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# ADDITION OF FENTANYL TO THE LOCAL ANAESTHETIC FOR PROLONGATION OF POSTOPERATIVE ANALGESIA VIA SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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## ABSTRACT

**Background :** Regional anesthesia is a recommended technique for upper limb surgeries with better postopera tive profile. The aim of our study was to evaluate the effect of fentanyl addition to 0.5% bupivacaine and Lignocaine 2% with epinephrine (1:200,000) in supraclavicular brachial plexus block on the onset, duration and quality of block for upper extremity surgeries with lesser side effects and easy administration.

**Materials and Methods:** This study comprised 50 cases of ASA grade-I & II between the age group of 15 to 45 years undergoing upper limb surgeries. Group c (Control Group) consisted of 25 patients and was given 10 ml of 0.5% Bupivacaine (1 mg/kg) and 18 ml of 2% Lignocaine with adrenaline (7 mg 1 kg) + 2 ml normal saline (Total volume 30 ml). Group F (Fentanyl Group) 25 patients10 ml of Bupivacaine 0.5% (1 mg/kg) +2 ml Fentanyl (100 microgram) and 18 ml of 2% lignocaine with adrenaline (Total volume 30 ml)

**Results :** onset of sensory blockade in control group was within 10-15 min., in fentanyl group with in 16-20 min.Mean time of onset of sensory blockade was 13.12 + 3.952 in control group and 14.96 + 4.04 min in Fentanyl group. onset of motor blockade in group C within 5-10 minutes and in group F within 5-10 minutes.The mean onset of motor blockade in group C was 10.96+3.32 min. and group F was 11.04+3.36 min. Duration of analgesia in control group wass within 241-360 min and in Fentanyl group within 601-720 min.The mean duration of analgesia in control group is 320.60 + 68.61 min and in Fentanyl group that is 663.60 + 109.12 minThe mean duration of motor blockade in control group is 260.20 + 77.059 min and Fentanyl group is 350.40 + 109.006 min.

**Conclusion:** When fentanyl was mixed with the local anaesthetic drug it caused prolongation of duration of analgesia for supraclavicular brachial plexus block.There was no significant difference on onset of sensory and motor blockade in both groups.There was no significant occurrence of complication in both groups. Insignificant vital parameters changes throughout the study in both the groups.

**KEYWORDS** : Fentanyl, Supraclavicular Brachial Plexus Block ,Xylocaine ,Bupivacaine

**Introduction**

Upper limb surgeries are preferably done under regional anesthesia. Peripheral nerve blocks not only provide for intra operative anesthesia but also ensure analgesia in the post operative period without any systemic side effects. Since the introduction of brachial plexus block in the clinical practice, many local anaesthetic drugs has been used, of which main drugs are lignocaine and bupivacaine whose duration of action was limited. Hence introduction of other analgesic drugs for prolongation of analgesic effects were used, out of many drugs opioids was the most accepted group of drugs. Opioids have been used since long time for pain relief. Fentanyl is a phenyl piperidine derivative of synthetic opioid agonist that is structurally related to meperidine. As an analgesic, fentanyl is more potent than morphine, pethidine or alfentanyl. Peripheral opioids would allow analgesia without central side effects like nausea, vomiting, respiratory, depression, dysphoria, sedation or addiction and hepatic toxicity.

Fentanyl, a phenylpiperidine derivative synthetic opioid agonist that is structurally related to mepiridine, could act on these receptors and causes their activation, causing an increase in potassium current and a decrease in calcium current in cell bodies of sensory neurons, both of which can lead to inhibition of neuronal firing and transmitter release when this occurs throughout the neuron, there is attenuation of exitability of peripheral nociceptive terminal and the propagation of action potential. This is clinically manifested as a prolonged period of postoperative pain relief. Other mechanisms proposed included a hypothesis where fentanyl may diffuse from brachia plexus to epidural and subarachnoid space and then binds with opiate receptors in dorsal horn. Fentanyl may potentiate local anaesthetic action via central opioid receptor mediated analgesia via peripheral uptake of fentanyl to systemic circulation/!

**METHODOLOGY**

After obtaining approval from the institutional ethical committee, patients were explained about the drug and after taking written consent were included in the study. This study comprised 50 cases of ASA grade-I & II between the age group of 15 to 45 years undergoing upper limb surgeries. Group c (Control Group) consisted of 25 patients and was given 10 ml of 0.5% Bupivacaine (1 mg/kg) and 18 ml of 2% Lignocaine with adrenaline (7 mg 1 kg) + 2 ml normal saline (Total volume 30 ml). Group F (Fentanyl Group) 25 patients10 ml of Bupivacaine 0.5% (1 mg/kg) +2 ml Fentanyl (100 microgram) and 18 ml of 2% lignocaine with adrenaline (Total volume 30 ml) .The demographic data and surgical characteristics were comparable in both groups .

