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Original Research Article

Comparison of bupivacaine with fentanyl and bupivacaine with butorphanol for brachial plexus block by axillary approach- a prospective, double blind, randomized study

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ABSTRACT

Background: Brachial plexus block by axillary approach achieves good motor sensory and sympathetic blockade below elbow joint. Addition of opioid compounds to local anesthetics improves the block properties and reduces central opioid related side effects. We compared combination of local anaesthetic bupivacaine with fentanyl and butorphanol in axillary block for upper limb surgeries. Aims and objectives were to compare the block quality, duration of sensory and motor block, post-operative analgesia, safety and side effects in two groups.
Methods: 60 patients posted for elective or emergency forearm and hand surgeries were randomly divided into 2 groups of 30 each. group B (n=30) received 40ml of 0.25% bupivacaine with butorphanol (25mcg/kg) and group F (n=30) received 40ml of 0.25% bupicaine with fentanyl (1mcg/kg). Onset and duration of sensory block (pinprick) and motor block (Lovett's rating scale), hemodynamic parameters, postoperative analgesia and side effects were noted in each group.
Results: The mean time of onset of sensory block was earlier in group B (2.29±0.62 min) as compared to group F (7.53±2.24 min) in group B. The mean time of onset of motor block was also rapid in group B (4.13±0.78 minutes) than in group F (9.98±2.94 minutes). The mean duration of motor block was longer in group F (9.73±2.48) hours as compared to group B (7.15±2.20) hours in group A. Post-operatively at the end of 10 hours patients in group F were having discomforting pain (65%) as compared to group B who were having distressing and horrible pain (50%) as evaluated by Mc Gill pain questionnaire. Both the groups were hemodynamically stable, no side effects were noted.
Conclusions: Onset of sensory and motor blockade was rapid in group B, however group F showed longer lasting motor block and postoperative analgesia. Both groups were hemodynamically stable and without any side effects.

Keywords: Axillary block, Bupivacaine, Butorphanol, Fentanyl

INTRODUCTION

Surgical stress and pain elicits a consistent and well defined metabolic response, involving release of neuroendocrine hormones and cytokines that leads to myriad of detrimental effects. Regional anesthesia effectively produces mitigation of nociception as it diminishes the intensity of afferent impulses reaching the spinal cord. Brachial plexus block by axillary approach is one the most popular and reliable technique to provide anesthesia for forearm and hand surgeries. Furthermore, central neural blockade and pneumothorax are avoided as it may occur with other approaches of brachial plexus blockade.

Studies examining the benefits of adding adjuvants to local anesthetics for blockade have produced mixed results. Various adjuvants like clonidine, dexamethasone, opioids and neostigmine can be added to local anesthetics to augment the action and to increase duration of sensory and motor blockade.[1-4] The mechanism of action of these agents is unclear. It may be a direct action on nerve itself, facilitation of local anaesthetic action or effect on their systemic absorption.

Opioids can produce analgesia and anti-inflammatory effects by activating opioid receptors outside the central nervous system.[5] Addition of opioids as adjuvants not only affects the block properties but it is also devoid of potential side effects of opioids like nausea, vomiting and respiratory depression.

Butorphanol is a synthetic opioid like morphine having partial agonistic activity at μ receptors and agonistic activity at kappa receptors. It has been used alone and in combination with local anaesthetic agents for axillary block.

Fentanyl is also a synthetic opioid which is 50-100 times more potent than morphine as an analgesic. This is due to its greater lipid solubility, facilitating its rapid passage across the blood brain barrier.

We conducted this study to compare the effect of addition of opioid compound butorphanol to bupivacaine and fentanyl to bupivacaine for axillary brachial plexus block. We studied their effect on onset and duration of sensory and motor block, quality of block, post-operative analgesia and opioid related side effects.

METHODS

This study was a prospective, randomized, double-blind, single centre study. The study was conducted in a tertiary care level institute and a clinical research organization after ethical committee approval. 60 patients of American society of anaesthesiologist physical status (ASA) grade I and II, age between 18-50 years of both sex were studied after taking written informed consent. Patients with co-morbid conditions like hypertension, diabetes, renal or hepatic disease, bleeding disorder and pregnancy were excluded. Patients were randomly allocated to one of two groups by allocation sequence generated by computer generated random number table. Each group consisted of 30 patients. Group allocation was done by the anaesthesiologist who was not the part of study design. Drugs were administered by the anaesthesiologist who was not the part of data collection and analysis.

