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Original Research Paper

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TO COMPARE THE EFFECTS OF ADDING DEXMEDETOMIDINE AND FENTANYL AS ADJUVANTS TO 0.5% BUPIVACAINE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK ON THE ONSET AND DURATION OF SENSORY AND MOTOR BLOCKS

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ABSTRACT

Background: Peripheral nerve blocks, including supraclavicular brachial plexus blocks, provide significant advantages in anesthesia, such as reduced opioid use, fewer side effects, and quicker recovery times, especially in patients with comorbidities. The use of ultrasound for nerve localization and the addition of adjuvants to local anesthetics, like dexmedetomidine and fentanyl, can enhance the quality and duration of the block. **Objective:** This study aimed to compare the effects of adding dexmedetomidine and fentanyl as adjuvants to 0.5% bupivacaine in supraclavicular brachial plexus block on the onset and duration of sensory and motor blocks, as well as postoperative analgesia, in patients undergoing upper limb orthopedic surgeries. **Methods:** A prospective, comparative study was conducted with 80 patients (aged 18-60 years, ASA 1 and 2) undergoing upper limb orthopedic surgeries under supraclavicular brachial plexus block. Patients were randomly assigned to two groups: Group A received 1 mcg/kg dexmedetomidine with 0.5% bupivacaine, and Group B received 1 mcg/kg fentanyl with 0.5% bupivacaine. Various parameters, including the onset and duration of sensory and motor blocks and the duration of postoperative analgesia, were measured. Statistical analysis was performed using Mann-Whitney U tests and independent sample t-tests. **Results:** Group A (dexmedetomidine) exhibited a significantly faster onset of both sensory (6.43 ± 1.22 min) and motor (9.7 ± 0.95 min) blocks compared to Group B (fentanyl) (sensory: 10.03 ± 1.25 min, motor: 12.93 ± 1.82 min) ($p < 0.001$). Group A also demonstrated significantly longer durations of sensory (538.67 ± 48.6 min), motor (528 ± 48.02 min), and analgesia (734 ± 34.4 min) compared to Group B (sensory: 487.33 ± 48.28 min, motor: 460 ± 34.74 min, analgesia: 650 ± 23.34 min) ($p < 0.001$). **Conclusion:** The addition of dexmedetomidine to 0.5% bupivacaine in supraclavicular brachial plexus blocks significantly accelerates the onset and prolongs the duration of both sensory and motor blocks, as well as postoperative analgesia, compared to fentanyl. These findings suggest that dexmedetomidine is a more effective adjuvant for enhancing the quality of regional anesthesia in upper limb surgeries.

KEYWORDS : Supraclavicular brachial plexus block, dexmedetomidine, fentanyl, bupivacaine, sensory block, motor block

INTRODUCTION

Benefits of peripheral nerve blockade include reducing the need for opioids, assisting patients with a range of cardiorespiratory comorbidities, preventing pulmonary and thromboembolic problems, and avoiding the side effects of anaesthetics used during general anaesthesia.[53] also leads to less pain, an expedited recovery period, and an enhanced standard of living in the days immediately following surgery. New tools and technology have emerged to support the expanding field of regional anaesthesia. Using paraesthesia as a starting point, the method has now evolved to include electrical nerve stimulation and, more lately, ultrasonography for nerve localisation.

The supraclavicular approach inhibits the plexus at its most densely packed point, at the level of the nerve trunks, to create a block with a rapid onset. The brachial plexus's trunks and divisions pass quite close together when they reach the first rib, which improves the quality of anaesthesia. An important consideration when administering block is the closeness of the brachial plexus to the chest cavity and pleura at this site. Ultrasound (US) guidance, on the other hand, allows for better anatomical monitoring and needle placement, which enhances safety while evaluating the plexus, ribs, pleura, and subclavian artery.[54]

It is possible to create a brachial plexus block with any number of local anaesthetics. Bupivacaine is the most widely used one due to its longer duration of action and higher potency. By raising the threshold for electrical excitation, local anaesthetics often prevent nerve cells from generating action potentials. The elements that determine how anaesthesia progresses include the nerve fiber's diameter, degree of myelination, and conduction velocity. How long a local anaesthetic stays effective is related to how well it dissolves in lipids. This occurs because the locations of action of the medicine are closer to lipid membranes, where it has a stronger affinity. In contrast to absorption, the duration of the drug's action on the membrane's Na+ channel increases with its localisation to the membrane.

