Comparison Of Magnesium Sulphate With Dexamethasone As Adjuvant To Local Anaesthetics For Supraclavicular Brachial Plexus Block

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Abstract: Background: Background and objectives: Brachial plexus block is routinely performed method of regional nerve block. Different adjuvants have been used to hasten the onset and prolong the duration of peripheral nerve blocks. In this study we compared dexamethasone and magnesium sulphate as an adjuvant to combination of bupivacaine and lignocaine in supraclavicular brachial plexus block with regards to comparison of time required for onset and duration of sensory and motor block, duration of post-operative analgesia and requirement of rescue analgesics in first 24 hours postoperatively. Material And Methods: This prospective, observational, comparative study was performed on 60 patients of ASA class I, II and III in the age group of 18 to 70 years, weighing 40 to 70 kilogram and undergoing lower arm, elbow, forearm and hand surgeries divided in to 2 equal groups D and M. Group D received dexamethasone 8mg and group M received magnesium sulphate 500mg along with bupivacaine(0.5%) and lignocaine(2%). Result: Onest of sensory and motor blockade was significantly faster in group D compared to group M (p-0.001, p<0.001 respectively). Duration of sensory and motor blockade and duration of postoperative analgesia was prolonged in group D compared to group M (p-0.008, p-0.034). Conclusion: Addition of dexamethasone or magnesium sulphate as adjuvant in supraclavicular block prolongs postoperative analgesia. Dexamethasone provided quicker onset and longer duration of analgesia with lesser consumption of rescue analgesic in comparison to magnesium sulphate. [Dudhat N Natl J Integr Res Med, 2022; 13(2): 01-06, Published on Dated:10/02/2022]

Key Words: Magnesium Sulphate, Dexamethasone, Bupivacaine, Supraclavicular Block

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Introduction: The use of peripheral nerve blockade has grown in popularity because it produces complete muscular relaxation and maintains hemodynamic stability. It offers better preservation of mental functions in elderly, decreases risk of aspiration by preventing loss of pharyngeal and laryngeal reflexes, avoids difficult intubation, increases postoperative analgesia without undue sedation, facilitates early mobilization and early hospital discharge[1,3].

Amongst various approaches to brachial plexus block, Supraclavicular approach is widely employed method to provide anesthesia and analgesia for upper limb surgeries of arm, forearm and hand. It provides a rapid, dense and predictable anesthesia in a more consistent manner, also provides tourniquet pain relief, good muscle relaxation and hence better surgeon satisfaction[2]. Postoperative pain causes discomfort to the patient and also impedes recovery. Increasing the duration of local anesthetic action is often desirable as it prolongs surgical anesthesia and analgesia. Different additives have been used to prolong regional block like opioids, alpha 2 agonists, adrenaline etc. to local anesthetics[4,5]. Steroids have been used since many years as an adjuvant to local anesthetics due to both anti-inflammatory and analgesic effect. They relieve pain by reducing inflammation and blocking potassium channel mediated transmission of nociceptive C – fibers and by suppressing ectopic neural discharge[5].

Magnesium is necessary for the presynaptic release of acetylcholine from nerve ending and act as calcium –entry-blocking drugs. Antinociceptive effects of magnesium are due to regulation of calcium influx into the cell and antagonism of N-methyl-D-aspartate receptors; this leads to the prevention of central sensitization from peripheral nociceptive stimulation and decreases acute pain[6].

Material & Methods: After obtaining approval from the Institutional ethical committee, and patients informed consent, a prospective observational comparative study was carried out on 60 patients of either sex, belonging to ASA class I, II and III, in the age group of 18 to 70 years, weighing 40 to 70 kg posted for upper extremity surgeries below mid arm to be done

under supraclavicular brachial plexus block. Patients with the following conditions were excluded from the study: known allergy to local anesthetics, uncontrolled diabetes, hypertension, coagulopathy, pre-existing peripheral neuropathy, hepatic, renal or endocrinal disorders and pregnant patients.

In this study we had observed 60 patients divided into two equal groups scheduled for supraclavicular brachial plexus block receiving magnesium sulphate or dexamethasone as adjuvant to local anesthetics bupivacaine and lignocaine.

