



EFFECT OF MAGNESIUM SULPHATE PRETREATMENT ON ONSET, DURATION OF ACTION AND RECOVERY OF NEUROMUSCULAR BLOCKADE WITH VECURONIUM

Anaesthesiology

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ABSTRACT

Aim: To determine the effectiveness of magnesium sulphate pretreatment on the onset of action of vecuronium and on the duration of action of vecuronium. **Material And Methods:** 100 patients of aged between 18-55 years of ASA grade I and II undergoing surgery under general anaesthesia were included and divided in two groups. Fifteen minutes before induction of anaesthesia, patients in Group- I received magnesium sulphate 40mg/kg in 0.9% normal saline 100 ml as an intravenous infusion over 15 minutes, and Group-II received 0.9% normal saline 100 ml without magnesium sulphate. After the end of surgery, when the amplitude of T1 was recovered to 10%, patients in both groups received inj. neostigmine 0.05 mg/kg and inj. glycopyrolate 0.02mg/kg IV. After neostigmin-glycopyrolate administration, T1 was measured up to 10 minutes in both groups. Neuromuscular transmission was assessed by electromyography on the left hypothenar muscle, using trans-cutaneous electrodes. The measurement was done after induction of anaesthesia. **Result:** reduction in mean onset time was statistically highly significant in magnesium sulphate group 171.26±30.97 sec vs control group 281.02 ± 33.22 second, (p<0.0001). The mean duration of action was prolonged in magnesium sulphate group 44.26±9.92min vs control group 28.6±6.83m, and was statistically highly significant, (p<0.0001). We used neuromuscular monitoring by train of four (TOF) because the response of neuromuscular blocking drugs is not predictable. Hence, TOF monitoring by NMT provided more predictable and rational approach to the use of muscle relaxants. **Conclusion:** Magnesium hastens the onset of neuromuscular blockade as well as reduces the variability of onset time of neuromuscular blockade and decreases the recovery rate of vecuronium and so prolongs the duration of action of blockade

KEYWORDS

vacuronium, magnesiumsulphate, neuromuscular monitoring

INTRODUCTION

General anaesthesia is a medically induced coma with loss of protective reflexes, resulting from the administration of one or more general anaesthetic agents. It is done to allow intolerably painful medical procedures in the patient.¹

Nondepolarizing neuromuscular blocking agents are competitive acetyl choline antagonist that binds directly to nicotinic receptor on post synaptic membrane, blocking binding of acetyl choline to its receptors. Thus, these agents do not depolarize motor end plate and leads to muscle paralysis.²

Neuromuscular monitoring is a technique that involves the electrical stimulation of a motor nerve and monitoring the response of the muscle supplied by that nerve.³

Magnesium sulphate antagonize the action of calcium ion that binds to acetylcholine vesicles and on presynaptic motor nerve terminals and leads to decrease the amount of acetylcholine release, which decrease the excitability of muscle fiber and amplitude of end plate potential. Hence it potentiates the neuromuscular block produced by nondepolarizing neuromuscular blocking agents.⁴

MATERIALS AND METHODS

After obtaining approval from ethical committee the prospective, randomized controlled trial study was done in G.R. Medical College, J.A. Group of hospitals, Gwalior (M.P) . 100 patients of aged between 18-55 years of ASA grade I and II undergoing surgery under general anaesthesia were included and explained about the procedure and written consent was taken.

All the patients were examined a day before surgery to do complete general, physical and systemic examination. All the required routine and special investigations as per hospital protocol was carried out.

All patients were kept nil orally for at least 6 hours before the procedure. Upon arrival of the patient in the operation theatre, intravenous access with 18 G cannula was inserted into the patient's forearm. All routine monitors were connected and observations were

recorded by multipara monitor. Preloading was done with approximately 10ml/kg of lactated ringer solution. All the baseline vital parameters were recorded preoperatively.

