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To compare the effects of adding buprenorphine vs dexmedetomidine in patients undergoing forearm surgeries under supraclavicular brachial plexus block

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***Abstract*---**Background: Supraclavicular brachial plexus block is the most commonly employed regional anaesthesia technique for upperlimb surgeries below elbow joint. Many drugs are used as adjuvants to local anaesthetics in order to extend and improve the quality of intraoperative and postoperative anaesthesia. We conducted a study to compare the effects of adding Buprenorphine vs Dexmedetomidine to intermediate-acting local anaesthetic 2% lignocaine with adrenaline in supraclavicular brachial plexus block. Aims and objectives: To compare the effects of adding Buprenorphine vs Dexmedetomidine to 2% lignocaine with adrenaline (1 in 200000) in patients undergoing forearm surgeries under supraclavicular brachial plexus block in terms of onset and duration of sensory and motor blockade, as well as the duration of postoperative analgesia. Materials and methods: 80 ASA Grade 1 & 2 patients aged between 18 and 60 years, of both sexes, undergoing forearm surgeries under supraclavicular brachial plexus block were divided into 2 groups of 40 each. Group A received 7mg/kg of 2% lignocaine with adrenaline +

Buprenorphine 3µg/kg. Group B received 7mg/kg of 2% lignocaine with adrenaline (1 in 200000)+ Dexmedetomidine(1µg/kg). The onset and duration of sensory and motor block, duration of postoperative anaesthesia, and side effects were assessed. Results: The study showed that 55% of patients in Group A experienced onset of sensory block within 11-13 min, whereas 60% of patients in Group B experienced onset of sensory block after 13 minutes. The onset of motor block was earlier in Group A compared to Group B. The duration of sensory & motor block, postoperative analgesia was prolonged in Group A compared to Group B. Conclusion: Buprenorphine is a better adjuvant compared to Dexmedetomidine for brachial plexus block.

***Keywords*---**2% Lignocaine with adrenaline, Dexmedetomidine, Buprenorphine, Supraclavicular brachial plexus block.

Introduction

Upper limb surgeries are generally done using regional anesthesia techniques like the brachial plexus block. Regional blocks not only provide intraoperative anesthesia but also provide postoperative analgesia. Because of the ease of blocking nerve roots at this level of the brachial plexus, the supraclavicular technique is frequently employed all around globe for upper limb surgeries[1].To extend the duration of postoperative analgesia, opioids are mixed with local anesthetics in supraclavicular brachial plexus blocks. Buprenorphine is a lipophilic opioid with a high molecular weight, strong mu receptor affinity, longer duration of action, ease of access, and low cost[1].Due to their hemodynamic stabilizing qualities, sedative, analgesic, and sympatholytic actions, α2 adrenergic receptor agonists have been successfully used in various anesthetic techniques[7].

Dexmedetomidine, an α2 agonist, in clinically effective doses, doesn't cause respiratory depression but has analgesic characteristics, making it a potentially safe adjunct to local anaesthetics[7]. Although the effects of both Buprenorphine and Dexmedetomidine on the quality of block, when used as adjuvants with local anesthetics, has been examined separately, a comparison of the two medications has not yielded a clear consensus on which adjuvant is more effective. In addition, numerous earlier studies looked at how these adjuvants affected long-acting local anesthetics such as bupivacaine. Hence, we conducted a study to compare the effects of adding Buprenorphine versus Dexmedetomidine to intermediate-acting local anesthetic, lignocaine with adrenaline, in a supraclavicular brachial plexus block.

Methodology

The study involved 80 ASA grade I and 2 patients of either gender, aged 18 to 60 years, who were undergoing various forearm procedures under supraclavicular brachial plexus block ,after receiving approval from the Ethical Committee in Santhiram Medical College and General Hospital, Nandyal. Informed and written consent was taken. Result values were recorded by using preset proforma.It is a

Prospective randomized study conducted in the Department of Anaesthesiology,Santhiram Medical College and General Hospital ,Nandyal ,from October 2020 to November 2021 (1year).

