

Effect of Addition of Fentanyl on The Onset And Duration of Action of Ropivacaine in Brachial Plexus Block.

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Abstract:

Background: Brachial plexus block is a valuable adjunct to general anesthesia for surgery of the upper limb and a suitable alternative in poor risk patients for general anesthesia. However, over the past 20 years, several studies have suggested that the addition of certain opiates to the local anaesthetics which are used for brachial block may provide effective, long-lasting postoperative analgesia. 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 60 ASA I and II patients aged 20-60 were included and were divided into 2 groups, group A(30) and B (30). Supraclavicular brachial plexus block was performed in the group A using 0.75% ropivacaine 30 ml plus 5 ml NS (total 35 ml) and in group B received 0.75% ropivacaine plus 2micrograms/kg fentanyl in 5 ml NS (total 35 ml) in brachial plexus block. The onset time of analgesia, duration of analgesia were recorded.

Results: Demographic parameters and block onset time were comparable in both groups. Regarding the mean onset time there is a statistically significant difference between the two groups ($p < 0.001$). Regarding the mean duration of action is concerned there is no statistical significant difference between the two groups ($p > 0.05$).

Conclusions: So addition of Fentanyl to ropivacaine produced a quicker onset compared to the plain ropivacaine.

Keywords: Ropivacaine, fentanyl, onset and duration of analgesia.

I. Introduction

Pain is one of man's most compelling experiences. It is unpleasant sensation which only the individual himself can appraise and as such incapable of a satisfactory definition. Herrington (1906) in his classic work on central Nervous System, has defined pain as "The Psychological adjunct to an imperative protective reflex" the concept certainly draws attention to the protective aspects of pain in preventing body injury by noxious stimuli.

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 pain¹.

The effects of postoperative pain are largely psychological, causing distress and anxiety and can be associated with less serious autonomic disturbances such as sweating and nausea. Therefore most obvious motive for relieving postoperative pain is the humanitarian one. Good postoperative pain can reduce the metabolic response to trauma and thus may prevent or postpone postoperative negative nitrogen balance.

Regional anaesthetic techniques produce superior analgesia, decrease adverse effects compared to systemically used opioids and improve patient outcome & satisfaction². 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 both⁷. Studies have shown an increase in the block duration and success rate of brachial plexus block on addition of opioid adjuvant⁸⁻¹¹ but some studies show no additional benefit^{12,13}. This enhanced antinociception may have been mediated via activation of peripheral opioid receptors¹⁴. There are also reports that Fentanyl may have local anaesthetic like action¹⁵. Hence 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.

II. Materials And Methods

After approval by the Institutional ethics committee, this randomized, prospective, blinded, single hospital study was conducted in Sixty patients between the age group of 20-60 and confining to ASA class-I and class-II scheduled to undergo upper limb surgery . A written informed consent was obtained from each patient after explaining the procedure. Patient unwilling to participate in the study and who have neurological disorders, anemia, hypertension, cardiac and respiratory disorder are excluded from the study.

These 60 patients were randomly divided into two groups of 30 each. **Group A** patients received Ropivacaine 0.75% 30 ml of solution + 5 ml normal saline. **Group B** patients received Ropivacaine 0.75% 30 ml of solution + Fentanyl 2 micro g / kg body weight diluted to 5 ml .35 ml of solution was given to same anesthetist who will be performing brachial plexus block under standard supraclavicular approach and he does not know which group the patient belongs to. All patients were premedicated with tab alprazolam 0.5 mg one day prior to surgery and at 6am on the morning of surgery. Maximum care was taken in proper positioning of the patient, as it is one of the essential features for a successful block. Patient was placed in Supine With a pillow under the shoulders head turned to opposite side with arm drawn down to depress the shoulder. Skin preparation with Strict aseptic conditions is done. Supraclavicular brachial plexus block, as described by Macintosh and modified by Ball was used in the present series. An intradermal wheal was raised 1 cm: above the midpoint of the corresponding clavicle with 0.5cc of analgesic solution. A 22 gauge needle with a syringe loaded with analgesic solution was introduced through the skin taking care not to injure the external jugular vein at the same time the subclavian artery was palpated and pushed medially to prevent puncturing or accidental injection in to the vessel. The needle was passed downwards, backwards and medially towards the upper surface of first rib. In some cases, before the upper surface of first rib was reached, paraesthesia were felt, as a sense of tingling, numbness or shooting burning pain along the upper limb. In such cases analgesic solution was deposited as a single shot.

