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Original Research Article

A Comparative Study of Dexamethasone and Magnesium Sulphate as an Adjuvant to 0.5% Bupivacaine in Supraclavicular Brachial Plexus Block

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Abstract

Introduction: Upper extremity fractures are usually associated with marked postoperative pain. The goal of postoperative pain management is to reduce pain to a tolerable level with minimal or no associated suffering or distress. Brachial plexus block provides us with an alternative anaesthesia technique for upper limb surgeries that provides excellent surgical conditions and a prolonged duration of postoperative analgesia. The addition of an adjuvant to a local anaesthetic solution has helped in the early onset of blockade with a prolonged duration of anaesthesia and analgesia in the postoperative period. In our study, we evaluated the analgesic efficacy of the addition of dexamethasone and magnesium sulphate as an adjunct to 0.5% bupivacaine in Brachial plexus block.

Methods: The present prospective randomized comparative study was carried out in a tertiary care hospital from Jan.2021 to June 2022 amongst 50 patients in the age group of 18-55 years of either gender undergoing surgery below the lower 1/3rd humerus categorized under ASA physical status I & II. Patients were divided into two groups using simple randomization as follows: 1. Group I (N=25) = Patients receiving 0.5% bupivacaine (28 ml) +Dexamethasone 8 mg (2 ml). 2. Group II (N=25) = Patients receiving 0.5% bupivacaine (28 ml) + Magnesium Sulphate 500 mg (2ml).

Results: The onset of sensory block was earlier in group I than in group II. It was observed that the mean onset time of motor block is significantly lower in Group I as compared to group II. It was proved that the mean duration of the motor block is significantly higher in Group I as compared to group II. (p<0.001). It was observed that there is a prolonged duration of analgesia in Group I as compared to Group II which is statistically significant. (p<0.001). It eanlies a proper to Group II (p<0.001). It was observed to Group II which is statistically significant. (p<0.001). It eanlies a proper to Group II (p<0.001). It was provide that there is a prolonged duration of analges in Group I as compared to Group II which is statistically significant. (p<0.001). It was been provided to Group II (p<0.001). It was been provided

Conclusion: The onset and duration of sensory and motor blockade were faster with dexamethasone as compared to magnesium sulphate. The duration of postoperative analgesia was also significantly longer in the dexamethasone group with a reduced requirement for rescue analgesics for up to 24 hours. Both the additives did not alter the hemodynamics of the patients. **Keywords:** Dexamethasone, Magnesium Sulphate, Brachial Plexus Block, Postoperative Pain, Supraclavicular.

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Introduction

The Taxonomy Committee of the International Association for the study of pain defines pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage." [1] Upper extremity fractures are usually associated with marked postoperative pain. The goal of postoperative pain management is to reduce pain to a tolerable level with minimal or no associated suffering or distress.

Uncontrolled postoperative pain has the potential to produce a range of acute and chronic detrimental effects in the perioperative period that leads to negative neuroplasticity. [2] Early postoperative mobilisation and rehabilitation with minimum associated pain and discomfort is the most desirable feature in modern orthopaedic surgery.

Brachial plexus block provides us with an alternative anaesthesia technique to general anaesthesia for upper limb surgeries that provides excellent surgical conditions and a prolonged duration of postoperative analgesia. [3] It avoids side effects such as somnolence, nausea and vomiting, and hemodynamic instability which is inherent to general anaesthesia. Brachial plexus block is a simple technique, that provides a rapid onset, reliable block of plexus, bloodless operative field and early recovery. [4]

Recently, the addition of an adjuvant to a local anaesthetic solution has helped in the early onset of blockade with a prolonged duration of anaesthesia and analgesia in the postoperative period. Many adjuvants have been tried in an effort to prolong the duration of local anaesthetics like epinephrine, butorphanol tartrate. dexamethasone, tramadol, buprenorphine, verapamil, methylprednisolone, clonidine, dexmedetomidine. [5]

AIM: In our study, we evaluated the analgesic efficacy of the addition of dexamethasone and magnesium sulphate as an adjunct to 0.5% bupivacaine in terms of onset and duration of sensory and motor block, duration of postoperative analgesia and analgesic requirement in the postoperative period in supraclavicular brachial plexus block.

