Section: Anaesthesia

Original Research Article

COMPARISON OF EFFICACY OF 0.375% ROPIVACAINE WITH MAGNESIUM SULPHATE 100MG AND 0.375% ROPIVACAINE WITH DEXMEDETOMIDINE 30MCG IN ULTRASOUND GUIDED AXILLARY BRACHIAL PLEXUS BLOCK FOR FOREARM AND HAND SURGERIES

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Abstract

Background: Axillary brachial plexus blocks are frequently used during hand and forearm procedures. Ropivacaine's effectiveness is increased when Dexmedetomidine and magnesium sulphate are used for peripheral nerve blocks because they increase the duration of analgesia. This study was aimed to evaluate the effects of Ropivacaine with magnesium sulphate and Ropivacaine with Dexmedetomidine in the axillary block. **Materials and Methods:** A total of 60 patients belonging to ASA grade I and II admitted for forearm and hand surgeries were randomly divided into two groups to receive either 30ml of 0.375% Ropivacaine and MgSO4 100 mg (Group RM) or 30ml of 0.375% Ropivacaine along with Dexmedetomidine 30 mcg (Group RD). **Result:** The average onset time of sensory-block in group RM was higher than group RD. The average time for initiation of motor-block in RM group was more. Whereas average sensory block duration was less in RM group than in Group RD. The mean motor block duration was comparatively less in RM group. The duration of the sensory and motor blocks showed a statistically significant difference between the two study groups ($p< 0.001$). There was an insignificant alteration in hemodynamics in both Group RD and RM without any side effects. **Conclusion:** Dexmedetomidine (30 mcg) as an adjuvant to Ropivacaine (0.375 percent) in Axillary brachial plexus block resulted in a faster onset of sensory and motor block and a longer duration of sensory and motor block, as well as a significant prolongation of postoperative analgesia when compared with Magnesium sulphate (100 mg).

INTRODUCTION

Site-specific, efficient, and long-lasting anaesthetic is provided via regional anaesthesia. To enable painless surgery, plexus block is employed as the primary anaesthetic approach. It is also utilised to alleviate chronic pain and post-operative discomfort.[1]

Regional anaesthesia is administered during procedures on the upper limbs using a brachial plexus block. Interscalene, supraclavicular, infraclavicular, and axillary are some other techniques. The axillary method to the brachial plexus block is well-liked for its simplicity, dependability, and safety. It is recommended for forearm and hand surgery.[2]

With a safer cardiac profile than bupivacaine, ropivacaine is a brand-new long-acting amide local anaesthetic (LA) used for peripheral nerve blocks. It offers both a sensory and a motor blockage. Adjuvant supplementation increases the effectiveness of LA by accelerating the start of action, extending the duration of activity, and providing postoperative analgesia.[3]

When administered systemically, magnesium sulphate (MgSO4) has analgesic, antihypertensive, and anaesthetic sparing effects. MgSO4 is now often

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utilised as an adjuvant to plane blocks, other peripheral nerve blocks, and neuroaxial blocks. However, research on MgSO4's use as an adjuvant in the axillary block is quite limited.[4-5]

As an adjuvant to LAs, dexmedetomidine is a selective alpha 2 adrenoreceptor agonist. It is believed to shorten the onset and increase the duration of activity, and prolong postoperative analgesia.[6]

The aim of the study was to compare the effectiveness of 0.375% Ropivacaine with magnesium sulphate 100mg and 0.375% Ropivacaine with Dexmedetomidine 30mcg in ultrasound guided axillary brachial plexus block for forearm and hand surgeries.

MATERIALS AND METHODS

Randomized Interventional Double blinded study was carried out from January 2021 to June 2022. The current study was conducted at Narayana Medical College and Hospital, Nellore, on 60 patients admitted for forearm and hand surgeries after taking informed written consent. This study was conducted after obtaining approval from institutional ethical committee (No. NMC/ Adm/ Ethics/ approval/007/2021) clearance and informed written consent from all patients included in the study.

Sample Size

60 patients (Two groups of 30 each).

We hypothesized that onset of sensory block with Ropivacaine and Dexmedetomidine faster compared to Ropivacaine & Magnesium sulphate. Sample size was calculated by keeping two sided alpha error at 5% and power at 80% by using below formula Minimum of 23 patients were required for each group, for better validation 30 patients were selected in each group.

