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Research Article

Fentanyl as an adjuvant for brachial plexus block: a randomized comparative study

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ABSTRACT

Background: Adjuvants are known to enhance the effect of local anaesthetics (LA). Several adjuvants have been suggested to enhance the duration and analgesic effect of local anesthetic agents. We designed this randomized single blinded prospective study to compare the analgesic efficacy of Fentanyl used as an adjuvant to ropivacaine for supraclavicular brachial plexus block in patients undergoing orthopaedic surgeries of forearm.
Methods: For this randomised prospective, single blinded study 66 ASA I and II patients aged 18-65 years were included and were divided into 2 groups, group R (35) and RF (31). Supraclavicular brachial plexus block was performed in the group R using 0.5% ropivacaine 30 ml plus 1 ml NS (total 31 ml) and in group RF received 0.5% ropivacaine plus 50 micrograms fentanyl in 1 ml NS (total 31 ml) in brachial plexus block. The onset time of sensory and motor block, duration of sensory and motor block were recorded.
Results: Compared to group R, group RF showed a significant greater duration of sensory and motor blockade (P=0.0001). Demographic parameters and block onset time were comparable in both the groups.
Conclusions: The addition of fentanyl to ropivacaine significantly prolonged the duration of analgesia compared to ropivacaine used alone for supraclavicular brachial plexus blocks in patients undergoing forearm surgeries.

Keywords: Brachial plexus block, Fentanyl, Ropivacaine

INTRODUCTION

Anesthesia primarily aims to alleviate a patient's pain, agony and discomfort associated with the surgical procedure. Considering the central, peripheral and immunological stress response to tissue injury relief of intraoperative and postoperative pain has gained special importance. Postoperative pain specially is associated with increased morbidity and central sensitization is believed to be among the mechanisms implicated in the persistence of postoperative pain.[1] Regional anaesthetic techniques produce superior analgesia, decrease adverse effects compared to systemically used opioids and improve patient outcome & satisfaction.[2] Brachial plexus block is a useful regional anaesthetic technique for upper limb surgeries. The supraclavicular approach is reliable and safe for brachial plexus blockade for any surgery involving the upper extremity, but not the shoulder. Ropivacaine, the S (-) enantiomer of N-(2,6-dimethylphenyl)-1-propyl-2-piperidinecarboxamide is a new long-acting local anesthetic like bupivacaine. Ropivacaine, compared to bupivacaine blocks pain transmitting A-delta and C fibers to a greater extent than A-beta fibers (controlling motor function).[3,4] Ropivacaine has a wider margin of safety and is less cardiac & neurotoxic compared to bupivacaine with similar duration of action.[5,6] Adjuvants like opioids (fentanyl, morphine, tramadol etc), clonidine, vasoconstrictor agents, steroids etc. have been used for regional nerve plexus blocks to improve the block duration or quality or both.[7] Studies have shown an increase in the block duration and success rate of brachial plexus block on addition of opioid adjuvant,[8-11] but some studies show no additional benefit.[12,13] This enhanced antinociception may have been

mediated via activation of peripheral opioid receptors.[14] There are also reports that Fentanyl may have local anaesthetic like action.[15]

We hypothesized that fentanyl, when used as an adjuvant to ropivacaine for supraclavicular brachial plexus blocks may enhance the analgesic duration as compared to ropivacaine used alone. To test our hypothesis, we designed this randomized, blinded, comparative study to evaluate the analgesic duration of Fentanyl when added to ropivacaine compared to ropivacaine used alone for supraclavicular brachial plexus block in patients undergoing orthopedic surgeries of forearm.