All patients were premedicated with inj. Midazolam 1mg IV, inj. Glycopyrolate 0.2mg IV, and inj. Fentanyl 2µg / kg IV as analgesic. Fifteen minutes before induction of anaesthesia, patients in Group- I received magnesium sulphate 40mg/kg in 0.9% normal saline 100 ml as an intravenous infusion over 15 minutes, and Group-II received 0.9% normal saline 100 ml without magnesium sulphate.

In both groups, anaesthesia was induced with thiopentone 5 mg/kg. Then, neuromuscular transmission was set to deliver supramaximal train-of-four (TOF) stimulus at 2 Hz frequency to get control twitch height. Patients in all groups received inj. vecuronium bromide 100 µg/kg and tracheal intubation was done with appropriate size endotracheal tube when maximum twitch depression occurred and anaesthesia was maintained with 1% isoflurane and 60% nitrous oxide in oxygen. Along with intermittent inhalation anesthetic agents of 0.5 MAC to prevent awareness with controlled ventilation. Inj. Vecuronium was administered as necessary to maintain muscle relaxation all standard monitoring were observed closely intra-operatively.

After the end of surgery, when the amplitude of T1 was recovered to 10%, patients in both groups received inj. neostigmine 0.05 mg/kg and inj. glycopyrolate 0.02mg/kg IV. After neostigmin-glycopyrolate administration, T1 was measured up to 10 minutes in both groups. Endotracheal extubation was done and all patients were oxygenated and observed in operating room till all the signs of recovery were achieved.

Neuromuscular transmission was assessed and the measurement was done after induction of anaesthesia. The relaxograph was set to deliver supramaximal train-of-four (TOF) stimuli (0.1 mg duration) at 2 Hz every 20th second. The first of the four responses was considered at twitch height (T1); TOF ratio was noted. Body temperature was maintained (36.0-36.5°C) constant during the study. The following parameters were measured in both the groups:

- Arterial blood pressure
- Time of onset = Time between administration of vecuronium and maximal twitch depression.
- Clinical duration of action = Time between administration of vecuronium and 25% recovery of T1
- Recovery index = Time from 25% to 75% recovery of T1
- Clinical sign of neuromuscular recovery after reversal of neuromuscular block. i.e ability to open the eyes widely, cough effectively, sustain tongue protrusion, hand grip, head lift, leg raising.

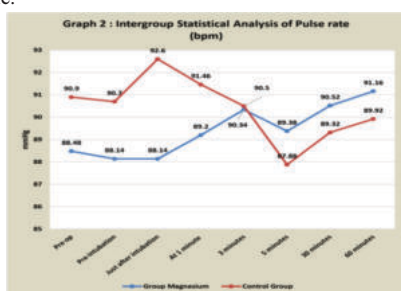
OBSERVATION AND RESULT

Table 1: Demographic Profile

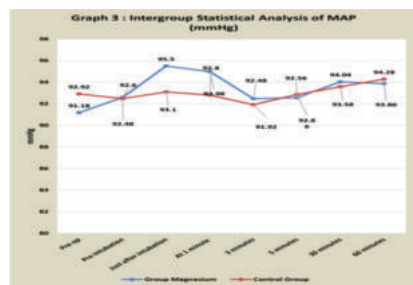
Demographic parameter		Group Magnesium (n=50)	Control Group (n=50)	p value
Age (years)	40.38±10.84	40.1±10.7	0.896	0.527
Weight (Kg)	59.1±5.48	57.5±6.83	0.200	
Gender	Male	35 (70%)	31 (62%)	0.689
	Female	15 (30%)	19 (38%)	
ASA	I	23(46%)	25(50%)	0.689
	II	27(64%)	25(50%)	

In the present study, due to the age wise distribution of participants, it was found that mean age of the participants in Group Magnesium was 40.38±10.84 years and control group was 40.1±10.7 years. The difference between groups were statistically insignificant ($p>0.05$) and comparable.

