A Comparitive Study Between Magnesium Sulphate Versus Dexamethasone as an Adjuvant to Bupivacaine in Supraclavicular Brachial Plexus Block

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Abstract

Introduction: Magnesium Sulphate and Dexamethasone are used as adjuvants to local anaesthetics in regional anaesthesia to improve the quality of block

Objective: To compare the efficacy of magnesium sulphate and dexamethasone on the characteristics of the block and its effect on postoperative analgesia when added as an additive to bupivacaine in supraclavicular brachial plexus block.

Materials and Methods: Fifty patients belonging to American Society of Anaesthesiologists (ASA) Grade I and II, aged between 18 to 55 years, scheduled for elective upper limb surgeries under supraclavicular brachial plexus block were enrolled in this study. Patients were equally divided into two groups : group M received 0.5% Bupivacaine 30ml with 10% Magnesium sulphate 5 ml (500mg) and group D received 0.5% Bupivacaine 30ml with Dexamethasone 2ml (8mg) + Normal saline 3ml. Onset and duration of sensory and motor block , duration of postoperative analgesia and any complications were observed.

Results: In our study the demographic profile of patients, duration of surgery and ASA status between the two groups were comparable. Onset of sensory block was earlier in group D than group M (17.12±0.93 minutes and 19.40 ±1.08 minutes respectively, p=0.001). Duration of motor block and analgesia were longer in group D as compared to group M (479.00 ±50.83 minutes vs 346.40 ±32.77 minutes respectively, p= 0.001 for motor block and 533.80 ±59.80 minutes vs 415.00 ±57.23 minutes respectively, p=0.001 for analgesia). No significant side effects were noted.

Conclusion: Dexamethasone is a better adjuvant than Magnesium Sulphate when added to bupivacaine in supraclavicular brachial plexus block as it prolongs duration of motor block and analgesia significantly with minimal side effects.

Key Words: *Magnesium Sulphate, Dexamethasone, Supraclavicular Brachial plexus block*

Introduction

Regional anaesthesia for upper limb surgeries have an edge over general anaesthesia as it has many benefits like ensuring superior quality of intraoperative and postoperative analgesia, stable hemodynamics and avoidance of airway manipulation [1].

Supraclavicular approach to brachial plexus block gives a rapid onset and dense block as it is performed at the level of the brachial plexus trunks which is confined to a very small surface area [2]. Bupivacaine, the amide local anaesthetic, usually used for brachial plexus block

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has a duration of action from 3 to 6 hours which may be insufficient for providing satisfactory postoperative analgesia. Hence various adjuvants have been used to prolong its effect [3]. These include epinephrine, midazolam, magnesium sulfate, alpha-2 agonists i.e. Clonidine and dexmedetomidine [3,4,5,6]. Magnesium is a physiological calcium channel blocker and has N-methyl-D-aspartate (NMDA) receptor antagonist effect which prevents central sensitization by the peripheral nociceptive stimulation and is used to prolong the duration of block [7]. Dexamethasone has been also studied recently as an additive in regional blockade [8]. It relieves pain by reducing inflammation and blocking the transmission of nociceptive C-fibers and suppressing ectopic neural discharge [9].

The aim of this study was to compare the efficacy of magnesium sulfate and dexamethasone in terms of duration of analgesia, onset and duration of sensory and motor block, when used as an adjuvant to 0.5% bupivacaine in supraclavicular brachial plexus block.

Material And Methods

After obtaining approval from the institutional ethics committee and patients informed consent, a prospective observational study was carried out on 50 patients of American Society of Anaesthesiologists (ASA) grade I and II of either gender, aged 18 to 55 years undergoing elective upper limb surgery under supraclavicular brachial plexus block. Patients with the following conditions were excluded from the study: coagulopathy, local infection at site of block, known allergy to local anesthetic or adjuvants used, renal or hepatic dysfunction, pregnant women, neuromuscular disorder, psychiatric or neurological deficit.

50 patients were divided into two groups of 25 each:

Group M received 30 ml of 0.5% bupivacaine with 5 ml of 10% Magnesium Sulphate (500 mg).

Group D received 30 ml of 0.5% bupivacaine with Dexamethasone 2 ml (8mg) + normal saline 3ml.

Patients were familiarized with the Visual Analogue Scale (VAS)[4] for pain preoperatively and they were kept nil per orally 6 hours for solids and 2 hours for clear fluids preoperatively .

