

## THE EFFECTS OF MAGNESIUM SULFATE AND DEXAMETHASONE AS ADDITIVES TO LOCAL ANAESTHETIC IN SUPRACLAVICULAR BLOCK A RANDOMISED CONTROLLED STUDY

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### ABSTRACT

#### BACKGROUND

The aim of this study was to evaluate the effects of dexamethasone and magnesium sulfate as additives to local anaesthetic solution containing lignocaine and bupivacaine in supraclavicular brachial plexus block.

#### MATERIALS AND METHODS

A prospective randomised double blind control study was conducted on 90 healthy patients of ASA grade I, II of age group 18-50 years scheduled for upper limb surgeries under supraclavicular block. Patients were allocated to three groups of 30 each as a control group (S) received only local anaesthetic, group getting dexamethasone as additive (SD) and group getting magnesium sulfate as additive to local anaesthetics (SM). Parameters observed were time of onset of sensory and motor block, duration of analgesia and side effects.

#### RESULTS

Onset of sensory block was most rapid in Group SD and was statistically significant when compared to Group S ( $p < 0.01$ ) and Group SM ( $p < 0.01$ ). The meantime for sensory block onset was  $11.07 \pm 2.033$  mins in Group S,  $6.80 \pm 2.384$  minutes in Group SD and  $8.70 \pm 1.896$  minutes in Group SM. Mean time for onset of motor block in Group S, Group SM, and Group SD was  $13.17 \pm 2.66$  minutes,  $10.27 \pm 2.39$  minutes and  $9.40 \pm 2.29$  mins respectively. Onset of motor block was earliest in Group SD and this was statistically significant when compared to Group S ( $p < 0.01$ ) but statistically insignificant ( $p = 0.526$ ) between Group SD and Group SM. Duration of analgesia was found to be highest in Group SD with mean duration of analgesia ( $738.33 \pm 187.69$  minutes) and in Group S it was ( $308.33 \pm 60.05$  minutes) and Group SM was  $628.02 \pm 182.06$  minutes. It was statistically significant when compared to Group S ( $p < 0.01$ ) and Group SM ( $p < 0.01$ ).

#### CONCLUSION

It is concluded from this study that both magnesium sulfate and dexamethasone prolong the duration of analgesia, when used with local anaesthetic solution containing lignocaine and bupivacaine for supraclavicular brachial plexus block, without producing any major side effects. Dexamethasone is a better adjuvant than magnesium sulfate because, in addition to prolonging the duration of analgesia, it also results in more rapid onset of sensory and motor blockade.

#### KEYWORDS

Supraclavicular Block, Magnesium Sulphate, Dexamethasone, Bupivacaine, Lignocaine, Analgesia.

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#### BACKGROUND

Pain is an unpleasant sensory and emotional experience described in terms of actual or potential tissue damage.<sup>1</sup> It is always a subjective experience. Peripheral nerve blocks provide longer duration of pain relief compared to neuraxial blockade and avoids the systemic effects of drugs. Koller's demonstration in 1884 of ocular surface anaesthesia with cocaine has marked a new era in regional anaesthesia

techniques for prevention of pain associated with surgery. Halsted performed the first brachial plexus block.<sup>2</sup> Using a surgical approach in the neck, Halsted applied cocaine to the brachial plexus.<sup>3</sup> The first percutaneous supraclavicular block was performed in 1911 by German surgeon Diedrich Kulenkampff.<sup>4,5</sup> on his own supraclavicular nerve. Brachial plexus block is a popular and widely employed regional nerve block technique for perioperative anaesthesia and analgesia for surgery of the upper extremity. This can be blocked by various approaches like interscalene, supraclavicular, infraclavicular or the axillary blocks. However the most classic and usually done brachial plexus block is the supraclavicular block. Different drugs have been used as adjuvants with local anaesthetics in supraclavicular blocks to improve the quality of anaesthesia. Various drugs like opioids (Buprenorphine, Fentanyl) that have been used as additives were found to

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produce respiratory depression and psychomimetic effects. Among the adjuvants dexamethasone and magnesium sulfate is found to be with minimal side effect. This study is to compare the effect of these two additives in supraclavicular block.

Dexamethasone, a steroid, is a fluorinated derivative of prednisolone to extend the duration of analgesia by its anti-inflammatory properties.<sup>6</sup> and blocking the nociceptive impulse transmission along the unmyelinated C fibers.<sup>7</sup> Magnesium has antinociceptive effect which is based on physiological calcium antagonism, voltage-dependent regulation of calcium influx into the cell and non-competitive antagonism of N-methyl-D-aspartate (NMDA) receptors.<sup>8</sup>

## MATERIALS AND METHODS

After approval from the Hospital Ethics Committee, a prospective double blind randomised controlled study was conducted on 90 patients of ASA grade I, II in the age group of 18 to 50 yrs. posted for upper limb surgery.