When paraesthesia was not elicited, the needle was advanced inwards cautiously till it struck the upper surface of first rib and gently walk over the rib till we elicit paresthesia and then only deposit the drug. An assessment was made for onset of analgesia, duration of analgesia. Onset of analgesia was taken as the period after injection of the analgesic solution to the absence of pin prick sensation at the surgical site. Duration of analgesia was taken as the period from the time of loss of pinprick sensation to the first appearance of pin prick sensation at the surgical site. These observations are made by another anesthetist who does not know what drug was administered to the patient. Numerical parametric data was presented as mean and standard deviation and compared using “student t-test” and a “p value” of less than 0.05 was considered significant.

III. Observation And Results

Group A- There are 30 patients in group A out of which 25 patients are male and 5 patients are female.

Group B- There are 30 patients in group, out of which 24 are male and 6 are female.

AGE distribution between group A and group B for 60 patients

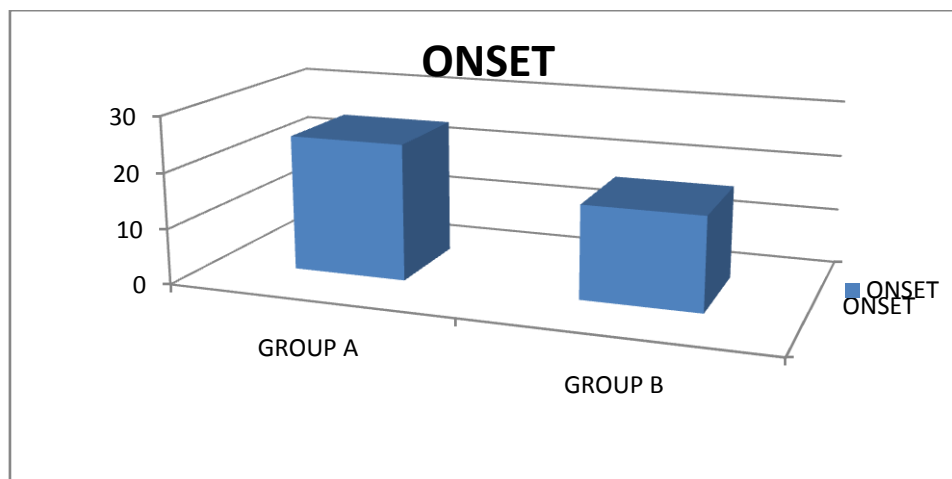
	GROUP A	GROUP B
MEAN AGE + SD	35.16 + 9.4	37.16 + 10.9

The difference is not statistically significant as the p value is 0.2 Hence there is no statistically significant difference we can conclude that the two groups are comparable.

Mean onset time of analgesia in minutes plus standard deviation of the two groups are shown

	GROUP A	GROUP B
ONSET TIME(MIN) + SD	24.5 + 7.01	16.7 + 8.5

Mean Onset Time Between Group A And Group B For 60 Patients As Shown In The Bar Diagram



The P value is 0.001 which indicates a highly significant difference in the onset time between the two groups.

The mean duration of action in minutes plus standard deviation of two groups are shown below

	GROUP A		GROUP B
DURATION(HRS)+ SD	9.43	+ 2.64	9.4 + 1.7

The p value is 0.47 which indicates that there is no statistically difference between the mean duration of actions between the two groups.

