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Original Research Article

To Evaluate and Compare the Effect of Magnesium Sulfate and Dexmedetomidine as an Adjuvant to 0.5% Ropivacaine in Infraclavicular Brachial Plexus Block

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Conflict of interest: Nil

Abstract

Background & Method: This study is conducted with an aim to evaluate and compare the effect of magnesium sulfate and dexmedetomidine as an adjuvant to 0.5% ropivacaine in infraclavicular brachial plexus block, comprised of 90 patients divided into three groups of 30 each, scheduled for elective surgeries in hand, wrist and forearm. The present study was conducted in Department of Anaesthesiology, M.G.M Medical College and M.Y. Hospital, Indore. The study was explained in detail to the patient and/or his/her legally acceptable representative in their own language including the procedures, risks/benefits, complications, etc. in detail. A voluntary written informed consent was obtained from the patient and/or his/her legally acceptable representative for participation in the study. All the study related procedures were conducted after obtaining their voluntary written informed consent.

Result: In Group RP, 8 (26.7%) patients were moderately satisfied, 15 (50%) were very satisfied and 7 (23.3%) were extremely satisfied. In Group RM, 5 (16.7%) patients were moderately satisfied, 15 (50%) were very satisfied and 10 (33.3%) were extremely satisfied. In Group RD, 4 (13.3%) patients were moderately satisfied, 14 (46.7%) were very satisfied and 12 (40%) were extremely satisfied. The proportion of extremely satisfied patients were in Group RD, followed by Group RM and lowest in Group RP. There was no statistically significant association between patient satisfaction and the groups (P=0.577), showing the groups are independent of the patient satisfaction. In group RP and Group RM, no adverse events. In Group RD, bradycardia was seen in 2 (6.7%) patients and hypotension in 3 (10%) patients. There was a statistically significant association between adverse events and the groups (P=0.032), showing that the groups are dependent on the adverse events. Adverse events were seen only in Group RD.

Conclusion: In our study, Magnesium sulphate (2mg/kg) versus Dexmedetomidine (1mcg/kg) were compared as an adjuvant to 0.5% Ropivacaine in Infraclavicular Brachial plexus block. Based on the present clinical comparative study, following conclusions can be drawn: - As compared to Magnesium sulphate, Dexmedetomidine as an adjuvant to Ropivacaine, in Infraclavicular brachial plexus block for upper limb surgeries, fastened the onset time and

prolonged the duration of sensory & motor blockade. The mean duration of analgesia was prolonged with Dexmedetomidine as compared to Magnesium sulphate causing a later requirement of first rescue analgesia.

Keywords: Magnesium Sulphate, Dexmedetomidine, Ropivacaine & Infraclavicular brachial plexus block.

Introduction

In recent anaesthetic practice, Peripheral Nerve Blocks (PNBs) are used extensively for a broad spectrum of surgical, interventional and diagnostic procedures. They have gained significant popularity over the last few decades due to their improved efficacy and patient safety. The Infraclavicular block [1] is a safe and effective approach for brachial plexus block (BPB) that can provide anesthesia for hands, wrist and forearm. Unlike the axillary approach, it can be performed without abduction of the arm, making it useful for patients with limited shoulder mobility (ease of patient positioning). This approach offers pronounced pertinency due to greater coverage and obviates the need for special arm positioning.

The World Health Organization and International Association for Study of Pain have recognized pain relief as a Human Right [2]. Successful pain relief augments early ambulation and lessens the hospital stay. As a result, the management of post-operative pain is an increasingly quality measure. The mechanism of pain transmission in the central and peripheral nervous system is highly complex and involves an array of neurotransmitters and several interlinked signaling pathways [3]. Local anaesthetics act by infiltrating the nerve and blocking the transmission of pain signals to the brain. Such anaesthetic effect lasts for a few hours only.

Therefore, a major concern with such anaesthesia is post-operative pain which remains the key issue in regional anesthesia. To address this issue, several drugs have been studied and proven useful as an adjuvant to local anaesthetics, these agents are known as analgesic adjuvants.

They are often used with local anaesthetics for its synergistic effect by prolonging the duration of sensory-motor block and limiting the cumulative dose requirement of local anaesthetics.

Such use of additional agent along with local anaesthetics is clinically termed as “multimodal perineural analgesia”. This mode of analgesia is beneficial in terms of avoiding potential neurotoxicity and tissue damage caused by a higher dose of local anaesthetics.