Inclusion Criteria: Patients of age between 18 to 60 years with normal biochemical and hematological parameters, ASA physical status (American society of anesthesiologists) class I, II, Forearm and Hand surgical procedures, Surgery lasting less than 90 minutes duration.

Exclusion Criteria: Known hypersensitivity to drugs, Patients with known psychiatric, cardiovascular, pulmonary, neuromuscular, renal, and hepatic disorders; Local infections/sepsis, Coagulation abnormalities, Patients with bilateral upper limb surgery, opposite side pneumothorax or collapsed lung, pregnant women, peripheral neuropathy

Sample Size

The sample size was calculated after discussion with the statistician by using theformula. $[(Z_\alpha + Z_\beta)^2 \times (SD)^2 \times 2]/d^2$. Substituting values for a significant level of 0.05, power of 80% $Z_\alpha=1.96$, $Z_\beta=0.842$, SD (standard deviation) = (SD1 + SD2)/2, d= difference between means. Substituting values for SD1, SD2, and d from the previous studies [6,9] .
$[7.84*([3.19+1.05)/2)^2 x2]/(16.04-9.2)^2=2.97\approx3$, as the value is less than 10, it was decided to include forty patients in each group.
After the pre-anesthetic checkup, patients who met the inclusion criteria, posted for various forearm surgeries are selected.
Group A- received 7mg/kg of 2% lignocaine with adrenaline (1:200000) +3µg/kg of buprenorphine were in group A.
Group B received 7mg/kg of 2% lignocaine with adrenaline (1:200000) and dexmedetomidine (1 µg/kg). A complete preoperative evaluation was performed after the inclusion and exclusion criteria were met. The patients were informed regarding upcoming supraclavicular block, its benefits over general anesthetic, and any potential consequences. The patient and relatives signed a written and informed consent in the local language. All the patients were taught how to use the visual analog scale scoring system. Prior to surgery, all patients were required to fast for 6 hours. Pulse rate, blood pressure, respiratory rate, and peripheral oxygen saturation were measured at the commencement of the process. Patients were positioned in a supine position. Intravenous access was established using an 18G cannula, and Ringer Lactate IV fluid was administered. Before the procedure, noninvasive blood pressure, heart rate, ECG, and SpO2 were recorded using monitors.

Under aseptic precautions, brachial plexus block was performed by supraclavicular approach (classic approach). The patient was placed in a supine position with both arms straight and adducted. The head should be turned away from the operating side, and the arm should be adducted with the hand extended towards the ipsilateral knee. A small roll of the towel was placed under the shoulder blades to make the plexus taut. The marking was done at the clavicle's midpoint. The entry location was on the lateral edge of the anterior scalene muscle, about 1.5 to 2 cm posterior to the clavicle's mid-point. After proper

antiseptic painting and draping, a skin wheal was raised with a local anesthetic. A 22G needle was inserted at the point of entry above the mid-point of the clavicle in the caudal-posterior and medial (CPM) direction.
Paraesthesia in the finger, forearm, or hand was elicited. Following a negative aspiration for air or blood, the study drugs were given. With a face mask, oxygen was supplied at a rate of 2-5 Litre/min. Those who received 7mg/kg of 2% lignocaine with adrenaline (1:200000) +3 µg/kg of buprenorphine were in group A. Those who received 7 mg/kg of 2% lignocaine with adrenaline (1:200000) + l µg/kg of dexmedetomidine were in group B.

For the first 30 minutes, vital indicators (pulse rate, noninvasive blood pressure, respiration rate) were measured every 5 minutes, then every half hour until 8 hours, and then every 1 hour, until the patient complained of pain ,corresponding to a VAS score of 4. The onset of sensory and motor blockade, the duration of sensory and motor block, and the duration of postoperative analgesia were all recorded. Any adverse events such as hypotension, bradycardia, hypoxemia, and peri- operative nausea and vomiting, if occured ,were recorded. A three-point scale was used to assess sensory blockage by measuring loss of feeling to pinprick over the C5-T1 dermatomes.

