Original Article

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A Comparative Evaluation of MgSo4 and Dexamethasone as an Adjuvant to Local Anaestheticin Brachial Plexus Block (USG Guided) for Upper Limb Surgery

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Abstract

Background: The aim of this research was to evaluate the addition of MgSO4 beside dexamethasone to bupivacaine in the prolongation of ultrasound-guided supraclavicular brachial plexus block for uppet limb surgeries. **Subjects and Methods:** A total of 60 patients, ASA I and II grades, undergoing upper limb surgeries were registered in this research. The Ultrasound guided Supraclavicular brachial plexus block was performed with 0.5% bupivacaine 20 ml plus either 2 ml dexamethasone 8 mg (group D) or 2 ml of 10% MgSO4 (group M). The data collected were: the onset of sensory and motor block, the duration of sensory and motor block and the analgesic duration. **Results:** The onset of sensory and motor block, the duration of sensory and motor block and the time to first analgesic demand was significantly longer ($P<0.05$) in Group D. Intra-operative hemodynamics was analogous and no substantial side effect was observed in the research. **Conclusion:** Present research exhibits that the addition of Dexamethasone to Bupivacaine when compared to addition of MgSO4 to Bupivacain in supraclavicular brachial plexus block provides improved sensory and motor block duration and prolonged duration of analgesia with no side effects, therefore could be a additional balanced mixture.

Keywords: Dexamethasone, Magnesium Sulfate, Bupivacaine, Ultrasound, Supraclavicular Brachial Plexus Block.

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Introduction

Regardless of developments in perioperative care, chief surgical operations are still followed by sequel such as pain, organ dysfunction and extended recuperation.[1]

Subjects undergoing surgery in the upper extremity frequently account postoperative pain that is strong and hard to control. Regional anaesthesia has numerous advantages, including reduced hemodynamic unsteadiness, evasion of airway instrumentation, and intra-operative and postoperative analgesia.[2]

Peripheral nerve block not merely offers intraoperative anaesthesia but too expand analgesia in the postoperative phase without chief systemic side effects by minimizing stress retort and utilizing negligible anesthetic drugs.[3,4]

Upper limb surgeries are frequently carry out under peripheralnerve blocks such as brachial plexus block.[5]

Brachial plexus blockade for upper limb surgery is beneficial as the outcome of the drug is limited to the part of the body to be operated upon. It is devoid of complications linked with general anaesthesia. Moreover it offers premature oral feeding and ambulation thereby dipping postoperative complications.[6,7]

Brachial plexus blockade by supraclavicular approach is too recognized as spinal anaesthesia of the upper limb since its frequent application for upper limb surgical events. The dense structure of the plexus is an additional benefit to nerve block at this levels.[8]

Successful brachial plexus blocks rely on appropriate methods of nerve localization, needle placement, and local anaesthetic injection. Frequently, multiple trial-and-error needle efforts are necessary, ensuing in procedure-related pain and complications. Ultrasound guidance for brachial plexus blocks can potentially advance achievement and

difficulty rates.[9]

Local anaesthesia with both of the amides Lignocaine or Bupivacaine has a place in the option of anaesthetic for a unfortunate risk patient. Bupivacaine is extremely protein bound, 94% being bound to plasma protein compared with 64% Lignocaine at the same plasma concentration. The extended period of action of Bupivacaine has been connected to its tissue binding properties. With the accessibility of a long acting drug such as Bupivacaine, extended surgery can be performed, and postoperative analgesia is guaranteed.[10]

Subjects expand severe pain on the primary postoperative day following the effect of the local anaesthetics has worn off. As a result, continuation of the length of local anaesthetics is advantageous.[11] Adjuvants such as opioids, clonidine, verapamil, midazolam, dexmedetomidine, ketorolac etc. were added to local anaesthetics, to lower doses of each agent and improve the analgesic effectiveness while dipping the incidence of adverse reaction.[12]