Material and Methods

The present prospective randomized comparative study was carried out in a tertiary care hospital from Jan.2021 to June 2022 amongst 50 patients (25 in each group) in the age group of 18-55 years of either gender undergoing surgery below lower 1/3rd humerus categorized under ASA physical status I & II after ethics committee approval.

Inclusion Criteria: Patients undergoing below lower 1/3rd humerus surgeries (elbow, forearm and hand surgeries), age group 18-55 years, ASA physical Status I and II.

Exclusion Criteria: Patient refusal for the procedure, surgeries taking more than 90 minutes, patients having sickle cell disease and surgery requiring tourniquet, patients with bleeding disorders or on anticoagulation therapy, patients who require anaesthesia supplementary to block (i.e general anaesthesia), local infection at the site of proposed puncture for supraclavicular block, patients with diabetes mellitus, ASA grade III and IV, patients with known allergy to local anaesthetics, and any of the study drug.

Investigations: Complete hemogram, X-ray chest, Blood urea nitrogen, Blood Sugar, Electrocardiogram, if >40 years.

Methodology:

The study included fifty patients divided into two groups using simple randomization as follows:

- 1. Group I (N=25) = Patients receiving 0.5% bupivacaine (28 ml) +Dexamethasone 8 mg (2ml)
- 2. Group II (N=25) = Patients receiving 0.5% bupivacaine (28 ml) + Magnesium Sulphate 500 mg (2ml).

A detailed history was taken and relevant examination and investigations as per the case record form were done.

On arrival in the pre-operative room, every patient was monitored for ECG, pulse rate (beats/min), NIBP (mm Hg), RR (breath/min) and SpO2. IV access was secured with a 20G cannula and an infusion of ringer's lactate was started. Midazolam 1mg IV was given for sedation. All patients underwent pain assessment using the Visual Analog score before the block. The patient was kept in a supine position on the operation table with arms by the side and head turned to the opposite side. With all aseptic precautions subclavian artery pulsations were felt at a point 1.5 to 2.0 cm posterior and cephalad to the midpoint of the clavicle. A skin wheal was raised with local anaesthetic cephalo-posterior to the localization pulsations. Neural was achieved by using a nerve stimulator connected to a 22G, 50mm long stimulating needle. Following negative aspiration 30ml of local anaesthetic drug with dexamethasone or magnesium sulphate as mentioned above was injected. Haemodynamic monitoring - Pulse rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), and saturation (Spo2) were recorded immediately after completion of the block, then 1min, 2min, 5 min, 10 min, 15 min and hourly thereafter till 24 hours. During the conduct of the block and thereafter, the patient has been observed vigilantly for any complications of the block and for the toxicity of the drugs injected.

Assessment:

• Sensory block was evaluated by pinprick on skin dermatomes C4 to T2 with 22G

- hypodermic needle.
- Motor block was evaluated by thumb movements. e.g. abduction (radial nerve), adduction (ulnar nerve), opposition (median nerve). Musculocutaneous nerve block assessed by flexion of the elbow and supination-pronation of the forearm.
- Hollmen scale was used to assess sensory blockade.

Vas Score:

VAS is a unidimensional measure of pain intensity, widely used in many studies because of its ease and simplicity. First, the pain score at rest was noted. Visual Analog Score (VAS score), sensory block and motor block were assessed in the postoperative period after 4 hours of administration of supraclavicular block every hour for the first 24 hours after completion of injection. The numeric rating scale was recorded post-operatively till the score of 5. The rescue analgesia was given in the form of analgesic inj. Diclofenac 75mg was given intramuscularly when the VAS score is equal to or more than 3.

Statistical Analysis:

All the collected data was entered in a Microsoft Excel sheet and then transferred to SPSS software ver. 22 for analysis. Qualitative data was presented as frequency and percentages and analysed using the chi-square test. Quantitative data was presented as mean and SD and compared by t-test. P-value < 0.05 was taken as the level of significance.

Results

Patient's age, weight, height, gender ratio and ASA physical status were considered as demographic parameters. Age, weight and height were analysed by

using one way ANOVA and chi-square

test was used for analysis of gender ratio and ASA physical status. Both groups were comparable in terms of age, weight, height, gender ratio and ASA physical status.