0- Normal sensation
1- loss of sensation of pinprick (analgesia)
2- loss of tactile feeling (anesthesia)

The time gap between the conclusion of local anesthetic injection and the establishment of score 2 ,on a three-point scale ,on all nerve areas is known as sensory onset time. The time period between the end of local anesthetic injection and complete resolution of anesthesia is defined as the duration of sensory blockade (score 0 on a three-point scale on all nerve areas).
Motor block was assessed using modified Bromage scale[11]
0- normal motor function, including full elbow, wrist, and finger flexion and extension.
1- reduced motor strength, resulting in the capacity to only move the fingers.
2- a total motor blockage results in the inability to mov e one's fingers.

The absence of voluntary movements in the hand and forearm is known as a total motor block (score 2 on the Bromage scale). The time period from the completion of local anesthetic injection to recovery of complete motor function of the hand and forearm ischaracterized as the duration of motor block (score 0 on Bromage scale). Block was considered inadequate when sensory anesthesia was not achieved within 30 minutes, and such patients were excluded from the study. Duration of analgesia defined: “the time interval after supraclavicular brachial plexus block administration and the onset of pain [2], that is, Visual Analog Score >4. Visual analog scale- on a scale of 0 to 10, is used to assess the postoperative pain.

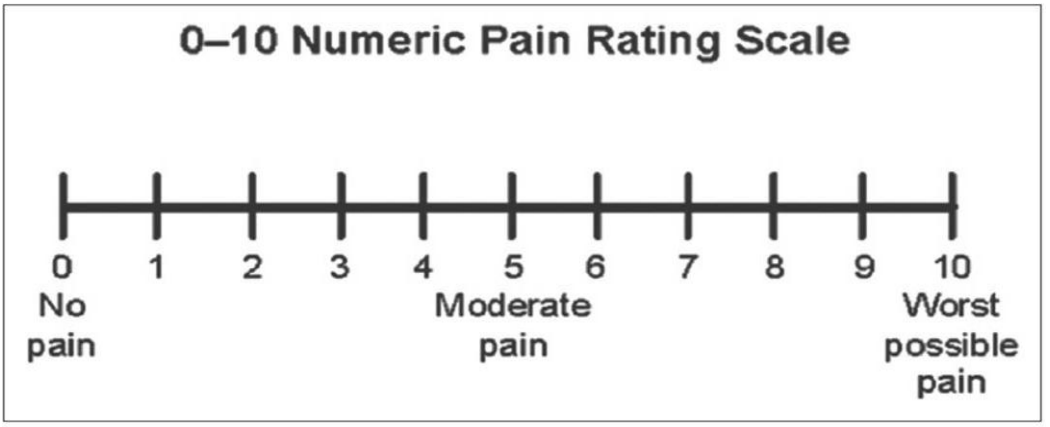

Figure-1: Visual analog scale

0-5 no pain to moderate pain, 10-maximum/worst pain. Inj. diclofenac 75 mg will be administered after a test dose, if the Visual Analog Score reaches 4. The study was started after having institutional ethical committee clearance, and informed written consent was taken from all patients before the procedure.

Data Analysis:

The data were collected and entered into a Microsoft Excel spreadsheet and analyzed using Statistical Package for Social Sciences (SSPSS 24). Descriptive data were presented in frequencies, percentages, mean and standard deviation. Based on whether data is following parametric or non-parametric distribution. The Student's 't-test or independent 't-test and chi-square test was used to compare various study outcomes. Statistical significance was considered when p-value is <0.05 .For several continuous variables, the student's t-test was employed to see if there was a significant difference between the two groups.