On arrival to the operating room, an 18-gauge intravenous (i.v.) line was secured in the nonoperating hand and Ringer lactate solution was started at a rate of 5 ml/kg/h. Standard ASA monitors were attached namely electrocardiography (ECG), pulse oximetry (Sp02), noninvasive blood pressure measuring systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) . Oxygen was administered by nasal prongs @4 L/min. All patients were premedicated with Injection (Inj.) Glycopyrrolate 0.004mg/kg i.v, Inj. Ondansetron 0.1 mg/kg i.v and Inj. Midazolam 1mg i.v.

Block was performed with patient in supine position, head turned away from the side to be blocked and with the arm to be anaesthetized adducted. With all antiseptic and aseptic precautions, midpoint of the clavicle was identified and 1.5 to 2 cm posterior to the midpoint of the clavicle in the interscalene groove a 22G , 5cm insulated needle was inserted and directed in a caudate, slightly medial and posterior direction and block was given with the aid of a peripheral nerve stimulator . Once the desired motor response is obtained (i.e., muscle twitch of the fingers) at a current of 0.8 mA, 35ml of study drug was administered after negative aspiration [10].

The Sensory Block (SB) was assessed by pinprick method and was graded as follows [11]: 0 = No block (normal sensation), 1 = Partial block (loss of sensation to

Pinprick/ decreased sensation) and 2 = Complete block (loss of touch sensation/ no sensation). The onset time of the SB was taken as the time interval from injection of study drug till complete sensory block (SB=2) was achieved. The duration of the SB was the time interval between the onset of complete sensory block (SB = 2) and its complete resolution (SB=0). Duration of analgesia was the time interval between the onset of the complete SB (SB=2) and time when VAS (Visual Analog Scale) was ≥4.

The Motor Block (MB) was graded according to Bromage three-point score [12]: 0= normal motor function with full flexion and extension of elbow, wrist and fingers, 1 = decrease motor strength with ability to move fingers only and 2= complete motor blockade with inability to move fingers [12]. The onset time of the

MB is the time interval between injection of study drug and achievement of complete motor block (MB=2). The duration of MB is the time interval between the onset of the complete MB and complete resolution of the MB. The block was considered successful when complete sensory and motor block was achieved within 30 min after injection of the study drug and inadequate block was excluded from the study.

Hemodynamic parameters were noted at 0 min, 3 mins, 5 mins and every 15 mins till the end of surgery. Postoperatively, patients were assessed for sensory block, motor block and analgesia. Rescue analgesia was given when VAS ≥ 4. Any perioperative complications were also noted.

Statistical Analysis

All the data were expressed as mean ± standard deviation. Quantitative data were compared using Student's unpaired *t*-test, while qualitative data were compared using Student's paired *t*-test. Statistical Package for Social Sciences (SPSS, IBM version 22.0) was used to compare continuous variables between the two groups. $P < 0.05$ was considered statistically significant.

Results

50 patients were enrolled in the study with 25 patients in each group and they were comparable with respect to demographic profile.

The onset time of sensory block was earlier in group D as compared to group M (17.12 ± 0.93 minutes and 19.40 ±1.08 minutes respectively, p = 0.001). There was no statistically significant difference between the groups in regard to onset time of motor block. Group D had longer duration of motor block than group M (479.00 ± 50.83 minutes and 346.40 ± 32.77 minutes respectively, p = 0.001) as shown in Table 1. The duration of sensory block was longer in group D but not statistically significant. Group D had significantly prolonged duration of analgesia as compared to group M (533.80 ± 59.80 minutes and 415.00 ± 57.23 minutes respectively, p= 0.001). The baseline haemodynamic parameters were comparable in both groups. The mean pulse rate in group M at 3, 5, 10, 15, 30 minutes were significantly lower than in group D (p<0.05). Side effects were comparable in both groups.