Opioids, midazolam, magnesium sulphate, dexamethasone, neostigmine, clonidine, and other adjuvants have been used into local anaesthetics in order to prolong the block and postoperative analgesia. Dexmedetomidine, an 2 receptor agonist, is administered intravenously (IV) to intubated and mechanically ventilated patients in intensive care units for the purposes of sedation and analgesia.[55] There have been reports of its use in peripheral nerve blocks recently. It is safe for peripheral nerve blocks, has a rapid onset time, is believed to prolong the duration of local anaesthetics, and is approximately eight times more strong than clonidine.[56]

The 2C and 2A receptors in the dorsal horn are stimulated to mediate the analgesic effect, which inhibits the transmission of pain signals by lowering the release of substance P and glutamate, as well as the hyperpolarisation of interneurons. It is well-known that opioids have narcotic effects in the brain and spinal cord. Oxycodone analgesic responses can be initiated by peripheral opioid receptor activation, however.[57]

Opioids such as fentanyl have been utilised to lengthen and improve the quality of blocks applied to the regional nerve plexus. Without causing central side effects, opioids given peripherally provide a stronger and longer-lasting analgesia.

Consequently, enhancing analgesia by focussing on peripheral receptors can forestall the debilitating effects of centrally mediated side effects such altered consciousness, respiratory depression, and addiction. Fentanyl increases the success rate and block duration of brachial plexus blocks, according to research. The synthetic opioid agonist fentanyl is both more powerful and more rapidly effective than the naturally occurring parent opioid morphine.

When given intrathecally, fentanyl provides better analgesia during and after surgery without producing haemodynamic instability. The medicine has become popular due to its greater safety profile when compared to other opioids.[58] Multiple clinical studies have shown that neuraxial and peripheral nerve blocks that combine local anaesthetics with dexmedetomidine or fentanyl prolong the duration of sensory and motor blockage.

METHODS

In this prospective comparative study, 80 patients, ranging in age from 18 to 60 years, from ASA 1 or 2 backgrounds, were enrolled. All of them were scheduled to undergo upper limb orthopaedic procedures with a supraclavicular brachial plexus block.

Eighty patients, ranging in age from 18 to 60 years old and classified as either I or II by the American Society of Anaesthesiologists Physical Status, had orthopaedic, plastic, and upper limb procedures using the supraclavicular brachial plexus block.

Statistical Analysis

Independent samples and the Mann-Whitney U test A p-value of less than 0.005 indicates that there were statistically significant differences in all variables between the two drug groups, including the onset of sensory block, duration of motor block, duration of sensory block, duration of motor block, and duration of analgesia. T tests were chosen and executed according to the data distribution in order to discover any statistically significant differences.

RESULTS

Onset Of Sensory And Motor Block

According to our study, group A experienced a motor block onset at an average speed of 9.7 ± 0.95 minutes, while group B had an average speed of 12.93 ± 1.82 minutes, and the p-value was less than 0.001. Hence, a statistically significant difference was found. The average onset time for Group B was 10.03 ± 1.25 minutes, with a p-value of less than 0.001, compared to Group A's 6.43 ± 1.22 minutes. As a result, there was a remarkable level of statistical significance between the two categories.

Duration Of Sensory And Motor Block

Group B's average sensory block duration was 487.33 ± 48.28 minutes, while Group A's average duration was 538.67 ± 48.6 minutes ($p < 0.001$). Thus, there was a statistically significant difference. Group A had a larger average motor block duration of 528 ± 48.02 minutes, while group B had a shorter duration of 460 ± 34.74 minutes, with a p-value of less than 0.001. Thus, there was a statistically significant difference.

Duration Of Analgesia

Group B had a shorter duration of analgesia (734 ± 23.34 min) with a p-value of less than 0.001, while group A had a longer length (734 ± 34.4 min). Thus, there was a statistically significant difference.

DISCUSSION

There was little difference between Groups A and B in terms of demographic data. The average age of the participants in the study was 36.82 ± 12.18. The average height of the participants in the study was 166.26 ± 7.88. Its average weight was 65.27 ± 8.17 kilogrammes.