Parameter	Group I	Group II	P value
Age (years)	48.50 ± 6.4	47.37 ± 6.3	0.496
Weight (kg)	59.17 ± 9.05	60.43 ± 9.4	0.599
Height (cm)	154.93 ± 6.8	155.80 ± 9.4	0.686
Gender (M/F)	16/9	18/7	0.791
ASA (I/II)	20/5	21/4	0.584

 Table 1: Distribution of patients according to Demographic profile.

Table no.1 shows that the mean age of patients in Group I and Group II was 48.50 \pm 6.4 and 47.37 \pm 6.3 years respectively. The mean weight of patients in Groups I and Group II was 59.17 \pm 9.05 and 60.43 \pm 9.4 kilograms respectively. The mean height of patients in Groups I and II was 154.93 \pm 6.8 cm and 155.80 \pm 9.4 cm

respectively. The gender ratio of Male: Female, in patients of Group I was 16:9 and in patients of Group II was 18:7. American Society of Anaesthesiologists (ASA) physical status ratio (I/II) was 20/5 in patients of Group I and 21/4 in patients of Group II. Both groups did not differ significantly in their demographic status.

Table 2:	Comparison	of VAS Score	among study	groups
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Parameter	Group	Mean	SD	P Value
VAS Score	Group I	6.28	1.01	0.128
	Group II	5.93	1.02	

Table no.2 shows that the basal VAS score of the patients in both groups was compared statistically using unpaired student 't' test. Mean vas score in Group I was 6.28 while in Group II was 5.93. It was found that there was no statistical difference between the two group of patients with respect to basal vas score.

Parameter	Group	Mean (Mins)	SD	P Value
Sensory Block Onset	Group I	8.01	1.46	< 0.001
	Group II	11.85	1.35	
Motor Block Onset	Group I	10.65	1.56	< 0.001
	Group II	14.15	1.41	

 Table 3: Comparison of Onset of Sensory and Motor Block Among Study Groups

Table no.3 shows that the mean onset time of sensory block in Group I was 8.01 ± 1.46 minutes while that in Group II was 11.85 ± 1.35 minutes. It was observed that mean onset time of sensory block in Group was significantly lower as compared to Group II which is statistically significant (p<0.001).

Mean motor block onset time in Group I was 10.65 ± 1.56 minutes while that in Group II it was 14.15 ± 1.41 minutes. It was observed that mean onset time of motor block is significantly lower in Group I as compared to group II. This difference was statistically significant (p<0.001).

Table 4:	Comparison	of Duration	of Sensory	and Motor	Blockade	Among Stu	dy Groups

Parameter	Group	Mean (Mins)	SD	P Value
Duration of Sensory	Group I	879.0	72.6	< 0.001
Blockade	Group II	520.5	49.7	
Duration Of Motor	Group I	751.5	85.9	< 0.001
Blockade	Group II	439.5	47.8	

Table no.4 shows that the mean duration of sensory block in Group I was 879.0 ± 72.6 minutes while that in Group II was 520.5 ± 49.7 minutes. It was observed that mean duration of sensory block is significantly higher in Group I as compared to group II. This difference between the two groups is

statistically significant (p<0.001). The Mean duration of motor block in Group I was 751.5 ± 85.9 minutes while that in Group II it was 439.5 ± 47.8 minutes. It was proved that mean duration of motor block is significantly higher in Group I as compared to group II. (p<0.001).

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Table 5: Com	iparison of	duration	of Analgesia	among study	groups

Parameter	Group	Mean (Mins)	SD	P Value
Duration of	Group I	1009.5	83.6	< 0.001
Analgesia	Group II	589.5	60.6	

Table no.5 shows that the mean duration of analgesia in group I was 1009.5 ± 83.6 minutes while that in Group II it 589.5 ± 60.6 minutes. It was observed that there is prolonged duration of analgesia in Group I as compared to Group II which is statistically significant. (p<0.001).

Table 6: Comparison Of Rescue Analgesia Required In 24 Hours Among Study Groups

Parameter	Group	Mean (Mins)	SD	P Value
Analgesic	Group I	1.050	0.221	
Consumption	Group II	2.000	0.453	< 0.05

Table no.6 shows that the analgesic requirement was higher in group II (2 times) as compared to Group I (1 time). This difference was statistically significant (p < 0.001).