Group D: Bupivacaine (0.5%) 20ml + lignocaine (2%) 10ml + dexamethasone 8mg (2ml) +Distilled water to make 40ml total volume

Group M: Bupivacaine (0.5%) 20 ml + lignocaine (2%) 10ml + magnesium sulphate 500mg (1ml) + Distilled water to make 40ml total volume

On the day of the surgery, overnight fasting status was confirmed and informed written consent was taken after explaining the procedure. On arrival to the operating room, baseline pulse rate, systolic blood pressure and respiratory rate were measured and premedicated with injection midazolam 1 mg and fentanyl 1-2mcg/kg intravenously.

All the patients were placed in supine position with head turned away from the side to be blocked. The arm to be anesthetized was adducted and elbow flexed with wrist supinated.

After sterile preparation, the lateral border of sternocleidomastoid muscle was identified by asking the patient to raise the head slightly which made lateral border of sternocleidomastoid muscle prominent. The palpating finger was then rolled over the belly of the anterior scalene muscle into the interscalene groove, where a mark was made 1.5 to 2cm posterior to the midpoint of clavicle. Palpation of subclavian artery at this site confirms the landmark. An insulated 5cm, 22 gauge nerve stimulator needle was inserted at this point in a caudal, slightly medial and posterior direction until motor response was elicited or the first rib was encountered. When motor response was elicited, the current was reduced to 0.5-0.3mA. If motor response persisted local anesthetic drug was given after negative aspiration[3].

Intraoperative systolic blood pressure, heart rate, respiratory rate, oxygen saturation, sensory and motor blockade were recorded every 5 min up to 30 min, then every 15 min up to 2 hrs, there after hourly up to 6 hrs, then at 12^{th} ,18^{th} and 24^{th} hour.

Sensory blockade was assessed by three point sensory score. Onset of sensory blockade was taken as the time from injection of the study drug to attainment of a sensory score of 2.

Sensory Blockade Was Graded As Below:

- **0**: Sharp Pain On Pin Prick
- **1**: Touch Sensation On Pin Prick
- **2**: Not Even Touch Sensation

Motor blockade was assessed by Lovett rating scale. Onset of motor blockade was taken as the time from injection of the study drug to attainment of a motor score of 3.

Motor Blockade Was Graded As Below:

- **0**: Complete Paralysis
- **1**: Almost Complete Paralysis
- **2**: Pronounced Impairment Of Mobility
- **3**: Slightly Impaired Mobility
- **4**: Pronounced Reduction Of Muscular Force
- **5**: Slightly Reduced Muscular Force
- **6**: Normal Muscular Force

Quality Of Block Assessed During Intraoperative Period: Satisfactory Block: surgery without patient discomfort or need for anesthetic supplementation.

Unsatisfactory Block: A sensory region involved in the surgery was not completely anaesthetized and needed ketamine bolus 0.5mg/kg intravenously.

Complete Failure: General anesthesia was given by attending anesthesiologist using his/her preferred technique. These patients were included in the study.

Postoperative pain was assessed by visual analogue scale (VAS). VAS score was noted immediately after surgery, every hourly up to 6 hours then at 12^{th}, 18^{th} and 24^{th}hour.When VAS>4, injection diclofenac sodium 1.5 mg/kg intramuscularly was administered as rescue analgesic, time was noted and total doses

required were noted up to 24 hours. Duration of sensory blockade was defined as the time from onset of sensory block to the time when patient again developed sharp pain to pin prick.

Duration of motor blockade was defined as the time from onset of complete motor block to the restoration of normal muscular force.

Complications and side effects like systemic toxicity, hypotension, bradycardia, nausea, vomiting, respiratory depression, neuropathy, pneumothorax, infection at the site of injection were noted.

Results: The statistical analysis was done using SPSS software version 23 using the "chi square test and independent t test". The difference was considered to be statistically significant when P value < 0.05 and highly significant when P<0.001.

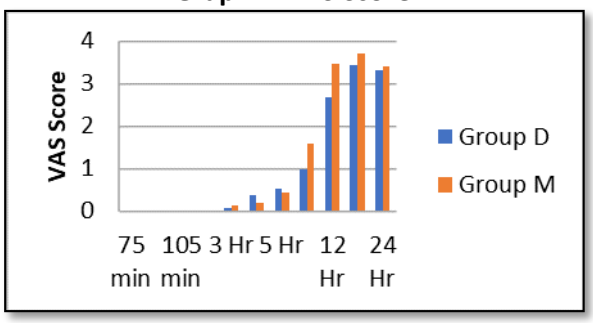
Both the groups were comparable with respect to the demographic profile, baseline values of hemodynamic variables and surgical duration (p>0.05).