Inclusion Criteria

Patients aged between 18years to 60years with ASA grade I & II. Patients undergoing forearm and hand surgeries.

Exclusion Criteria

Patient's refusal for participation. Patients with ASA grade of III and IV and age less than 18 years and more than 60 years. Co-existing severe cardiovascular, respiratory or neurological disorders. Patients with any known history of coagulation disorders and inflammatory / infective skin lesions at the site of block. Pre-existing neuropathies and allergy to local anaesthetics. Pregnant women and lactating mothers.

Materials

The Following equipment was used for the procedure in our stud

- SONOSITE M TURBO ultrasound machine with 13-6 MHz linear probe & sterile lubricating gel for the procedure.
- A tray covered with the sterile towels having disposable Syringes, Disposable needles (22G, 20G) and 10cm extension, Sponge holding forceps, One Sterile drape was used.
- A bowl containing the povidone - iodine and another bowl containing the ethyl alcohol was used for disinfecting the site of block.
- One bowl containing drug - which is prepared by another anaesthetist who is not a part of the study, was used according to the corresponding group.

Methodology

After randomly dividing the patients into two groups of 30 each

Group RM

Patients in group RM received (30ml) 0.375% Ropivacaine + MgSO4 100 mg.

Group RD

Patients in group RD received (30ml) of 0.375% Ropivacaine + Dexmedetomidine (30 mcg).

After patient's arrival into the operation theatre, patient was connected to all the standard ASA monitors such as pulse oximeter, ECG, non-invasive blood pressure monitor, and the baseline parameters were recorded. After securing a wide bore intravenous cannula, the ringer's lactate infusion was started, and oxygen will be given at 5L/min via a poly mask. Patient was placed in the supine position with arm abducted on the side of block. Skin is disinfected over the area of the block and sterile draping was done. Axillary artery and terminal nerves of brachial plexus were identified using ultrasound. A skin wheal was raised at needle insertion site using 2ml 1% lignocaine, and 5-cm, 22-gauge insulated needle was inserted using in-plane approach. Needle was carefully directed and advanced under ultrasound guidance. 8 ml of the drug was deposited posterior to the artery around the Radial nerve and 15 ml of the drug was deposited around the Ulnar and Median nerves. Finally, 7 ml of the drug was deposited around the musculocutaneous nerve. Throughout the procedure, the patients were monitored for any adverse drug effects.

Vital Parameters Recorded

Variability in Heart rate Blood pressure by non-invasive method, Oxygen saturation.

Assessment

Assessment of Sensory Block

Sensory block onset: The time period for, onset of sensory block was calculated as the time from the administration of the local anaesthetic solution to the cessation of pinprick feeling. The sensory onset was tested by using spirit swab.

Duration of The Sensory Block

The length of sensory block calculated as the period from the loss of the pinprick feeling to its resolution. Duration of the sensory block was evaluated by using 25G hypodermic needle for pinprick sensation every 30min postoperatively using Visual analogue scale (VAS) [Figure 1].

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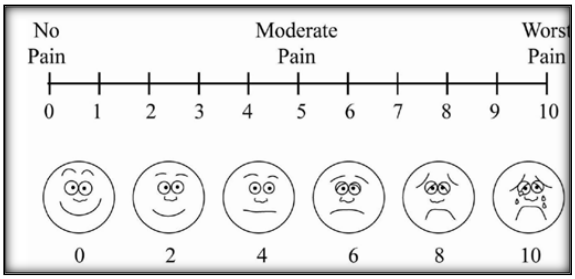

Figure 1: Visual analog scale

Assessment of motor block: Onset of Motor-block: After the local anaesthetic solution was administered, the time between, onset of the motor block and the emergence of grade 1 motor blocking was taken into consideration. Motor-block duration: duration of motor blockade was defined as the time between the onset of motor block and full recovery of motor function. Motor-block was assessed using the Bromage score for upper limb [Table 1].

