Comparison of ultrasound guided interscalene brachial plexus block using 0.2% ropivacaine with dexmedetomidine and 0.2% ropivacaine with dexamethasone - A prospective observational study

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Introduction
Adding adjuvants to local anaesthetics in brachial plexus block is known to enhance the quality and duration of analgesia. This study was undertaken to compare 1 µg/kg of dexmedetomidine, or 100 µg/kg of dexamethasone added as adjuvants to 0.2% ropivacaine in ultrasound guided interscalene brachial plexus block for arthroscopic shoulder surgeries.

Subjects and methods
A prospective observational study in which 92 patients scheduled for arthroscopic shoulder surgery under ultrasound guided interscalene block with 15 ml of 0.2% ropivacaine and dexmedetomidine (Dexmed) or dexamethasone (Dexa) as adjuvants. Onset, duration of sensory and motor blockade, sedation score, time for rescue analgesia (duration of analgesia) were recorded and analysed.

Results
Demographic data and surgical characteristics were similar in both the groups. Sensorimotor blockade onset was earlier in group Dexmed (8.67 ± 3.06 min) as compared to group Dexa (14.61 ± 6.71 min) [P < 0.001]. Blockade duration was longer in group Dexmed than group Dexa. Time of request for rescue analgesia was delayed in group Dexmed (930.0 ± 83.45 min) when compared to group Dexa (620.0 ± 125.54 min). Mild sedation was observed in group Dexmed.

Conclusion
Dexmedetomidine as an adjuvant to 0.2% ropivacaine in ultrasound guided interscalene blockade is more efficacious than dexamethasone in hastening the onset, prolonging sensory blockade and delaying the time of request for rescue analgesia. Dexmedetomidine produces mild sedation compared to dexamethasone as an adjuvant.

Keywords: Interscalene brachial plexus block; adjuvants; dexmedetomidine; dexamethasone

Introduction

Arthroscopic shoulder surgeries can be done under general anaesthesia, regional anaesthesia or a combination of both. In patients undergoing shoulder arthroscopy, pain can persist for more than 48 hours in the postoperative period despite multimodal analgesia, thus making pain control challenging for anaesthesiologists.

Effective postoperative pain management is important for initiating rehabilitation, thus decreasing hospital stay and improving patient satisfaction. Various analgesic regimens like intravenous, oral and transdermal patches have been tried to control postoperative pain but with certain limitations.

Interscalene brachial plexus block is one of the most widely practiced regional anaesthetic technique for shoulder surgeries and it provides better analgesia, greater satisfaction and fewer side effects. When combined with general

anaesthesia, it reduces intraoperative anaesthetic and analgesic requirements and provides postoperative analgesia.

Adjuvants to local anaesthetics improve the quality of analgesia, prolong duration of blockade and reduce the dose of local anaesthetics.[1-4] In this study we observed and compared the efficacy of two adjuvants – dexmedetomidine and dexamethasone with 0.2% ropivacaine. Aim of the study was to compare the block characteristics with dexmedetomidine and dexamethasone as adjuvants to 0.2% ropivacaine in ultrasound guided (USG) interscalene block for arthroscopic shoulder surgeries. Comparison of onset and duration of sensory blockade was our primary objective. Secondary objectives were to compare the onset, duration of motor blockade, time of request for rescue analgesia and sedation score.

Subjects and methods

Institutional ethics committee approval was sought before commencing this prospective observational study. Clinical Trials Registry of India (CTRI) registration was done. Patients of American Society of Anaesthesiologists physical status (ASA PS) I or II, aged 18 - 60 years of either gender scheduled for elective arthroscopic shoulder surgeries under interscalene block using 15 ml of 0.2% ropivacaine with 1 μg/kg of dexmedetomidine or 100 μg/kg of dexamethasone as adjuvants along with general anaesthesia were included in the study. Patients who refused to participate, those with neurological deficits, known allergy to local anaesthetics and history of seizures were excluded. Informed consent was obtained from all participants. Consultant anaesthesiologists administered the USG guided interscalene blocks with 0.2% ropivacaine and adjuvant of their choice (dexmedetomidine or dexamethasone). Patients who received dexmedetomidine as adjuvant were observed under group Dexmed and who received dexamethasone as adjuvant were observed under group Dexa. Observed parameters include onset of sensory and motor block, duration of sensory and motor block, sedation score and time for rescue analgesia. The time interval between administration of local anaesthetic solution to loss of prick sensation in C5, 6, 7 dermatomes was taken as onset time; it was assessed every 3 min till complete loss of