The mean ± SD of onset of sensory block in group D and group M was 7.57±3.09 min and 10.30±2.98 min, respectively (p-0.001). The mean ± SD of onset of motor block in group D and group M was 9.17±3.75 min and 13.07±3.21 min, respectively (p<0.001).

The mean ± SD of duration of sensory block in group D was 562.00±184.75 min and group M was 514.00±151.69 min (p<0.05). The duration of motor block in group D was 544.00±182.35 min whereas in group M was 477.33±143.43 min(p<0.05).

The duration of postoperative analgesia was significantly prolonged in group D as compared to group M (788.00±270.05 min vs 645.33±203.42min, respectively) (p<0.05).

Graph 1: VAS Score



Addition of dexamethasone to local anesthetic prolonged the duration of analgesia by nearly 143 min in comparison to magnesium sulphate and reduced the consumption of postoperative analgesics(p<0.05).

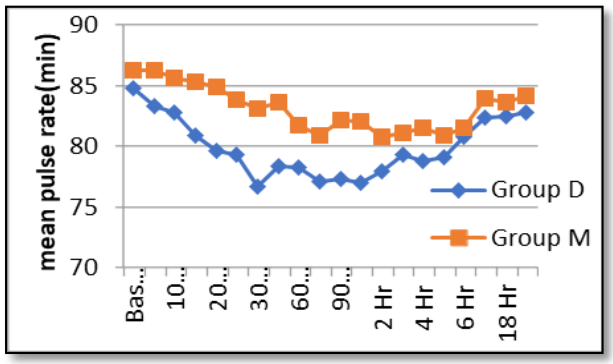
Table 1: No. Of Analgesic Required In Post Operative 24 Hours

Number Of Injections	Group D		Group M	
	No.	%	No.	%
1	19	63.33	9	30
2	11	36.67	19	63.33
3	0	0	2	6.67
Mean	1.37		1.77	
SD	0.49		0.57	
'P' Value	0.005			

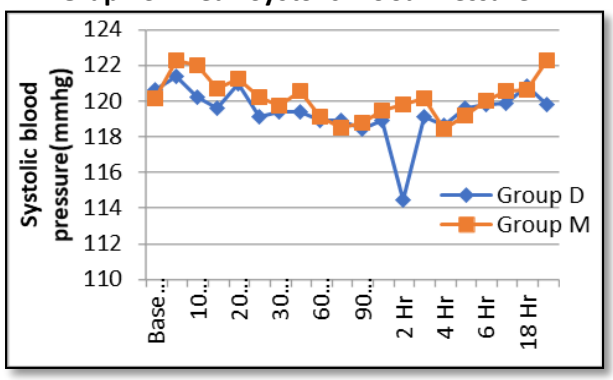
In group D, 93.33% patients obtained satisfactory block, 6.67% patient required injection ketamine analgesic dose (0.5mg/kg). In group M, 96.67% patients obtained satisfactory block, 3.33% patients required ketamine analgesic dose (0.5mg/kg). There was no incidence of failed cases in either of the groups.

The difference in the blood pressure and pulse rate between the two group was statistically insignificant (p>0.05) throughout the observation period.

Graph 2: Mean Pulse Rate



Graph 3: Mean Systolic Blood Pressure



There was no incidence of any side effects in either of the groups.

Discussion: Regional anesthesia is a boon in the present era of patient care because of simplicity of the technique, preservation of consciousness, avoidance of airway instrumentation and rapid recovery with adequate post operative analgesia[16].

Currently available local anesthetics alone for supraclavicular brachial plexus block provide good operative condition but have shorter duration of post operative analgesia when used as a single injection. To extend the analgesia beyond the operative room various methods have been tried with an aim of prolonging the local anesthetic action like continuous infusion of local anesthetics via indwelling catheter or use of different additives to local anesthetics[2].

In the present study we compared dexamethasone and magnesium sulphate as an adjuvant to local anesthetics, and found that dexamethasone leads to early onset of anesthesia, significantly prolongs duration of sensory and motor block and provides postoperative analgesia compared to magnesium sulphate without any adverse effects.

Steroids are very potent anti-inflammatory and immunosuppressive agents. Perineural injection of steroid is reported to influence post-operative analgesia. Various steroids have been used for this purpose, but dexamethasone, a synthetic glucocorticoid derivative is preferred because of its highly potent anti-inflammatory property, about 25 to 30 times more potent than hydrocortisone and without any mineralocorticoid activity[5].