Table 1: Bromage scale for upper limb

Grade	Criteria
Grade 0	Normal motor function with full flexion and extension of elbow, wrist and fingers
Grade 1	Decreased motor strength with ability to move the fingers only
Grade 2	Complete motor block with inability to move fingers

Assessment of Duration of Analgesia

Duration is analgesia: The time period between the administration of local anaesthetic solution and the administration of first rescue analgesia was considered the duration of the analgesia. Rescue analgesia was given on patients request usually when the VAS score is 3 to 4. Intravenous Tramadol 100 mg or intravenous Paracetamol 1gram was used for rescue analgesia in the post-operative period.

Statistical Analysis

Data were entered in MS excel and analysis was done using SPSS 21.0 version. Data were presented as Mean and Standard deviation for continuous variables and as percentages for categorical variables. A Chi-square test was done to find out any association between categorical variables. Independent sample t test was compared when applied to quantitative variables (Age, weight, onset and the duration of Motor and sensory, duration of rescue analgesia, HR, SBP, DBP, MAP) between the groups (RM, RD). A p value of less than or equal to 0.05 was considered significant.

RESULTS

This prospective randomised double-blind trial was conducted in 60 pts of either gender of ASA class I & II in the age group of 18-60 yrs posted for forearm and hand surgeries. The patients were divided into two study groups by slips in the box technique.

Group RM 30ml 0.375% Ropivacaine + MgSO4 100 mg

Group RD 30ml 0.375% Ropivacaine + 30 mcg Dexmedetomidine.

All 60 patients were evaluated in the study and the results are as follows.

The maximum patients were reported in age group of 41 to 50 years in both RM (33.3%) and RD (36.7%) groups. The mean age was reported to 38.26 years and 38.53 years for Group RM and RD respectively. The male predominance was reported in both group. The mean weight was also reported comparable in both RM and RD groups [Table 2].

Table 2: Demographic variable of patients in both groups

Variables	Group RM	Group RD
Gender		
Male	21 (70%)	21 (70%)
Female	9 (30%)	9 (30%)
Age Group (years)		
19-30 years	8 (26.7%)	8 (26.7%)
31-40 years	10 (33.3%)	9 (30%)
41-50 years	10 (33.3%)	11 (36.7%)
51-60 years	2 (6.7%)	2 (6.7%)
Mean Age (years ±SD)	38.26±9.29	38.53±9.32
Weight (kg) Mean ± SD	62.5±9.83	63.86±8.02

In Group RM, average time for the onset of sensory block was 12.37 ± 1.94 minutes, whereas in Group RD, it was 10.50 ± 1.87 minutes. Whereas the duration of sensory blockade in RM group, lasted an average of 421.50±34.14 minutes, and in the RD group, it lasted an average of 500.33 ± 41.50 minutes. In the RM group, mean time for the commencement of a motor block was 15.93 ±1.44 minutes, whereas in the RD group, it was 13.03 ±1.92 minutes. In the RM group, the average time of the motor-blockade was 309.50 ±26.70 minutes, but in the RD group, it was 341.00 ± 32.07 minutes. RD group experiencing the block for a longer period of time. The average wait time for the initial request for rescue analgesia was 438 ± 36.58 minutes in Group RM and 533.5 ± 40.79 minutes in Group RD. In comparison to the RM group, the duration of analgesia was significantly prolonged in the RD group [Table 3].

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Table 3: Comparison of the mean onset, duration and time Required for rescue analgesia between two groups

Variables		Group RM (mean± SD)	Group RD (mean± SD)
Onset (min)	Sensory	12.37±1.94	10.5±1.87
	Motor	15.93±1.44	13.03±1.92
Duration (min)	Sensory	421.5±34.14	500.33±41.5
	Motor	309.50 ±26.70	341.0 ±32.07
Time for requirement of rescue analgesia (Min)		438.67 ±36.58	533.50 ±40.79

Comparison of the heart rate variability between two groups was also carried out in our study. In the RM group, the average heart rate was 75.53 bpm; in the RD group, it was 73.10 bpm at base line whereas mean heart rate after 2 hours was found 75.27 bpm and 75.30 bpm in group RM and RD respectively. The statistical difference in the mean heart rate between the two study groups was insignificant [Table 4].