Perineural injection of steroids is reported to influence postoperative analgesia.[13] Dexamethasone is a powerful and extremely selective glucocorticoid drug which helps by attenuating the release of inflammatory mediators, dipping ectopic neuronal discharge and inhibiting potassium channel mediated discharge of pain carrying nociceptive C – fibres.[14,15]

Magnesium's effects of N-methyl-D-aspartate (NMDA) receptor antagonism and sympathetic blocking have been noted, and magnesium is now utilized to decrease the expenditure of anaesthetics and pain medications. Magnesium blocks the effects of excitatory amino acids on NMDA receptors and supplies to central sensitization.[16]

Subjects and Methods

Randomized prospective observational research was performed during the period of 2017 to 2019 after Institutional Review Board approval on 60 subjects aged among 18 to 70 years of either sex of ASA grade I or II undergoing various scheduled upper limb surgeries under supraclavicular brachial plexus block using Inj.Bupivacaine with Inj.Dexamethasone and Inj.Bupivacaine with Inj.Magnesium Sulfate.

Pre-requisites

All subjects undergo a thorough pre-anaesthetic check-up which incorporated history taking, general and systemic examination. Routine investigations like Haemoglobin, Blood sugar, Blood urea, Serum creatinine, Serum electrolytes, Prothrombin time(PT) with International normalized ratio (INR) and liver function test were carried out for all the patients. Chest X-ray and ECG were also done. All patients were explained regarding VAS score in detail for postoperative assessment of analgesia.

Inclusion Criteria includes Patient aged among 18 to 70 years, Either sex, Having ASA grade I or II, Undergoing various upper limb surgeries, Planned surgeries,

Exclusion Criteria includes Subject's denial, Patients with identified hypersensitivity or contraindication to the study drugs, Local infection, Patient with altered coagulation profile or bleeding diathesis, Patients having weight <50 kg, Patients with mental retardation or neurological deficit.

Consent- The method was elucidates to the subject and written informed consent was taken.

Preparation- All subjects were kept nil by mouth for at least 6 hours previous to surgery. An intravenous line was secured with an intravenous cannula in the unaffected limb. Pulse oximeter, non-invasive blood pressure cuff and ECG electrodes were applied and baseline pulse, blood pressure, saturation and respiratory rate were recorded. Patients were arbitrarily owed to either of the two groups of 30 each.

Group M	Inj. Bupivacaine 0.5% 20 ml +Inj. Magnesium Sulphate 10 % 2 ml(200 mg)
Group D	Inj. Bupivacaine 0.5% 20 ml +Inj. Dexamethasone 2 ml (8 mg)

Premedication- All patients were premedicated with Inj. Ondansetron 0.08 mg/kg iv, Inj. Midazolam 0.02 mg/kg iv. Vitals were noted before and after pre-medication.

Procedure

POSITION: Proper positioning for supraclavicular block with the patient supine and head turned to opposite side with sandbag under the shoulder was given.

PROBE USED: After skin and transducer preparation, a linear 38- mm, high frequency 6-13 MHz transducer was placed firmly over the supraclavicular fossa in the coronal oblique plane to obtain the best possible transverse view of the subclavian artery and brachial plexus. The brachial plexus can be seen as a bundle of hypoechoic round nodules (e.g., "grapes") just lateral and superficial to the artery. Two different sonographic appearances of the brachial plexus are easily seen by changing the angle of the transducer orientation during imaging. The brachial plexus is typically visualized at a 1 to 2 cm depth at this location, an important anatomical characteristic of the plexus that must be kept in mind throughout the procedure.

Sensory and motor block were recorded at the regular intervals after drug injection.

Sensory block was evaluated using 3-point scale by the pin prick method.

