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Original Research Article

Comparison of Dexamethasone and Dexmedetomidine as Adjuvants to 0.2% Ropivacaine for Post-Operative Analgesia in Ultrasound Guided Brachial Plexus Block

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Abstract:

Background and Aim: An optimal adjunct to local anaesthetic in a nerve block would be one that accelerates the onset of sensory and motor blockade without inducing substantial adverse effects, while also extending the duration of analgesia. The purpose of this research was to compare the analgesic effects of Dexamethasone and Dexmedetomidine during an ultrasound-guided Brachial Plexus Block following surgery.

Material and Methods: One hundred (50 patients each) ASA I and II patients, aged 18–60 years, who were undergoing orthopaedic operations on the upper limb under general anaesthesia with ultrasound-guided brachial plexus block for post-operative analgesia, participated in a prospective, double-blind clinical study. In Group A, 20ml of 0.2% Ropivacaine was combined with 8mg of Dexamethasone. 20ml of 0.2% Ropivacaine containing 50 µg of Dexmedetomidine was administered to Group B. The aims of this study were to compare the duration of sensory and motor block in the post-operative period, the time between the initial request for analgesia and its occurrence in both groups, and the cumulative requirement for analgesia in 24 hours.

Results: The differences between the two groups in terms of age, gender, height, weight, and BMI were not statistically significant. A notable distinction in hemodynamic parameters was observed between the two groups after 10 hours, after which there was no significant difference. In both groups, the mean time to administer the first rescue analgesic was significantly different. The VAS scores deviated significantly ($p < 0.0001$) at each of the following time points: 2 hours, 4 hours, 8 hours, 12 hours, 18 hours, and 24 hours.

Conclusion: The adjuvants Dexamethasone and Dexmedetomidine demonstrate efficacy in extending the duration of analgesia following surgical procedures. Dexmedetomidine, on the other hand, prolongs the duration of analgesia and the overall analgesic requirement more effectively than dexamethasone.

Keywords: Brachial Plexus Block, Dexamethasone, Dexmedetomidine, Ropivacaine.

Introduction

A regional anaesthetic technique offers numerous benefits, including the avoidance of the need for multiple medications, a conscious patient, and, above all, superior postoperative analgesia. [1] Although brachial plexus block (BPB) offers effective postoperative analgesia, its effectiveness is limited in duration. Although continuous catheter techniques are efficacious, they may give rise to technical complications, infection, and catheter migration-related failure. [2] The addition of adjuvants to local anesthetics prolongs the effect of the local anesthetic; by utilizing adjuvants, one can provide extended post-operative analgesia, ensure patient adherence to physiotherapy, and facilitate early patient mobilization while maintaining stable hemodynamic variables. The investigations have unveiled that various additives to LA, including dexamethasone, dexmedetomidine, clonidine, tramadol, buprenorphine, magnesium sulphate, and fentanyl, exhibited distinct durations of analgesia. [3-9] As adjuvants to local anesthetics, clonidine, dexmedetomidine, and dexamethasone prolonged the duration of analgesia, according to the literature. Clonidine was found to be less efficacious perineural dexmedetomidine, according to a meta-analysis. As a result, we opted to incorporate dexmedetomidine into our research.

Adjuvantic Brachial Plexus Blocks have expanded the range of anesthetic options available for procedures involving the troublesome upper limbs. Using ultrasound-guided peripheral nerve blocks to visualize the block needle, peripheral nerves, and

local anesthetic distribution in real time has improved the efficiency, safety, and overall quality of the procedure. This ultimately results in prolonged analgesia accompanied by a decreased incidence of complications. Dexamethasone and Dexmedetomidine were selected as adjuvants in conjunction with Ropivacaine for usage in ultrasound-guided brachial plexus block.

Material and Methods

One hundred (50 patients each) ASA I and II patients, aged 18–60 years, who were undergoing orthopaedic operations on the upper limb under general anaesthesia with ultrasound-guided brachial plexus block for post-operative analgesia, participated in a prospective, double-blind clinical study. The patients were assigned at random to one of the following categories using a sealed envelope system.

