(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 7, Issue 3 , Page No: 338-344
May-June 2024

IJMSCR

Comparison Between Dexamethasone and Fentanyl as Adjuvants to Bupivacaine and Lignocaine in Ultrasound guided Supraclavicular Brachial Plexus Block for Upper Limb Surgeries

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Background: Upper limb surgeries are mostly performed under peripheral blocks like brachial plexus blocks which provide intra-operative motor and sensory anesthesia and also extend analgesia in the post-operative period without major systemic side effects. Adjuvant drugs when added to local anesthetics improves all these desired effects.

Aims & objectives: The Prospective randomized control study was aimed to compare dexamethasone and fentanyl as additives to bupivacaine and lignocaine in the supraclavicular brachial plexus block in terms of duration of postoperative analgesia as a primary objective and the onset of sensory and motor blockade, duration of sensory, and motor blockade as a secondary objective.

Methodology: This study included 90 patients of both gender, undergoing upper limb surgeries were divided into 3 groups of 30 patients each. Group S -bupivacaine (0.5%) 20 ml + injection lignocaine (2%) 10 ml + injection normal saline (0.9%); 2ml , Group D- injection bupivacaine (0.5%) 20 ml + injection lignocaine (2%) 10 ml + injection dexamethasone 8 mg and Group F- bupivacaine (0.5%) 20 ml + injection lignocaine (2%) 10 ml + injection fentanyl 50 mcg (1ml) + NS (0.9%) 1ml.

Results: Group Dexamethasone showed a significantly reduced onset of sensory and motor block, prolonged sensory and motor block duration, duration of analgesia, reduced VAS score at return of sensations compared to fentanyl and saline group (P >0.05). Comparison of hemodynamic variables revealed statistically insignificant differences between all the groups.

Conclusion: Both dexamethasone and fentanyl are good adjuvants in the supraclavicular block, but dexamethasone has faster onset and longer duration of anesthesia and analgesia hence is a better choice.

Keywords: Bupivacaine, Dexamethasone, Fentanyl, , Lignocaine, Supraclavicular block

Introduction

Brachial plexus block is one of the most widely used regional nerve block technique for perioperative anesthesia and analgesia in upper limb surgeries. The supraclavicular approach to the brachial plexus results in faster onset and complete block, as it can be given at distal trunks where it is most compact throughout the plexus.[1,2] This regional block also avoid the unwanted effects of anesthetic drugs used during general anesthesia. Introduction of ultrasound guidance (USG) has led to better visualization of

brachial plexus anatomy, needle placement, and perineural dispersion of local anesthetic, hence decreasing the requirement of local anesthetic as well as decreasing the complications associated with these blocks.[3] An additive to bupivacaine is aimed for the quick onset and prolonged duration of blockade.[4] Various adjuvants, including fentanyl, midazolam, magnesium sulfate, dexamethasone, and neostigmine, have been added to local anesthetics to prolong the block duration and postoperative analgesia.[5].

Opioids such as fentanyl have been used for regional nerve plexus blocks to improve the block duration and quality. The peripheral administration of opioids provides stronger and longer lasting analgesia without central side effect.[6]

Recently, dexamethasone, a glucocorticoid, when used as an adjuvant to local anesthetics in brachial plexus block has been found to have prolonged postoperative analgesia and a favorable side effect profile [7].

Hence, the present study is aimed to compare the efficacy of dexamethasone and fentanyl as additives to bupivacaine and lignocaine in the supraclavicular block with the duration of postoperative analgesia as a primary objective and the onset of sensory and motor blockade, duration of sensory and motor blockade as a secondary objective.

Material And Methods

This randomized, prospective study was conducted in a tertiary care institute after obtaining institutional ethical committee clearance (IEC/GMJ/2023/1281) and written informed consent from all the patients participating in the study over a duration of 6 months. This study included 60 patients of both gender, scheduled for upper limb surgeries (Orthopaedic and Plastic surgeries).