Shrestha BR et al[9] studied that dexamethasone when added to lignocaine in axillary block significantly prolonged duration of analgesia without any change in onset time.

Also, Golwala MP et al[10] concluded that dexamethasone as an adjuvant to local anesthetics in brachial plexus block results in significantly early onset and markedly prolonged duration of analgesia.

Pathak DR. R.G. et al[1] (2012) observed dexamethasone along with bupivacaine leads to early onset of sensory and motor blockade and significantly prolong the duration of sensory and motor blockade and postoperative analgesia($p<0.05$).

S.Choi et al(2014)[13] conducted a meta-analysis to compare the effect of dexamethasone in nerve block. They observed that mean duration of analgesia or sensory block using long acting LA was 730 min while with long acting local anaesthetic with dexamethasone it was 576 min longer. Mean duration of motor block in local anaesthetic alone group was 664 min while in LA with dexamethasone group was 438 min longer.

Magnesium, a cation existing inside the cell whose quantities are second only to potassium, plays a crucial role in activating enzymes in the cardiovascular system. In addition, magnesium acts as a physiological calcium antagonist.

It is used to treat arrhythmia, myocardial or nerve ischemia, and gestational toxicosis, and to inhibit uterine contraction. More recently, magnesium's effects of N-methyl-d-aspartate receptor antagonism and sympathetic blocking have been noted, and magnesium is now used to help reduce the consumption of anesthetics and pain medications. Magnesium blocks the effects of excitatory amino acids (e.g. glutamate, aspartate) on N-methyl-d-aspartate receptors and contributes to central sensitization[15].

Use of magnesium sulphate as an adjuvant mixed with local anesthetics has been performed with neuraxial anesthesia in both spinal and epidural routes, even with different doses. Mixing magnesium sulphate as adjuvant with local anesthetics during peripheral nerve and nerve plexus blockade has recently been practiced by anesthesiologists.[6]

In agreement with our result, Gunduz et al[8] found that magnesium added to prilocaine prolongs the duration of axillary plexus block in dose dependent manner. however, they did not evaluate the effect of magnesium on the consumption of postoperative analgesics. Various researchers have used different doses of magnesium sulphate by various routes.

Lella Nageswara Rao et al(2015)[14] used 200mg magnesium sulphate as adjuvant to bupivacaine and observed prolonged duration of motor and sensory blockade.

Verma et al[11] studied two different doses (125 mg vs 250 mg) of magnesium sulphate as an adjuvant to bupivacaine in brachial plexus block and found greater efficacy with higher doses.

They found hastening of the onset of block in magnesium sulphate groups was dose-dependent.

While Mohammad Haghighi et al(2014)[12] studied 600mg of magnesium sulphate as adjuvant to lidocaine and observed that total mean duration of sensory and motor blockade was prolonged in magnesium sulphate group.

There are only a small number of studies comparing effect of dexamethasone and magnesium sulphate as adjuvant to local anesthetic on onset and duration of sensory and motor block and postoperative analgesia in brachial plexus block.

In a similar study Radha Korumbil Raghavan et al (2017)[7] observed that time of onset of sensory blockade was significantly faster in dexamethasone (8mg) group compared to magnesium sulphate (150mg) group($p<0.01$).

Onset of motor blockade was faster in dexamethasone group but it was statistically insignificant (p-0.52). Total duration of analgesia was longer in dexamethasone group compared to magnesium sulphate group ($p<0.01$).

Niven G. Fahmy et al(2014)[15] studied that the addition of either 500 mg magnesium sulphate or 8 mg dexamethasone to a long-acting local anesthetic (bupivacaine) prolonged the duration of analgesia and reduced the postoperative pain after ultrasound-guided interscalene nerve block.

There was no significant difference in sensory onset and the motor block duration among all the groups.

Conclusion: In the present study we found that dexamethasone leads to early onset of anesthesia, significantly prolongs duration of sensory and motor block and provides postoperative analgesia compared to magnesium sulphate without any adverse effects.

Thus we have concluded that dexamethasone is a better, safe and effective alternative to magnesium sulphate. Major limitation of our study was we could not biochemically analyze the blood concentration of bupivacaine, magnesium sulfate and dexamethasone because of nonavailability of facilities at our institution when this study was carried out.