Group A

8ml of 0 5% Ropivacaine +8 mg Dexamethasone (2ml +10 ml normal saline.

Group B

8ml of 0.5% Ropivacaine+50 mcg Dexmedetomidine (0.5 ml Dexmedetomidine+ 1.5ml of Normal Saline) + 10ml Normal Saline.

Refusal to undergo ESPB, the presence of coagulopathy or bleeding disorder, bradycardia, cardiac conduction block, administration of a β-adrenergic antagonist or antiplatelet agent, local infection at the site of injection, hypersensitivity to local amide anaesthetics, or allergy or hypersensitivity to dexmedetomidine were all considered as exclusion criteria. In addition, individuals who met the following criteria were ineligible: central neuropathy, body mass index exceeding 35 kg/m2, uncontrolled diabetes mellitus, substantial cardiopulmonary disease, or psychiatric illness.

Once the patient was transported to the operating room via trolley, non-invasive blood pressure monitors, a pulse oximeter, and electrocardiogram were affixed, and intravenous fluid administration commenced. Premedication was administered intravenously via Fentanyl 2 mcg/kg and Ondansetron 4 mg. Vencuronium 0.08 mg/kg i.v. and Propofol 2 mg/kg i.v. were administered intravenously to induce induction.

Following mandible relaxation, a suitable-sized I-Gel was inserted. 50% oxygen and 50% air were utilised for maintenance, while desflurane was titrated to a MAC value of 0.8.

A brachial block guided by ultrasound was administered subsequent to the surgical procedure and prior to the reversal of anaesthesia. The patient was placed in a supine position with a modest elevation of the head and a turn towards the opposite side of the interscalene brachial block. With the ultrasound equipment on the opposite side of the patient, the operator is positioned on the operative limb. A high frequency linear instrument ranging from 8 to 13 MHz was employed to perform a transverse scan of the neck encompassing the supraclavicular fossa and cricoid cartilage. The brachial plexus roots frequently manifest at the interscalene level as hypoechoic nodules that resemble peas arranged in a container between the anterior and middle scalene muscles.

Brachial supraclavicular block: The supraclavicular fossa was scanned in a coronal-oblique plane using a linear ultrasound high frequency probe positioned above the clavicle. This allowed for a pertinent short-axis view of the closely packed nerve plexus, which was commonly perceived as a cluster of grapes positioned cephalo-dorsally with respect to the subclavian artery. A volume of the desired substance was injected after an in-plane block needle insertion was performed.

An evaluation of postoperative discomfort was performed utilising the Visual Analogue Scale. Rescue analgesic was administered upon initial request for analgesia (VAS score>3) in our study. IV Diclofenac 75 mg was administered, and if relief was not observed within 30 minutes, IV Paracetamol 1 g was added. The independent anesthesiologist monitored the postoperative heart rate, systolic and diastolic blood pressure, visual analogue scale score, analgesia administered, and time intervals of 0 hours, 2 hours, 4 hours, 8 hours, 12 hours, 18 hours, and 24 hours. The consumption of analgesics over a period of 24 hours was documented. The duration of analgesia was determined by the time between the patient's initial request for analgesic (when VAS >3) and the administration of rescue analgesia. The duration of the sensory block was measured from the moment the epidermis became sensitive to a pin prick. Time required for the complete reversal of motor functions was recorded as motor block. The total amount of analgesia administered was determined by the number of times analgesia was required in the twenty-four hours following the operation. The total amount of analgesic consumed within the initial twenty-four hours was also evaluated.

Statistical analysis

Following the compilation and entry of the recorded data into a spreadsheet application (Microsoft Excel 2007), the information was exported to the data editor tab of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). On the basis of their distribution, quantitative variables were described as means and standard deviations or median and interquartile range. The presentation of qualitative variables consisted of counts and

percentages. The levels of significance and confidence were established at 5% and 95%, respectively, for every test.

