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The effects of magnesium sulphate-pretreatment on suxamethonium-induced complications during induction of general endotracheal anaesthesia.

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Summary

To determine the effects of Magnesium-Sulphate-pretreatment on Suxamethonium-induced complications (serum potassium rise, fasciculations and apnea). Eighty-four adult patients were selected and randomly allocated into two study groups during induction of general endotracheal anaesthesia. Endotracheal intubation was facilitated with suxamethonium in group A, while in group B magnesium sulphate pretreatment and suxamethonium. Blood sample for serum potassium estimation was taken before induction and at 5min after induction. Degree of fasciculations and duration of apnea were assessed clinically. Anaesthetic technique and monitoring of patient was standardized This study showed statistically significant increase in serum potassium of Group A patients {average 0.34mmol/L} from baseline value p value 0.00. Magnesium sulphate pretreatment significantly reduced suxamethonium-induced hyperkalaemia by an average of 0.3mmol/L(p-value0.01). The severity of fasciculations was also significantly reduced (*p*-value 0.00). There was no significant effect of magnesium pretreatment on duration of apnea during endotracheal intubation (p-value 0.41). Fourteen point six percent (14.6%) of patients that received magnesium pretreatment complained of feeling of heat or warmth but there was no life threatening dysrrhythmias observed in any of the eighteen patients that had continuous ECG monitoring. The study shows that magnesium sulphate pretreatment has significantly reduced suxamethonium-induced hyperkalaemia and severity of fasciculations during induction of general endotracheal anaesthesia, however there was no significant effect on the duration of apnea. The average of 0.034mmol/L in Group B was not significant {p value 0.06}. We advocate the use of magnesium pretreatment in all patients at risk of these complications.

Keywords: *Magnesium-sulphate, pretreatment, suxamethonium-induced, complications, endotracheal anaesthesia.*

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Résumé

L'objectif de cette étude était de déterminer les effets du prétraitement du magnésium-sulphate sur les complications induites de suxaméthonium. Quatre-vingt patients adultes étaient sélectionnés et au hasard groupés en deux durant l'induction de l'anesthésie générale endotracheale. L'intubation endotracheale était facilitée avec le suxaméthonium au groupe A lorsque le groupe B suivait un prétraitement de magnésium-sulphate plus suxaméthonium. La technique de supervision et d anesthésie du patient était standardisée. Les échantillons de sang prélevés 5mins avant et après l'induction de l'anesthésie ; La durée de l'apnée et le degré de fasciculation étaient évalués cliniquement. Les résultats démontraient qu'il y avait une augmentation en potassium dans le sérum de sa value initiale au groupe A(moyenne 0.34mmol/L).*P*=0.000).Le prétraitement a l'aide du magnésium-sulphate réduisait significativement l'hypercalemie induite par le suxaméthonium d'une moyenne de 0.3 mmol/L P+0.01). La Sévérité des fasciculations était aussi significativement réduite P=0.000 sans effet sur la durée de l'apnée. 14.6% des patients qui recevaient le prétraitement du magnésium se plaignaient de la chaleur, sans aucun danger après la suivie au ECG. Cette étude que le prétraitement du magnésium-sulphate cause une réduction significative sur l'hypercalemie induite par le suzametaxole et des fasciculations sévères avant l'induction de l'anesthésie endo-trachiale ;cependant, il n'y avait pas d'effets significatifs sur la durée de l'apnée. La moyenne de 0.034mmol/L n'était pas significative au groupe B, nous recommandons l'emploi du prétraitement de magnésium sulfate à tout les patients à risque de ces complications .

Introduction

The use of suxamethonium as a short acting depolarizing muscle relaxant during induction of general endotracheal anaesthesia is associated with several complications such as rise in serum potassium,

fasciculations, postoperative myalgia and prolonged apnea in patients with abnormal serum cholinesterases[1]. In an effort to prevent such complications, several drugs such as lidocaine, muscle relaxants, and diazepam have been concomitantly administered with suxamethonium [2,3,4] The effects of magnesium sulphate pretreatment on such complications have not been studied in South-Western Nigeria where our hospital, University College Hospital, Ibadan, is located. This study seeks to determine the influence of magnesium sulphate pretreatment on suxamethonium-induced complications such as serum potassium rise, fasciculations and apnea in stable surgical patients during induction of general endotracheal anaesthesia in university college hospital, Ibadan Nigeria.

Materials and methods

Following approval by University of Ibadan / University College Hospital, Ibadan institutional ethical review committee, eighty-four adult patients belonging to the American Society of Anaesthesiologist (ASA) risk classification I or II were selected and studied during induction of general endotracheal anaesthesia in UCH main theatre complex. Exclusion criteria include all patients with serum potassium imbalance (normal range 3.0 - 5.0mmol/L) and patients at risk of potassium imbalance during induction of anaesthesia such as patients with acute or chronic diarrhea, muscle dystrophy, paraplegia or burns.