**TABLE : 1**
**ASSESSMENT OF ONSET OF SENSORY BLOCK**

| S.No. | Time (minutes) | Group C | | Group F | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| 1. | 10-15 | 16 | 64% | 9 | 36% |
| 2. | 16-20 | 6 | 24% | 12 | 48% |
| 3. | 21-25 | 3 | 12% | 4 | 16% |
| Total | | 25 | 100% | 25 | 100% |
| **Mean** | | **13.12 min** | | **14.98 min** | |
| **SD** | | **3.992 min** | | **4.040 min** | |

The above table shows onset of sensory blockade in control group the maximum number of cases i.e. 16 (64%) was within 10-15 min., in fentanyl group maximum number of cases i.e. 12 (48%) with in 16-20 min.

Mean time of onset of sensory blockade was 13.12 + 3.952 in control group and 14.96 + 4.04 min in Fentanyl group.

**TABLE : 2**
**ASSESSMENT OF ONSET OF MOTOR BLOCK**

| S.No. | Time (minutes) | Group C | | Group F | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| 1. | 5-10 | 17 | 68% | 14 | 56% |
| 2. | 11-15 | 4 | 16% | 5 | 20% |
| 3. | 16-20 | 4 | 16% | 6 | 24% |
| Total | | 25 | 100% | 25 | 100% |

| | | |
|---|---|---|
| **Mean** | **10.96 min** | **11.40 min** |
| **SD** | **3.322 min** | **3.366min** |

This table shows that onset of motor blockade in group C within 5-10 minutes in maximum number of cases i.e. 17 (68%) and in group F within 5-10 minutes in maximum number of cases i.e. 14 (56%).The mean onset of motor blockade in group C was 10.96+3.32 min. and group F was 11.04+3.36 min.

**TABLE:3**
**ASSESSMENT OF DURATION OF SENSORY BLOCKADE**

| S.No. | Time (minutes) | Group C | | Group F | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| 1. | 120-240 | 6 | 24% | - | 0% |
| 2. | 241-360 | 14 | 56% | 1 | 4% |
| 3. | 361-480 | 5 | 20% | 4 | 16% |
| 4. | 481-600 | - | - | 6 | 24% |
| 5. | 601-720 | - | - | 14 | 56% |
| **Total** | **12 hr** | **25** | **100%** | **25** | **100%** |
| **Mean** | | **320.60 min** | | **663.60 min** | |
| **SD** | | **68.618min** | | **109.120 min** | |

The above table shows the duration of analgesia in control group, the maximum number of cases, i.e. 14 (56%) is within 241-360 min and in Fentanyl group the maximum number of cases i.e. 14 (56%) within 601-720 min.The mean duration of analgesia in control group is 320.60 + 68.61 min and in Fentanyl group that is 663.60 + 109.12 min.

**TABLE:4**
**ASSESSMENT OF DURATION OF MOTOR BLOCK**

| S.No. | Time (minutes) | Group C | | Group F | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| 1. | 120-240 | 7 | 28% | 1 | 4% |
| 2. | 241-360 | 16 | 64% | 12 | 48% |
| 3. | 361-480 | 2 | 8% | 10 | 40% |
| 4. | 481-600 | - | - | 2 | 8% |
| 5. | 601-720 | - | - | - | - |
| **Total** | | **25** | **100%** | **25** | **100%** |
| **Mean** | | **260.20 min** | | **350.40 min** | |
| **SD** | | **77.059 min** | | **109.60 min** | |

This table shows duration of motor blockade. In control group, the maximum number of cases i.e. 16 (64%) is within 241-360 minutes and the maximum number of cases in fentanyl group i.e. 12 (48%) within 241-360 minutes.The mean duration of motor blockade in control group is 260.20 + 77.059 min and Fentanyl group is 350.40 + 109.006 min.

**Statistical Analysis:** . After all parameters, patient's age and duration of surgery were analyzed by student's unpaired 't'-test. Sex distribution and ASA grading were analyzed by chi-square test. Time for onset of adequate sensory block, duration of sensory and motor block was analyzed by student's unpaired 't'test. Comparison of intraoperative complications like bradycardia and hypotension were analyzed by Fisher exact test. The data was compiled and subjected to statistical analysis using Statistical Package for Social Sciences (SPSS), version 17. Demographic and hemodynamic data were subjected to Student's 't-test' and for statistical analysis of onset time and duration of sensory and motor blocks, and DOA unpaired *t*-test. p-value was considered as significant as shown below .$p > 0.05$ not significant, $p < 0.05$ significant, $p < 0.0001$ highly significant.