Results

The patients in both the groups were comparable with respect to age, weight, height and sex distribution. Majority of the patients in Group A and Group B come under the age group of 25- 45 years. The mean age of groups A and B is 36.075 ±7.687 and 38.025± 11.1274, respectively, as shown in the table below. The significant difference between the two groups is not significant (P- 0.365,i.e >0.05). The mean weight of groups A and B is 54.425± 3.9606 and 55.325±2.9905, respectively, as shown in the table below. The significant difference between the two groups is not significant (P-0.255, i.e>0.05).

Table-1
Comparison with age & weight

Group		Mean	Std. Deviation	P – Value
AGE	A	36.075	7.6874	0.365
	B	38.025	11.1274	
WEIGHT	A	54.425	3.9606	0.255
	B	55.325	2.9905	

In our study,55 % of the patients in group A experienced sensory blockade within 11 to 13 minutes. while 60 percent of patients in group B experienced sensory blockade after 13 minutes.

Table 2
Comparison of mean onset of sensory and motor blockade

Group		Mean	Std. Deviation	P – Value
Sensory Block Onset	A	11.600	1.8784	0.001
	B	13.550	1.8250	
Motor Block Onset	A	13.925	2.0555	0.003
	B	15.850	2.0324	

The mean onset time of sensory blockade in groups A and B is 11.600±1.8784,13.550±1.8250, respectively, as shown in the table above, with a significant p-value 0.001 (i.e P<0.05). The mean onset of the motor blockade in groups A and B is 13.925± 2.0555 minutes,15.850 ±2.0324 minutes, respectively, as shown in the table above; the significant difference between the two groups is substantial (0.003, P<0.05). In our study,82.5% of patients in group A experienced motor blockade within 10 to 15 minutes, while 60 % of patients in group B experienced motor blockade within 15 to 20 minutes.

In our study ,majority of the patients in group A had sensory blockade lasting between 451 to 500 minutes, while majority of patients in group B had sensory blockade between 250 to 300 minutes.

Table-3
Comparison of mean duration of sensory and motor blockade

Group		Mean(minutes)	Std. Deviation	P – Value
Duration of Sensory Blockade	A	409.750	70.9455	0.002
	B	298.000	16.9766	
Duration ofMotor Blockade	A	349.750	70.9094	0.001
	B	240.250	17.7573	

The mean duration of sensory blocking in groups A and B is 409.750± 70.9455 minutes and 298.000± 16.9766 minutes respectively, as shown in the table above; the significant difference between the two groups is substantial (0.002, p<0.05). Majority of the patients in group A had a motor block duration of 401 to

450 minutes,whereas in patients in group B had a duration of 200 to 250 minutes. To assess the substantial difference between the two groups, the mean duration of the motor blockade in group A and B is 349.750±70.9094 minutes, 240.250±17.7573 minutes respectively, with a significant p-value of 0.001.

