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Original Research Article

TO EVALUATE AND COMPARE THE EFFECT OF MAGNESIUM SULFATE ANDDEXMEDETOMIDINE AS AN ADJUVANT TO 0.5% ROPIVACAINE IN USG GUIDED INFRACLAVICULAR BRACHIAL PLEXUS BLOCK

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Abstract:

Background: As adjuvants to local anesthesia, Magnesium sulfate and Dexmedetomidine were utilized to enhance the effectiveness of regional anesthesia.

Objective: The purpose of this study is to assess and compare the efficacy of magnesium sulfate and dexmedetomidine as an adjuvant to 0.5% ropivacaine in infraclavicular brachial plexus block under the guidance of ultrasound. The study's 90 patients are split into three groups of 30, each, and are scheduled for elective hand, wrist, and forearm surgeries.

Methods: The current study was carried out at the M.G.M. Medical College's Department of Anaesthesiology and M.Y. Hospital in Indore. The patient and/or his/her legally recognized representative received a detailed explanation of the study in their native tongue, covering all aspects such as the procedures, potential risks and benefits, potential complications, etc. The patient, or his or her legally recognized agent, voluntarily provided written informed consent for the patient to participate in the study. All procedures relevant to the study were carried out only after receiving their informed, voluntary written agreement.

Result: Out of the patients in Group RP, 8 (26.7%) reported moderate satisfaction, 15 (50%) reported very satisfaction, and 7 (23.3%) reported extreme satisfaction. Of the patients in Group RM, 10 (33.3%) were extremely satisfied, 15 (50%) were very satisfied, and 5 (16.7%) were moderately satisfied. Four (13.3%), fourteen (46.7%), and twelve (40%) of the patients in Group RD reported being somewhat satisfied, very satisfied, or extremely satisfied. Group RD had the highest percentage of extremely satisfied patients, followed by Group RM and Group RP with the lowest percentage. The groups are independent of patient satisfaction, as evidenced by the lack of a statistically significant correlation (P=0.577) between patient satisfaction and the groups. There were no unfavorable incidents in groups RP and RM. Two patients (6.7%) and three patients (10%) in Group RD experienced bradycardia and hypotension, respectively. Adverse events and the groups had a statistically

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significant correlation (P=0.032), indicating that the groups are dependent on the adverse occurrences. Adverse occurrences were limited to Group RD.

Conclusion: In our investigation, we compared the use of magnesium sulphate (2 mg/kg) and dexmedetomidine (1 mcg/kg) as adjuvants to 0.5% ropivacaine in USG-guided infraclavicular brachial plexus blocks. The current clinical comparative study leads to the following conclusions: - Dexmedetomidine, when used as an adjuvant to ropivacaine in infraclavicular brachial plexus block for upper limb surgeries, shortened the time to onset and extended the duration of sensory & motor blockade, in comparison to magnesium sulphate. Dexmedetomidine produced an extended mean duration of analgesia as compared to magnesium sulphate, necessitating the use of first rescue analgesia later.

Keywords: Magnesium Sulphate, Dexmedetomidine, Ropivacaine & Infraclavicular brachialplexus block.

1. Introduction

Just two decades ago, regional anesthesia was performed blindly with dubious outcomes and little support from surgeons and patients. The monitoring of the local anesthetic injectate's disposition was not possible using the surface anatomy-based procedures that were previously in use, such as nerve stimulation, palpation of landmarks, fascial "clicks," paresthesia's, and trans arterial approaches. Technological advances in regional anesthesia have revolutionized techniques and largely improved outcomes. Ultrasound (US) technology continues to advance and has become more affordable. Peripheral nerve blocks, or PNBs, are widely utilized in modern anesthetic treatment for a wide range of surgical, interventional, and diagnostic procedures. The Infraclavicular block [1] is a safe and effective method for brachial plexus block (BPB) that can give anesthesia for hands, wrist, and forearm. It is advantageous for patients with restricted shoulder movement because, in contrast to the axillary approach, it can be executed without requiring arm abduction (ease of patient positioning). Because of its wider coverage, this method gives strong pertinency and eliminates the requirement for specific arm posture.

Pain relief has been declared a human right by the World Health Organization and the International Association for Study of Pain. [2]. A successful pain management strategy increases early ambulation and shortens hospital stays. Consequently, postoperative pain management is becoming a more crucial strategy. A variety of neurotransmitters and multiple interconnected signaling pathways are involved in the intricate process of pain transmission in the central and peripheral nervous systems [3]. Local anesthetics work by penetrating the nerve and preventing the brain from receiving pain signals. The effects of such anesthetics wear off after a few hours.

Post-operative pain, which continues to be the main problem with regional anesthetic, is therefore a big worry with this kind of anesthesia. In order to solve this problem, a number of medications have been investigated and found to be effective when added to local anesthetics; these substances are referred to as analgesic adjuvants.

Because they have a synergistic effect that prolongs the duration of sensory-motor block and

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reduces the cumulative dose required of local anaesthetic, they are frequently used in conjunction with them.

