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Original Research Article

Comparative Study of Dexmedetomidine and Dexamethasone as an Adjuvant to Bupivacaine in Supraclavicular Brachial Plexus Block in Upper Limb Surgeries

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Abstract

Background: One of the most recommended methods for perioperative anaesthesia and analgesia during upper limb surgical procedures is the supraclavicular brachial plexus block. The inclusion of various adjuvants can lengthen the block's lifespan. In addition to comparing pain levels and postoperative morphine use, our goal is to examine the effectiveness of dexamethasone and dexmedetomidine as an adjuvant to bupivacaine in extending the duration of supraclavicular brachial plexus block.

Methods: In this prospective randomised study, we divided 60 patients who were scheduled for upper limb procedures into three groups, each of which had 20 patients. The three groups of patients each got 25 ml of 0.5% bupivacaine. Patients in Group A also got 8 mg of Dexamethasone and patients in group B also got 1mgkg^{-1} of Dexmedetomidine respectively. Group C patients received 0.5% bupivacaine only. All patients received morphine by patient-controlled analgesia (PCA) following surgery, and the block characteristics, pain ratings, and overall opioid consumption were recorded.

Results: When comparing the dexamethasone group to the dexmedetomidine group, we found that the motor block (1202.63±197.85 min vs 798.65±50.69 min) and the sensory block (1520.58±228.65 vs 1198.28±210.85 min) were considerably extended. Dexamethasone and dexmedetomidine group postoperative pain scores and morphine intake were comparable.

Conclusion: In comparison to dexmedetomidine, dexamethasone dramatically prolongs the time that the supraclavicular brachial plexus is blocked when used as an adjuvant to bupivacaine. The two adjuvants mentioned above are both successful in reducing postoperative morphine intake.

Keywords: Supraclavicular block, Anaesthesia, Analgesia, Dexmedetomidine, Dexamethasone, Bupivacaine, Sensory blockade, Motor blockade.

Introduction

Since many years ago, brachial plexus blocks have been used successfully to deliver anaesthesia and analgesia for procedures on the upper limbs. Due to the high cost, skill requirement, and infection risk associated with continuous catheter method, single shot supraclavicular brachial plexus block is more common.[1,2] The supraclavicular block method has been made simpler and safer due to the use of ultrasonography.[3,4]

To increase the duration and effectiveness of supraclavicular block, a number of medications have been researched as adjuvants to local anaesthetics. Dexmedetomidine is an 8 times more powerful alpha 2 agonist than clonidine, having Alpha1: Alpha 2 ratio of 1600:1.[5] Numerous studies have demonstrated that using dexmedetomidine as an adjuvant in nerve blocks lengthens the analgesic effect.[6,7] The suggested method involves preventing the cation current that hyperpolarization activates. [8]

Numerous studies have demonstrated the effectiveness of dexamethasone as an adjuvant in nerve blocks due to its strong anti-inflammatory and antinociceptive effects. When administered as adjuvants in brachial plexus blocks, the two medicines mentioned above have had inconsistent results in studies comparing them.[9-11] In this study, we compared the brachial plexus block features, postoperative pain ratings, and morphine consumption when dexamethasone and dexmedetomidine were used as adjuvants to bupivacaine.

Material and Methods

This prospective and randomized study was conducted at Madhubani Medical College and Hospital, Madhubani, Bihar from December 2019 to May 2020. All participants gave their written consent after being fully informed. This prospective randomised trial comprised 60 patients between the ages of 18 and 75 who were scheduled for hand, wrist, forearm, or elbow procedures and had physical status classifications I and II by the American Society of Anaesthesiologists (ASA). This trial excluded patients who were pregnant, had pre-existing neuropathy of the operative limb, had taken systemic corticosteroids for at least two weeks within six months of the procedure, were allergic to the study medicines, or had coagulopathy or hypersensitivity to the study treatments. The patients were split into three groups :

Group A- 25 ml of 0.5% bupivacaine with 8 mg of dexamethasone.

Group B- 25 ml of 0.5% bupivacaine with 1 gkg-1 of dexmedetomidine

Group C- 25 ml of 0.5% bupivacaine only.