The armamentarium of local anaesthetic adjuvants has evolved over time from classical opioids to a wide array of drugs spanning several groups and varying mechanisms of action. Several studies have been carried out on a myriad of drugs from different classes when used as an adjuvant to local anaesthesics, that can be used to prolong the duration of the analgesia such as clonidine, opioids, dexamethasone and midazolam [4,5,6,7]

Material & Method

The study was conducted for duration of 12 months from the time of approval by the Institutional Ethics and Scientific Review Committee (August 2020 – July 2021). The study was comprised of 90 patients divided into three groups of 30 each, scheduled for elective surgeries in hand, wrist and forearm.

The present study was conducted in Department of Anaesthesiology, M.G.M Medical college and M.Y. Hospital, Indore.

The study was explained in detail to the patient and/or his/her legally acceptable representative in their own language including the procedures, risks/benefits, complications, etc. in detail. A voluntary written informed consent was obtained from the patient and/or his/her legally acceptable representative for participation in the study. All the study related procedures were conducted after obtaining their voluntary written informed consent.

A thorough pre-anesthetic evaluation was carried out and required clinical and lab investigations were done accordingly. Patients were randomly allocated into 3 groups (Group RP, Group RM and Group RD) by chit method just before the surgery.

On arrival to the operating room, an intravenous (i.v) line 20-gauge was inserted in the non-operating hand. Lactate Ringer's solution was started at a rate of 5 ml/kg/h.

Standard monitoring including electrocardiography (ECG), pulse oximetry (SpO2), and non-invasive blood pressure (NIBP) were continuously monitored.

O2 was administered through nasal prongs at a rate of 2 L/min. Vital signs were recorded as baseline values.

Patients were received Nerve stimulator-guided Infraclavicular Brachial plexus block using Landmark technique i.e., CORACOID TECHNIQUE [8]

Inclusion criteria:

- ASA grade I-II.
- Patients aged 18 to 60 years.
- Patients undergoing elective surgery in hands, wrist and forearm.
- Duration of surgery-1 to 2 hours.

Exclusion criteria

- Patient refusal.
- Coagulopathy.
- Renal or hepatic dysfunction.
- Pregnant woman.
- Patient having hypersensitivity towards local anesthetic drugs.
- Patient receiving alpha adrenergic agonist or antagonist.
- Patients with a psychiatric and neurological deficit.
- Patients with head injury.

Statistical Analysis

One-way ANOVA followed by Post-hoc Tukey applied. P value < 0.05 was taken as statistically significant.

Results

Table 1: Comparison of mean onset and duration of sensory block between the groups

	Group	No.	Mean sensory block [Mean±SD]	F value	P value	Post-hoc		
						RP-RM	RP- RD	RM- RD
Onset of	Group	30	16.63 ±	15.446	0.001*	0.572,	0.001*	0.001*
sensory	RP		1.45			NS		
block	Group	30	17.00 ±					
	RM		1.49					
	Group	30	15.10 ±					
	RD		1.27					
Duration	Group	30	357.00 ±	994.695	0.001*	0.001*	0.001*	0.001*
of	RP		18.96					
sensory block	Group RM	30	564.00 ± 27.11					
	Group	30	612.73 ±					
	RD		23.95					
Total		90						

The above table shows the comparison of mean onset and duration of sensory block between the three groups.

Onset of sensory block: The mean onset of sensory block in Group RP was 16.63 ± 1.45 min, in Group RM was 17.00 ± 1.49 minutes and in Group RD was 15.10 ± 1.27 minutes. The comparison of mean onset of sensory block among the three groups was found to be statistically significant (P=0.001),

showing a significantly varying mean onset of sensory block among the three groups. The mean onset of sensory block was highest in Group RM lowest in Group RD. The pair wise comparison was done using Post-hoc Tukey test. The mean onset of sensory block was comparable between Group RP and Group RM (P=0.572), while it was significantly higher in Group RP compared to Group RD (P=0.001) and significantly higher in Group RM compared to Group RD (P=0.001).

Duration of sensory block: The mean duration of sensory block in Group RP was 357.00 ± 18.96 min, in Group RM was 564.00 ± 27.11 minutes and in Group RD was 612.73 ± 23.95 minutes. The comparison of mean duration of sensory block among the three groups was found to be statistically significant (P=0.001), showing a significantly varying mean duration of sensory block among the three groups. The mean duration of sensory block was highest in Group RD lowest in Group RP. The pair wise comparison was done using Post-hoc Tukey test. The mean duration of sensory block was significantly shorter in Group RP compared to Group RM (P=0.001), and also significantly shorter compared to Group RD (P=0.001). The mean duration of sensory block was significantly shorter in Group RM compared to Group RD (P=0.001).