Results

There were no significant differences observed in age, sex, height, weight, or BMI between the two groups (Table 1). Heart rate, systolic blood pressure, and diastolic blood pressure were determined at the following time intervals: 0 hours, 2 hours, 4 hours, 8 hours, 12 hours, 18 hours, and 24 hours. A notable distinction in hemodynamic parameters was observed between the two groups after 10 hours, after which there was no significant difference.

The duration of motor and sensory block differed significantly between the Dexamethasone and Dexmedetomidine groups ($p < 0.05$). In the Dexamethasone group, the average duration of motor block was 640.48 ± 25.48 minutes, whereas in the Dexmedetomidine group, it was 826.10 ± 53.69 minutes. In the Dexamethasone group, the average duration of sensory block was 685.4 ± 26.18 minutes, whereas in the Dexmedetomidine group, it was 873.22 ± 53.48 minutes. According to Table 2, the average time to administer the first rescue analgesic was 712.50 ± 17.22 minutes in the dexamethasone group and 912.3 ± 50.44 minutes in the dexmedetomidine group. The disparity was exceedingly noteworthy (p value < 0.0001). Analgesics were administered intravenously: 75 mg of diclofenac was administered at the initial request, and 1 g of paracetamol was injected after half an hour if alleviation was not achieved. A statistically significant difference of $0 \leq 0.05$ was observed between the two groups; the Dexamethasone group had a mean of 1.19 ± 0.89, while the Dexmedetomidine group had a mean of 0.3 ± 0.22. Clearly, the Dexmedetomidine group necessitated a reduced quantity of analgesics within twenty-four hours following the procedure. Therefore, it was determined that although both medications provided postoperative analgesia, Dexmedetomidine exhibited superior efficacy.

At zero hours, the difference in VAS scores between the two groups was insignificant. At 2, 4, 8, 12, 18, and 24 hours, however, it remained significant.

Table 1: Demographic data

Variables	Group A Mean±SD	Group B Mean±SD	P value
Age(yrs)	36.97 ± 10.29	35.78 ± 8.10	0.48
Height(cm)	159.48 ± 5.34	159.2 ± 5.10	0.98
Weight(kg)	57.10 ± 7.35	59.23 ± 6.15	0.1
BMI (kg/m2)	22.65 ± 2.30	23.10 ± 3.45	0.06

Table 2: Various parameters assessed

Variables	Group A Mean±SD	Group B Mean±SD	P value
Time to first rescue analgesia (minutes)	712.50 ± 17.22	912.3 ± 50.44	0.001*
Total analgesia given in 24 hours	1.19 ± 0.89	0.3 ± 0.22	0.01*
Duration of motor block (minutes)	640.48 ± 25.48	826.10 ± 53.69	0.001*
Duration of sensory block (minutes)	685.4 ± 26.18	873.22 ± 53.48	0.02*

* indicate statistically significance at $p \leq 0.05$

Discussion

Brachial plexus block is the anaesthetic technique of choice for upper limb surgical procedures. Dexamethasone and Dexmedetomidine are effective adjuvants for extending the duration of analgesia with minimal adverse effects.

The considerable difference in hemodynamic variables is due to the fact that sensory block begun to diminish in the dexamethasone group around this time. The duration of motor and sensory block differed significantly between the Dexamethasone and Dexmedetomidine groups ($p < 0.01$). Grading in accordance with the Bromage Scale was not possible because the operated limb was bandaged.