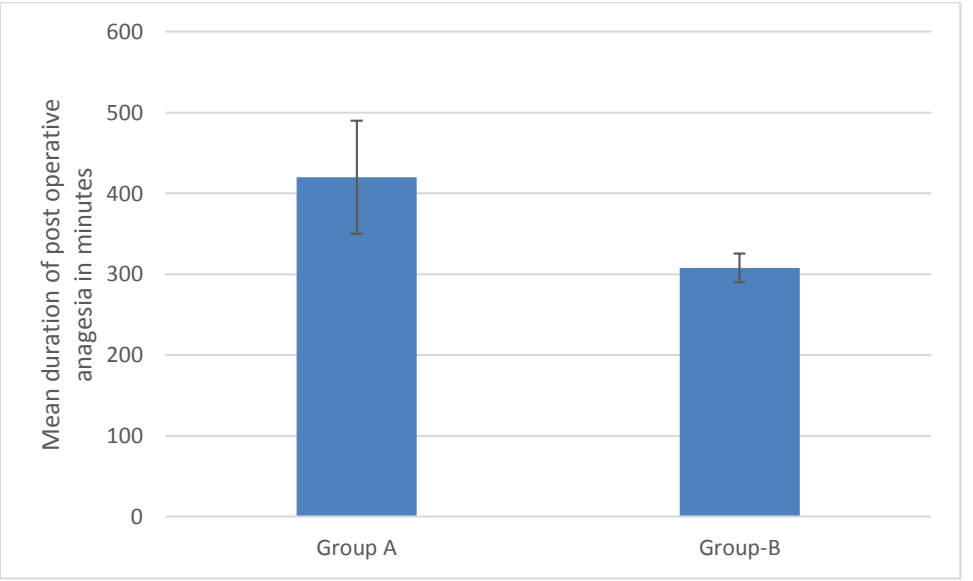

Figure-2: Comparison of mean duration of post-operative analgesia

The mean duration of postoperative analgesia in groups A and B is 420.00±70.8556 minutes and 308.500±17.7663 minutes respectively, as shown in the graph above, with a significant p-value (0.002, i.e.P<0.05). The hemodynamic parameters were comparable between the two groups and there was no incidence of hypotension or bradycardia in either group.
There was no incidence of nausea, vomiting, respiratory depression, hypotension, bradycardia, headache, or pruritus in either group**.**

Discussion

Most upper limb surgeries are done with a brachial plexus block (BPB), thereby avoiding the negative effects of general anesthetic drugs, the stress of laryngoscopy and tracheal intubation, and extend analgesia in the postoperative period without any systemic side effects like nausea, vomiting, or respiratory depression. For brachial plexus block, the supraclavicular technique provides the most effective approach for all surgeries of the upper extremeties . Carlo et al. found that the subclavian perivascular approach consistently provides an effective brachial plexus block for the upper limb.

The plexus and the sheath are both reduced to their lowest components at the injection site in supraclavicular approach, which explains its high success rate (98.8%). Franco etal[14] discovered that supraclavicular brachial plexus block gives the most consistent and time-efficient anesthesia of the entire upper limb.

Peripheral nerve blocks with local anesthetics provide excellent operating conditions with good muscle relaxation, but the duration of analgesia is rarely maintained to more than 2-3 hours even with the longest acting local anesthetics (Bupivacaine, Ropivacaine, and levobupivacaine). To overcome this limitation, anesthesiologists have added supplementary drugs to local anesthetics to extend the duration and improve the quality of regional blocks. However, no single source exists, that determines which adjuvants are most effective at extending the duration of action of a single local anaesthetic drug. Buprenorphine and Dexmedetomidine are two regularly used adjuvants along with local anesthetics in regional anaesthesia like spinal, epidural or peripheral nerve blocks for lengthening the duration of analgesia in patients undergoing orthopedic surgery. Comparitive study of the effects of adding Buprenorphine versus Dexmedetomidine to 2%Lignocaine with Adrenaline in supraclavicular brachial plexus block was undertaken at Santhiram Medical College and General Hospital, Nandyal, Andhra Pradesh.

The lignocaine dose employed in our investigation was the highest recommended dose of 2% lignocaine combined with adrenaline.[15] 1.5% lignocaine with adrenaline has been successfully used in axillary brachial plexus block in various studies with adequate anesthesia during the intraoperative period and without any complications or side effects [15].

A constant dose of 300 µg or 3 µg/kg has been employed in the majority of studies with buprenorphine as a local anesthetic (LA) adjuvant [4,16,17,18]. Based on these studies, we used 3 µg/kg of buprenorphine. The dose of Dexmedetomidine was chosen based on earlier studies in which dexmedetomidine 1 µg/kg and clonidine 1 µg/kg were used as adjuvants to lignocaine in Bier's block and 0.25 % bupivacaine in the supraclavicular block[8]. A study by Aman Thakur etal[21] also concluded that 1µg/kg dexmedetomidine has a better therapeutic profile as compared to 0.5µg/kg without any significant side effects, as an adjuvant to lignocaine with adrenaline in axillary brachial plexus block. Following informed consent, 80 ASA class 1 and 2 patients undergoing upper limb orthopedic surgery were divided into 2 groups: Group A received 7 mg/kg of 2% Lignocaine with Adrenaline (1:200000) +3 µg/kg of Buprenorphine, and Group B received 7 mg/kg of 2 % Lignocaine with Adrenaline (1:200000)+1 µg/kg of Dexmedetomidine. Supraclavicular brachial plexus block was performed using the conventional method(elicitation of paraesthesia) under strict aseptic conditions. In terms of age (p value- 0.365), weight (p value - 0.255), and gender (p value - 0.7), the two groups were demographically comparable.