Inclusion criteria:

1. ASA Grade I or II of either sex.
2. Ages between 18 and 60 years of either gender.
3. Patients undergoing elective upper limb surgeries.
4. Availability of informed consent.

Exclusion criteria:

1. Patient refusal.
2. Patients with ASA physical status III or more.
3. Noncooperative patient.
4. Local infection at the site of puncture.
5. Patients having any neurologic deficit in the upper limb.
6. Patients having history of hematological disorders, including coagulation abnormality.
7. Patient having a known allergy to study drugs.
8. Failure of supraclavicular block

All the patients underwent a thorough preoperative history and examination after which all the baseline tests were evaluated. Patients were asked to follow preoperative fasting guidelines and nature of study and their roles were explained to each of them in their local language in preoperative period and consent was taken.

At the time of surgery, monitors were attached and baseline preoperative vitals were recorded. Supraclavicular brachial plexus block was given using ultrasound guided technique in all the three groups.

The patients were randomly assigned to one of the 3 groups of 20 patients each using a computer-generated randomization table and patients were allotted through allocation concealment by opaque sealed envelope technique.

Group S -bupivacaine (0.5%) 20 ml + injection lignocaine (2%) 10 ml + injection normal saline (0.9%); 2ml ,

Group D- injection bupivacaine (0.5%) 20 ml + injection lignocaine (2%) 10 ml + injection dexamethasone 8 mg and

Group F- bupivacaine (0.5%) 20 ml + injection lignocaine (2%) 10 ml + injection fentanyl 50 mcg.

Complete sensory and motor blockade in all radial, median and ulnar regions indicated a successful block. Sensory and motor blockade evaluations were done every 2 min until complete sensory or motor block, or till 30 min whichever was earlier. We measured the duration of sensory and motor block by the time it took for pain sensation to disappear at the arm to reappear paresthesia or complete motor function recovery.

Heart rate, blood pressure, SpO2, respiratory rate, and ECG were monitored throughout the intraoperative and immediate postoperative period. Intraoperative sedation was provided whenever needed.

We evaluated the onset of sensory block by pin prick sensation. Dull sensation on pin Prick, which was compared with the other arm, was taken as the time of onset of sensory blockade.

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Duration of Sensory Block was evaluated as the period between the sensory blockade and reappearance of the pinprick response.

Assessment of Motor Block was done with the help of Modified Bromage Scale.

The Onset of Motor Block was considered from the injection of the drug up to the time of complete paralysis.

Duration of Motor Block was the interval between the successful block completion and the full recovery of motor function in the upper limb.

Duration of Postoperative Analgesia was the time taken from the drug administration to giving first rescue analgesia. Injection Diclofenac 75 mg IM was used as rescue analgesia. It was given when the patient complained of the visual analogue score (VAS) >4. Depiction of VAS was explained to patients preoperatively.

At the end of the surgery, the patient was kept under observation postoperatively for 1 hour to monitor vital signs (conscious level, blood pressure, heart rate, respiratory rate and pattern) then discharged to ward to be followed for observing offset of block, returning of pain and VAS score assessment. The patients were also observed for the occurrence of any adverse effect and/or complication related to the procedure, nausea, vomiting, and hypoxemia (SpO2 <90%). Any complications including vascular puncture, horner's syndrome, pneumothorax, and phrenic nerve palsy, was recorded.

The assessment of postoperative pain was done hourly in the recovery room and in surgical ward with the help of Visual Analogue Score in which Zero was considered as no pain, 1-3 as mild pain, 4-6 as moderate pain and 7-10 as severe pain. At score of 4, rescue analgesic (inj. diclofenac sodium (1.5 mg/kg) iv infusion) was given. Duration of analgesia was the time from drug injection to the time of first resque of analgesia. Total analgesic dose during first 24 hours will be recorded.

Statistical Analysis

Obtained data were presented as mean±SD, ranges, numbers and percentages as appropriate. Nominal variables were analyzed using Chi-square test or Fischer exact test as appropriate. Continuous variables were analyzed using unpaired Student's t-test or univariate two-group repeated measures analysis of variance (ANOVA) with post hoc Dunnett's test as appropriate. Nominal and non-normally distributed variables were analyzed using Mann–Whitney U test. Statistical analysis was performed using SPSS (Version 20, 2011). P value <0.05 was considered statistically significant.