Sensory block was graded as-

Grade 0	Sharp pin felt
Grade 1	Analgesia, dull sensation felt
Grade 2	Anaesthesia, no sensation felt

Complete sensory block was considered when there was complete loss of sensation to pinprick.[17]

Motor block was assessed by asking the patient to do abduction of arm and flexion of elbow. Motor block was determined according to Modified Bromage Scale of upper extremities.[18]

This scale consists of the following four scores:

Grade 0	Able to raise the extended arm to 90o for a full 2 sec
Grade 1	Able to flex the elbow and move the fingers but unable to raise the extended arm
Grade 2	Unable to flex the elbow but able to move the fingers
Grade 3	Unable to move the arm, elbow or fingers

After establishment of block surgery was started and time of beginning of surgery noted. If the effect was inadequate, general anaesthesia was given and those patients were

excluded from the study.

Intraoperatively tourniquet time, haemodynamic parameters like pulse rate, oxygen saturation, non-invasive arterial blood pressure, ECG were monitored intraoperatively. Postoperatively patients were observed for hemodynamic variations and any complications of block like pneumothorax, local anaesthetic toxicity and side effects of drugs used.

Pain assessment was done by using Visual Analogue Scale (VAS) which was express it on 11-point numerical scale 0-10.

0 = No pain (one extreme)

10 = Worst pain possible (other extreme)

Duration of analgesia was time from completing block to the time demanding first rescue analgesia (VAS>4). Rescue analgesia in the form of injection Diclofenac 1.5mg/kg intravenously was given to patients with VAS > 4.16

Statistical Analysis

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented as Mean ± SD and results on categorical measurements are presented in Number (%). The student "t" test was used to determine whether there was a statistical difference between study groups in the parameters measured. In the above tests the "p" value of less than 0.05 was considered as statistically significant.

Results

After studying 60 cases, observation and results are summarized in tabulated form and described below. Both groups comprised of 30 patients each.

Table 1: Patient Characteristics

		Group D	Group M	P value	Inference
Gender	Male	21	22	0.88	NS
	Female	9	8	0.80	NS
Age (Years)		40.7 ± 14.5	39 ± 14.7	0.65	NS
Weight (kg)		64.5 ± 8.7	67 ± 8.5	0.26	NS
ASA Grade	Grade I	18	19	0.87	NS
	Grade II	12	11	0.83	NS
Duration of Surgery (Min.)		98.2 ± 38.1	88.2 ± 39.5	0.32	NS

[Table 1] describes the demographic data in both the groups (D and M) were comparable. Duration of surgery was also similar in both the groups.