Mean onset time of sensory block was 11.600 ± 1.8784 min in group A and 13.550 ± 1.8250 min in group B. Statistical analysis showed a statistically significant difference in the time of sensory block onset between group A and group B with a p value of 0.001.Onset of sensory block was earlier in group A compared to group B .This shows that adding buprenorphine hastens the onset of sensory block [2,3,4]compared to dexmedetomidine[7,8].The average time it took for a motor block to start was 13.925 ±2.0555 minutes in group A, and 15.850± 2.0324 minutes in group B. With a p-value of 0.003, statistical analysis revealed that the mean onset time of motor blockade in group A (buprenorphine) was significantly earlier compared to group B(Dexmeditomidine) [2,3,7,21].

In group A, the sensory block lasted 409.750± 70.9455 minutes, while in group B, it lasted 298.00± 16.9766 minutes. Statistical analysis revealed that sensory block lasted much longer in group A (buprenorphine) than group B(dexmedetomidine), with a p-value of 0.002 [2,5,6,10,11,12]. The average duration of motor block in group A was 349.750± 70.9094 minutes, while in group B, it was 240.250± 17.7573 minutes. Statistical analysis revealed that the length of motor block in group A(buprenorphine) was substantially longer than in group B(dexmedetomidine), with a p-valueof 0.001[6,12,13,,2!].

In group A, the average duration of postoperative analgesia was 420.00± 70.8556 minutes; while in group B, it was 308.500± 17.763 minutes. Statistical analysis revealed that group A(buprenorphine) had considerably longer postoperative analgesia than group B(dexmedetomidine), with a p- value of 0.002. [9,17,18,21]. When compared to Dexmedetomidine, adding Buprenorphine to a local anesthetic dramatically increased the duration of sensory & motor blockade & postoperative analgesia in our study.

Many researchers have found that Buprenorphine prolongs the duration of sensory and motor block, similar to the findings of our study[2;3,18,19,21] .Eight studies have indicated a considerably longer duration of analgesia with Buprenorphine in brachial plexus block since 2001 [3,4,5,11,16,17,20].In our study, when compared to Dexmedetomidine, adding Buprenorphine to lignocaine sped up the onset of sensory and motor blockades, in contrast to prior research studies[6,17] ,where buprenorphine had no influence on the onset of sensory and motor blockade. In the future ,this will need to be studied further.

Buprenorphine is a partial opioid receptor agonist with potent analgesic effects . It is thought that opiod receptors are found on peripheral nerve terminals and that Buprenorphine is more likely to reach these receptors due to its high lipophilic characteristics[4,6]. When used as an adjuvant in peripheral nerve blocks, buprenorphine stimulates these peripheral selective opioid receptors, causes analgesia, and considerably increases the duration of action of local anesthetics.

The use of adjuvants such as Buprenorphine and Dexmedetomidine in peripheral nerve blocks reduces systemic side effects such as respiratory depression, hemodynamic changes, nausea, and vomiting [1,5,6,7,8], as evidenced by the fact that none of the patients in our study experienced any serious adverse effects or complications during the trial period.

Conclusion

Buprenorphine, when used as an adjuvant to 2% Lignocaine with adrenaline in supraclavicular brachial plexus block, reduces the time taken for onset of sensory and motor blockade, when compared to Dexmedetomidine. When administered as an adjuvant to 2% Lignocaine with Adrenaline in supraclavicular brachial plexus block, Buprenorphine enhances the duration of sensory and motor block, as well as the duration of postoperative analgesia when compared to Dexmedetomidine without any significant side effects or complications.

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