

Original Research Article

Does fentanyl prolong the analgesia of local anaesthetics in brachial plexus block? A randomized controlled study

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ABSTRACT

Background: Several adjuvants have been added to enhance the effects of local anaesthetic agents in peripheral nerve blocks. In this randomized controlled study we aimed to assess the effects of addition of fentanyl to local anaesthetics in brachial plexus block with respect to onset time and total duration of analgesia.

Methods: In this prospective randomized double-blind study, 40 adult patients of 18-65 years age group were randomly divided into two groups of 20 each. In group L supracavicular brachial plexus block was performed with 30 ml of local anaesthetic solution (10 ml 1.5% lignocaine with adrenaline +20 ml 0.25% bupivacaine) +1ml saline whereas in group LF received the same 30 ml local anaesthetics with 50µg fentanyl in 1ml added to it. The characteristics of block with respect to onset time of sensory and motor blockade, total duration of analgesia and any side effects were evaluated.

Results: Both groups were comparable with respect to demographic parameters and duration of surgery. The onset time of complete sensory and motor block was significantly prolonged in group LF (17.2±2.5min and 20.3±2.9min) compared to group L (13.7±3.6min and 17.45±3.7min). The total duration of analgesia was also significantly prolonged (P <0.001) in group LF (374.5±51min) compared to group L (239.25±40.27min). There were no significant side effects noted in any patients in both groups.

Conclusions: Addition of fentanyl to local anesthetics in brachial plexus block significantly prolonged the duration of analgesia without any significant side effects though it had delayed the onset of block.

Keywords: Bupivacaine, Fentanyl, Lignocaine, Supracavicular brachial plexus block

INTRODUCTION

The peripheral nerve blockade technique, developed early in the history of anaesthesia, still remains a well-accepted anaesthetic technique and unavoidable component of today's comprehensive anaesthetic management. Brachial plexus block is a suitable anaesthetic for upper limb surgeries and got greater significance in recent years due to renewed interest in day care surgery and increased number of trauma cases. Many adjuvant drugs like opioids α agonists, steroids and vasoconstrictor agents have been co-administered in nerve blocks with local anaesthetic agents to improve the block quality or

duration of analgesia.¹⁻⁷ Although many studies have shown an increase in success rate and duration of analgesia on addition of opioids in brachial plexus block, some studies showed no benefit like this.^{8,9}

Activation of peripheral opioid receptors may be responsible for the enhanced opioid antinociception.¹⁰ Fentanyl has some local anaesthetic like action also.¹¹ In this randomized double-blind study we aimed to assess the effects of addition of fentanyl to local anaesthetic agents in brachial plexus block with respect to onset of sensory and motor block, duration of analgesia and side effects.

METHODS

This study was conducted after getting approval from the institutional research and ethics committee and obtaining written informed consent from patients. Forty adult patients of either sex in 18-65 years age group belonging to American society of anaesthesiologists physical status I and II (ASA I & II) scheduled for upper limb surgeries below elbow were included. Patients on chronic opioid or analgesic medication, coagulation disorders, local infection and history of hypersensitivity to study drugs were excluded from the study. After preoperative assessment patients satisfying the criteria were randomly divided into two groups of 20 each using computer generated random number charts. The study group was named as group LF and control group as group L. The procedure was explained to patients and written consent was taken. The visual analogue scale (VAS) was explained to them for postoperative pain assessment.

On arrival to the operation theatre, after application of standard monitors (electrocardiography, pulse oximeter and noninvasive blood pressure) an 18 G intravenous cannula was secured on non-operated arm and lactated ringers solution started as infusion. All patients were premedicated with Inj Midazolam 0.02mg/kg to get anxiolysis. Supraclavicular brachial plexus block was performed under strict aseptic precaution using peripheral nerve stimulator (Stimuplex; B. Braun Melsungen, Melsungen, Germany) upon elicitation of twitch on fingers with 0.5mA current. The control group (group L) received 30 ml local anaesthetic agents (10 ml 1.5% lignocaine with adrenaline 1 in 200000 + 20 ml 0.25% bupivacaine) and 1ml normal saline. The study group received the same local anaesthetic solution with 50 µg of fentanyl in 1ml added to it. The drug preparation was done by a second anaesthesiologist not involved in further data collection or analysis. Characteristics of block were evaluated with respect to time of onset of sensory block, onset of motor blockade and total duration of analgesia. Sensory block was assessed by pin prick method using 23 gauge needle. Time of onset of complete sensory block was taken from the time of injection of drugs to total abolition of pin prick sensation. Time of onset of motor blockade was taken from injection time to complete absence of voluntary movement of that limb against gravity. Total duration of analgesia was taken as the time between the onset of analgesia and appearance of pain (VAS \geq 4).