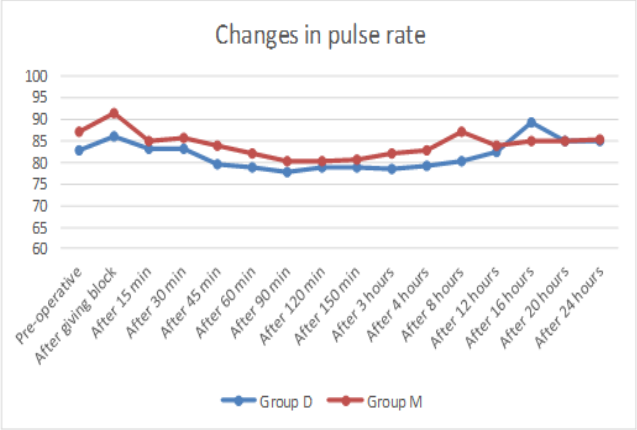

Figure 1: Changes in Pulse rate

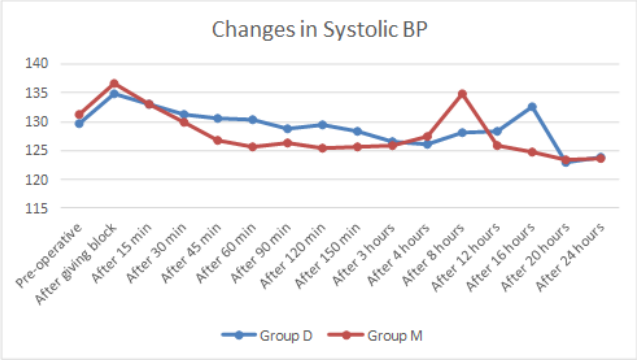

Figure 2: Changes in Systolic BP

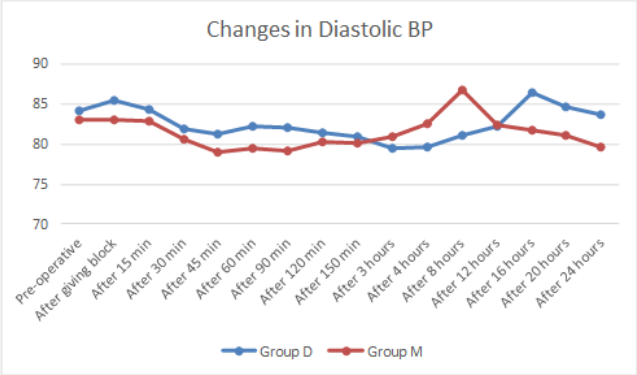

Figure 3: Changes in Diastolic BP

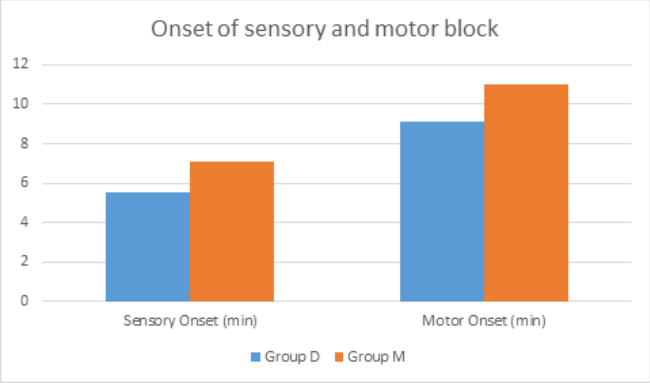

Figure 4: Onset of sensory and motor block

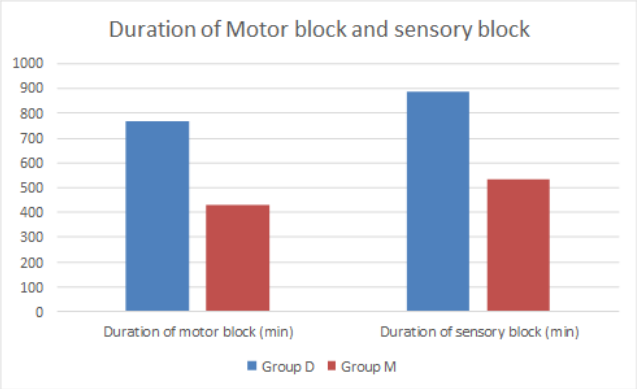

Figure 5: Duration of motor block and sensory block

As illustrated above in [Figure 1-3] there were no significant changes in hemodynamic parameters in all patients of either of the groups.

The onset of sensory block was quicker in Group D (5.5 ± 2.1 min) contrast to Group M (7.1 ± 1.3 min). The comparisons of onset of sensory and motor block between two groups were statistically significant ($p < 0.05$).

The duration of motor block was longer in Group D (767.5 ± 111 min) as compared in Group M (428.6 ± 76.5 min). The duration of sensory block was longer in Group D (887.1±120.8 min) compared to Group M (534.4 ± 112.2min). The comparison of duration of motor block and sensory block between two groups were statistically significant ($p < 0.05$).