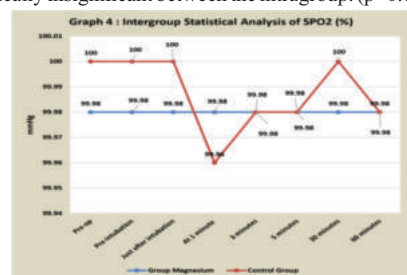
In the present study, due to the weight wise distribution of participants, it was found that mean weight of the participants in Group Magnesium was 59.1±5.48 kg and control group was 57.5±6.83 kg. The difference between groups were statistically insignificant ($p>0.05$) and comparable.



In the present study, pulse rates were noted down as Pre-op, Pre-intubation, just after intubation, At 1, 3, 5, 30 and 60 minutes for patients which was statistically insignificant between the intragroup. ($p>0.05$)

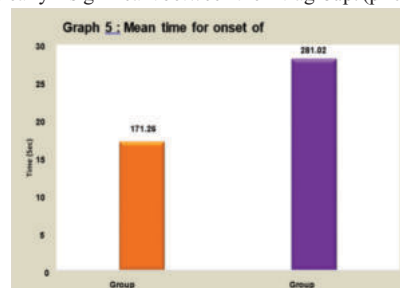


In the present study, MAP were noted down as Pre-op, Pre-intubation, just after intubation, At 1, 3, 5, 30 and 60 minutes for patients which was statistically insignificant between the intragroup. ($p>0.05$)

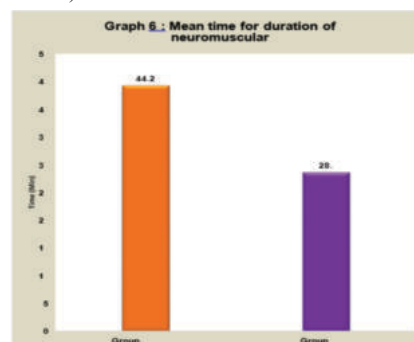


In the present study, SPO2 were noted down as Pre-op, Pre-intubation,

just after intubation, At 1, 3, 5, 30 and 60 minutes for patients which was statistically insignificant between the intragroup. ($p>0.05$)



In the present study, due to onset time of neuromuscular block, it shows mean onset time was found statistically highly significant between group magnesium 171.26±30.97 sec vs control group 281.02±33.22 second. ($p<0.0001$)



In the present study, duration of neuromuscular block, it shows mean duration time was found statistically highly significant between group magnesium 44.26±9.92min vs control group 28.6±6.83min. ($p<0.0001$).

DISCUSSION

The present study, was done to compare the time of onset and duration of action of neuromuscular blockade, with and without magnesium sulphate 40 mg/kg pretreatment, and to see any adverse events in patients posted for surgery under general anaesthesia.

Demography Paramters

In our study, as shown in table no 1 the demographic profiles in terms of age, weight, sex, were comparable between the two groups and were statistically insignificant, (p value >0.05).

The mean and standard deviation of age and weight were calculated as (40.38±10.84 yrs vs 40.1±10.7 yrs) and (59.1±5.48 kg vs 57.5±6.83 kg) for both the groups respectively which was statistically not significant. ($p>0.05$). The gender status in both the groups were majority males (70% vs 62%) than females (30% vs 38%).

The results of the ASA classification status described as majority of patients from group I belonged to ASA II status and In group II there was equal number of patients from both ASA grades

Another study such as Nalini KB et al⁶ have found that Demographic parameters like age (34.44±12.91 yrs vs 34.12±12.62 yrs); ($p=0.73$) and weight (55.24±4.44kg vs 56.84±7.44 kg) were statistically insignificant in both groups (group-M and group-Control) and were comparable. However, the gender status in the group M, majority were females (52.5%) then males (47.5%). While in control group male (55%) were higher than female (45%). Additionally, it was observed that ASA grade were mostly belongs to grade I then ASA grade II in both the groups. Another similar study done by Singh S et al⁷ and Buder TF et al⁷ had no significant differences in age, weight, sex and ASA status, (p value >0.05).

