ORIGINAL ARTICLE

Comparative Evaluation of Perineural Versus Intravenous Dexmedetomidine as an Adjuvant to Ropivacaine for Interscalene Brachial Plexus Block in Shoulder Joint & Lateral Clavicular Surgeries : A Randomised Control Trial

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Abstract

Background & Aims: Upper extremity regional anesthesia is the mainstay of an anesthesiologist's armamentarium. The aim of this study was to evaluate the analgesic efficacy of 50mcg perineural dexmedetomidine versus 50mcg of intravenous dexmedetomidine when given along with usg guided interscalene block using 15 ml of 0.75% ropivacaine and superficial cervical plexus block using 10 ml of 0.5% ropivacaine in patients undergoing shoulder joint and lateral clavicular surgeries.-**Materials & Methods:** This randomized controlled clinical study included 105 patients of ASA group I & II divided into three groups as **Group R** received 14.5 ml of 0.75% ropivacaine with 0.5ml normal saline as placebo, **Group RDp** received 14.5 ml of 0.75% ropivacaine with 50mcg (0.5ml) of perineural dexmedetomidine and **Group RDi** received 14.5 ml of 0.75% ropivacaine with 0.5ml normal saline with 50mcg (0.5ml) of intravenous dexmedetomidine. In addition, each group was given superficial cervical plexus block with 10 ml of 0.5% ropivacaine.**Results:** The duration of analgesia was significantly prolonged in group RDp (704.57$\pm$272.90 mins) than group RDi (586.86$\pm$283.67 mins) & group R (335.71$\pm$35.17 mins) which was statistically significant. No significant adverse effects were noted.**Conclusion:** The administration of adjuvant 50 mcg dexmedetomidine via perineural or intravenous route along with 0.75% ropivacaine for interscalene brachial plexus block significantly enhanced the onset of motor and sensory blockade as well as the duration of analgesia without any significant side effects and better patient satisfaction than patients receiving plain ropivacaine.

Keywords

Interscalene, Brachial Plexus, Ropivacaine, Dexmedetomidine

Introduction

Shoulder surgeries are associated with severe degrees of post-operative pain that necessitates opioid use for several days but side effects of opioids (nausea & vomiting, pruritus and constipation etc.) limit their use in such clinical scenarios. Significant pain after ambulatory arthroscopic shoulder surgery is common and among the most frequent reasons for unplanned postoperative admission.[1]

The gold standard of peripheral nerve block for shoulder surgery is interscalene brachial plexus block (ISBPB) plus cervical plexus block (CPB). Interscalene brachial plexus block provides analgesia and anaesthesia to the shoulder, lateral 2/3rd of the clavicle and proximal humerus surgeries.[2]

Ultrasound guidance has become the accepted standard

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of practice for peripheral nerve blocks as it reduces the incidence of vascular injury, local anaesthetic toxicity, pneumothorax and phrenic nerve block.[3] Ultrasound guided interscalene brachial plexus block combined with superficial cervical plexus block is considered a safe and effective mode of anaesthesia in comparison to general anaesthesia for clavicular surgeries.[4-7]

Various local anesthetics have been used for peripheral nerve blockade which mainly include lignocaine, bupivacaine, levo-bupivacaine and ropivacaine. Ropivacaine, because of its increased CNS and cardiovascular safety, appears to be a safer local anaesthetic agent than bupivacaine and is particularly indicated for major peripheral nerve blocks.[8] Adjuvants act synergistically with local anaesthetic thereby enhancing the quality of regional anaesthesia while minimising adverse effects.[9]

Dexmedetomidine has been shown to decrease the time of onset and prolong the duration of sensory and motor block, with prolonged analgesia when administered along with local anesthetics via various routes including neuraxial, perineural, and intravenous.[10-13] Among these, the perineural route for dexmedetomidine has been the subject of increasing interest as it has the potential to significantly prolong the duration of analgesia after single-injection peripheral nerve blocks (PNBs).[14]

Some studies suggest that intravenous dexmedetomidine is equally effective when compared to perineural dexmedetomidine with regard to onset and duration of block and duration of analgesia but has greater hemodynamic instability.[15] The ideal dose of dexmedetomidine for nerve blocks is still uncertain. We empirically chose 50mcg dexmedetomidine for both perineural and intravenous dosing based on earlier studies.[16,17]

Aims & Objectives

Primary Objectives

- To compare the onset and duration of sensory and motor block
- To compare duration of analgesia between the three groups.