METHODS

After approval by the Institutional ethics committee, this randomized, prospective, blinded, single hospital study was conducted under the Department of Anaesthesiology and Critical Care, Gauhati Medical College and Hospital from October 2013 to December 2014. After obtaining proper informed consent, 66 adult patients of both sexes, aged 18 to 65 years, belonging to ASA I or II, undergoing elective orthopaedic surgery of the forearm were enrolled for this study. A written informed consent was obtained from each patient after explaining the procedure, the possible outcomes and complications. Patient unwilling to participate in the study, suspected coagulopathy, hypersensitivity to the study drugs, localized or systemic infection, cardiovascular disease, renal disease and patients having chronic pain were excluded from the study. Based on a computer generated tables patients were randomly allocated into 2 groups: group R containing 35 and group RF containing 31 patients. Group R received 0.5% ropivacaine 30 ml plus 1 ml NS (total 31 ml) in supraclavicular brachial plexus block, Group RF received 0.5% ropivacaine plus 50 micrograms fentanyl in 1 ml NS (total 31 ml). All the drug containing syringes were prepared by a third anaesthesia resident not taking part in this study. Intraoperative sedation was provided if needed. Regional anaesthesia was administered in the operation theatre prior to the starting of surgery. Under proper monitoring and aseptic & antiseptic technique, peripheral nerve stimulator guided single shot brachial plexus nerve block by supraclavicular approach was given. All the patients received 50 microgram of Fentanyl IV after brachial plexus block was performed. Evaluation of sensory and motor block onset was performed at every 3 minutes interval after needle withdrawal, upto 30 minutes. Sensory block evaluation was done with a 25 gauge needle for presence or absence of pain sensation along the dermatomal distribution of the forearm and hand. Similarly motor block onset was also evaluated by the assessing the following motor movements wrist flexion and extension, third finger flexion, thumb abduction and little finger flexion and further classified as complete or incomplete. Failed block was defined as patient complaining of significant pain to surgical stimulus at the operative site 30 minutes after administering brachial plexus block. In cases of failed block subsequent conversion to general anaesthesia was done. Intra & postoperatively the patients were observed for any complications, motor and sensory block assessment was done every 30 minutes by anaesthesia doctor performing the block. Duration of motor block was deemed from the time of administration of nerve block till all range of above mentioned motor movements were observed in hand (failed block excluded). Similarly the duration of sensory block was evaluated by assessing the VAS score (VAS scale: 0 cm=no pain, 10 cm=worst pain) of the patients. Duration of sensory block (analgesic duration) was deemed from the time of administration of nerve block till a VAS score of ≥4 was noted in our study patients postoperatively (failed block excluded). Rescue analgesia in the form of Inj. tramadol 50 mg slow IV was administered when a VAS scores of ≥4 cm was recorded. The data obtained from our study was entered into MS Excel spread sheets and was analyzed accordingly. Parameters used to compare the two groups statistically were demographic characteristics, duration of sensory block (VAS score), duration of motor block etc. Numerical parametric data was presented as mean and standard deviation and compared using “unpaired student t-test”, chi square test wherever applicable and a “P value” of less than 0.05 was considered significant. The statistical analysis was done using “GrapPad InStat-version 3.0” software.

RESULTS

The age, sex, weight, height and the demographic data were comparable between the two groups R and RF. The operative procedures performed were predominantly open reduction and fixation of fracture (ORIF), followed by closed reductions forearm bones and implant removal.

Table 1: Demographic parameters of the two groups R and RF.

Demographic parameters	Group R (N=35)	Group RF (N=31)
Age (years)	44± 4.3	43± 5.9
Weight (Kg)	56 ± 5.2	58.2 ±3.4
Sex (M:F)	24:11	23:08
Height (cms)	153±8.2	152±6.4
ASA physical status I/II (n)	25:5	24:6
Duration of surgery (minutes)	62.5±15.3	64±16.1
Surgical procedures		
ORIF	18	16
Closed reduction of forearm bones	8	9
Implant removal	4	5

Block onset and duration of sensory and motor block

5 blocks failed in Group R and only one block failed in Group RF (cause not evaluated).The duration of onset of

sensory and motor block were comparable in between the two groups, while the duration of analgesia (sensory block) was 4.5 (4.11-4.89) hours in group R and 7.75 (7.28-8.22) hours in group RF, whereas the duration of motor block was 3.66 (3.2-4.12) hours in group R and 6.56 (6.13-6.99) hours in group RF respectively were highly significant (p=0.0001).

Table 2: Onset of sensory and motor block and duration of sensory and motor block.

Parameters	Group R N=30	Group RF N=30	P value
Onset of sensory block (minutes)	7.52±1.49	8.15±1.22	0.0784
Onset of motor block (minutes)	12.45±1.44	13.2±1.64	0.0648
Duration of sensory block (hours)	4.5±0.39	7.75±0.47	0.0001
Duration of motor block (hours)	3.66±0.46	6.56±0.43	0.0001

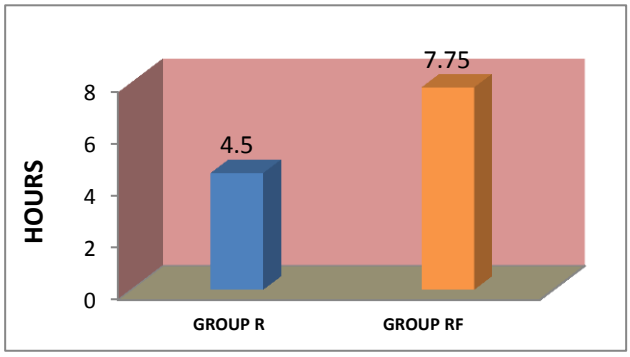

Figure 1: The mean duration of analgesia in both the groups R and RF.