**DISCUSSION**

Pain is defined as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage". Pain is the most frequent cause of suffering and disability which seriously impairs the quality of life of millions of people,' Relief of pain during intraoperative and postoperative period is one of the mainstay of balanced anaesthesia, as an uneventful postoperative period makes surgery comfortable for surgical patients.

There has been increasing interest in the combination of local anaesthetic and opioids to improve the quality and duration of nerve blocks. Peripheral effects of opioids may improve regional anaesthesia without centrally mediated side effects. This would be of beneficial during brachial plexus anaesthesia, a commonly used anaesthetic technique for upper limb surgery.

This study was conducted to evaluate the efficacy of addition of fentanyl 100 jug to bupivacaine 0.5% and Lignocaine 2% with epinephrine (1:200,000) in supraclavicular brachial plexus block for upper limb surgeries.

50 patients of either sex between the age group of 15 to 45 years, belonging to ASA physical status I and II scheduled for routine as well as emergency upper extremity surgeries were performed using single shot supraclavicular brachial plexus block.

Kardash Ken et al. evaluate the addition of Fentanyl 70 μg to Mepivacaine 1.5% with epinephrine (1:200,000) in supraclavicular block.[1] Bazin et al. used a mixture of Lignocaine and bupivacaine, either alone or combine with morphine (75 μg/kg), buprenorphine (3 μg/kg), or sufentanil (0.2 jag/kg).[2] Nishikawa Kohki et al used 40 ml of Lignocaine 1.5% with epinephrine (1:200,000) mixed with 100 μg of fentanyl in axillary brachial plexus block.[3] Karakaya Denin et al. studied the 60 patients divided into three groups. Group B received 40 ml of bupivacaine 0.25%, group BF received 40 ml of bupivacaine 0.25% with Fentanyl 2.5 jag/ml and Group DBF - received 40 ml of 0.125% bupivacaine with fentanyl 2.5 μg/ml.[4] Lutfal et al. evaluate the addition of opioids to local anaesthetic in axillary brachial plexus block. 120 patients divided into four groups and group C received 0.25% bupivacaine (30-40 ml) alone, group BM (bupivacaine morphine) 75 mg/kg Morphine group BP (bupivacaine pethidine) 750 μg/kg pethidine and group BF (bupivacaine fentanyl) 0.75 μg/kg of fentanyl was given in addition to 0.25% bupivacaine.[5]

In our study, the mean time of onset of sensory blockade was 13.12±3.99 minutes in group - C and 14.96±4.04 minutes in group - F, while mean time of onset of motor blockade was 10.96±3.32 minutes in control group and 11.04±3.36 minutes in Fentanyl group. Thus no significant difference in mean time of onset of sensory blockade as well as mean time of onset of motor blockade in two study group were observed. The difference were statistically insignificant. Hemi Racz, Kevin Cunning et al. [6] evaluate the 5 mg of morhine added to local anaesthetic solution in axillary brachial plexus block does not alter the time of onset of block. Kardash Ken et al. found that there was no significant effect on block characteristies when fentanyl added to local anaesthetic. Fenelli G. et al. [7] found that no improvement in the onset of anaesthesia was achieved on addition of fentanyl to ropivacaine in axillary brachial plexus block. Karkaya Deniz et al. concluded that no significant improvement in the onset of sensory and motor blockade when fentanyl was added to bupivacaine in axillary brachial plexus block. Fletcher D. et al. (1994) observed faster onset of sensory blockade for musculocutaneous nerve in fentanyl group.Nishikawa Kohki et al. (2001) observed significant delay in onset of sensory blockade when fentanyl was added to Lignocaine with epinephrine in axillary brachial plexus block.

In our study the mean duration of sensory blockade in group C was 320.60+68.61 minutes and 663.60±109.12 minutes in group F. The mean duration of motor blockade was 260.20±77.05 minutes in group C and 350.40±109.006 minutes in Fentanyl group. Duration of sensory as well as motor block were significantly longer in fentanyl group compared to control group Bazin et al. (1997) they concluded that the addition of an opioid to a local anaesthetic increased the duration of analgesia. Murphy DB, McCartney CJ et al. studied the

addition of fentanyl to local anaesthetic for wound infiltration can enhance the post operative analgesia. Nishikawa Kohki et al found that the addition of fentanyl (100 μg) to Lignocaine showed duration of sensory blockade was significantly increased. Karakaya Deniz et al. concluded that addition of 100 μg fentanyl to 0.25% bupivacaine almost doubles the duration of analgesia. Lutful Aziz et al. observed that mean duration of analgesia was 12.27±2.4 hours in fentanyl group compared to 4.07±0.78 hours in control group ($p< 0.01$). Fletcher D. et al. (1994), Kardash Ken et ai. (1995), Fenelli G. et al. (2000), Lee K.Y. et al. (2003) and Yong J.H. et al. (2004) did not observe significant difference in duration of analgesia when fentanyl was added to local anesthetics.