Secondary Objectives

- To compare the need and dose of rescue analgesia between three groups.
- To compare the incidence of any adverse events like nausea/vomiting, sedation, hypotension and bradycardia

Sample Size Estimation

The sample size was calculated using the GPOWER software (v 3.0.10; Franz Faul, Kiel University, Keli, Germany), it was estimated that the least number of patients required in each group with 80% power, effect size of 0.31 and 5% significance level is 35(n), thus a total of 105 patients were included in our study.

Method

After approval from the Ethical Committee of the institute (IEC/GMC/2022/767) and after obtaining informed written consent from the enrolled participants, this study was undertaken in the Department of Anesthesiology of a tertiary care hospital for the duration of one year. This randomized controlled clinical study included 105 patients of ASA group I & II undergoing elective shoulder joint orthopaedic surgeries under regional anesthesia. We excluded patients with a history of allergy to drugs used in the study, a history of substance abuse, with a body mass index (BMI) e"35 and patients with psychosis/gross neurological disorders. Pre-operatively, all patients underwent a detailed general physical as well as systemic examination. All patients were kept fasting overnight. On the day of surgery, intravenous line was secured before the anaesthetic procedure**.** The patients were randomised into three groups by a computer-generated randomisation list to receive one of the three regimes via interscalene brachial plexus block.

Group Allocation

Group R (n=35): received 14.5 ml of 0.75% ropivacaine with 0.5 ml normal saline to a total volume of 15 ml.

Group RDp (n= 35): received 14.5 ml of 0.75% ropivacaine with 50mcg (0.5ml) of perineural dexmedetomidine.

Group RDi (n= 35): received 14.5 ml of 0.75% ropivacaine with 0.5ml normal saline perineurally and 50mcg of intravenous dexmedetomidine in 100 ml of saline over 10 mins intravenously.

In addition, each group was given superficial cervical plexus block with 10 ml of 0.5% Ropivacaine. To ensure blinding, group R and RDp each received 100 ml of normal saline intravenously over 10 mins.

Interscalene Block Procedure

After placing the patient in supine position, the skin on the side to be blocked was cleaned with antiseptic solutions (povidone iodine followed by spirit) and draped. A skin wheal was made with 2% lignocaine (2.5 ml) by using 25 G needle. The transducer probe of ultrasound was placed over sternocleidomastoid muscle to identify key structures of the brachial plexus. Thereafter a 22 G 50 mm needle was advanced using in-plane technique in between C5 and C6 nerve roots. After negative aspiration of blood, study drugs were given as per their respective group allocation. After the block, pulse rate, non-invasive blood pressure (NIBP), respiratory rate and SpO2 and sensory and motor block assessment were recorded instantly and then every 2 minutes till 10 minutes and then every

5minutes till 30 mins and thereafter every 15 mins till the completion of surgical procedure.

Block Assessment

Onset and duration of sensory and motor blocks were assessed. Motor blockade was determined by loss of shoulder abduction and sensory blockade was taken as loss of sensation to pin-prick in the C4-7 dermatome. The duration of analgesia and time to request for first analgesia were noted. Immediate complications, such as hematoma formation, Horner's syndrome, hoarseness of voice, respiratory distress, and spinal /epidural injection were assessed during this period as well as post-operatively.

In the postoperative period, pain was evaluated at 1, 3, 6, 12 and at 24 hours from the completion of surgery using a Numerical pain Rating Scale (NRS) scoring from zero (no pain) to 10 (worst pain). Rescue analgesia in the form of Injection Paracetamol 1 g intravenous was administered on demand or if NRS score is e" 4 and its time was noted. Sedation score was assessed for 30 mins after injecting the study drug and thereafter every 30 mins using Richmond Agitation Sedation Score.