The summary of results is that the demographically both the groups are comparable as there is no significant difference between the two groups. Regarding the mean onset time there is a statistically significant difference between the two groups ($p < 0.001$). So addition of Fentanyl to ropivacaine produced a quicker onset compared to the plain ropivacaine. Regarding the mean duration of action is concerned there is no statistical significant difference between the two groups ($p > 0.05$). Addition of Fentanyl did not have any effect on the mean duration of action between the two groups.

IV. Discussion

There are different adjuvants being used along with local anesthetics in clinical Practice. Vasoconstrictors like adrenaline and Sodium bicarbonate, Dextrans, Hyluronidase and addition of CO₂ to the local anesthetics were tried.

In this study we are combining opioids along with local anesthetics to study how the onset and duration are affected. Opiates are widely known to have an antinociceptive effect at the central and/or spinal cord level. If opioid administration improves regional anaesthesia without centrally mediated side effects, it would be useful in clinical practice. It is speculated that the peripheral administration of opioids provides stronger and longer lasting analgesia with a lower dose of opioid without central side effects such as respiratory depression, nausea, vomiting and pruritus. Unlike the other adjuvants which actually interfere with the action of local anesthetics, opioids act on the peripheral opioid receptors and exert their action.

Sirish G Chavan, Alka R Koshire Et Al¹⁶ concluded that addition of Fentanyl had a significant difference in the onset and duration of action in brachial plexus block. Their possible explanation was that Fentanyl may act on the peripheral opiate receptors located on primary afferent roots and penetrate the nerve membrane and act on the dorsal root. It may diffuse in to epidural space and sub arachnoid space from brachial plexus. It may act on the central opioid receptors by peripheral uptake in to systemic circulation by diffusion.

According to the study done by **s p singh and vinitha singh**. Fentanyl added to supraclavicular block showed a significant fall in VAS (visual analogue scale (VAS) for the fentanyl group at one hour after surgery¹⁷.

Bazin et al. (1997) reported sustained analgesic effect from opioids used in supraclavicular brachial plexus block which outlasted the local anesthetic action of bupivacaine. Patients reported prolonged satisfactory analgesia with buprenorphine, morphine and sufentanil compared with saline. An earlier study by this group demonstrated prolonged post-operative analgesia after the addition of sufentanil 0.2 µg/kg to supraclavicular block¹⁸.

The addition of 100 µg/mL fentanyl to 0.25% bupivacaine almost doubles the duration of analgesia following axillary brachial plexus block when compared with 0.25% bupivacaine alone¹⁹.

All these studies suggest the presence of peripheral opioid receptors and there are various studies supporting their action.

Christoph Stein, M.D.²⁰ Recent research has shown that, in addition to these mechanisms in the central nervous system, intrinsic modulation of nociception can occur at the peripheral terminals of afferent nerves. Specifically, these studies indicate that the immune system can interact with peripheral sensory-nerve endings to inhibit pain. This neuro immune link was discovered while studying the effect of opioids on peripheral tissues. The opioid receptors on the peripheral nerve terminals are upregulated during inflammation. Cytokines will activate the endogenous opioid peptides and cause local analgesia at the site of inflammation. All three types of receptors μ , δ , κ are present on the peripheral nerves.

Mechanism for antinociception in peripheral neurons are opioids increase the potassium currents and decrease the calcium currents in the peripheral neurons. Both of which will lead to inhibition of neuronal firing and transmitter release. They also inhibit the release of substance P which is a excitatory and proinflammatory compound. Faster onset of action has also been observed in two studies conducted by **GOBEAUX D et al and Singelyn F Et al**²¹.

In our study addition of Fentanyl to Ropivacaine produced a quicker onset compared to the plain Ropivacaine. Regarding the mean duration of action is concerned there is no statistical significant difference. By taking in to account all the above data we can suggest that the fentanyls action on the peripheral opioid receptors is responsible for the faster onset in our study.

V. Conclusion

In this study addition of fentanyl 2 micrograms per kg to 0.75% ropivacaine produced quicker onset of action in supraclavicular brachial plexus block and it did not have any effect on the duration of action.

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