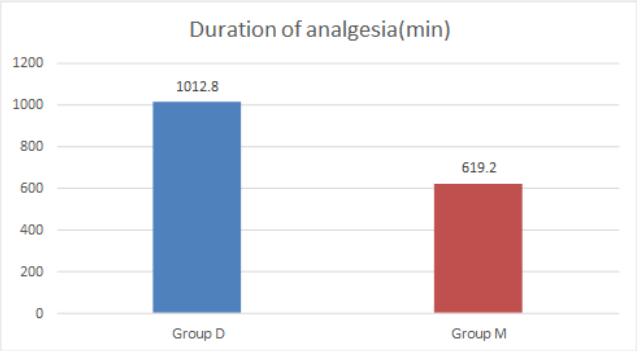

Figure 6: Duration of analgesia

The duration of analgesia was longer in Group D (1012.8 ± 105.4 min) in comparison to Group M (619.2 ± 124.4 min). The comparisons of duration of analgesia among two groups were statistically significant ($p < 0.05$).

Table 2: Complications & Adverse Effects

	Group D	Group M
Pneumothorax	Nil	Nil
Hematoma	Nil	Nil
Horner's Syndrome	Nil	Nil
Nausea and vomiting	Nil	Nil
Bradycardia	Nil	Nil
Hypotension	Nil	Nil
LAST	Nil	Nil

As illustrated in Table 8, no complications or adverse effects were noted in any of the two groups throughout our study period.

Discussion

Supraclavicular block is a usually performed anaesthetic technique for patients undergoing surgeries on the upper limb due to rapidity of onset, dense and expected anaesthesia of entire upper extremity in the most dependable way of any brachial plexus technique. The use of USG has revolutionized the field of regional anaesthesia by increasing the success rates of peripheral nerve blocks and avoiding complications such as inadvertent intravascular injection, and pneumothorax, which were seen with the classical"Blind"/"Landmark" techniques.

In the present research, there is comparison of 8 mg Dexamethasone (Group D) and 200 mg Magnesium Sulfate (Group M) as adjuvants to Bupivacaine 0.5% in ultrasound guided supraclavicular brachial plexus block.

Demographic data comparing age, sex, weight, ASA risk as well as peri operative hemodynamics were comparable in both the groups as shown in the observation.

In our study, the mean time of onset of sensory block was 5.58 ± 2.1 min and mean time of onset of motor block was 9.1 ± 2.5min in Group D.

Engineer SR et al observed that onset of sensory block was 7.12 ± 1.73 min and onset of motor block was 11.46 ± 2.39 min with 8 mg Dexamethasone with 0.375% 30 ml Bupivacaine in supraclavicular brachial plexus block with classical approach.[19,20]

Raghavan RK et al,[21] studied 8 mg Dexamethasone as adjuvant to 0.25% 20 ml Bupivacaine and 10 ml 2% Lignocaine with 1:200000 Adrenaline in supraclavicular brachial plexus block by conventional method. It was observed that onset of sensory block was 6.8 ± 2.384 min and onset of motor block was 9.4 ± 2.29 min.

These results concur to our study.

Rai S et al,[22] studied 8 mg Dexamethasone with 0.5% 30 ml Bupivacaine in USG guided supraclavicular brachial plexus block. They observed that onset of sensory block was 6.49 ±1.09 min and onset of motor block was 14.63 ± 2.39 min. The onset of sensory block is similar to our study however onset of motor block was found quicker in our study.

In our study, the mean time of onset of sensory block was 7.1±1.3 min and mean time of onset of motor block was 11± 1.4 min in Group M.

Verma V et al,[19] in their study of Magnesium Sulfate and 0.5% 20 ml Bupivacaine in USG guided supraclavicular brachial plexus block.

Raghavan RK et al,[21] observed that onset of sensory block was 8.7 ±1.896 min and onset of motor block was 10.27 ±2.39 min.

Above findings are consistent with present research.

In the present research, the mean time of onset of sensory block was 7.1±1.3 min and mean time of onset of motor block was 11± 1.4 min in Group M.

Verma V et al,[19] in their study observed that onset of sensory block were 8.9 ± 2.3 min and 5.17 ± 2.2 min with 125 mg MgSO4 and 250 mg MgSO4 respectively. Raghavan RK et al (21) observed that onset of sensory block was 8.7 ±1.896 min and onset of motor block was 10.27

±2.39 min.