sensation for 30 min. Three point scale was used to assess the sensory blockade (Grade 0: Sharp prick felt, Grade 1: Analgesia, dull sensation felt, Grade 2: Anaesthesia, no sensation felt). Onset of motor blockade was defined as the duration from injection of local anaesthetic solution to loss of movements in the arm, assessed every 3 min for 30 min using modified Bromage scale (Grade 0: Normal motor function, Grade 1: Ability to move only fingers, Grade 2: Complete motor block with inability to move below the wrist and finger). Time interval between complete loss of sensation on toothpick prick to reappearance of sensations was considered as duration of sensory blockade. Interval between complete motor blockade to reappearance of movements was regarded as duration of motor blockade. Sensory blockade of less than grade 2, for 30 min following administration of study drug was considered as unsuccessful blockade and those patients were excluded from analysis. Interval between administration of block to request for any pain relieving medications by the patient was considered as time for rescue analgesia. Five-point sedation score described by Culebras et al. was used for assessing sedation.[5] Once the parameters were noted, general anaesthesia was administered as per the standard protocol. Any additional dose of analgesic administered were documented. Post-operative follow-up was done every 30 min to measure the outcomes mentioned earlier.

Sample size

Calculated based on the duration of sensory blockade (pilot study). To consider 30% difference in duration of sensory blockade between the groups to be significant, with an alpha error of 0.05 and power of 80%, sample size calculated was 92 with 46 patients in each group.

Formula used

$$n = 2[Z_{1-\alpha/2} + Z_{1-\beta}]^2 \, \sigma^2 \div d^2$$

where, $Z_{1-\alpha/2} = 1.96$ for alpha at 5% level of significance

$Z_{1-\beta} = 0.84$ for 80% power

d/σ = effect size (0.5 = anticipated value)

Results

All the 92 patients enrolled have completed the study with nil dropouts and none had failed block. The data were analysed using SPSS version 16 software. Continuous data were represented as

mean ± SD and categorical data as number of patients. Independent t –test and Chi-square tests were used for data analysis. P- value of < 0.05 was considered as significant. Sixty-nine male and twenty-three female patients participated in the study. Sixty-five patients belonged to ASA PS I and 27 patients belonged to ASA PS II. Age, weight and the duration of surgery were comparable between groups. Onset of sensorimotor blockade was significantly longer in group Dexa compared to group Dexmed (Table 1). The duration of sensorimotor blockade and time for request of rescue analgesia was significantly prolonged in group Dexmed compared to group Dexa (Table 2). Statistically significant sedation was observed in group Dexmed than group Dexa (Table 3). Intraoperatively none of the patients required any additional dose of analgesics.

Table 1:
Onset of blockade (Mean ± SD)

	Group Dexmed (n = 46)	Group Dexa (n = 46)	P value
Sensory onset (min)	8.67 ± 3.06	14.61 ± 6.71	0.001*
Motor onset(min)	13.96 ± 5.06	19.47 ± 6.97	0.001*

* Independent t-test

Table 2:
Duration of blockade and time to rescue analgesia (Mean ± SD)

	Group Dexmed (n = 46)	Group Dexa (n = 46)	P Value
Sensory blockade (min)	884.0 ± 85.46	564.13 ± 83.22	0.001*
Motor blockade (min)	823.70 ± 128.25	522.0 ± 76.89	0.001*
Time to rescue analgesia (min)	930.0 ± 83.45	620.0 ± 125.54	0.001*

*Independent t-test

Table 3:
Sedation score

Group	Sedation score	
	1 (Awake and alert)	2 (Sedated, responding to verbal stimulus)
Dexmed (n = 46)	29	17
Dexa (n = 46)	45	1