Statistical Analysis

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as percentages. Analysis of variance (ANOVA) was employed for inter group analysis of data and for multiple comparisons, least significant difference (LSD) test was applied. Chi-square test or Fisher's exact test, whichever appropriate, was used for comparison of categorical variables. A P-value of less than 0.05 was considered statistically significant

Results

In this study demographic and surgical characteristics were comparable between the two groups. The mean onset of sensory blockade (in mins) was 5.5±1.5 in group RDp, 8.3±1.4 in group RDi and 11.2±1.6 group R (***Table 1***). The mean onset of motor blockade (in mins) was 7.2±1.6 in group RDp, 10.2±1.7 in group RDi and 13.3±1.6 group R (***Table 2***). The mean duration of analgesia (in mins) was 704.57±272.90 in group RDp, 586.86±283.67 in group RDi and 335.71±35.17 in group R **(Table 3)**. On intergroup comparison, the duration of analgesia was found to be statistically significant (p value < 0.05) in between groups RDp & R and groups RDi & R whereas the results were statistically insignificant between groups RDp & RDi (p value > 0.05). Distribution of pain score (NRS) was comparable between the groups RDp, RDi and R (no pain:94.3% vs 100% vs 100% respectively, mild pain:5.7% vs 0% vs 0% respectively) (p value 0.327) **(Table 4)**.

Discussion

Our observations and results showed that the onset of sensory and motor block was significantly faster in group RDp than in group RDi & group R.. Similar observations were found in a study conducted by Hussain N *et al.*[18] where it was found that perineural dexmedetomidine is associated with faster onset of sensory and motor blockade as compared to intravenous dexmedetomidine and control group. This is also in accordance with a study done by Ping Y *et al.*[19] who concluded that the use of perineural dexmedetomidine as a local anaesthetic adjuvant in brachial plexus block accelerated the time to onset of sensory and motor block. Similar results were seen in a study by Fritsch G *et al.*[12] who concluded that addition of dexmedetomidine to 0.5% ropivacaine hastened the time to sensory and motor blockade onset, though they used a much higher dose of dexmedetomidine (150mcg) which was associated with a higher incidence of side effects such as hypotension and bradycardia. This was the reason why we chose a lower dose to balance the analgesic effects and duration vis-à-vis complications. Our study is in contrast to Sehmbi H *et al.*[14] who concluded that use of intravenous dexmedetomidine as an adjuvant does not prolong the duration of sensory and motor blockade in brachial plexus block.

The mean duration of analgesia was significantly prolonged in group RDp and group RDi as against group R. Our results are in accordance with the studies by Abdallah FW *et al.*[20] and Kathuria S *et al.*[16] who concluded that intravenous and perineural dexmedetomidine prolong the duration of analgesia equally after interscalene block. However, there was statistically insignificant difference in the duration of analgesia between the groups RDp & RDi as in our study. Similarly, Swami SS *et al.*[21] in their study showed significant increase in duration of analgesia on addition of dexmedetomidine to bupivacaine in brachial plexus block. Similar observations were found by Vorobeichik L *et al.*[22] in their study showing that perineural dexmedetomidine improves brachial plexus block analgesia. However, our results are in contrast to a study by Bao N *et al.*[23] who concluded that perineural dexmedetomidine prolongs the analgesic effects of ropivacaine while no effect with intravenous dexmedetomidine was observed.