Results

In this prospective randomized study, a total of 75 patients were initially enrolled in the study, out of which 15 patients had to be excluded based on the strict exclusion criteria, sixty patients were divided equally into three groups receiving dexamethasone, fentanyl, and normal saline, respectively, to a mixture of bupivacaine and lignocaine in the supraclavicular block. Regarding demographic data and ASA classification, there was no statistically significant difference between the groups (Table 1). The mean onset of sensory blockade showed that in Group S, it was 12.64±3.90 min, in Group F, it was 8.17 ± 3.61 min, and whereas in Group D, it was 6.25 ± 3.15 min (Table 2). Using Pearson's chi-square test for analysis it was observed that these results were significant (P-value = 0.001). The mean onset of the motor blockade in Group S was 19.10 ± 3.62 min, Group F was 13.45 ± 2.96 min, and Group D 10.45 ± 3.16 min. As per Pearson's chi-square test for analysis, it was found that these results were statistically significant (P-value = 0.001) (Table 2). The mean duration of sensory blockade in Group S was 4.85 ± 1.36 h, in Group F mean duration of sensory blockade was 10.60 ± 1.54 h, whereas in Group D, mean duration of sensory blockade was 16.10 ± 1.95 h. Using Pearson's chi-square test for analysis, it was found that these results were statistically significant (P-value <0.001) (Table 3). The mean duration of the motor blockade in Group S was 5.35 ± 0.96 h, mean duration of the motor blockade in Group F was 6.05 ± 1.45 h, and mean duration of the motor blockade in Group D was 14.20 ± 1.79 h. As per Pearson's chi-square test for analysis, it was found that these results were statistically significant (P-value < 0.001) (Table 3). Regarding the visual analogue score (VAS score) at the time of the return of sensations, there was statistically significant difference between the three groups, Group D had the lowest score 2.25 ± 0.41, whereas in Group F vas score was 3.10 ± 0.45, and Group S had the highest score of 3.75 ± 0.54 (P-value <0.05) (Table 4). Duration of analgesia in group S was 6.26 ± 1.24 , in group F it

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was 11.72 ± 1.34 h while in group D it was 16.80 ± 1.76 h and the results were statistically significant. Intraoperative and postoperative hemodynamic parameters were recorded at regular intervals and the differences were found to be statistically insignificant. There were statistically insignificant complications noted in the study groups.

Discussion

Regional anesthesia has gained wide popularity in current orthopedic surgeries. Supraclavicular Brachial Plexus Block is one of the widely practiced regional anaesthesia techniques for upper limb surgeries [8]. Early onset of block with increased duration of local anesthetic actions along with better pain control is desired for prolongation of postoperative patient comfort, as well as decreasing perioperative intravenous opioid consumption and their subsequent side effects. Many adjuvants to local anesthetics such as epinephrine, clonidine,[9] tramadol, opioids,[10] dexmedetomidine, and neostigmine have been studied in brachial plexus block, but each drug has its own side effects,[11] and analgesic effect extends only up to early postoperative period.

Ma et al. believed that analgesic properties of dexamethasone are the result of their systemic effect [12] whereas *Kumar et al.* suggested local action on nerve fiber and systemic action both potentiate dexamethasone analgesic properties [13].

Some of the possible mechanisms for improvement of analgesia produced by the peripheral application of fentanyl are that fentanyl could act directly on the peripheral nervous system and that fentanyl may potentiate local anesthetic action via central opioid receptor mediated analgesia by peripheral uptake of fentanyl to systemic circulation [14].