In the past, clinical trials have demonstrated the advantages of utilising different adjuncts in conjunction with local anaesthetics; however, none of these adjuncts have been able to adequately extend the duration of effective blockade. [10,11] Dexmedetomidine functions as an agonist of ⍺2-adrenoceptors. [12] It stabilises hemodynamics and is sympatholytic; it does not induce respiratory depression. In the locus coeruleus, one of the greatest densities of a2 receptors has been identified. The site within the central nervous system that is responsible for the hypnotic and sedative effects of a2 adrenoceptor activation has been identified. Furthermore, it serves as the starting point for the descending medullospinal noradrenergic pathway, a significant regulator of nociceptive neurotransmission. The presence of shared effector mechanisms between the a2-adrenergic and opioid systems in the brain region suggests that Dexmedetomidine exerts its effects at a supraspinal site. In their research comparing Dexamethasone and Dexmedetomidine as adjuvants to 0.375%, Krishna et al [13] Ropivacaine observed that the difference between the two groups in hemodynamic parameters was

insignificant. There was a statistically significant difference in the duration of analgesia between the Dexmedetomidine and Dexamethasone groups ($p<0.05$). This study also demonstrates that dexmedetomidine offers an extended duration of analgesic effects.

Consistent with findings from prior research, our data indicated that perineural dexmedetomidine might prolong the duration of anaesthesia block, postpone the initial request for PCA use, and decrease the necessity for postoperative rescue analgesics. [14-17] A number of studies on the use of peripheric dexmedetomidine as an adjuvant to LAs have found that 0.5–1 g/kg of dexmedetomidine improved the quality and duration of analgesia without causing significant adverse effects. [13,14,16] As an adjuvant, 100–150 g of dexmedetomidine reduced the pulse rate without affecting blood pressure. [18] Possible mechanisms associated with the action of dexmedetomidine to enhance blockade efficacy have been identified in prior research. The potential interaction between dexmedetomidine and local anesthetics could be the initial cause. Dexmedetomidine has the potential to induce vasoconstriction at the injection site, resulting in a protracted duration of local anaesthetic action and postponement of absorption. [19,20] Furthermore, perineural dexmedetomidine inhibits the hyperpolarization-activated cation current and reduces acute local anesthetic-induced perineural inflammation without inducing nerve injury. It also exerts a direct impact on peripheral nerve activity. Dexmedetomidine possesses analgesic and analgesic-sparing properties; its mechanisms of action in peripheral nerve block (PNB) were mediated by 2A-adrenergic receptors (α2A-ARs).

Haemodynamic parameters at 10, 15, 30, 45, 60, 90, 120, and 150 minutes did not differ significantly between the two groups, according to N K Verma et al [21] ($p>0.05$). The onset and duration of sensory and motor paralysis were observed to be earlier in the Dexmedetomidine group in comparison to the Dexamethasone group. Additionally, they discovered that in the Dexamethasone group, the visual analogue scale was higher at 24 hours, whereas patients in the Dexmedetomidine group exhibited a significantly reduced VAS after 6 hours.

In their research, Kaur et al. [22] aimed to compare the duration of analgesia, onset, and duration of sensory and motor block in response to the addition of two substances to a solution containing 2% lignocaine with adrenaline and 0.5% bupivacaine: an α-2 agonist Dexmedetomidine and a steroid Dexamethasone. Motor and sensory blockade durations were significantly prolonged when dexmedetomidine was administered. Dexmedetomidine, Dexamethasone, and Ropivacaine in Axillary Brachial Plexus Blocks were the subject of an additional study. In comparison to the Ropivacaine group, the duration of the sensory block was significantly longer in the Dexamethasone and Dexmedetomidine groups (P0.05); however, no significant difference was observed between the Dexamethasone and Dexmedetomidine groups. [23]

Despite employing a randomized and controlled study design, no information pertaining to the complexity of the surgical procedure, the severity of disease pathology, or the surgical approach (minimally invasive versus open versus endoscopic versus luminal) was included. Further research will be required to assess the synergistic effects, cost-effectiveness, and safety of these medications in various combinations using a larger sample size.

Conclusion

Adjuvant-guided ultrasound-guided brachial plexus blocks are an efficacious method for mitigating post-operative pain while minimising adverse effects. Adjuvants composed of dexamethasone and dexmedetomidine have demonstrated efficacy in extending the duration of post-operative analgesia. Dexmedetomidine, on the other hand, prolongs the duration of analgesia and the overall analgesic requirement more effectively than dexamethasone.

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