Inside operating room intravenous (i.v) line was secured and standard monitors were placed. Monitoring included Heart rate (HR), Electrocardiogram (ECG), Non-invasive Blood pressure (NIBP), Pulse oximeter (SpO2) and Respiratory rate (RR). Before block all patients received Inj. midazolam 0.03mg/kg i.v. and Injection ondansetron 4mg i.v. Brachial plexus block was given by axillary approach using paraesthesia technique. Indications of correct needle placement was either a fascial click or elicitation of paraesthesia. Infiltration in the belly of coracobrachialis muscle was given to block musculocutaneous nerve which may be spared in axillary approach. Group B received 40ml of 0.25% bupivacaine with butorphanol (25mcg/kg) and group F received 40ml of 0.25% bupivacaine with fentanyl (1mcg/kg) for axillary block.

Sensory blockade and motor blockade was assessed at 10, 30, 60,120 and 180 minutes of block. Sensory blockade was assessed by pinprick method and compared to the contralateral arm. Sensory blockade was rated on a scale from 100% (normal sensation) to 0% (no sensation). Motor blockade was evaluated by testing thumb abduction (radial nerve), thumb adduction (ulnar nerve), thumb apposition (median nerve) and elbow flexion in supination and pronation of forearm (musculocutaneous nerve). Measurements were performed using modification of Lovett's rating scale (Table 1). Duration of sensory blockade was considered as the time interval between the local anaesthetic administration and offset of paraesthesia. Duration of motor blockade was defined as time interval between local anaesthetic administration and recovery from motor blockade. Evaluation of postoperative analgesia was done by using McGill pain questionnaire (Table 2). Any opioid related side effects like nausea, vomiting, itching and respiratory depression were recorded.

Table 1: Lovett's rating scale for quantification of muscular force.

Observation	Score
Normal muscular force	6
Slightly reduced muscular force	5
Pronounced reduction of muscular force	4
Slightly impaired mobility	3
Pronounced mobility impairment	2
Almost complete paralysis	1
Complete paralysis	0

Table 2: Mc Gill pain questionnaire.

Observation	Score
No pain	0
Mild pain	1
Discomforting pain	2
Distressing pain	3
Horrible pain	4
Excruciating pain	5

Statistical evaluation

Preliminary sample size estimation using previous studies showed that approximately 30 patients should be included in each group, assuming alpha error of 0.05

(95% confidence interval) in order to obtain power of study >80%.

Patient characteristics were compared using 2 independent sample t test and chi square test. Heart rate, SBP, RR were compared using 2 independent sample t test. Time of onset and duration of block was compared using paired t test. P<0.05 was considered significant, P>0.05 not significant and P<0.001 highly significant. Data analysis was done using SPSS (statistical package for social science) version 17.0 (SPSS Inc., Chicago II, USA).

RESULTS

The two groups were comparable with regards to demographic data like age, sex and weight.

Both the groups were comparable with regards to heart rate, blood pressure and respiratory rate and duration of surgery.

The mean time of onset of sensory analgesia was earlier (2.29±0.62 min) in group B, whereas it was 7.53 minutes in group F, highly significant (P-0.001). The mean time of onset of motor blockade was also earlier (4.13±0.78 minutes) in group B, whereas it was 9.98±2.94 minutes in group F, highly significant (P-0.001) (Figure 1).

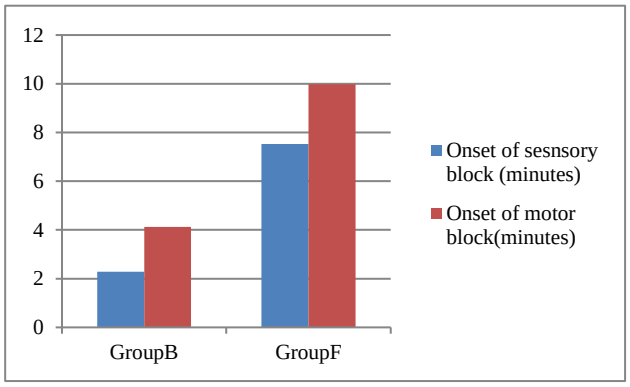

Figure 1: Comparison of time of onset of sensory and motor block (Mean±SD).

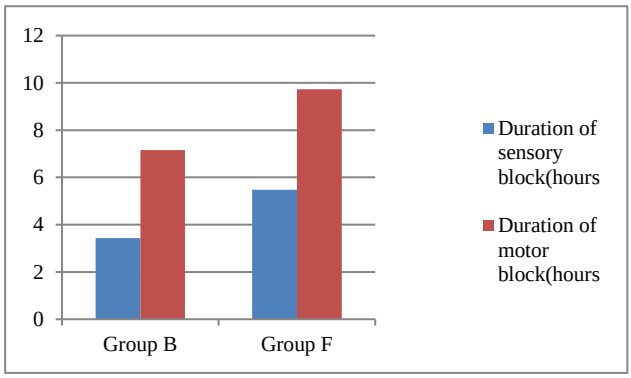

Figure 2: Comparison of duration of sensory and motor block (mean±SD).