Table 2: Comparison of mean onset and duration of motor block between the groups

	Group	No.	Mean motor block [Mean±SD]	F value	P value	Post-hoc		
						RP-RM	RP- RD	RM-RD
Onset of motor block	Group RP	30	18.87 ± 2.11	10.228	0.001 *	0.986, NS	0.001 *	0.001 *
	Group RM	30	18.93 ± 1.26					
	Group RD	30	17.27 ± 1.34					
Duration of motor block	Group RP	30	337.00 ± 25.35	734.879	0.001 *	0.001 *	0.001 *	0.001 *
	Group RM	30	535.67 ± 27.63					
	Group RD	30	589.00 ± 27.46					
Total		90						

The above table shows the comparison of mean onset and duration of motor block between the three groups.

Onset of motor block: The mean onset of motor block in Group RP was 18.87

± 2.11 min, in Group RM was 18.93 ± 1.26 minutes and in Group RD was 17.27 ± 1.34 minutes. The comparison of mean onset of motor block among the three groups was found to be statistically significant (P=0.001), showing a

significantly varying mean onset of motor block among the three groups. The mean onset of motor block was highest in Group

RM lowest in Group RD. The pair wise comparison was done using Post-hoc Tukey test. The mean onset of motor block was comparable between Group RP and Group RM (P=0.986), while it was significantly higher in Group RP compared to Group RD (P=0.001) and significantly higher in Group RM compared to Group RD (P=0.001).

Duration of motor block: The mean duration of motor block in Group RP was 337.00 ± 25.35 min, in Group RM was 535.67 ± 27.63 minutes and in Group RD was 589.00 ± 27.46 minutes. The comparison of mean duration of motor block among the three groups was found to be statistically significant (P=0.001), showing a significantly varying mean duration of motor block among the three groups. The mean duration of motor block was highest in Group RD lowest in Group RP. The pair wise comparison was done using Post-hoc Tukey test. The mean duration of motor block was significantly shorter in Group RP compared to Group RM (P=0.001), and also significantly shorter compared to Group RD (P=0.001). The mean duration of motor block was significantly shorter in Group RM compared to Group RD (P=0.001).

Table 3: Comparison of mean duration of analgesia between the groups

	Group	No.	Mean duration of analgesia [Mean±SD]	F value	P value	Post-hoc		
						RP-RM	RP- RD	RM-RD
Duration of analgesia	Group RP	30	420.67 ±29.21	**596.735**	**0.001***	**0.001***	**0.001***	**0.001***
	Group RM	30	589.33 ±17.99					
	Group RD	30	631.27 ±26.41					
Total		90						

The above table shows the comparison of mean duration of analgesia between the three groups.

The mean duration of analgesia in Group RP was 420.67 ± 29.21 min, in Group RM was 589.33 ± 17.99 minutes and in Group RD was 631.27 ± 26.41 minutes. The comparison of mean duration of analgesia among the three groups was found to be statistically significant (P=0.001), showing a significantly varying mean duration of analgesia among the three groups. The mean duration of analgesia was highest in Group RD lowest in Group RP. The pair wise comparison was done using Post-hoc Tukey test. The mean duration of analgesia was significantly shorter in Group RP compared to Group RM (P=0.001), and also significantly shorter compared to Group RD (P=0.001). The mean duration of analgesia was significantly shorter in Group RM compared to Group RD (P=0.001).

Table 4: Comparison of patient satisfaction among the three groups

Patient Satisfaction	Group RP		Group RM		Group RD	
	No.	%	No.	%	No.	%
Moderately satisfied	8	26.7	5	16.7	4	13.3
Very satisfied	15	50.0	15	50.0	14	46.7
Extremely satisfied	7	23.3	10	33.3	12	40.0
Total	30	100.0	30	100.0	30	100.0

Pearson chi-square test applied.
Chi-square value = 2.885, df=4, P value = 0.577, Not significant

The above table shows the comparison according to patient satisfaction level. In **Group RP,** 8 (26.7%) patients were moderately satisfied, 15 (50%) were very satisfied and 7 (23.3%) were extremely satisfied.

In **Group RM,** 5 (16.7%) patients were moderately satisfied, 15 (50%) were very satisfied and 10 (33.3%) were extremely satisfied.

In **Group RD,** 4 (13.3%) patients were moderately satisfied, 14 (46.7%) were very satisfied and 12 (40%) were extremely satisfied.

The proportion of extremely satisfied patients were in Group RD, followed by Group RM and lowest in Group RP.

There was no statistically significant association between patient satisfaction and the groups (P=0.577), showing the groups are independent of the patient satisfaction.