There were 60% men and 40% females in the research group. Notably, 55% of the participants in the study belonged to ASA PS class 1, while 45% were in PS class 2.

The two groups compared sensory blocks. In group A, the sensory block began at 6.43 ± 1.1.22 minutes, while in group B, it began at 10.03± 1.25 minutes. With a p-value less than 0.001, the outcome was deemed statistically significant.

For group B, the sensory block lasted 487.33 ± 48.28 minutes, while for group A, it was 538.67 ± 48.62 minutes. We can say that the result is statistically significant because the p-value is less than 0.001. Group B experienced a motor block onset of 12.93 ± 1.82 minutes, while group A experienced it at 9.7 ± 0.97 minutes. We may say that the result was statistically significant because the p-value was less than 0.001.

Group B's motor block duration was 460 ± 34.74 minutes, in contrast to group A's 528 ± 48.02 minutes. We can say that the result is statistically significant because the p-value is less than 0.001.

Group B experienced 650 ± 23.34 minutes of analgesia, but group A experienced 734 ± 34.4 minutes. With a p-value below 0.001, the result was considered statistically significant. 2017—Renuka Holy Achi and Co.[59] compared the efficacy of ropivacaine with that of fentanyl and dexmedetomidine as adjuvants. Eighty patients with elective upper limb surgeries scheduled and anaesthesiology grades I or II were randomly divided into two groups. For a supraclavicular brachial block guided by USG, patients in group A were administered 30 mL of a mixture consisting of 0.5% ropivacaine and 1 g kg−1 dexmedetomidine. Patients in the B group were administered 30 millilitres of a mixture containing 1 microgramme per kilogramme of fentanyl and 0.5% ropivacaine. The start and duration of the sensory and motor block, the necessity of rescue analgesia, and any adverse perioperative events were to be noted.

In contrast to the fentanyl group, which experienced sensory blocking at 14.18 ± 1.41 minutes, the dexmedetomidine group was found to have it at 13.95 ± 1.34 minutes. There was a notable disparity ($p<0.0001$) in the duration of the sensory blockade between fentanyl (590.25 ± 40.41 min) and dexmedetomidine (801.75 ± 46.07 min). There was a highly significant difference between group A and group B in terms of the duration of motor blockage. Group A experienced it for 649.56 ± 42.73 minutes, while group B for 456.75 ± 32.93 minutes.

Dexmedetomidine, when combined with ropivacaine in a supraclavicular brachial plexus block, increases the duration of the sensory and motor block compared to fentanyl without significantly increasing the risk of adverse effects. In addition, it offers superior post-operative pain management. Findings were consistent with our research.

The authors of the study are Swastika Swaro et al., Daisy Kurian et al., and Swarna Nanerjee et al., and they compared the use of bupivacaine with dexmedetomidine and fentanyl as adjuvants in a prospective, randomised, double-blind trial.

Fifty patients classified as Physical Status I or II by the American Society of Anaesthesiologists were set up for elective upper limb procedures under a supraclavicular brachial plexus block as part of a randomised, double-blinded study. Each patient was randomly assigned to one of two groups. Patients in the BF group received 30 millilitres of bupivacaine combined with 50 Î¼g of fentanyl, while those in

the BD group received 50 Î¼g of dexmedetomidine. We looked studied the analgesia and anaesthesia features of both groups.

While in Group BF the duration of the motor and sensory blocks was 357Â ± 36.77 minutes and 441.52 ± 48.46 minutes, respectively, in Group BD it was 452.96 ± 77.12 minutes. The two groups differed significantly in the beginning stages of the motor and sensory blocks. The time it took for Group BD to feel analgesia (the time it took to need rescue analgesia) was significantly longer (471.44 ± 65.88 minutes vs. 366.48 ± 38.02 minutes) ($p < 0.0001$). Neither group saw many haemodynamic disruptions or side effects, with the exception of group BD's greater grade 3 sedation score.

They found that compared to using fentanyl alone, prolonging the analgesic duration and sensory and motor block with dexmedetomidine added to bupivacaine in a supraclavicular brachial plexus block was more effective. We likewise found comparable results in our research.