With a 5% significance level and 80% power, we estimated a sample size of 18 in each group, accounting for a 45-minute difference in block length. In order to account for block failure and dropouts, we estimated the final sample size to be 20 in each group.When performing statistical analysis, we used SPSS 19 version. Using Kolmogorov-Smirnov tests, the normality of the data distribution was determined. The gender and ASA data were analysed using the Chi square test. Age and weight were provided as mean standard deviation (SD). A p value of <0.05 was deemed significant.

Results

52 of the 60 randomly selected patients were examined and evaluated. We had to eliminate 8 patients from the research because the block had failed; there were 16 in the dexamethasone group, 18 in the dexmedetomidine group, and 18 in the control group.

There were no differences in the distribution of age, weight, gender, and ASA categorization, as indicated in (Table 1). As

shown in (Table 2), we discovered that the groups had similar sensory and motor block onset times (p>0.05). The average time a person experienced a motor block was 1202.63±197.85 minutes in Group A, 798.65±50.69 minutes in Group B, and 519.48±52.87 minutes in Group C. When group A was compared to group B, the length of the motor block was significantly increased by 415.31 minutes (p <0.01).

Table 1: Age and weight distribution of patients of three groups

	Group A (n=16) (Mean±SD)	Group B (n=18) (Mean±SD)	Group C (n=18) (Mean±SD)	p-value
Age (in years)	29.91±9.99	35.36±14.12	34.06±14.04	0.90
Weight (in kg)	59.28±5.99	68.09±8.99	68.44±7.68	0.60

Table 2: Onset of sensory and motor block of three groups

Onset of block (min)	Group A (n=16) (Mean±SD)	Group B (n=18) (Mean±SD)	Group C (n=18) (Mean±SD)	p-value
Motor block	16.79±4.87	12.99±3.56	21.09±36.24	0.27
Sensory block	8.99±2.96	8.57±3.09	8.96±3.59	0.69

According to the time it took for the first analgesic to be requested in the postoperative period, the average length of sensory block was 1702.47±246.56 min in Group A, 1102.20±209.56 min in Group B, and 701.01±59.41 min in Group C. This demonstrates that Group A's sensory block was substantially longer than Group B by 535.14 min (p <0.01) and Group C was significantly longer by 972.38 min (p <0.01). When comparing group B with group C, we discovered that group B sensory block was considerably extended by 437.24 min (p <0.01), as shown in (Table 3).

Table 3: Duration of sensory and motor block of three groups

Duration of block (min)	Group A (n=16) (Mean±SD)	Group B (n=18) (Mean±SD)	Group C (n=18) (Mean±SD)	p-value
Motor block	1202.63±197.85	798.65±50.69	519.48±52.87	<0.01
Sensory block	1520.58±228.65	1198.28±210.85	701.01±59.41	<0.01

There was no discernible change in the total amount of fentanyl consumed during the intraoperative period (p>0.05). In comparison to Group C (14.99±4.68 mg), Group A (9.99±3.72) and Group B (10.74±3.34 mg) consumed considerably less PCA morphine during the first 24 hours (p<0.01) than Group C. There was no statistically significant difference in PCA morphine use between Groups A and B (p>0.05). The dexamethasone and dexmedetomidine groups did not significantly differ in their NRS scores over the postoperative period. There was no discernible change in the frequency of bradycardia and hypotension episodes.

Table 4: Opioid requirement of three groups

Opioid requirement	Group A (n=16) (Mean±SD)	Group B (n=18) (Mean±SD)	Group C (n=18) (Mean±SD)	p-value
Intraoperative Fentanyl requirement (mg)	23.21±39.63	15.52±33.01	25.86±39.23	0.55
Postoperative Morphine requirement (mg)	9.99±3.72	10.74±3.34	14.99±4.68	<0.01

Discussion

One of the straightforward and efficient anaesthetic techniques for surgeries affecting the upper limb is the supraclavicular brachial plexus block. The safety profile of supraclavicular block has been improved by the use of ultrasonography. Numerous studies have been done on the various adjuvants that can be added to a local anaesthetic solution. In this study, we compared dexamethasone and dexmedetomidine when used in a supraclavicular block with 0.5% bupivacaine for upper limb procedures. After using an ultrasound to examine the brachial plexus and a nerve stimulator to establish that there was a motor response, we injected the study medication solution. With the aid of USG guidance, the nerve plexus may be located with more accuracy, and local anaesthetic solution can be applied precisely where it is needed without the risks of accidental needle insertion.[13]