Graph 1: Comparison of Heart Rate between the two groups



Graph 2: Comparison of systolic blood pressures between the two groups



Graph 3: Comparison of Diastolic blood pressures between the two groups



Graph 4: Comparison of Oxygen saturations between the two groups



Graph 5: Comparison of respiratory rates in patients between the two groups

Discussion

Supraclavicular brachial plexus block is a popular and widely employed regional nerve block technique for perioperative anaesthesia and analgesia for surgery of the upper extremity. Its supremacy over general anaesthesia for the upper extremity comes from its ability to achieve good sympathetic block, better postoperative analgesia, a marvellous success rate and minimal side effects. [6] Application of local anaesthetics in combination with several adjuvants is now a good way to fasten the onset of the block and to increase its time and potency, prolonging the analgesia, achieving a good block without causing systemic side effects and also, reducing the total dosage of local anaesthetic. Adjuncts like opioids, neostigmine, bicarbonate, clonidine, magnesium sulphate and dexamethasone have been tried. [7] Dexamethasone exerts its action by blocking the nociceptive impulse that travels along the unmyelinated C fibres in addition to its anti-inflammatory features. [8]

Magnesium sulphate, being a physiological antagonist to calcium, has the ability to produce an anti-nociceptive effect and voltage-dependent regulation of calcium influx into the cell in addition to noncompetitive antagonism of N-methyl-Daspartate (NMDA) receptors. [9]

In the present study, both groups were comparable in terms of age, weight, height, gender ratio and ASA physical status. Similarly in the study conducted by Hamed, R et al, there was no significant difference in the demographic data and surgical characteristics in the study groups. [10]

In the present study, the mean VAS score in Group I (BD) was 6.28 while in Group II (BM) was 5.93 that there was no statistical difference between the two groups, this was in accordance with the study conducted by Hamed R et al. [10]

In the present study, the mean onset time of sensory block in Group I (BD) was 8.01 ± 1.46 minutes while in Group II (BM) was 11.85 ± 1.35 minutes. It was observed that the mean onset time of sensory block in Group I (BD) was significantly lower as compared to Group II (BM) which is statistically significant (p<0.001). This was in agreement with the study conducted by Hamed R et al., in which the sensory block onset time in minutes was earlier in group 2 (dexamethasone) as compared to group 1 (control) and 3 (magnesium sulphate); 8.20 ± 2.09 versus 16 ± 3.48 (P< 0.05) and 8.20 ± 2.09 versus 12.70 ± 2.92 (P< 0.05)

respectively, also the sensory block onset was earlier in group 3 (magnesium) than group 1 (control) 12.70 ± 2.92 versus $16 \pm$ 3.48 (P<0.05). [10]

In the present study, the mean motor block onset time in Group I (BD) was 10.65 \pm 1.56 minutes while in Group II (BM) was 14.15 ± 1.41 minutes. It was observed that the mean onset time of motor block is significantly lower in Group I (BD) as compared to group II. This difference was statistically significant (p<0.001). This was in agreement with the study conducted by Hamed R et al., in which the onset of the motor blockade in minutes was earlier in group 2 (dexa) than in group 1 and 3 (MgSO4; 1.50 ± 2.09 versus 13.10 ± 3.34 (p < 0.05) and 12.75 ± 3.43 respectively, while the difference in motor block onset was clinically insignificant between group 1 and 3 (P>0.05). [10]

In the present study, the mean duration of sensory block in Group I (BD) was $879.0 \pm$ 72.6 minutes while in Group II (BM) was 520.5 ± 49.7 minutes. It was observed that the mean duration of sensory block is significantly higher in Group I (BD) as compared to group II (BM). This difference between the two groups is statistically significant (p<0.001). This was in agreement with the study conducted by Yousef MF et al., in which the duration of sensory block (hours) was significantly higher in Group I (BD) as compared to group II (BM). [11]

In the present study, the mean duration of motor block in Group I (BD) it was $751.5 \pm$ 85.9 minutes while in Group II (BM) was 439.5 ± 47.8 minutes. It was proved that the mean duration of the motor block is significantly higher in Group I as compared to group II (p<0.001). This was in agreement with the study conducted by Hamed R et al., in which the motor power was significantly prolonged in dexa group than in the magnesium group; $563.00 \pm$ 69.29 versus 214.50 ± 36.92 respectively. [10] In the present study, the mean duration of analgesia in Group I (BD) was 1009.5 \pm 83.6 minutes while in Group II (BM) was 589.5 ± 60.6 minutes. It was observed that there is a prolonged duration of analgesia in Group I (BD) as compared to Group II (BM) which is statistically significant (p < 0.001). This was in agreement with the study conducted by Hamed, R et al., in which as regard duration of analgesia in minutes it was significantly longer in dexa group than the magnesium group (1104.00 \pm 289.16 versus 558.00 \pm 48.08) respectively. [10] Our results are also in accordance with the work of Parveen et al [12], Ghali et al [13] and Raghavan et al. [14]