After preoperative assessment and getting a written informed consent from patients, they were randomized into 3 groups of 30 each- a control group (S) received only local anaesthetic, group getting dexamethasone as additive (SD) and group getting magnesium sulfate as additive to local anaesthetics (SM). Supraclavicular block performed using nerve stimulator.

Group S received 30 mL of local anaesthetic solution (10 mL 2% Lignocaine with 1:200000 Adrenaline + 20 mL 0.25% Bupivacaine) and 2ml normal saline.

Group SD received the same local anaesthetic solution with 8 mg Dexamethasone added to it.

Group SM received 30 ml local anaesthetic solution with 150mg magnesium sulfate added to it and made it to the same volume as other groups.

**Onset of Analgesia-** Considered as the time between injection and complete abolition of pin prick response.

**Onset of Motor Block-** Considered as the time between injection and complete absence of voluntary movement of the limb.

**Duration of Analgesia-** Taken as the time between onset of analgesia and the reappearance of pain or request for pain relief.

Post-operative analgesia was assessed by Visual Analogue Score hourly. Rescue analgesia of inj Tramadol 50 mg was given as per the requirement.

## Statistical Analysis

The data collected were recorded and entered into charts and the necessary statistical tables constructed. The statistical analysis was done by ANOVA.

## RESULTS

All the 3 groups were similar with regards to age and weight

Group	Mean Age (yrs.)	Std. deviation
S	34.43	8.633
SM	34.27	8.342
SD	34.20	7.175

**Table 1. Age**

P VALUE is 0.939 (not significant)

Group	Mean weight	Std. deviation
S	57.13	4.833
SM	59.37	3.469
SD	58.30	3.271

**Table 1. Weight**

P Value is 0.0933(not significant)

Group	Mean Onset of Sensory Block (min)	Std. deviation
S	11.07	2.033
SM	8.70	1.896
SD	6.80	2.384

**Table 2. Onset of Sensory Block**

Onset of sensory block was most rapid in Group SD and slowest in Group S. The mean time for sensory block onset was  $11.07 \pm 2.033$  mins in Group S,  $6.80 \pm 2.384$  minutes in Group SD and  $8.70 \pm 1.896$  minutes in Group SM. Onset of sensory block was earliest in Group SD and this was statistically significant when compared to Group S ( $p < 0.01$ ) and Group SM ( $p < 0.01$ ). Shorter mean onset of sensory block in Group S is statistically comparable to Group SM ( $p < 0.01$ ) and Group SD ( $p < 0.01$ ).

Group	Mean Onset of Motor Block (min)	Std. deviation
S	13.17	2.66
SM	10.27	2.39
SD	9.40	2.29

**Table 3. Onset Of Motor Block**

Mean time for onset of motor block in Group S, Group SM, and Group SD was  $13.17 \pm 2.66$  minutes,  $10.27 \pm 2.39$  minutes and  $9.40 \pm 2.29$  mins respectively. Onset of motor block was earliest in Group SD and this was statistically significant when compared to Group S ( $p < 0.01$ ). Even though there was a difference in the time of onset of motor block between Group SD and Group SM, this difference was found to be statistically insignificant ( $p = 0.526$ ). Onset of motor block was late in Group S and this is statistically significant when compared to Group SD ( $p < 0.01$ ) and Group SM ( $p < 0.01$ ).

Group	Mean Duration of Analgesia (Min)	STD Deviation
S	308.33	60.05
SM	628.02	182.06
SD	738.33	187.69

**Table 4. Duration of Analgesia**

Duration of analgesia was found to be highest in Group SD with mean duration of analgesia ( $738.33 \pm 187.69$  minutes) and least in Group S ( $308.33 \pm 60.05$  minutes).

The mean duration of analgesia in Group SM was  $628.02 \pm 182.06$  minutes. Mean duration of analgesia was higher in Group SD. The difference in mean duration of analgesia between was statistically significant when compared to Group S ( $p < 0.01$ ) and Group SM ( $p < 0.01$ ). The shorter mean duration of analgesia in Group S was statistically significant when compared to Group SM ( $p < 0.01$ ) and Group SD ( $p < 0.01$ ).