Hemodynamic Parameters

In our study, baseline Heart rate, mean arterial blood pressure at different time intervals as Preop, Pre-intubation, Just after intubation, after 1, 3, 5, 30, and 60 minutes after intubation among the two groups were noted and compared. The mean and standard deviation of all the parameters were calculated. The results obtained from analysis, as shown in graph 2, showed that there was increase in heart rate,

compared to baseline in both groups at 1 minute after intubation but this may be due to stress response. They gradually returned to the baseline value at 5 minutes and there was no statistically significant difference (p value >0.05).

The results obtained from analysis, as shown in graph 3, showed that there was increase in mean arterial pressure, compared to baseline in both groups just after intubation till 1 minute after intubation. They gradually returned to the baseline value at 3 minutes and there was no statistically significant difference (p value >0.05).

It was found out that the changes in heart rate, mean arterial blood pressure were comparable in both the groups at different intervals and had no significant difference (p value >0.05).

Our study also in accordance with **Nishimaya M et al⁸ & Singh S et al & Abdulatif M et al⁹**

Onset And Duration Of Blockade Time

In the present study, as shown in graph 5, mean onset time was found to be significantly reduced in Magnesium Sulphate group as compared to control group (171.26 ± 30.97 sec vs con 281.02 ± 33.22 sec) which was statistically highly significant ($p < 0.0001$).

As shown in graph 6, duration of neuromuscular duration of blockade time was found to be significantly prolonged in Magnesium Sulphate group as compared to control group (44.26 ± 9.92 min vs 28.6 ± 6.83 min) which was statistically highly significant, ($p < 0.0001$).

Kauffman B et al¹⁰ determined the effects of prior administration of $MgSO_4$ 60 mg/kg intravenous, on the onset and duration of rocuronium induced neuromuscular block. [14] They found that mean onset time were similar in $MgSO_4$ group (71 ± 20 seconds) and in normal saline group (75 ± 23 seconds), but times to initial, 10% and 25% recovery from neuromuscular block were significantly longer in the $MgSO_4$ group 42.1 ± 16.3 , 49.0 ± 12.4 and 56.5 ± 13.2 minutes respectively, than in the saline group 25.1 ± 9.1 , 33.0 ± 11.1 and $35.6 \pm$ minutes, respectively ($p < 0.05$).

our study is also in accordance with Singh S et al⁶, Nalini mKB et al 5 & **Fuchs-Buder et al⁷** When compared to the control group, the $MgSO_4$ pre-treated group had an earlier onset time and a longer clinical duration of atracurium-induced neuromuscular block. These findings were also consistent with the findings of **Azer et al⁴** who found that pre-treatment with $MgSO_4$ significantly accelerated the onset of atracurium compared to control group. The mean onset time was 1.76(0.36) min and 2.14(0.42)min ($p = 0.002$), respectively. Furthermore significant prolongation of its clinical duration is seen from 27.32 ± 3.74 min in control, to 34.7 ± 5.91 in magnesium sulphate group ($P < 0.0001$).

In our study, patients who received $MgSO_4$ before vecuronium had a faster onset, a longer clinical duration, and a delayed recovery from vecuronium induced neuromuscular block. Several studies have reported similar findings, demonstrating the effect of $MgSO_4$ on the clinical duration of various neuromuscular blocking drugs.

CONCLUSION

From our clinical comparative study, It can be concluded that there is early onset of action and prolonged duration of action of vecuronium with Magnesium sulphate pretreatment. Both the drugs provided stable haemodynamic status in terms of changes in heart rate and mean arterial blood pressure and none of the participant from either group shown any adverse reaction.

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