In our study the mean duration of analgesia in fentanyl group was 663.63±109.12 minutes and 320.60±68.61 minutes in control group, thus mean duration of analgesia was statistically highly significant in fentanyl group, compared to control group. Gormley WP, Murray et al. [12] suggested that fentanyl and meperidine prolonged the analgesia and reduced the dose of local anaestehtic due to blockade of the peripheral opiate receptors .Bazin J.E. et al. [2] found that adition of opioids to a local anaesthetic mixture lengthens the duration of analgesia.. Nishkiawa Kohki et al. [3] concluded that addition of fentanyl to Lignocaine causes duration of sensory blockade was significantly increased. K. Kardash et al. [1] observed that addition of fentanyl to mepivacaine in supraclavicular block enhance postoperative analgesia. Karakaya Deniz et al. [4] they studied that addition of fentanyl to bupivacaine in axillary brachial plexus block atmost double the duration of mean sensory block.Lutful Aziz et al [5] concluded that addition of equianalgesic doses of different opioids to local anaesthetics in brachial plexus block prolongs the analgesia. Fletcher D. et al. [10], Kardash Ken et al. [1], Fenelli G. et al. [7], Lee K.Y. et al. [8] and Yong J.H. et al. [9] did not observe significant difference in duration of analgesia when fentanyl was added to local anesthetics.

In our study the difference in the mean VAS score used to assess analgesia was found to be highly significant in fentanyl group from 4 hours to 10 hours after performing the block ($p<0.01$). This is inspite of the fact that the patients in the control group received more rescue analgesia than fentanyl group.Kardash Ken et al. [1] observed a significantly lower VAS score among the patients with fentanyl added to their block. Lutful Aziz et al. [5] also observed a significant decrease in VAS in fentanyl group compared to control group from 4 hours to 12 hours. Lee K.Y. et al. [7] also observed a significantly lower VAS score at 180 to 210 minutes among the patients with fentanyl group. In our study rescue analgesics were provided at VAS ≥5. Injection diclofenac sodium 1.5 mg/kg intramuscularly was given.The mean number of injection received in group C was 1.28±7.77 and that in group F 0.44±0 was the difference between the two groups was statistically highly significant ($p<0.01$).

In our study incidence of dizziness was 1 patient in group C while none of the patients had dizziness in group F.

While the incidence of nausea or vomiting was 1 patient in both the groups. While the incidence of respiratory depression was 1 patient in group F. Nausea and vomiting are due to direct stimulating effect of fentanyl on the chemoreceptor trigger zone in the floor of the fourth ventricle. Fentanyl causes respiratory depression primarily by its agonist effect on Hz receptors leading to a direct depressant effect on brainstem, ventilatory centers. Respiratory depression was not significantly observed because peripherally acting opioids receptors produce analgesia without central side effects.Kankaya Deniz et al. [4] observed dizziness in one patient in bupivacaine group and nausea in one patient in fentanyl group. Respiratory depression bradycardia or vomiting was not seen in any group.

Lufful Aziz et al. [5] observed nausea and vomiting in 2 patients in group C and 1 patient in fentanyl group. There was no significant difference in side effects between the two groups.

In our study we did not found statistically significant change in mean pulse rate, mean systolic blood pressure, mean respiratory rate and mean oxygen saturation between the two groups at different time intervals during the study period ($p>0.05$). Karakaya Deniz et al. [4] did not observe any significant change in hemodynamic parameter, respiratory rate or peripheral oxygen saturation.Kardash Ken et al. [1] had no significant effect on vital parameters.Thus this study suggest that addition of fentanyl to 0.5% bupivacaine and 2% Lignocaine with epinephrine (1:200,000) causes prolonge analgesia with insignificant change in vital parameters and less complication.

## CONCLUSION

When fentanyl was mixed with the local anaesthetic drug it caused prolongation of duration of analgesia for supraclavicular brachial plexus block.There was no significant difference on onset of sensory and motor blockade in both groups.There was no significant occurrence of complication in both groups. Insignificant vital parameters changes throughout the study in both the groups.

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