Table 4: Comparison of the heart rate and SBP variability between two groups

Time intervals	Hear Rate		SBP	
	Group RM (mean± SD)	Group RD (mean± SD)	Group RM (mean± SD)	Group RD (mean± SD)
Base line	75.53± 6.88	73.10 ±4.76	118.90 ±9.11	117.27 ±9.17
5 min	72.70± 5.98	77.60 ±7.36	117.97± 8.62	117.07 ±8.43
10 min	74.87 ±6.97	77.60 ±6.89	117.83 ±9.00	117.47± 8.44
15 min	74.90 ±7.27	77.67 ±5.96	117.30 ±9.36	115.90 ±7.97
30 min	74.97 ±6.86	78.20± 6.60	118.10 ±8.90	115.37 ±9.43
45 min	75.23 ±6.94	77.87± 7.61	117.93± 8.74	116.27 ±7.65
1 hr	75.43 ±7.15	77.60 ±7.88	117.80 ±9.49	117.43 ±8.18
1 hr 15 min	75.23 ±7.00	77.83±7.68	117.93± 9.24	116.67 ±8.10
1 hr 30 min	75.23 ±6.62	78.33 ±6.90	118.47 ±8.80	115.17 ±7.38
1 hr 45 min	75.53 ±6.47	77.53 ±7.45	118.60 ±9.06	116.77 ±7.17
2 hr	75.27± 6.76	75.30 ±6.73	118.90± 8.86	117.57 ±7.38

In the RM group, the mean systolic blood pressure (SBP) was 118.9 mmHg; in the RD group, it was 117.25 mmHg at base line whereas mean SBP after 2 hours was found 118.9 mmHg and 117.57mmHg in group RM and RD respectively. The statistical difference in the mean heart rate between the two study groups was insignificant [Table 4].

Comparison of the diastolic blood pressure (DBP) variability between two groups was also recorded and it was found that in the RM group, the mean DBP was 77.67 mmHg; in the RD group, it was 79.73 mmHg at base line whereas mean DBP after 2 hours was found 76.77 mmHg and 79.07 mmHg in group RM and RD respectively. The statistical difference in the mean heart rate between the two study groups was insignificant [Table 5].

Table 5: DBP variability the groups at different time intervals

Time intervals	DBP		MAP	
	Group RM (mean± SD)	Group RD (mean± SD)	Group RM (mean± SD)	Group RD (mean± SD)
Base line	77.67 ±5.96	79.73 ±9.06	91.00±6.06	90.13± 7.33
5 min	76.40 ±7.70	79.07 ±5.79	89.17±7.67	90.23± 5.37
10 min	75.90 ±7.33	79.37 ±6.10	89.70 ±7.34	91.27± 6.38
15 min	76.30 ±6.64	79.13 ±5.96	89.63 ±6.94	89.53 ±5.56
30 min	76.67 ±7.37	78.83 ±6.68	90.20 ±7.33	88.47 ±5.61
45 min	76.63± 7.25	79.00± 6.83	90.13± 6.99	89.37± 5.46
1 hr	76.27 ±7.30	79.07±5.99	89.80 ±7.23	89.53± 5.54
1 hr 15 min	76.47 ±7.33	79.27 ±5.92	90.17± 6.78	89.10± 5.54
1 hr 30 min	76.40 ±7.12	79.17 ±6.84	90.13± 6.78	89.50±4.82
1 hr 45 min	76.87 ±7.36	79.17± 6.54	90.70± 6.95	88.80± 6.20
2 hr	76.77 ±7.14	79.07± 6.51	91.33± 6.96	89.30 ±7.00

In the RM group, the mean arterial pressure (MAP) was 91 mmHg; in the RD group, it was 90.13 mmHg at base line whereas mean MAP after 2 hours was found 91.33 mmHg and 89.3 mmHg in group RM and RD respectively. The statistical difference in the mean heart rate between the two study groups was insignificant [Table 5].

The distribution of the subjects according to the Ramsay sedation scale is depicted in the graph above. No sedative effect was noticed in either group. There was no discernible difference between the two groups. Mean RSS in group RM was 1.76 0.43, while it was 1.93 0.57 in group RD [Figure 2].