In the current study, we demonstrated that addition of dexamethasone or fentanyl to local anesthetics in supraclavicular block significantly reduced the onset time of sensory and motor block. Our results were consistent with Seddik et al which observed that adding dexamethasone to local anesthetic in infraclavicular block leads to significantly shorter latency time [15]. In another study, *Vieira et al.* stated that dexamethasone, as adjuvant to bupivacaine in ultrasound guided supra clavicular block produced a relatively rapid onset of motor and sensory block [16]. Our results also correlate with the study done by Hasan S *et al.* who achieved the onset of the sensory and the motor blocks at 7.60±3.711 minutes and 9.23±5.114 minutes respectively among patients receiving fentanyl as adjuvant in supraclavicular block [17]. Also Ahmed *et al*. found that with fentanyl as adjuvant in bupivacaine in the supraclavicular approach, the onset of the sensory and motor block were seen at 8.9±2.9 minutes and 8.8±2.7 minutes respectively [18].

In the current study, we found that addition of dexamethasone or fentanyl to local anesthetics in supraclavicular block significantly prolonged the duration of sensory and motor block; amongst which dexamethasone showed more prolonged sensory and motor blockade and also total duration of analgesia was significantly prolonged in dexamethasone group than fentanyl group which in turn had significantly prolonged duration of analgesia when compared to normal saline group. Our results were consistent with Vieira et al which studied the the effect of dexamethasone with bupivacaine in interscalene block and concluded that the sensory and motor block was prolonged and increased the duration of analgesia postoperatively using dexamethasone [16]. Swain et al also noted that the addition of additive to bupivacaine like fentanyl and dexamethasone enhanced the duration of post-operative analgesia till the analgesia request and leads to reduction in pain score in 1st 24hours post-operative [19].

Prolongation of duration of sensory and motor block observed is consistent with the results by Movafegh et al which also found that the addition of dexamethasone to lidocaine in axillary block prolongs the duration of sensory and motor block [20]. Swaminathan et al. observed that dexamethasone is advantageous for the longer duration of analgesia with all local anesthetics [21]. Yaghoobi et al studied postoperative analgesic effect of dexamethasone and fentanyl added to lidocaine in axillary block and reported that the durations of sensory and motor block were significantly longer in lidocaine + fentanyl group compared to other groups [22]. Chavan et al. observed that the addition of fentanyl 50 µg into local anesthetic solution supraclavicular block prolongs the duration of analgesia [6]. This study found that hemodynamic profile in all the three groups were statistically insignificant at all the times in perioperative period and that the side effects were also statistically insignificant in all the three groups

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Conclusion

This study concluded that both dexamethasone and fentanyl are good adjuvants in the supraclavicular block for quick onset of both sensory and motor block as well as prolonging the duration of block and postoperative analgesia duration without any significant alteration in hemodynamic profile and side effects. Among the two adjuvants dexamethasone is adjuvant agent of choice as it has quickest onset, more duration of analgesia, better and longer pain control among the two, hence is a better choice.

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Tables

Table 1. Table showing demographic details

	Group S	Group F	Group D	P VALUE
Age	41.48	39.56	40.42	>0.05
Gender	12/8	13/7	11/9	>0.05
Asa I/II	17/3	15/5	18/2	>0.05
Duration of Sx	72.25	69.16	71.70	>0.05

Table 2. Table showing onset of sensory and motor blockade

Groups	Group S	Group F	Group D	P VALUE
Onset time of sensory block	12.64±3.90 min	8.17 ± 3.61 min	6.25 ± 3.15 min	<0.05
Onset time of motor block	19.10 ± 3.62 min	13.45 ± 2.96 min	10.45 ± 3.16 min	<0.05

Table 3. Table showing duration of sensory and motor blockade

Groups	Group S	Group F	Group D	P VALUE
Duration of sensory block	4.85 ± 1.36 h	10.60 ± 1.54 h	16.10 ± 1.95 h	<0.05

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Duration of motor block	5.35 ± 0.96 h	6.05 ± 1.45 h	14.20 ± 1.79 h	<0.05

Table 4. Table showing VAS score in 3 groups

Groups	Group S	Group F	Group D	P VALUE
VAS score (at the time of return sensation)	3.75 ± 0.54	3.10 ± 0.45	2.25 ± 0.41	<0.05

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