"Multimodal perineural analgesia" is the clinical term for this combination of extra agent and local anesthetics. By minimizing possible neurotoxicity and tissue damage brought on by a higher dose of local anesthetics, this kind of analgesia is advantageous.

Over time, the arsenal of adjuvants for local anesthesia has expanded from traditional opioids to a diverse range of medications with different modes of action and covering multiple therapeutic classes. Numerous studies have been conducted on a wide range of medications from various classes that, when added to local anesthetics, can be utilized to extend the duration of analgesia. These medications include clonidine, opioids, dexamethasone, and midazolam [4,5,6,7].

2. Material & Method

After receiving approval from the Institutional Ethics and Scientific Review Committee, the study was carried out for a full year (August 2020 – July 2021). Ninety patients, scheduled for elective hand, wrist, and forearm procedures, were included in the study. The patients were split into three groups of thirty each.

The current investigation was carried out at the M.G.M. Medical College's Department of Anaesthesiology and M.Y. Hospital in Indore.

The patient and/or his/her legally recognized representative received a detailed explanation of the study in their native tongue, covering all aspects such as the procedures, potential risks and benefits, potential complications, etc. The patient, or his or her legally recognized agent, voluntarily provided written informed consent for the patient to participate in the study. All study-related operations were carried out only with their informed, free, and written consent.

The patient underwent a comprehensive pre-anesthetic evaluation, following which the necessary clinical and laboratory investigations were completed. Just prior to surgery, patients were randomly assigned using the chit method into three groups: Group RP, Group RM, and Group RD.

Patients were randomized into three groups:

- Group I (ropivacaine group): Patients received ultrasound-guided infraclavicular BPB with 20 ml ropivacaine 0.5%
- Group II (magnesium sulfate group): Patients received ultrasound-guided infraclavicular BPB with 20 ml ropivacaine 0.5% and magnesium sulfate (150 mg)
- Group III (dexmedetomidine group): Patients received ultrasound-guided infraclavicular BPB with 20 ml ropivacaine 0.5% and dexmedetomidine (100 μg)

An intravenous (i.v.) line (20-gauge) was placed in the non-operating hand as soon as the patient arrived in the operating room. The rate at which lactate Ringer's solution was begun was 5 ml/kg/h.

Standard monitoring was carried out continuously, including non-invasive blood pressure

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(NIBP), pulse oximetry (SpO2), and electrocardiography (ECG).
O2 was injected at a rate of 2 L/min using the nasal prongs. Baseline values were recorded for vital indicators.
The patient had infraclavicular BPB while supine, with his head tilted slightly to the side and his upper extremities abducted 90 degrees. The entry point to the coracoid process was measured to be 2 cm medially and 2 cm caudal.
To locate the axillary artery and the three brachial plexus cords, the ultrasonography probe (8–12 MHz) was positioned medial to the coracoids process in the parasagittal plane.
The pinprick test and the alcohol swab cold test were used to evaluate the SB. We evaluated all dermatomes supplied by the ulnar, median, radial, and musculocutaneous nerves. The SB was evaluated as follows: 0 represented normal sensation, 1 pinprick loss, and 2 touch loss.
The time period between the injection of LA and the achievement of the full SB is known as the SB's onset time. The amount of time that elapses between the start of the entire SB and its final resolution is known as its duration. Duration of analgesia is the time interval between the onset of the complete SB and the first dose of postoperative analgesia.
The modified Bromage scale was used to grade the MB: 0 represented no movement in the fingers, wrist, or elbow; 1 represented finger movement exclusively; 2 represented wrist flexion against gravity; and 3 represented elbow flexion against gravity.
The difference in time between the injection of LA and the completion of the MB is known as the MB's onset time. The amount of time that passes between the start of the entire MB and its final resolution is known as the MB's duration.
The block was considered successful when the SB is 2 and MB is 0 within 30 min after injection of the local analgesia (LA). Otherwise, the block was considered as failed or inadequate block and the patients would receive general anesthesia or analgesia to complete the surgical intervention. These patients were excluded from the study. Intraoperative mean arterial blood pressure (MAP) and heart rate (HR) were recorded preoperatively and every 15 min after the administration of LA solution till the end of surgery. Postoperative pain was assessed using a 10-cm visual analog scale (VAS) (0: no pain to 10: worst pain imaginable) and recorded at admission to postoperative care unit and 1, 2, 4, 6, 8, 12, 18, and 24 h postoperative. Patient's satisfaction was assessed by direct asking the patients regarding the degree of their satisfaction about the block using a four-point scale (1 = very dissatisfied, 2 = dissatisfied, 3 = satisfied, and 4 = very satisfied). Any intraoperative or postoperative complications were recorded such as pneumothorax, vascular puncture, Horner syndrome, somnolence, local anesthetic toxicity, bradycardia (HR <50 beats/min and managed by atropine 0.5 mg), and hypotension (defined as a decreasedof blood pressure >25% of the baseline and managed by
i.v. fluids and ephedrine 10 mg bolus if no response to fluid administration).