Table 1 : Characteristics of supraclavicular block

Characteristics of block	Group D	Group M	p value
	Mean±SD(in minutes)	Mean ± SD (in minutes)	
Onset of sensory block	17.12 ± 0.93	19.40 ±1.08	0.001
Onset of motor block	12.56±1.00	12.80±1.41	0.493
Duration of sensory block	440.80±42.83	426.00±39.05	0.208
Duration of motor block	479.00±50.83	346.40±32.77	0.001
Duration of post op analgesia	533.80±59.80	415.00±57.23	0.001

Discussion

The observations of our study showed that dexamethasone 8mg is a superior adjuvant than $MgSO_4$ 500mg when used with local anaesthetic for supraclavicular brachial plexus block as it significantly increased duration of motor block and analgesia. Previous researches have concluded that Magnesium Sulphate (Mg SO_4) when used as an additive to local anaesthetic increased the duration of analgesia, sensory

and motor block [4,13,14]. AM Abdelfatah et al in their randomized double-blind study of 60 patients undergoing interscalene block using 500 mg $MgSO_4$ with 20 ml of Lidocaine 2% with epinephrine 1:200000 versus control have found that $MgSO_4$ significantly prolonged duration of analgesia [15]. N-methyl-D-aspartate (NMDA) receptors plays a role in central nociceptive transmission and the potential analgesic effect of magnesium sulphate is due to its antagonistic effect on NMDA receptors [16]. $MgSO_4$ also has properties of regulating calcium influx in cells and interferes with the release of neurotransmitters at the synaptic cleft thereby potentiating the action of local anesthetic [17]. Its effect as an adjuvant is also explained by the surface charge theory which suggests that modulation of the external magnesium concentration results in the synergistic effect on nerve blockade with local anesthetic [18].

Various studies have explored the use of dexamethasone as an adjuvant in brachial plexus block and have agreed that it causes faster onset of block action and increased both duration of block and analgesia [19,20,21,22]. Albrecht et al did a systematic review and indirect meta-analysis comparing dexamethasone and dexmedetomidine, as to identify the better adjunct and they concluded that dexamethasone is superior to dexmedetomidine as a perineural adjunct for supraclavicular brachial plexus block as it prolonged the duration of analgesia by a mean difference (95% confidence interval [CI]) of 148 minutes (37-259 minutes) (P = .003) [23]. Sudha et al conducted a randomized comparative study between tramadol (2mg/kg) and dexamethasone (.15mg/kg) as an adjuvant to bupivacaine 0.5% (2mg/kg) in supraclavicular blocks. The mean duration of postoperative analgesia in the dexamethasone group was 1023.87±161.01minutes while in the tramadol group it was 454.47±44.29 minutes, p-value<0.05 [24].

Dexamethasone prolongs block duration by enhancing the action of inhibitory potassium channels on nociceptive C fibres or by causing vasoconstriction via glucocorticoid receptor mediated nuclear transcription modulation. Suppression of inflammatory mediators including prostaglandins (PGE2) may also play a role [25,26,27]. In our study, we found that dexamethasone gave better duration of analgesia and prolonged motor blockade than $MgSO_4$when used as an additive in supraclavicular brachial plexus block. This result was similar to the observations of the randomized double blind study conducted by Hamed et al [28]. In their study, 90 patients were divided into three groups; group one received 20 ml 0.5% bupivacaine, group two received 18 ml 0.5% bupivacaine and 8mg dexamethasone and group 3 received 18 ml 0.5% bupivacaine and 200mg $MgSO_4$. The sensory block onset time in minutes(min) was earlier in dexamethasone group than $MgSO_4$ (8.20±2.09 versus 12.70±2.92, p<0.05). Also group 2 (dexamethasone) had a faster onset of motor block than group 3($MgSO_4$)[1.50±2.09 min versus 12.75±3.43 min, p<0.05]. Motor block was significantly prolonged in group 2 than 3 (563±69.29 min and 214.50±36.92 min respectively, p<0.05); similarly group 2 had a longer duration of analgesia as compared to group 3 (1104.00±289.16 min and 558±48.08 min respectively, p<0.05) [28]. Fahmy NG et al did a analysis in which 500 mg $MgSO_4$, dexamethasone 8 mg and 0.9 % Normal Saline 5ml were compared as adjuvants to 0.5% Bupivacaine 20 ml and they observed that both dexamethasone and $MgSO_4$ prolonged the duration of analgesia significantly as compared to the control group [29]. Radha et al also proved that 8mg Dexamethasone prolonged duration of analgesia significantly more than 150 mg of $MgSO_4$when added to 30 ml of local anaesthetic [30].

Conclusion

Dexamethasone is a better adjuvant than $MgSO_4$ for supraclavicular brachial plexus block as it provided faster onset of action and longer duration of motor block and analgesia with minimal side effects.

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