Sane et al. compared the effects of bupivacaine alone with those of dexmedetomidine plus bupivacaine in upper extremity orthopaedic surgery, looking at factors including pain score, haemodynamic variations in the supraclavicular block, and the duration of the sensory and motor blocks. The study included sixty people ranging in age from twenty-five to sixty-plus.

The patients who were part of the dexmedetomidine group, which was an intervention group, were given a total of 40 ml, consisting of 39 ml of bupivacaine (0.25%) and 0.75 g/kg of dexmedetomidine. For the control group, the dosage was 40 ml, consisting of 39 ml of 0.25% bupivacaine and 1 ml of normal saline.The average beginning time of sensory block in patients who received only bupivacaine was 31.03 ± 9.65 minutes, while the average beginning time of motor block was 24.66 ± 9.2 minutes. The average beginning times in the group that took dexmedetomidine were approximately 21.36 ± 8.34 minutes and 15.93 ± 6.36 minutes. The average changes in heart rate and arterial blood pressure were similar in the two groups. The duration of sensory and motor blocks, as well as the time it took to initially request analgesia, were all longer in the intervention group. Less pain persisted for an entire day following surgery in the intervention group.

Researchers found that bupivacaine and dexmedetomidine prolonged the time of numbness and immobility and reduced the rate of sensory and motor block development. When supraclavicular blocks were done with bupivacaine, dexmedetomidine significantly reduced postoperative discomfort.

Mohamed Ahmed Hamed et al.[56] conducted a prospective randomised controlled double-blind clinical trial at Fayoum University Hospital comparing the efficacy of dexmedetomidine and fentanyl when added to 0.5% bupivacaine.

There were three groups of twenty patients each, and the patients ranged in age from eighteen to fifty. All were slated for upper limb surgeries and fell into one of two physical status classes according to the American Society of Anaesthesiologists: Amount: 0.5 mL/kg; volume limit: 40 mL; C Group. Administer 1.5 mg/kg of bupivacaine. The D group served as a control and received 1 mcg/kg of dexmedetomidine in addition to bupivacaine. For the F Group, we used bupivacaine in addition to 1 mcg/kg fentanyl. Postoperative pain, adverse effects, analgesic duration, sensory and motor blockage onset and duration, and medication compliance were all closely tracked in these patients.

In the D group ($p < 0.001$) and the F group ($p < 0.001$), they found that the sensory and motor blockage started earlier and lasted longer. There was a 13.5-hour difference in the duration of postoperative analgesia between the D and F groups (8.3 vs. 7.5 hours). In the D group, two individuals had bradycardia and hypotension, while in the F group, nausea and vomiting were the symptoms.

The pharmacologically active d-isomer of medetomidine, dexmedetomidine, is a very selective and specific 2 adrenoceptor agonist that lessens the negative side effects of 1 receptors. Its 2: 1 binding selectivity ratio is 1620:1, which is lower than clonidine's 220:1 ratio. Postsynaptic activation of 2 adrenoceptors reduces norepinephrine release by the central nervous system (CNS), hence blocking the transmission of pain signals. Blood pressure and heart rate are both decreased by this.[60]

CONCLUSION

We studied the effects of adding dexmedetomidine vs. fentanyl as adjuvants to 0.5% Bupivacaine in a supraclavicular brachial plexus block for upper limb orthopaedic procedures. We measured the onset and duration of sensory block, motor block, and duration of analgesia. After comparing 1 mcg/kg of fentanyl to 0.5 percent Bupivacaine, the researchers found that adding 1 mcg/kg of dexmedetomidine significantly delayed the start of sensory and motor block and prolonged its duration.

Table 1: Onset of Sensory and Motor Block

Onset of Sensory and Motor Block	Group A	Group B	p. value
Onset of Sensory Block (minutes)	6.43±1.22	10.03±1.25	*<0.001
Onset of Motor Block (minutes)	0.7±0.95	12.93±1.82	*<0.001

Table 2: Duration of Sensory and Motor Block

Duration	Group A	Group B	p. value
Duration of Sensory Block (minutes)	538.67±48.6	487.33±48.28	*<0.001
Duration of Motor Block (minutes)	528±48.02	460±34.74	*<0.001

Table 3: Duration of Analgesia

Duration of Analgesia	Group A	Group B	p. value
Duration of Analgesia (minutes)	734±34.40	650±23.34	*<0.001

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