Original Article

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Comparison of Dexmedetomidine and Dexamethasone Used as Adjuvant to Ropivacaine in Ultrasound-guided Supraclavicular Brachial Plexus Block: An Observational Study

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Abstract

Background: Supraclavicular brachial plexus block is one of the preferred technique to provide perioperativeanaesthesia and analgesia for upper limb surgical procedures. The duration of block can be extended by the addition of various adjuvants. Our aim was to compare the efficacy of dexamethasone and dexmedetomidine as an adjuvant to ropivacaine in extending the duration of supraclavicular brachial plexus block and quality of postoperative analgesia. **Subjects and Methods:** This prospective observational study was carried out in 60 American Society of Anaesthesiologists gradeI-III patients, aged18-70years scheduled for upper limb surgeries randomly allocated in to two groups with each group consisting of 30 patients. All patients under ultrasound-guided supra clavicular brachial plexus block received 25 ml of 0.5% ropivacaine. Along with ropivacaine, GroupDX patients received 8 mg(2 ml) of Dexamethasone and Group DM received 1μ gkg-1 (2ml) of dexmedetomidine. **Results:** We noted a significantly extended duration of motor block (853.5 +/- 115 min vs628.6 +/- 135 min) and extended duration of complete analgesia (1374.2 +/- 185.4vs 1084.2 +/- 156.5min) in dexmedetomidine group compared to dexamethasone group. The postoperative pain scores were significantly lower in dexmedetomidine group and total consumption of intravenous diclofenac sodium in 24 hours was less in dexmedetomidine group. No adverse effects were noted in either group. Patient satisfaction score was comparable in both the groups. **Conclusion:** Dexmedetomidine when used as adjuvant to ropivacaine for supraclavicular brachial plexus block prolongs the duration of block and improves the quality of postoperative analgesia as compared to dexamethasone without any serious side effects.

Keywords: Dexmedetomidine, dexamethasone, ropivacaine, supraclavicular brachial plexus block, ultrasound.

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Introduction

Different nerve blocks in anaesthesia have merits like feeling free from suffering of disease, lower complications, & reduces the stay of patients within both hospital& post-anaesthesia care unit. USG guided supraclavicular brachial plexus (SCBP) blockade not only produces quality anaesthesia for extremity surgery and post-operative analgesia but also avoids intravascular injection thereby avoiding complications.[1] Ropivacaine is a long-acting amide local anaesthetic with a potentially improved safety profile when compared to bupivacaine. Ropivacaine produces less cardiac as well as central nervous system toxic effects, less motor block and a similar duration of action of sensory analgesia as bupivacaine[2] Many drugs have been studied including opioids, glucocorticoid like dexamethasone,alpha-2 receptors agonists like dexmedetomidine & clonidine into supraclavicular system as an adjuvant to ropivacaine to extend the length of postoperative pain relief but none found ideal.[3] Adjuvant like Dexmedetomidine & Dexamethasone had resulted in increasing the time period of postoperative pain relief after using it as additive with epidural anesthesia.

Dexmedetomidine, an alpha-adrenergic agonist when mixed with local anaesthetics for brachial plexus block facilitates better anaesthesia and analgesia.[4] The chase for quintessential adjuvant with most benefits and minimal side-effects continues. Although literature is replete with studies comparing these adjuncts to control, very few studies have directly compared combination of ropivacaine with dexmedetomidine and ropivacaine with dexamethasone in SCBP block.[5,6] Results of these studies are discordant and call for more direct comparison between the two adjuncts. This study was done at bone and joint hospital barzulla an associated hospital of government medical college srinagar. Study was done in between august 2017 to august 2018.The current study aimed to compare the efficacy of

dexmedetomidine and dexamethasone as adjuvants to 0.5% ropivacaine in ultrasound-guided SCBP block. The primary outcomes studied were onset and duration of sensory and motor block. Secondary outcomes included duration of analgesia, total analgesic consumption in 24 hr postoperatively, quality of block and complications.

Subjects and Methods

After getting ethical committee approval and taking written informed consent, 60 American Society of Anaesthesiologists (ASA) physical status I/III patients, scheduled for elective upper limb surgeries below mid-humerus level, under ultrasound-guided SCBP block were recruited in the present prospective observational study. Patients having significant coagulopathies, documented neuromuscular disorders, infection at block site, pregnancy and known allergy to study drugs, were excluded from the study.

Exclusion Criteria

Pregnant patients, patients with pre-existing neuropathy of the surgical limb, patients on systemic corticosteroids for two weeks or more within six months of surgery, hypersensitivity to the study drugs and coagulopathy.