Above findings are consistent with present research.

In our study, the duration of motor block, duration of sensory block and duration of analgesia in Group D were 767.5 ± 111 min, 887 ± 120.8 min and 1012.8 ± 105.45 min respectively. Similar findings were observed by Golwala MP et al and Shaikh MR et al.[23,24]

Rai Set al,[22] studied 8 mg Dexamethasone with 0.5% 30 ml Bupivacaine in USG guided supraclavicular brachial plexus block observed that duration of motor block was 870.87 ± 101.14 min and duration of analgesia was 1160 ± 143.1 min.

Hoq N et al,[25] in a similar study observed that duration of motor block was 846.47 ± 102.69 min and duration of analgesia was 1091.17 ± 107.42 min with 0.5% Bupivacaine 2 mg/kg and Dexamethasone (0.2mg/kg) with distilled water 15 ml in supraclavicular brachial plexus block with classical approach.

Above findings are consistent with present research.

The addition of Dexamethasone as an adjuvant to regional anaesthesia with local anaesthetics has added a newer feature to medical utilizations of corticosteroids. Steroids have very sturdy anti inflammatory and immunosuppressive effects. Perineural injection was found to be safe, devoid of adverse effects.[26,27,28,29]

In the present research, the duration of motor block, duration of sensory block and duration of analgesia in Group M were 428.6 ± 76.5 min, 534.4 ±112.2 min and 619.2±124.4 min respectively.

Verma V et al,[19] studied Magnesium Sulfate and 0.5% 20 ml Bupivacaine in USG guided supraclavicular brachial plexus block. They observed that duration of motor block, duration of sensory block and duration of analgesia were 401.7 ± 56.1 min, 451.47 ± 51.632 min and 475.1 ± 53.29 min respectively with 125 mg MgSO4. Whereas they were 569 ± 100.8 min, 641.87 ± 100.152 min and 665.13 ± 97.87 min respectively with 250 mg MgSO4.

Hamed RA et al,[30] in their study of USG guided supraclavicular brachial plexus block used 200 mg MgSO4 with 0.5% 18 ml Bupivacaine. They observed that duration of analgesia was 558 ± 48 min.

Above findings are consistent with present research.

Raghavan RK et al,[21] studied 150 mg Magnesium Sulfate as adjuvant to 0.25% 20 ml Bupivacaine and 10 ml 2% Lignocaine with 1:200000 Adrenaline in supraclavicular brachial plexus block by conventional method. They observed that duration of analgesia was 628.02 ± 182.06 min.

The primary theory of present research, about the effect of MgSO4 as an adjuvant on peripheral nerves is on the foundation of on the surface charge theory as explained by Akutagawa T et al.[31]Mert T et al,[32] too observed Similar Findings.

No hemodynamic instability such as tachycardia, bradycardia, hypotension, was present in a few of the subjects in both the study groups. Our observations were similar to Azzazi E et al,[14] Patel D et al,[33] and Rai S.[22]

No complications or significant adverse effects were present in all the study groups.Our findings were supported by Azzazi E et al,[14] Kumar S et al,[15] and Patel D et al,[33] who also performed ultrasound guided supraclavicular brachial plexus block.

Conclusion

From our research of the use of Dexamethasone (8mg) and Magnesium Sulfate (200mg) as an adjuvant to local anaesthetic solution (0.5% Bupivacaine) in USG Guided supraclavicular Brachial plexus block for upper limb surgeries, it was observed that

1. Faster onset of sensory and motor block is seen with Dexamethasone as compared to Magnesium Sulfate.
2. Duration of motor and sensory block is significantly extended with Dexamethasone as compared to Magnesium Sulfate.
3. Duration of post operative analgesia is significantly prolonged with Dexamethasone as compared to Magnesium Sulfate.
4. Hemodynamic parameters and side effects are comparable between the two drugs.

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