor and sensory block, duration of motor and sensory block, duration of analgesia, sedative effect, hemodynamic changes and complication were evaluated.

The mean age (in years) of patients in groups LC and LF were 40.1 ± 9.5, 42.8 ± 9.8 respectively. The mean age of both groups is comparable. Male female percentage in group LC and LF are 90/10 and 86.6/13.3 which are comparable. The mean weight (in kg) in group LC and LF are 56.9 ± 6.6 and 59 ± 6.7 respectively which are comparable. Thus demographically these two groups are comparable.

Onset time of complete sensory and motor block in group LC are 7.06 ± 1.4 and 7.1 ± 1.5 minutes respectively. Onset time of complete sensory and motor block in group LC in our study correlate with study done by Chawda (2010).[17] In study done by Priti M Chawda (2010)[17] (in which there was lignocaine with bupivacaine with clonidine) and this time of onset corroborates with onset of sensory block with lignocaine alone. So there is no difference in the onset of sensory block after adding clonidine to local anesthetic which corroborates the study done by El-Hennawy et al (2009)[18] and Gabriel et al (2001).[19]

The onset time of complete sensory and motor block in LF group is significantly short which was in agreement of study done by Moharari et al[20] (in which the local anesthetic used was same but study was done in brachial plexus). Onset time of complete sensory and motor block in group LC and LF were 3 and 2 minutes respectively. Onset time of complete sensory and motor block in group LF was significantly reduced ($p < 0.05$) when compared to group LC.

Mean duration of sensory block in group LC and LF are 161.3 ± 22.7 and 120.6 ± 18.9 minutes respectively. Mean duration of motor block in group LC and LF are 125 ± 18.5 and 92.3 ± 15 minutes respectively. Mean duration of analgesia in group LC and LF are 208.3 ± 24.08 and 152.3 ± 25.2 minutes respectively.

All these duration of sensory block, motor block and analgesia duration in group LC was statistically significant ($p < 0.05$) when compared to group LF. This finding corroborates with the study done by Chawda et al (2010)[17] and Eledjam et al (1991)[21] (who used epinephrine and clonidine as adjuvant to local anesthetics).

And all these duration in fentanyl group (LF) is less than those with LC group in agreement with the study done by Moharari (2010)[20] et al. This study also corroborrates with the study done by Fahmy MD (2011).[22]

Mean BP in both the groups were comparable. Stable mean BP in group BC correlates with the study done by Jean J Eledjam et al (1991)[21] and EI Saied et al (2000).[23] The stable mean BP in our study may be due to complex effect of clonidine on autonomic nervous system and systemic vasculature, i.e. the dose response of clonidine is U-shaped in which the peripheral vasoconstriction exhibited by partial agonistic activity at α-1 adrenergic receptor opposes the central sympatholysis that was caused by α-2 receptor as described by Eisenach et al(1996).[24]

No patient in both the groups developed hypotension.

This stability in LF group corroborates with the study done by SP Singh et al (2010) and Mane et al (2011).[25] Mean pulse rate in both groups are comparable. Nausea and vomiting are not seen in both groups.

CONCLUSION

The present study was carried out to evaluate the effect of adding clonidine and fentanyl to lignocaine and adrenaline in lumbar plexus and sciatic block.

The onset of complete motor and sensory block, duration of motor and sensory block, duration of analgesia, sedative effect, hemodynamic changes and complication were evaluated.

- Both the study groups demographically were similar. The onset time of complete sensory block was less in LF group compare to LC group
- The onset time of complete motor block was less in LF group compare to LC group.
- Duration of sensory block was longer in group LC when compared to group LF which was found to be statistically significant ($p < 0.05$).
- Duration of motor block was longer in group LC when compared to group LF which was found to be statistically significant ($p < 0.05$).
- The time for first rescue analgesia was longer in group LC when compared to group LF which was found to be statistically significant ($p < 0.05$).
- Vital parameters were comparable between these groups, no patient in both groups developed either bradycardia or hypotension. Adverse effect like nausea and vomiting were not seen in both groups.

From present study it can be concluded that:

- Addition of clonidine to lignocaine with adrenaline increase the duration of sensory and motor block.

- Fentanyl reduces the onset time of sensory and motor block.
- Duration of postoperative analgesia is not significant because lignocaine and adrenaline which is used as local anesthetic agent, itself is a short acting local anesthetic agent. So, it will be better to add clonidine to long acting anesthetic agent like bupivacaine or ropivacaine.
- Both groups do not cause any side effects.
- Clonidine appears to be better adjuvant for prolongation of anesthesia and analgesia.

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