Materials and methods

All patients received standard premedication according to the department protocol on the night before surgery and the standard fasting guidelines were followed. We explained the procedure to the participants in their own language and informed consent was obtained. In the operating room, standard monitors such as non-invasive blood pressure (NIBP), SpO2 and ECG were attached and the baseline NRS (numerical rating scale) was noted. All patients received i.v midazolam 0.02mgkg-1 before the procedure. We identified the brachial plexus in the supraclavicular region using ultrasound by in-plane technique. Then with the help of a nerve stimulator, using 5 cm stimulating needle, we observed motor response at 1.0 mA intensity at a frequency of 1 Hz. After achieving a twitch, the current intensity was reduced to 0.5 mA and when we observed a continuing twitch at an intensity of less than 0.5 mA but not less than 0.3 mA,a test dose of 0.5 ml of the study drug was injected. The entire volume of the study drug solution was injected slowly superior and inferior to the brachial plexus after careful negative aspiration. The study drug solution was administered in all participants as follows.

Group DX: 25 ml of 0.5% ropivacaine with 8 mg (2ml) of dexamethasone.

Group DM: 25 ml of 0.5%ropivacaine with 1μ gkg-1(2ml) of dexmedetomidine

The patients were assessed for the onset of block every 5 minutes till the first 30 minutes. The onset of sensory and motor block was defined as the time from the injection of drug solution to the time of attainment of grade 1 sensory block and motor block respectively.

The sensory block was evaluated by pin prick method for the entire upper limb innervation which includes the musculocutaneous, radial, ulnar, median, intercostobrachial nerve and the medial cutaneous nerves of arm and forearm. The sensory block was graded as follows

Grade - 0: Normal sensation (sharp pain felt)

Grade - 1: Blunted sensation (dull sensation or slight heaviness)

Grade - 2: No pain perception

The motor block was evaluated by thumb abduction (radial nerve), thumb adduction (ulnar nerve), thumb apposition (median nerve), flexion of elbow in supination (musculocutaneous nerve) using modified Bromage scale.

Grade – 0: Normal muscle strength with complete flexion and extension of elbow, wrist and fingers.

Grade – 1: Reduced motor strength with weak grip.

Grade – 2: Complete motor blockade with loss of ability to move the fingers.

Fentanyl 1 microgmkg-1 was given as rescue analgesia if patient experienced pain. Even after two such doses of fentanyl, if patient perceived pain, general anaesthesia was administered and the block was considered to be failed. Total amount of intra operative fentanyl requirement was noted. Hemodynamic parameters such as heart rate (HR) and mean arterial pressure (MAP) were recorded. We defined bradycardia as HR less than 60 beats per minute and hypotension as 20% fall in MAP from the baseline. Any event of desaturation with SpO2 less than 88% was noted. We defined sensory block or absolute post-operative analgesia as the time interval between the onset of sensory block and the development of pain which requires administration of rescue analgesic in the post-operative period. We defined motor block as the time interval between the onset of motor block and the time of attaining modified Bromage grading of zero. In the post-operative period, numeric rating scale (NRS) for pain was noted and intravenous aqueous diclofenac sodium 75 mg was given at NRS of 4 or on patients request. If the pain was still not relieved, Paracetamol 1 g intravenous infusion was given. Pain was assessed every four hours for about 24 hours. Patient satisfaction was recorded according to satisfaction score: poor = 0; fair = 1; good = 2; excellent= 3.

Statistical Analysis

We estimated a sample size of 29 in each group, considering a 45 minutes' difference in the duration of block with 5% significance level and 80% power. Keeping block failure and drop outs in mind, we approximated the final sample size to 30 in each group. We used SPSS 19 version for doing statistical analysis. Normality of distribution of data was determined using Kolmogorov-Smirnov tests of normality. Chi square test for analysis of ASA and gender. We expressed age and weight as mean_standard deviation (SD).

Parametric variables like onset and duration of block, fentanyl requirement in the intra operative period and post-operative intravenous aqueous diclofenac sodium consumption were analysed using one-way ANOVA test. Post hoc Bonferroni test was done to compare within the groups. Variables were expressed as mean ±SD.

Kruskal Wallis test was used for the non-parametric variables like NRS scores and expressed as median with inter quartile range. We considered p value of <0.05 as significant.

Results

Sixty patients were randomised, 30 in dexamethasone group, 30 in dexmedetomidine. With regard to distribution of age, weight, gender and ASA classification, no difference were seen as shown in [Table 1]. We observed a comparable onset time of sensory and motor block among the groups (p>0.05) as depicted in [Table 2]. The mean duration of motor block in Group DX was 628.6 ±135 mins and 853.5 +- 115mins in Group DM. The duration of motor block was significantly extended in group DM by 224.9 mins when compared to group DX by (p<0.01).

The time to request of first analgesic in the postoperative period was 1374.2 ±185.4 mins in Group DM and 1084.2 ±156.5 mins in Group DX. This shows a significantly extended sensory blocking Group DM compared to Group DX by 290 mins (p<0.01).

The total consumption of fentanyl in the intra operative period showed no significant difference (p>0.05). The first 24 hours' intravenous diclofenac sodium consumption was significantly less in Group DM (78.5+- 12.2 mg) as compared to Group DX (108+- 23.3 mg) (p<0.01) [Table 4].

None of the patients required supplemental paracetamol. No significant difference in the number of bradycardia and hypotension episodes were observed. Patient satisfaction score was same in both the groups.