Inclusion criteria:

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

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Exclusion criteria

- Patient refusal.
- Coagulopathy.
- Renal or hepatic dysfunction.
- Pregnant woman.
- Patient having hypersensitivitytowards local anesthetic drugs.
- Patient receiving alpha adrenergicagonist or antagonist.
- Patients with a psychiatric andneurological deficit.
- Patients with head injury.

Statistical Analysis

One-way ANOVA & Chi Square Test by Post-hoc Tukey applied. P value < 0.05 was taken asstatistically significant.

3. Results

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

	Group	No.	Mean sensoryblock [Mean±SD]	F value	P value
Onset of sensory block	Group	30	18.63 ±1.45	13.446	0.001*
	RP				
	Group	30	19.00 ±1.49		
	RM				
	Group	30	17.10 ±1.27		
	RD				
Duration of sensoryblock	Group	30	391.00 ±18.96	991.695	0.001*
	RP				
	GroupRM	30	587.00 ± 27.11		
	Group	30	644.73 ±23.95		
	RD				
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 18.63 ± 1.45 min, in Group RM was 19.00 ± 1.49 minutes and in Group RD was 17.10 ± 1.27minutes. 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.

Duration of sensory block: The mean duration of sensory block in Group RP was 391.00 ± 18.96 min, in Group RM was 587.00 ± 27.11 minutes and in Group RD was 644.73 ±

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23.95 minutes. Thecomparison 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.

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
Onset ofmotor block	GroupRP	30	19.87 ± 2.11	11.228	0.001 *
	GroupRM	30	19.93 ± 1.26		
	GroupRD	30	18.27 ± 1.34		
Durationof motor block	GroupRP	30	343.00 ± 25.35	731.879	0.001 *
	GroupRM	30	561.67 ± 27.63		
	GroupRD	30	572.00 ± 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 19.87 ± 2.11 min, in Group RM was 19.93 ± 1.26 minutes and in Group RD was 18.27 ± 1.34 minutes. The comparison of mean onset of motor block among the threegroups 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

Duration of motor block: The mean duration of motor block in Group RP was 343.00 ± 25.35 min, in Group RM was 561.67 ± 27.63 minutes and in Group RD was 572.00 ± 27.46 minutes. Thecomparison 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.

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

	Group	No.	Mean durationof analgesia [Mean±SD]	F value	P value
Durationof analgesia	GroupRP	30	419.67 ±29.21	**594.735**	**0.001***
	GroupRM	30	576.33 ±17.99		
	GroupRD	30	629.27 ±26.41		
Total		90			

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The above table shows the comparison of mean duration of analgesia between the three groups. The mean duration of analgesia in Group RP was 419.67 ± 29.21 min, in Group RM was 576.33 ± 17.99 minutes and in Group RD was 629.27 ± 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.

Table 4: Comparison of patient satisfaction among the three groups

Patient Satisfaction	**Group RP**		**Group RM**		**Group RD**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Moderately satisfied	08	26.7	05	16.7	04	13.3
Very satisfied	15	50.0	15	50.0	14	46.7
Extremely satisfied	07	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, 0**8 (26.7%) patients were moderately satisfied, 15 (50%) were very satisfied and 07 (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, 0**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.**	**%**
Very Satisfied	19	63.3	27	90	29	96.6
Satisfied	11	36.6	02	6.6	01	3.3
Dissatisfied	00	00	00	00	00	00
None	30	100.0	30	100.0	25	83.3
Bradycardia	00	0.0	00	0.0	02	6.7
Hypotension	00	0.0	00	0.0	03	10.0
Nausea and vomiting	03	10.0	03	10.0	04	13.3
Somnolence	00	0.0	02	6.6	03	10.0

Pearson chi-square test applied.

Chi-square value = 06.112, df=2, P value = 0.047, Significant

The above table shows the comparison according to adverse events level.

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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. Nausea and vomiting 10%, 10% & 13.3 respectively & Somnolence RM (6.6%) & RD (10%)

There was a statistically significant association between adverse events and the groups (P=0.047), showing that the groupsare dependent on the adverse events.Adverse events were seen only in Group RD.

4. 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 andin Group RD was 612.73 ± 23.95 minutes. The mean duration of motor block in GroupRP 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 tobe statistically significant (P=0.001). The mean duration of sensory and motor block was highest in Group RD lowest in Group RP.

Hemodynamic Changes

In our study, we have observed the preoperative values of MAP and HR were non significantly different (P=0.892 andP=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 ZhangY et al [9,10,11]. No such incidence was seen in the other two groups. The results ofour 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 andbradycardia was higher than group RM.

Esmaoglu et al [9] reported that the additionof 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 intheir 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 MBdurations and the time for the first analgesicrequest

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as well as decreased total analgesicconsumption 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 ofinjection 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].

5. 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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