### Side Effects

There were no major side effects in any of the groups. Vitals were stable throughout the surgery in all the three groups. Two patient in Group S had emesis in the postoperative period, two patients in Group SM and one patient in Group SD complained of nausea during surgery. Symptoms of all the patients were relieved on giving Inj. Ondansetron 4mg intravenously

### DISCUSSION

Although general anaesthesia continues to be the choice of anaesthesia for most of the surgical procedures, regional anaesthesia has been increasing in popularity in recent years. This is mainly because of the fact that the regional anaesthesia techniques can be utilized for analgesia not only during the operative period, but during the postoperative period as well and avoids complications of general anaesthesia. Brachial plexus block is widely used in our practice for forearm and hand surgeries. It is the techniques by which injection of local anaesthetic agents in close proximity to the brachial plexus (which is formed by the ventral rami of C5, C6, C7, C8, T1, occasionally with small contributions by C4 and T2), temporarily blocks the sensation and ability to move the upper extremity. It provides good intraoperative and postoperative analgesia. Brachial plexus can be blocked by various approaches like interscalene, supraclavicular, infraclavicular or the axillary blocks. However the most classic and usually done brachial plexus block is the supraclavicular block. Here, in the supraclavicular area, almost the entire sensory, motor and sympathetic innervations are carried in just three nerve trunks, confined to a very small surface area. Consequently, typical features of this block include rapid onset, predictable and dense anaesthesia along with high success rate. Different drugs have been used as adjuvants with local anaesthetics in supraclavicular blocks to improve the quality of anaesthesia like opioids (Buprenorphine, Fentanyl) but were found to produce respiratory depression and psychomimetic effects. Our study demonstrated statistically significant faster onset of sensory and motor blockade and longer duration of analgesia in subjects receiving dexamethasone as adjuvant to local anaesthetic.<sup>9,10</sup>

Dexamethasone has been studied as Steroids which is having nerve block prolonging effects. They produce analgesia by blocking transmission of nociceptive unmyelinated C-fibres and suppressing ectopic neuronal discharge.<sup>11</sup> They might bring about this effect by altering the function of potassium channels in the excitable cells.

Action on glucocorticoid receptor is proposed to alter the functioning of ion channels and produce lactic acidosis in nerve cell thereby reducing the concentration of local anaesthetic required to produce conduction failure or trapping the highly ionized bupivacaine molecule into the neuronal cell. It is used as adjuvant because of easy availability, cost effectiveness and lack of significant side effects. In our study adding dexamethasone significantly shortened the onset of sensory and motor blockade compared to adding magnesium sulphate. Shrestha BR, Mahajan SK, Tebedar S also found significant difference in onset of sensory and motor blockade in local anaesthetics and steroid group.<sup>12</sup>

In a study by Castillo J, Curley J, Hotz J et al a prolonged percutaneous block of sciatic nerve in rat using bupivacaine- dexamethasone microspheres was demonstrated.

Magnesium is the fourth most plentiful cation in our body. It has antinociceptive effects in animal and human models of pain. It has been mentioned in a systematic review that it may be worthwhile to further study the role of supplemental magnesium in providing perioperative analgesia, because this is a relatively harmless molecule, is not expensive and also because the biological basis for its potential antinociceptive effect is promising. The effects are primarily based on physiological calcium antagonism, that is voltage-dependent regulation of calcium influx into the cell, and non-competitive antagonism of N-methyl-D-aspartate (NMDA) receptors. It has role as co factor in more than 300 enzymatic reaction involving energy metabolism and nucleic acid synthesis. It is also involved in several processes including hormone receptor binding, gating of calcium channel, transmembrane ion flux and regulation of adenylate cyclase, neuronal activity, control of vasomotor tone and neurotransmitter release.

By adding magnesium sulphate duration of analgesia can be significantly increased when compared to local anaesthetic alone group. Mohammed Haghighi, Mehran Soleymanha, Abbas Sedighinejad, Ahmadreza Mirbolook, Bahram Naderi Nabi, Mehdi Rahmati and Nasim Ashoori did a randomized double blind study about the effect of magnesium sulfate on sensory and motor axillary plexus blockade.<sup>13</sup> They concluded that the addition of magnesium sulfate to lidocaine increased the duration of motor and sensory axillary block in the upper extremities during surgeries when compared to the use of lidocaine alone. Another study done by Dogru k, Yildirim D, Ulgey A, Aksu R, Bicer C, Boyaci A on adding magnesium to levobupivacaine for axillary brachial plexus block in AV fistula surgery. They found that Motor and sensory block onset times were statistically decreased in the Group with magnesium sulphate.<sup>14</sup>

Many studies done previously had proved the advantage of using dexamethasone and magnesium sulfate as additive to local anaesthetic in nerve block but no study has done to compare these two. In this study we found that by adding dexamethasone the sensory and motor blockade

were rapid and duration of analgesia is prolonged compared to adding magnesium sulfate.

## CONCLUSION

It is concluded from this study that both magnesium sulfate and dexamethasone prolong the duration of analgesia, when used with local anaesthetic solution containing lignocaine and bupivacaine for supraclavicular brachial plexus block, without producing any major side effects. Dexamethasone is a better adjuvant than magnesium sulfate because, in addition to prolonging the duration of analgesia, it also results in more rapid onset of sensory and motor blockade.

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