In contrast to our study, the study done by Fahmy and his colleagues concluded that neither dexamethasone nor magnesium sulphate had significantly affected the onset time of sensory and motor blocks. Their study included 63 patients scheduled for arthroscopic rotator cuff repair through interscalene brachial plexus block under ultrasound guidance. The block was achieved using 0.5% bupivacaine 20 ml plus either 5 ml of 10% MgSO4 (group M) or 5 ml of normal saline containing dexamethasone 8 mg (group D) or 5 ml of 0.9% NaCl (group C). The onset of sensory block was 13.5 ± 0.92 min in group C, 14.3 \pm 1.4 min in group M, and 13.5 \pm 1.1 min in group D. The onset of motor block was 15.7 ± 0.85 min in group C, 15.9 ± 0.88 min in group M, and 16 ± 0.74 min in group D. [15]

In our present study, the difference in baseline mean heart rate was not statistically significant between the two groups. In both groups, the mean heart rate decreased after induction and it was statistically not significant. A significant fall in heart rate was observed at 15 minutes in Group II (BM) as compared to Group I (BD). (p=0.0001). Postoperatively, there was a significant fall in the heart rate in Group II (BM) as compared to Group I (BD) from 1 minute to 60 minutes. (p=0.0001)

In the present study, the difference in baseline systolic blood pressure was not statistically significant between the two groups. In both groups, the mean systolic blood pressure decreased after induction and it was statistically significant at 2 minutes after induction to 5 minutes after induction in Group II (BM) as compared to Group I (BD). (p=0.0001). From 10 minutes post-induction, the fall in SBP was more in Group II (BD) than in Group II (BM) and it was statistically significant (p=0.0001). Postoperatively, there was a significant fall in the systolic blood pressure in Group I (BD) as compared to Group II (BM) from 1 minute to 5 minutes postoperative. (p=0.0001). The values returned back to baseline in Group I (BD) gradually but not in Group II (BM). [16]

In the present study, the difference in baseline diastolic blood pressure was not statistically significant between the two groups. In both groups, the mean diastolic blood pressure decreased after induction and it was statistically significant at 2 minutes after induction to 10 minutes after induction in Group II (BM) as compared to Group I (BD). (p=0.0001). 15 minutes postinduction, the fall in DBP was more in Group I (BD) than Group II (BM) and it was statistically significant (p=0.0001). Postoperatively, there was a fall in the diastolic blood pressure in both groups and the fall was not significant.

The values returned back to baseline in Group I (BD) gradually but not in Group II (BM) In the present study, the difference in baseline oxygen saturation was not statistically significant between the two groups. In both groups, there was a gradual fall in oxygen saturation till 15 minutes into the procedure, the fall being more in Group I (BD) than Group II (BM), however, this fall was not statistically significant. The lowest mean saturation in Group I (BD) was 90.07 \pm 0.254 and the lowest mean saturation in Group II (BM) was 95.07 \pm

0.346. Postoperatively, there was no fall in the oxygen saturation

in both groups.

In the present study, the difference in baseline respiratory rate was not statistically significant between the two groups. In the present study, there was a fall in the respiratory rate in both groups but this fall was not statistically significant intraoperatively. Postoperatively, there was a gradual recovery of respiratory rate to the baseline values in both groups.

Conclusion:

The onset of sensory and motor blockade faster with dexamethasone was as compared to magnesium sulphate. The duration of sensory and motor blockade was longer with dexamethasone as an additive. The duration of postoperative analgesia was also significantly longer in the dexamethasone group with a reduced requirement for rescue analgesics for up to 24 hours. Both the additives did not alter the hemodynamics of the patients. Moreover, dexamethasone showed a better result as compared to magnesium sulphate when used as an adjunct to 0.5% bupivacaine in supraclavicular brachial plexus block.

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