When administered intravenously along with bupivacaine, the long-acting glucocorticoid dexamethasone prolongs the analgesia. This could be caused by a number of processes, including direct inhibition of glucocorticoid receptors, which decreases the activity of the nociceptive C fibres, local vasoconstriction, which decreases the absorption of local anaesthetics, or suppression of inflammatory mediator synthesis, which has anti-inflammatory effects.[14]

It has been demonstrated that adding dexmedetomidine, a highly selective □2 agonist, as an adjuvant to bupivacaine in nerve blocks increases the duration of analgesia.

According to an animal study, the analgesic action of perineural dexmedetomidine is caused by blocking the hyper-polarization activated cation current.

When used as an adjuvant to local anaesthetic solution in supraclavicular block, dexamethasone dramatically accelerated the onset of block, according to Shrestha *et al*.[15] When 100 mg of dexmedetomidine was combined with 30 ml of 0.325% bupivacaine in a supraclavicular block, Agarwal *et al*. discovered a quicker start of block.6 We found no discernible difference between the groups in the onset of block.

In our investigation, we found that, as compared to the control group, both adjuvant medicines considerably lengthened the duration of sensory and motor block, however this was significantly more pronounced with dexamethasone than with dexmedetomidine. Only a few trials, with varying results, explicitly examined the two medicines mentioned above as adjuvants to local anaesthetic solution in brachial plexus blocks. Dexamethasone and dexmedetomidine were both shown to be equally efficient in extending the axillary block when used as an adjuvant with 0.5% ropivacaine, according to Lee *et al*.[10] When compared to dexamethasone as an adjuvant with 0.5% ropivacaine in the supraclavicular block during elective upper limb surgical procedures, Verma *et al*. noticed a lengthier block with dexmedetomidine.11Kaur *et al*. evaluated the outcomes of a supraclavicular block using a combination of 20 ml of 2% lignocaine with adrenaline and 18 ml of 0.5% bupivacaine with the effects of 8 mg of dexamethasone and 50 mg of dexmedetomidineas an adjuvant.[16] When compared to dexamethasone, they discovered that dexmedetomidine prolonged the block. Our investigation, in contrast to earlier trials, demonstrated a block with dexamethasone that was noticeably longer.

In our investigation, the dexamethasone and dexmedetomidine groups required

considerably less postoperative PCA morphine in the first 24 hours following the initial analgesic request. There are no studies that directly compare using these two medications as adjuvants in supraclavicular block to postoperative morphine use. In patients undergoing total knee replacement arthroplasty, Packiasabapathy SK *et al*. found a substantial decrease in postoperative PCA morphine consumption when 2 □□gkg-1 of dexmedetomidine was added to bupivacaine for femoral nerve block.[17]

El-Hamid discovered that adding 8 mg of dexamethasone to 0.5% levobupivacaine for interscalene block during forearm procedures resulted in significantly lower postoperative morphine consumption.[18] In our investigation, we discovered that when administered as adjuvants to bupivacaine in supraclavicular block, both dexamethasone and dexmedetomidine are equally efficient in lowering postoperative morphine use.

Comparable amounts of pain were reported by NRS in the dexamethasone and dexmedetomidine groups. There was no discernible difference between the groups in the number of bradycardia and hypotension episodes.

Some restrictions apply to our investigation. To research the impact of perineural dexmedetomidine on sedation, we did not record the sedation score. In addition, PCA morphine was initiated in our trial after the patient requested analgesics during the postoperative period, and the total opioid consumption was tracked from that point forward for the following 24 hours.

Since the initial rescue analgesic was requested, the total postoperative PCA morphine consumption lasted for 24 hours. However, the time of demand varied depending on the patient and the severity of the sensory block.

Conclusion

In comparison to dexmedetomidine, the use of dexamethasone as an adjuvant to bupivacaine in supraclavicular brachial plexus block dramatically lengthens the duration of the motor and sensory block. Both adjuvants dramatically lower postoperative morphine intake.

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