If patient complains of pain in any of major nerve distribution even after 30minutes, block is considered failed and such cases were excluded from the study. All failed block was planned to manage appropriately either with supplemental sedation or conversion to general anaesthesia. Intraoperatively heart rate, blood pressure, oxygen saturation and respiratory rate were monitored every 5min for 30min and there after every 15min till completion of surgery. All patients were monitored for 1hr in the postoperative recovery room and thereafter in

the postoperative ward for 24hour. Postoperative analgesia was monitored by VAS at 1,2,4,6,12 and 24 hr and rescue analgesic was given when the pain score was \geq 4 or whenever patient requested analgesics. Inj diclofenac 75mg intramuscularly was the rescue analgesic given. Any side effects like nausea, vomiting, pruritus, urinary retention, bradycardia and respiratory depression were noted. Complications of supraclavicular brachial plexus block like respiratory distress due to pneumothorax also specifically looked for.

Data collected were analyzed using statistical package for social sciences (SPSS) version 18. Quantitative variables were compared using Student's t-test and qualitative variables using Chi-square tests and a P value of <0.05 was taken as significant.

RESULTS

In present study patient characteristics and duration of surgery were comparable between the groups (Table 1).

Table 1: Demographic details and duration of surgery.

Variable	Group L (n=20)*	Group LF(n=20)*
Age (years)	33.3 \pm 10.7	37 \pm 10.3
Weight (Kg)	54.7 \pm 7.5	55.7 \pm 7.4
Sex ratio (M:F)	10:10	9:11
ASA status I/II (n)	15/5	16/4
Duration of surgery(min)	72.5 \pm 15.6	73.5 \pm 17.5

Data as mean \pm SD. *Group L is local anaesthetics alone. Group LF is local anaesthetics with fentanyl

Addition of fentanyl to local anesthetics caused a significant prolongation of onset time of both sensory and motor blockade compared to control group. Time to onset of complete sensory block occurred with a mean time of 13.7 \pm 3.6min in group L compared to a mean time of 17.2 \pm 2.5min in group LF (Figure 1).

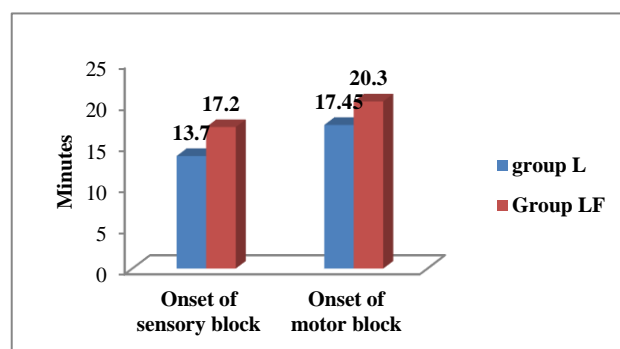


Figure 1: Mean time of onset of sensory and motor block.

This was statistically significant with a p value of 0.001. Mean onset time of complete motor block was

17.45±3.7min in group L and 20.3±2.9min in group LF. The difference in mean onset time of complete motor block between the groups was also statistically significant with a p value of 0.01. Assessment of block characteristics are summarised in Table 2.

Table 2: Block characteristics of two groups.

	Group L (n=30)*	Group LF (n=30)*	P value
Time to onset of complete sensory block (min)	13.7±3.6	17.2±2.5	0.001
Time to onset of complete motor block (min)	17.45±3.7	20.3±2.9	0.011
Total duration of analgesia (min)	239±40.2	374±51.5	0.001

Data as mean ± SD. *Group L is local anaesthetics alone. Group LF is local anaesthetics with fentanyl

The total duration of analgesia was significantly prolonged with addition of fentanyl in group LF (Figure 2). It was 239.2±40.2min in group L and 374.5±51.5min in group LF with a p value of 0.001.

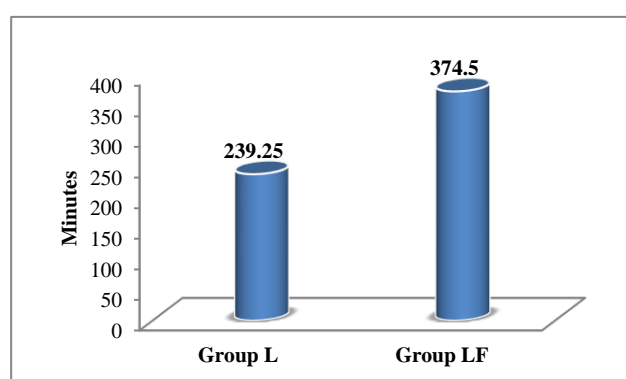


Figure 2: Mean duration of analgesia.