The total analgesic consumption in 24 hours postoperatively was significantly lower in group RDp than both the other groups. However, the total analgesic

Table 1: Duration and intergroup comparison of sensory block (in mins)

Groups	Duration of sensory block (mins) (Mean ± SD)	p-value	Remarks
Group RDp & RDi			
Group RDp	555.20 ± 51.21	0.000	S
Group RDi	425.80 + 25.45		
Group RDp & R			
Group RDp	555.20 ± 51.21	0.000	S
Group R	318.97 + 112.19		
Group RDi & R			
Group RDi	425.80 + 25.45	0.000	S
Group R	318.97 ± 112.19		

Table 2: Duration and intergroup comparison of motor block (in mins)

Groups	Duration of motor block (mins) (Mean ± SD)	p-value	Remarks
Group RDp & RDi			
Group RDp	602.66 +49.27	0.000	S
Group RDi	475.57 +46.25		
Group RDp & R			
Group RDp	602.66 +49.27	0.000	S
Group R	342.54 +92.52		
Group RDi & R			
Group RDi	475.57 +46.25	0.000	S
Group R	342.54 +92.52		

Table 3: Duration of analgesia and request to 1st analgesia (in mins)

Groups	Duration of analgesia (mins) (Mean ± SD)	p-value	Remarks
Group RDp & RDiv			
Group RDp	704.57 ± 272.90	0.081	NS
Group RDiv	586.86 + 283.67		
Group RDp & R			
Group RDp	704.57 + 272.90	0.000	S
Group R	335.71 + 35.17		
Group RDiv & R			
Group RDiv	586.86 ± 283.67	0.000	S
Group R	335.71 ± 35.17		

Table 4: Pain Score (NRS)

Group		Frequency	Percent	p value
RDp	No Pain(0)	33	94.3	0.327
	Mild Pain(1-3)	2	5.7	
	Total	35	100.0	
RDi	No Pain(0)	35	100.0	
R	No Pain(0)	35	100.0	

Table 5: *Adverse effects and Complications*

Adverse Effects	RDp	RDi	R	P Value
Nausea	0	0	0	-
Vomiting	0	0	0	-
Hypotension	0	2	0	0.327
Bradycardia	0	2	0	0.327
Pneumothorax	0	0	0	-
Vascular puncture	0	0	0	-
RLN palsy	0	0	0	-
Systemic LA toxicity	0	0	0	-
Horner syndrome	0	0	0	-

consumption in groups RDi & R was comparable with no statistical significant difference between them. This is in contrast to results recorded by Kathuria S *et al.*[16] who observed no statistically significant difference in the 24 hour analgesic requirement between groups RDp & RDi.

As regards to adverse effects **(Table 5)**, bradycardia was observed in two patients in group RDi intraoperatively that responded to injection atropine sulfate 0.6 mg intravenous. Hypotension was observed in two patients in group RDi which responded to 6mg intravenous bolus of injection mephentermine. This observation was found to be statistically insignificant in accordance with a study by Abdallah FW *et al.*[20] who found no difference in incidence of adverse effects like bradycardia and hypotension while Kathuria S *et al.*[16] reported sporadic cases of bradycardia and hypotension in intervention group. Similarly, Vorobeichik L *et al.*[22] in their study concluded that perineural dexmedetomidine increased incidence of bradycardia and hypotension and a 50-60 mcg dexmedetomidine dose maximised sensory block duration while minimising hemodynamic side-effects. That was the reason for us choosing a safe dose of 50 mcg of dexmedetomidine in our study.

In our study, there was statistically insignificant difference in NRS pain score post operatively between the three groups RDp, RDi and R. This is in contrast to Jung HS *et al.*[24] demonstrated that numeric pain rating scale (NRS) was significantly higher in control group. The sedation score between the three groups was comparable in contrast to study done by Mohasseb MAA[25] who concluded that sedation score was higher in dexmedetomidine groups in comparison to control group. This could probably be due to use of higher doses of dexmedetomidine (1mcg/kg) in their study as compared to the smaller dose we used.

Conclusion

To conclude, in our study we found that dexmedetomidine as a perineural or intravenous adjuvant to ropivacaine for ultrasound guided interscalene brachial plexus block shortens the onset time for sensory and motor block, prolongs the duration of sensory and motor blockade and

the duration of analgesia. Hence we strongly recommend the addition of low dose dexmedetomidine 50mcg either by perineural or intravenous route, preferably perineural, as an adjuvant to 0.75% ropivacaine in the interscalene brachial plexus block.

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Conflicts of interest

There are no conflicts of interest.

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