Table 1: Age and weightdistribution of patients among the groups

	Group DX (n=30) (Mean ±SD)	Group DM (n=30) (Mean ±SD)	p value
Age(years	32.50±10.51	33.31±13.22	0.90
Weight(kg)	66.82±6.91	67.03±8.54	0.60

Table 2: Onset of sensory and motor block

Onset of block (min)	Group DX(n=30) (Mean ±SD)	Group DM (n=30) (Mean ±SD)	p value
Motor block	15.71±3.78	13.79±3.44	0.27
Sensory block	9.11±3.34	8.45±3.01	0.69

Table 3: Duration of sensory and motor block

Duration of block (min)	Group DX(n=30) (Mean ±SD)	Group DM (n=30) (Mean ±SD)	p value
Motor block	628.6±135	853.5±115	<0.01*
Sensory block	1084.2 +- 156.5	1374.2±185.4	<0.01*

Table 4: Time to first analgesic administration and total analgesic consumption

	Group DX (n=30) (Mean ±SD)	Group DM (n=30) (Mean ±SD)	p value
IntraoperativeFentanyl requirement(μg)	46.52±9.01	49.21±10.63	0.55
Total analgesic consumption in 24 h (diclofenac mg)	108 +- 23.3	78.5 +- 12.2	<0.01

Discussion

Many adjuvants have been used along with the local anaesthetics in supraclavicular brachial plexus block. Dexamethasone and dexmedetomidine have been shown to prolong the duration of sensory and motor block.

The present study was conducted to examine and compare the effects of 1 microgm/kg dexmedetomidine and 8 mg dexamethasone when added to 0.5 % ropivacaine in USG guided supraclavicular brachial plexus block. We visualized the brachial plexus with an ultrasound and after confirming motor response , we injected the study drug solution. USG guidance helps in identifying the exact location of the nerve plexus and also in visualising the deposition of local anaesthetic , thereby avoiding the complications associated needle placement.[7,8]

In this study, we found that adding 1μg/kg dexmedetomidine as an adjuvant to 25 ml ropivacaine (0.5%) in ultrasound-guided SCBP block extends the duration of motor block, defers the demand for first rescue analgesic and significantly decreases the total 24 h analgesic consumption as compared to dexamethasone.

Dexmedetomidine when added to the local anaesthetics in peripheral nerve blocks prolongs analgesia by multiple mechanisms such as central action, alpha 2 receptor mediated vasoconstriction, inhibition of inflammatory responses, directaction on peripheral nerves, or it may enhance activity-dependent hyperpolarization by blocking the hyperpolarization- activated cation current and inhibits subsequent action potentials.[17,18,19]

Dexamethasone, a long acting glucocorticoid, prolongs the analgesia when given by perineural route in addition with bupivacaine. This may be due to multiple mechanisms such as direct action on glucocorticoid receptors reducing the nociceptive C fibre activity or a local vasoconstriction action reducing the absorption of local anaesthetic or anti inflammatory action by inhibition of the synthesis of inflammatory mediators.[9]

In our study, the duration of analgesia was significantly prolonged after use of dexmedetomidine with 0.5% ropivacaine [Table 2].

Ammaret al. found significantly decreased requirement of i.v. morphine (4.9 mg vs 13.6 mg) as rescue analgesic with dexmedetomidine as adjuvant in infraclavicular brachial plexus block.[10] Agarwalet al. also reported that in patients receiving SCBP block with 100 μgdexmedetomidine when added to 0.325% bupivacaine, increased the duration of analgesia significantly.[11]

In a meta-analysis, nine randomized controlled trials (801 patients) were analysed in which 393 patients received dexamethasone (4–10 mg). Authors observed significantly prolonged duration of analgesia when dexamethasone was administered along with long acting local LAs.[12] In another study, patients receiving dexamethasone in SCBP block required significantly less diclofenac in 24 h postoperative period as compared to control group.[13]

Vermaet al. found that dexmedetomidine with ropivacaine provides early onset of sensory and motor block with longer block duration in SCBP block as compared to dexamethasone.[5]

In an indirect adjusted meta-analysis of 49 trials, authors found dexamethasone to be superior to dexmedetomidine as it prolonged the duration of analgesia by 148 minutes more than dexmedetomidine, without the risks of hypotension or sedation.[16] A handful of other direct comparative studies

favour of dexmedetomidine over dexamethasone.[17]

Our study has few limitations like use of fixed dose of dexamethasone (8 mg) as compared to per kg body weight dose of dexmedetomidine (1 μg/kg), small sample size and postoperative follow-up period restricted to 24 h. Another limitation of our study was that different patients underwent diverse surgeries of varying nature and time duration, different tissue handling by differing level of prowess of surgeons, possibly leading to inconsistent perioperative requirement of analgesia.

Conclusion

We conclude that addition of 1μg/kg dexmedetomidine as an adjuvant to ropivacaine (0.5%)in SCBP block significantly prolongs sensory and motor block duration. It delays the demand for first rescue analgesic, decreases overall 24-hour total analgesic requirement and improves the quality of block without any added major side effects.

Conflicts of Interest

There are no conflicts of interest.

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