No significant side effects were noted in any patients in both groups. Specific complications of supraclavicular brachial plexus block like pneumothorax or haematoma formation were also not occurred in any patients. There were no incidences of failed block necessitating supplemental sedation or conversion to general anaesthesia. Haemodynamic parameters were also comparable and stable throughout.

DISCUSSION

Present study demonstrated that addition of fentanyl to local anaesthetics in brachial plexus block caused significant prolongation of duration of analgesia but delayed the onset of both sensory and motor blockade compared to local anaesthetics alone. Various opioids have been used in peripheral nerve blocks, but there is no agreement on effects of their addition to local anaesthetics or mechanism of prolonged analgesia in

peripheral nerve blocks. The primary effects of opioid antinociception are mediated at central or spinal cord level. Exact mechanism of action of opioids at peripheral nerve is still uncertain. Evidences have begun to support the presence of peripheral opioid receptors.¹⁰⁻¹³ So the possible mechanism of prolonged analgesia by peripheral opioid administration could be through direct binding at opioid receptors of dorsal nerve root aided by axonal flow, diffusion through brachial plexus sheath to extradural or subarachnoid space to dorsal horn and central action after peripheral systemic uptake.¹⁴ Fentanyl also reported to have a local anaesthetic like action, but this require a higher concentration (50g/ml).¹¹

The effects of addition of opioids to local anaesthetics in brachial plexus block had been studied by several researchers but the results are inconclusive to date. Chavan et al in their study on addition of 50g fentanyl to local anaesthetics in brachial plexus block showed an increase in mean duration of analgesia compared to control group.¹⁵ Rajkhowa et al also demonstrated improved success rate and duration of analgesia with addition of 50µg of fentanyl to 0.5% ropivacaine in supraclavicular brachial plexus block.¹⁶ In another study when 100µg of fentanyl added to axillary brachial plexus block, a doubling of postoperative analgesia was observed.¹⁷ Prolongation of postoperative analgesia was reported in other studies also.¹⁸ We also observed a significant prolongation of duration of analgesia with addition of fentanyl to local anaesthetics. Damien et al in their systematic review on analgesic adjuncts for brachial plexus block pointed out that evidences for analgesic benefit with addition of opioids in brachial plexus block over systemic opioids are minimal.¹⁹ When addition of fentanyl to local anaesthetics in brachial plexus block was compared to intravenous fentanyl, there was no overall clinical benefit except a significant reduction in VAS at 1hr.²⁰ In a study on addition of fentanyl to lignocaine in axillary brachial plexus block, Fletcher et al found no change in success rate or duration of analgesia compared to control group.²¹

In present study addition of fentanyl to local anaesthetics caused a delay in onset of both sensory and motor blockade. The change in pH of the anaesthetic solution resulting in slower penetration of nerve membrane by local anaesthetics could be responsible for this effect. Alkalinisation of local anaesthetic agents in nerve block has been shown to improve onset, quality and duration of analgesia.²²⁻²⁵ Gormley et al reported that alkalinized lignocaine solution for axillary brachial plexus block caused a faster onset of analgesia.²⁴ Kohli Nishikawa et al reported a reduction in pH by addition of fentanyl to lignocaine solution.²² In their study on fentanyl with lignocaine in axillary brachial plexus block, Kohli Nishikawa et al concluded that decrease in pH of lignocaine from 6.2 to 5.2 by addition of 100µg of fentanyl may have resulted in slower onset of analgesia. There are reports of no improvement with alkalinisation also.^{26,27} Further studies comparing the effects of addition

of fentanyl to local anaesthetic using different pH solution are required to confirm this hypothesis. One of the limitations of our study is low sample size. A large sample size would have given more precision to the result. Dynamic pain score was not assessed in the postoperative period. Also ultrasound guidance in brachial plexus block could have reduced the volume of local anaesthetics needed.

CONCLUSION

To conclude addition of fentanyl to local anaesthetics in brachial plexus block significantly prolonged the duration of analgesia without causing any significant side effects, though it had delayed the onset time of both sensory and motor blockade. So, if peripheral administration of opioids improves the regional anaesthesia without centrally mediated side effects it would be useful in clinical practice.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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