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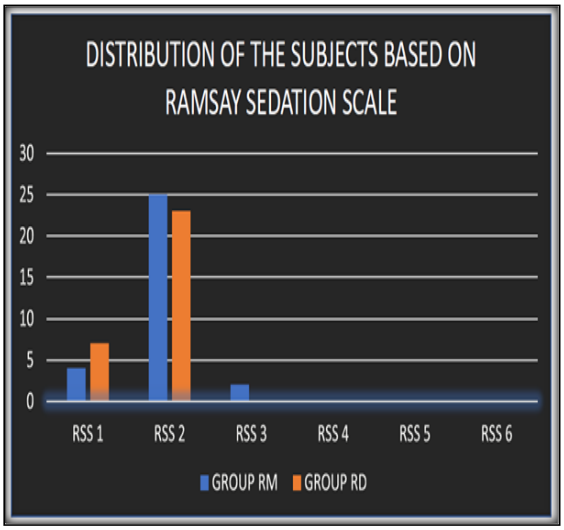

Figure 2: RAMSAY sedation scale among two groups

The side effect of both treatment were also recorded in present study and it was found that there was no side effects like hypotension, bradycardia and sedation reported in both RM and RD group patients.

DISCUSSION

In present study the maximum patients were reported in age group of 41 to 50 years in both RM (33.3%) and RD (36.7%) groups. The mean age was reported to 38.26 years and 38.53 years for Group RM and RD respectively. The male predominance was reported in both group. The mean weight was also reported comparable in both RM and RD groups. Deshpande et al., also reported similar findings in their investigations.[7]

In our research, the average onset time of sensory-block in group RM was 12.37 ± 1.94 min and in group RD was 10.50 ± 1.87 min. The average time for initiation of motor-block in RM group was 15.93 ± 1.44 min, while it was 13.03 ± 1.92 min in group RD. Our study results are similar with, the study conducted by Shahtaheri et al. the average onset of sensory and motor block was significantly lower in Dexmedetomidine group.[8] In their study as they have used lignocaine, onset times were shorter when compared with our study results (mean time 53 of onset of the sensory-block in group RM was 12.37 ± 1.94 min and in group RD was 10.50 ± 1.87 min).

In our research, average sensory block duration was 421.50 ± 34.14 min in RM group and 500.33 ±41.50 min in Group RD. The mean motor block duration was 309.50 ± 26.70 min in RM group and 341.00 ± 32.07 min in Group RD. The duration of the sensory and motor blocks showed a statistically significant difference between the two study groups, with a P-value of 0.001. Our study results are also similar to that of Shukla et al. study. In our study sensory duration time was min 421.50 ± 34.14 in RM 58 group and 500.33 ±41.50 min in Group RD.[9] This discrepancy in duration is due to the concentration (0.5% Ropivacaine) and large doses they have used in contrast to our study, also the approach (supraclavicular) they tried for the block.

In terms of the time required for the initial rescue analgesic need, the axillary block's analgesic duration was measured. In our investigation, the first rescue analgesia was administered on average in groups RM for 438 minutes and RD for 533.5 minutes. In our investigation, there was a substantial difference in the length of time it took to administer the initial rescue analgesia between the two study groups, with group RD taking noticeably longer. Our study results were similar to Koraki et al., research in time of analgesia duration with mean time for first rescue analgesia was 533.5 min in group RD where as in group RM it was 438 min.[10] In our study, using Dexmedetomidine as an adjuvant resulted in a longer duration of analgesia when compared with magnesium sulphate.

In our study, the mean baseline HR, systolic, diastolic, and mean arterial pressures were 75.53bpm, 118.9 mmHg, 77.67 mmHg, 91 mmHg respectively in RM Group whereas in RD group these were 73.1bmp, 117.27mmHg, 79.73 mmHg, 90.13 mmHg respectively in RD group. We found that the HR, SBP, DBP, and MAP in both Groups were comparable but we did not come across any bradycardia (defined as HR < 0.001). Similar results were found by Rancourt et al. in their study where mean systolic and DBP levels were stable throughout the study period in Group R but in Group RD, they noticed decrease in SBP and DBP between 60 and 480 min (P < 0.05).[11]

CONCLUSION

Based on our findings, we conclude that the addition of Dexmedetomidine (30 mcg) as an adjuvant to Ropivacaine (0.375 percent) in Axillary brachial plexus block resulted in a faster onset of sensory and motor block and a longer duration of sensory and motor block, as well as a significant prolongation of postoperative analgesia when compared with Magnesium sulphate (100mg).

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