References:

1. Ritu Baloda, Jatinder Paul Singh Bhupal, Pramod Kumar,Gurjit singh Gandhi. Supraclavicular Brachial Plexus Block with or Without Dexamethasone as an Adjuvant to 0.5% Levobupivacaine: A Comparative Study. Journal of Clinical and Diagnostic Research,2016 Jun,Vol-10(6).
2. Dr R. G. Pathak, Dr Anand P Satkar, Dr Rajendra N. Khade Supraclavicular Brachial Plexus Block with or Without Dexamethasone – A Comparative Study. International Journal of Scientific and Research Publication, Volume 2,Issue 12,December 2012
3. Dinise J. Wedel, Terese T. Horlocker, Sandra L. Kopp; Nerve Blocks; Miller Ronald D; Anaesthesia , 8th edition 2015;Vol-1,chapter 57:1721-51.
4. Prashant A Biradar, Padmanabha Kaimar, Kannappady Gopalakrishna. Effect of dexamethasone added to lidocaine in supraclavicular brachial plexus block: A prospective, randomized, double-blind study Indian Journal of Anaesthesia /vol. 57/Issue 2/Mar-apr 2013
5. Islam SM, Hossain MHMD, Maruf AA. Effect of addition of dexamethasone to local anaesthetics in supraclavicular brachial plexus block. Journal of Armed Forces Medical College, Bangladesh June 2011;Vol 7,No.1:11-4
6. Kasturi Mukherjee, Anjan Das, Anindya Mukherjee. Evaluation of Magnesium as an adjuvant in Ropivacaine-induced supraclavicular brachial plexus block: A prospective, double-blinded, randomized controlled study. Journal of Research in Pharmacy Practice/Oct-Dec 2014/Vol 3/Issue 4.
7. Radha Korumbil Raghavan, Shiril Ashraf: The effects of magnesium sulfate and dexamethasone as additives to local anaesthetic in supraclavicular block A randomized controlled study; Journal of Evidence Based Medicine and Healthcare.2017;4(71),4254-4257.
8. Gunduz A, Bilir A, Gulec S. Magnesium added to prilocaine prolongs the duration of axillary plexus block. Regional Anesthesia and Pain Medicine 2006; Volume 31,Issue 3,Pages 233-6.
9. Shrestha BR, Mahajan S K, S Tabedar :Supraclavicular brachial plexus block with and without dexamethasone-A comparative study

Kathmandu University Med J(KUMJ) 2003;1(3):158-160.
10. M.P. Golwala, V.N. Swadia, Aditi A Dhimar, N.V. Sridhar; Pain Relief by Dexamethasone as an adjuvant to local anaesthetics in Supraclavicular Brachial Plexus Block; Journal of Anaesthesia Clinical Pharmacology 2009;25(3):285-288.
11. Versha Verma, Shelly Rana, Sudarshan Kumar Chaudhary, Jai Singh, Ravinder Kumar Verma: A dose-finding randomized controlled trial of magnesium sulphate as an adjuvant in ultrasound guided supraclavicular brachial plexus block; Indian Journal of Anaesthesia Vol 61/Issue 3/250-255/2017.
12. Mohammad Haghighi, Mehran Soleymanha ,Nasim Ashoori Saheli : The Effect of Magnesium Sulfate on Motor and Sensory Axillary Plexus Blockade; Anesthesiology and Pain Medicine 2015 Feb;5(1):e21943.
13. S.Choi, R.Rodseth ,C. J. L. McCartney: Effects of dexamethasone as a local anaesthetic adjuvant for brachial plexus block: a systematic review and meta-analysis of randomized trials; British Journal of Anaesthesia 112(3):427-39(2014).
14. Lella Nageswara Rao, V. Jeyalakshmi, M. Nagaraju, S.Anitha: The effect of magnesium sulfate as an adjuvant to 0.5%bupivacaine on motor and sensory supraclavicular brachial plexus blockade; International Journal of Basic & Clinical Pharmacology/March-April 2015/vol 4/Issue 2/317-21.
15. Niven G. Fahmy, Dalia M. Ahmed, Ghada M. Sameer: A comparative study between the addition of MgSO4 against dexamethasone to bupivacaine in the prolongation of ultrasound-guided interscalene nerve block for shoulder arthroscopy; Ain-Shams Journal of Anesthesiology/2015/08/3:402-406.
16. B T Arish, D Dinesh Babu, Suneeth P Lazarus, D Dilip Chandar, K Suresh Kumar: Effect of dexamethasone as an adjuvant to local anesthetic in supraclavicular brachial plexus block; International Journal of Scientific Study/Jan 2016/Vol 3/Issue 10.

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