The mean duration of sensory blockade was lesser (3.43±0.55 hours) in Group B as compared to group F, in which it was 5.48±0.59 hours. Similarly, mean duration of motor blockade was lesser in group B (7.15±2.20 hours) as compared to group F in which it was 9.73±2.48 hours. Both results were statistically significant, P-0.001 (Figure 2).

No difference in quality of either sensory or motor blockade was observed between the two groups.

Post-operative analgesia at the end of 10 hours as assessed by McGill pain questionnaire showed that 65% of the patients in fentanyl group had discomforting pain, whereas 50% of patients in butorphanol group had more severe pain. All the patients were given analgesic in the form of Injection diclofenac 75 mg i.v when they complained of pain.

Table 3: Comparison of side effects.

Side effect	Group B	Group F
Nausea	Nil	Nil
Vomitting	Nil	Nil
Respiratory depression	Nil	Nil

No opioid related side effects were seen in both the groups (Table 3).

DISCUSSION

Brachial plexus block by axillary approach is an elegant block which provides satisfactory sensory and motor blockade for the forearm and hand surgeries. Various adjuvants like opioids, clonidine, dexamethasone and neostigmine[4] are added to local anaesthetic agents to improve the efficacy and safety of blocks. It also helps in prolongation of action of local anesthetics by unclear mechanisms.

Opioids when added as adjuvants can produce analgesia and anti-inflammatory effects by activating peripheral opioid receptors thereby reducing unwanted central nervous system side effects like nausea, vomiting and respiratory depression. Comparative studies of use of different opioids as adjuvants have produced conflicting results which resulted in further trials and newer modifications in their usage.

In present study both the groups were comparable in terms of demographic, hemodynamic parameters and respiratory rate. Few variations in heart rate, blood pressure and respiratory rate were noted which were not clinically significant. Both the groups were also comparable with regards to duration of surgery. There was no significant difference in the quality of sensory and motor block between the two groups. The time of onset of sensory block was significantly rapid with butorphanol as compared to fentanyl (P-0.001). Similarly, the onset of

motor block was significantly rapid with butorphanol than fentanyl (P-0.001).

These results are in accordance with study conducted by Nishikawa in which onset of analgesia was prolonged by adding fentanyl as an adjuvant in axillary block.[6] In his study pH of the lignocaine solution was decreased from 6.2 to 5.2 by addition of fentanyl. This could have reduced the rate of absorption of lignocaine into nerve membrane resulting in slower onset of action.

The duration of sensory block was significantly longer in fentanyl group (5.48±0.59 hours) than that in butorphanol group (3.43±0.55 hours). Also the duration of motor block was significantly longer in fentanyl group (9.78±2.48 hours) than in butaorphanol group (7.15±2.20 hours).

Postoperative analgesia was evaluated using Mc Gill pain questionnaire (Table 5). At the end of 10 hours 65% patients in fentanyl group had discomforting pain (score 2) whereas 50% patients in butorphanol group had distressing and horrible pain (score 4 to 5). This is in agreement with results obtained by Karakaya. Karakaya et al showed that addition of fentanyl to bupivacaine for axillary block almost doubled duration of analgesia.[7] Similar study was done by Wajima et al recorded that addition of butorphanol into brachial plexus block decreased the pain score as compared to addition of saline.[8]

A systemic review of 24 studies done by Murphy D reveals that evidence for use of opioids as adjutants to regional anesthesia is weak and needs further investigation.[4] Jena et al recorded that duration of motor blockade was prolonged in butorphanol group.[9] Which was statistically significant than in control group (P-<0.001).

In the year 2011 a study conducted by Chavan SG evaluated the effect of addition of fentanyl to local anaesthetic in brachial plexus block.[10] In his study duration of analgesia in fentanyl group was significantly longer (695+85 minutes) than in control group (415+78 minutes), P<0.01. Results of the study are in agreement with present study. No opioid related side effects were observed in present study.

We did not measure the pH of the prepared solutions after mixture of the drugs. This can be considered as drawback of present study.

CONCLUSION

Overall our study shows that addition of butorphanol as an adjuvant caused a rapid onset of action of sensory and motor block as compared to fentanyl. However, addition of fentanyl caused longer lasting analgesia and motor blockade. Patients in both groups remained hemodynamically stable and no opioid related side effects were noted.

We recommend the use of fentanyl 1ug/kg as a safe and effective adjuvant to bupivacaine in axillary block to prolong the sensory and motor blockade.

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

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