P value- 0.001   Chi-square test

Discussion
The benefits of regional anaesthesia, wherever feasible, is very well recognized. Ropivacaine is an amide local anaesthetic, less potent than bupivacaine. Being 10 times less lipid soluble compared to bupivacaine renders it less cardiotoxic.[6] Regional anaesthesia with local anaesthetics alone has limitations such as systemic toxicity, regression of block amidst surgery and requirement of additional sedation leading to side effects. Hence the concept of adding adjuvants to local anaesthetics came into practice. Additives provide quicker onset, prolonged dense blockade with reduction in the requirement of systemic analgesics and improves patient satisfaction. Several studies are available till date to find out efficacy of various adjuvants.[2-4] Dexmedetomidine is an alpha-2 adrenoreceptor agonist used as an adjuvant in neuraxial and peripheral nerve blocks. Mechanism of action is hypothesised to be multifactorial with both peripheral and central actions. Dexmedetomidine was approved by FDA in 1999 as a short acting sedative in intensive care setting.[4] It has gained popularity in recent years due to its sympatholytic, sedative, analgesic as well as amnestic properties. Various studies have proven that dexmedetomidine, as an adjuvant to local anaesthetics in peripheral nerve blocks prolongs the duration of sensorimotor blockade.[7-9] Being a glucocorticoid, dexamethasone is known to reduce tissue damage and inflammation by reducing the production and maintenance of inflammatory mediators and hence pain perception. It activates glucocorticoid receptor and inhibit phospholipase A2. Extended analgesic effect of dexamethasone is attributed to increased activity of inhibitory potassium channels in nociceptive C-fibres.[10] A study by Bani et al. observed that when dexamethasone was used as an additive in spinal anaesthetic, it extends the duration of block without any side effects.[11] Metaanalysis conducted by Jebraj et al highlights the advantages of use of dexamethasone at a dose of 4 – 8 mg in epidural analgesia along with usual local anaesthetic solutions.[12] However, it also emphasised the necessity of further studies to know its safety with respect to neurological complications. The onset of both sensory and motor block was quicker in group Dexmed compared to group Dexa. The onset of sensory block in group Dexmed and group Dexa was 8.67 ± 3.06 and 14.61 ± 6.71 min

respectively. This was found to be statistically significant (Table 1). Similarly, the onset of motor block in group Dexmed and group Dexa was 13.96 ± 5.06 min and 19.47 ± 6.97 min respectively. Significantly longer sensory blockade was observed in group Dexmed (884 ± 85.46 min) than group Dexa (564.13 ± 83.22 min). Similarly, motor blockade was also prolonged with addition of dexmedetomidine over dexamethasone with mean duration of 823.70 ± 128.25 min and 522 ± 76.89 min respectively, which was found to be significant (Table 2). Time to request of first rescue analgesia was also prolonged in group Dexmed (930 ± 83.45 min) than in group Dexa (620 ± 125.54 min), which is clinically and statistically significant (Table 2). Our results were similar to the results obtained by Verma NK et al and Kaur M et al.[13,14] However Lee MJ et al. observed that the sensory blockade was prolonged with dexmedetomidine or dexamethasone as adjuvants compared to plain ropivacaine, but there was no significant intergroup difference between dexmedetomidine and dexamethasone. Significant differences in onset time was not noticed among three groups, which is attributable to the higher dose of local anaesthetic.[15] A study conducted by Jadon A et al showed that dexamethasone as an adjuvant to ropivacaine had no effect on the onset of sensorimotor block in interscalene block. However, there was significant prolongation of block duration.[16] In our study, higher incidence of sedation, although mild was observed in group Dexmed (17 patients) compared to group Dexa (one patient). Although statistically highly significant, the observed sedation scores were clinically insignificant (Table 3). This was similar to the results obtained by Verma N etal.[13]Sridhar et al. did not observe any significant sedation among the groups with dexmedetomidine or dexamethasone as adjuvants with ropivacaine in caudal block.[17] This may be hypothesised due to higher volume of the local anaesthetics in caudal block compared to the adjuvant making its concentration lesser than what we used in our study. Bradycardia and hypotension are one of the most common adverse effects of alpha -2 agonists.[18] We did not come across such events in our study, which is likely due to smaller doses used. Use of adjuvants in nerve blocks is a well-established practice globally. Our observations affirm that dexmedetomidine can be considered a better adjuvant than dexamethasone.

Conclusion

Dexmedetomidine as an adjuvant to 0.2 % ropivacaine in ultrasound guided interscalene blockade is more efficacious than dexamethasone in hastening the onset, prolonging sensorimotor blockade and delaying the time for request of rescue analgesia.

Dexmedetomidine produces more sedation in comparison to dexamethasone when used as an adjuvant in interscalene blocks.

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