Table 5: Comparison of adverse events among the three groups

Adverse events	Group RP		Group RM		Group RD	
	No.	%	No.	%	No.	%
None	30	100.0	30	100.0	25	83.3
Bradycardia	0	0.0	0	0.0	2	6.7
Hypotension	0	0.0	0	0.0	3	10.0
Total	30	100.0	30	100.0	30	100.0

Pearson chi-square test applied.
Chi-square value = 10.588, df=4, P value = 0.032, Significant

The above table shows the comparison according to adverse events level.
In group RP and Group RM, no adverse events. In Group RD, bradycardia was seen in 2 (6.7%) patients and hypotension in 3 (10%) patients.

There was a statistically significant association between adverse events and the groups (P=0.032), showing that the groups are dependent on the adverse events. Adverse events were seen only in Group RD.

Discussion:

Duration of Sensory and Motor Block

The mean duration of sensory block in Group RP was 357.00 ±18.96 min, in Group RM was 564.00 ± 27.11 minutes and in Group RD was 612.73 ± 23.95 minutes. The mean duration of motor block in Group RP was 337.00 ± 25.35 min, in Group RM was 535.67 ± 27.63 minutes and in Group RD was 589.00 ± 27.46 minutes. The comparison of mean duration of motor block among the three groups was found to be statistically significant (P=0.001). The mean duration of sensory and motor block was highest in Group RD lowest in Group RP.

Haemodynamic Changes

In our study, we have observed the preoperative values of MAP and HR were non significantly different (P=0.892 and P=0.222, respectively). However, statistically significant changes were seen during the intraoperative period in MAP and HR as compared to its pre operative value.

However, none of our patients required any anticholinergic treatment or any vasopressor support during the study period. These results are comparable to other studies. Three patients of RD group had hypotension who needed no active management except increasing the rate of iv

fluid administration. In two patients of the same group, bradycardia was seen, managed with inj. Atropine 0.5 mg.

Esmaloglu A et al, Song JH et al and Zhang Y et al [9,10,11]. No such incidence was seen in the other two groups. The results of our research showed the addition of magnesium sulphate (2 mg/kg) or dexmedetomidine (1µg/kg) to ropivacaine 0.5% for infraclavicular BPB resulted in lengthening the duration of SB and MB, prolonged duration of analgesia with better patient's satisfaction than those of the control group. Dexmedetomidine Group (RD) showed the quickest onset of action and the longest duration of SB, MB, and analgesia than the Magnesium Sulphate Group (RM). Nonetheless, the incidence of intra-operative hypotension and bradycardia was higher than group RM.

Esmaoglu et al [9] reported that the addition of dexmedetomidine (100 µg) to levobupivacaine 0.5% for axillary BPB in 60 patients undergoing hand and forearm surgery resulted in fast onset time with long duration of the axillary block with prolonged duration of analgesia. Bradycardia was reported as a side effect in their study.

Mukherjee et al. [11] studied the effects of using 150 mg magnesium sulphate as an adjuvant to ropivacaine 0.5% for supraclavicular BPB in 100 patients undergoing forearm and hand surgeries. They concluded that the addition of magnesium sulphate to ropivacaine 0.5% resulted in prolongation of the SB and MB durations and the time for the first analgesic request as well as decreased total analgesic consumption without side effects Lee et al. [12] proved that the use of 2 ml of magnesium sulphate (10%) as an adjuvant to bupivacaine 0.5% with epinephrine (1:200,000) for the interscalene nerve block in 66 patients underwent arthroscopic rotator cuff repair increased the duration of analgesia and reduced the postoperative pain.

Above studies goes in hand with our study, depicting that both the drugs enhance the quality of the block by lengthening the duration of analgesia; however, Dexmedetomidine proves to be a better one. Apart from the central-mediated analgesia [13]. the mechanism by which dexmedetomidine enhances the quality of regional anaesthesia when used as an adjuvant to LA can be described by two peripheral mechanisms. The first is the vasoconstrictor effect around the site of injection which leads to delay of the absorption of the LA and prolong the duration of the LA effect. The second mechanism is the direct action of dexmedetomidine on the activity of PN. Dexmedetomidine may inhibit the compound action potentials that results in direct inhibition of the on-nerve transmission [14].

Conclusion:

In our study, Magnesium sulphate (2mg/kg) versus Dexmedetomidine (1mcg/kg) were compared as an adjuvant to 0.5% Ropivacaine in Infraclavicular Brachial plexus block.

Based on the present clinical comparative study, following conclusions can be drawn:
- As compared to Magnesium sulphate, Dexmedetomidine as an adjuvant to Ropivacaine, in Infraclavicular brachial plexus block for upper limb surgeries, fastened the onset time and prolonged the duration of sensory & motor blockade. The mean duration of analgesia was prolonged with Dexmedetomidine as compared to Magnesium sulphate causing a later requirement of first rescue analgesia.

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