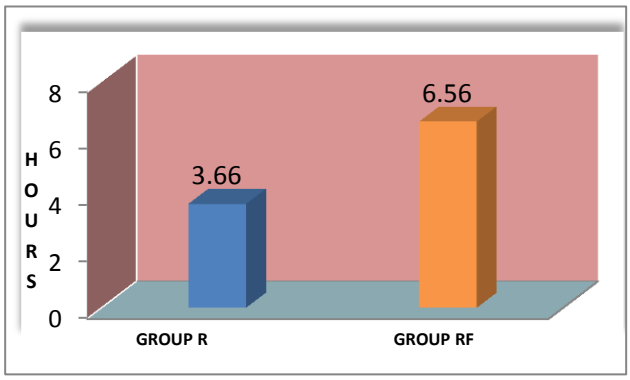

Figure 2: Mean duration of motor block in between groups R and RF.

VAS score

Most patients in group R attained a VAS score of 4 at 4.5 hours and most patients in group RF attained a VAS score of 4 at 8 hours post block administration. Overall lower VAS scores were recorded in group RF compared to group R.

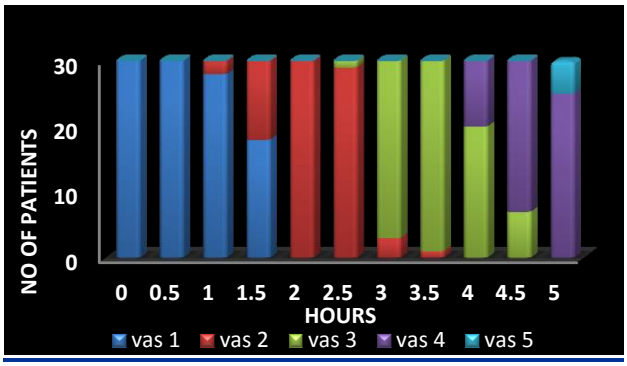

Figure 3: The hourly vas score in group R.

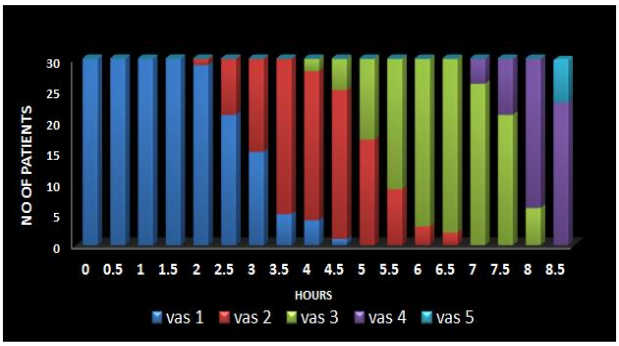

Figure 4: The hourly VAS score in group RF.

5 blocks failed in group R and only one event of block failure was noted in group RF. No complications or incomplete blocks were noted in our study patients.

DISCUSSION

The results obtained show that the addition of fentanyl (50 mcg) to ropivacaine 0.5% (30 ml) for supraclavicular brachial plexus blocks significantly prolonged the duration of sensory and motor blockade (Table 2) but delayed the sensory and motor block onset time. The analgesic/antinociceptive effect of opiates is primarily mediated at the central and/or spinal cord level.[16] Some studies have reported the existence of peripheral functional opioid receptors in animals, but their existence in human peripheral tissue is still doubtful.[14,17,18] Fentanyl used with ropivacaine in our study prolonged the duration of sensory and motor blockade, probably by directly binding with opioid binding sites on the dorsal nerve roots aided with these axonal transport or by diffusing into surrounding tissues and subsequently into the epidural and subarachnoid spaces, it may also have been central opioid receptor mediated after systemic absorption of fentanyl. Studies by viel et al. on use of opioids for brachial plexus block have reported to prolong the analgesic duration with or without the use of local anaesthetics. Madusudhan et al[19] demonstrated a significant increase in the duration of sensory, motor

blockade on addition of fentanyl to ropivacaine 0.75% for brachial plexus blocks compared to ropivacaine used alone, which were similar to our study results. In our study, the addition of fentanyl to local anesthetics for brachial plexus block (RF group) improved the success rate of nerve block. Study by Fletcher et al[12] however concluded that there was no additional benefit on addition of fentanyl to lidocaine with epinephrine for axillary brachial plexus block except for faster block onset along the musculocutaneous nerve trunk. These conflicting results were probably due to the use of a different local anesthetic from that used in our study. The delayed onset of sensory and motor block in ropivacaine with fentanyl (RF) group could be due to a change in the pH of the local anaesthetic solution on addition of fentanyl, resulting in the slower block onset. To confirm this hypothesis, further studies are required comparing the effects of Fentanyl on the pH of local anaesthetic used for brachial plexus block. Systemically administered fentanyl in the ropivacaine group (R) acting via central opioid receptors, may have a facilitatory effect on the early onset of analgesia at the operative site in our study. Our study did not evaluate the intraoperative haemodynamic parameters & sedation scores of patient, causes of block failure, rescue analgesic consumption in our study population.

CONCLUSION

The addition of fentanyl (adjuvant) to ropivacaine used for brachial plexus block may prolong the duration of sensory and motor block but may delay the onset of sensory and motor block compared to ropivacine used alone.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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