The study population were randomly allocated into two study groups A (control group) or B (study group). Patients in Group A received 1.5mg/kg of suxamethonium hydrochloride to facilitate endotracheal intubation during induction of anaesthesia while patients in Group B received a pretreatment of 1g of iv magnesium sulphate 3 minutes before induction of anaesthesia in addition to iv suxamethonium as muscle relaxant. Induction of anaesthesia in all patients was achieved with iv thiopentone 4mg/kg given 3minutes after administration of the magnesium sulphate. Baseline blood samples for serum potassium estimation were obtained before induction of anaesthesia and at 5 minutes after induction of anaesthesia. Physiologic parameters were monitored throughout the procedure with a Nonin electronic monitor that automatically displays the heart rate, blood pressure and the arterial oxygen saturation digitally. Continuous monitoring of the electrical activity of the heart was done with a 3-Lead ECG monitor in eighteen patients only because of paucity of the machine. Fasciculations following intravenous suxamethonium was assessed and graded as none, mild, moderate or severe using Mingus [6,8] system of grading fasciculations. Absence or no fasciculations when there is no visible fasciculation at all while mild fasciculations when there is movement of only facial and ocular muscles. Moderate fasciculations when there is movement of the trunk muscles such as the pectoral, intercostals and anterior abdominal muscles while severe fasciculations when there is movement of all the muscles of the whole body including the limb muscles. Period of apnea following suxamethonium administration in both groups were clinically assessed by timing the interval between cessation of spontaneous respiration and the resumption of spontaneous respiratory effort shown by the return of airway reflexes and movement of the reservoir bag. All the blood samples were coded by labeling the container with letter A for control and B for study group and sent to the laboratory for serum potassium estimation by a laboratory scientist who is not aware of the study groups. Flame photometer was used for the analysis. Complaints of the patients during administration of drugs and induction of anaesthesia were noted during the study period.

Collection of data

Data for each patient was collected and recorded on a data collection form which contains information on the patients biodata, surgical specialty, ASA status, induction agents used, muscle relaxants used, the study groups, baseline vital signs, intraoperative vital signs, grading of fasciculations, duration of apnea in minutes , baseline serum potassium and serum potassium five minutes after induction.

Analysis of data

The data were entered into computer based on the completed data form for each patient. Statistical analysis was performed using SPSS version 10.0. The results were presented in tables and figures, expressed as means and counts. Statistical association was determined using the chi-square (χ^2) test for categorical variables, student t-test for continuous variables. A p-value of less than 0.05 was considered significant.

Results

Ninety-three patients fulfilled the study protocol, however nine patients whose samples were haemolysed or insufficient for laboratory analysis were excluded leaving eighty-four patients as the study population. The two groups under study were comparable with respect to demographic variables: age, sex, weight and American Society of

Anesthesiologist's physical status classification (Table 1). There was preponderance of general surgical patients 37(44.0%) followed by gynaecological and ENT patients, 15(17.9%) and 11(13.1%) respectively. The distribution of patients in relation to specialty among the two study groups were however comparable showing a p-value of 0.08.

Table I: Demographic characteristics and ASA physical status. Result presented as (Mean ± SD) with the exception of sex and ASA status expressed in numbers.

Variables	Group A n=42	Group B n=42	Total n=84	P-value
Sex (male/female)	23/19	23/19	46/38	0.46
Age (yr)	41.24± 13.21	36.22± 12.33	37.73± 13.79	0.34
Weight (kg)	59.52± 7.70	63.45± 12.15	61.16± 10.31	0.19
ASA I/II	21/21	24/18	45/39	0.29

Group A = control group
Group B = study group (MgSO4 pretreatment)

Table 2. Distribution of patients according to specialty. Result is presented as counts and percentages (%).

Specialty	Group A n=42(%)	Group B n=42(%)	Total n=84(%)
Gynaecology	6(14.3)	9(21.4)	15(17.9)
Otorhinolaryn/ gology (ORL)	4(9.5)	7(16.7)	11(13.1)
Urology	2(4.8)	3(7.1)	5(6.0)
General surgery	23(54.8)	14(33.3)	37(44.0)
Orthopedic	1(2.4)	5(11.9)	6(7.1)
Dental surgery	5(11.9)	4(9.5)	9(10.7)
CTSU	1(2.4)	0.(0.0)	1(1.2)

Table 3 showed a statistically significant average increase in serum potassium of a magnitude of 0.34mmol/L from baseline value in group A (p-value 0.00) while the average increase in group B was of a magnitude of 0.03mmol/L which was not statistically significant (p-value 0.60). Fig.1 showed no significant difference in the duration of apnea between magnesium pretreatment (group B) and those without magnesium pretreatment (group A). (χ^2 value 1.77, P-value=0.41).

Table 3. Changes in mean serum potassium concentration (mmol/L) following administration of suxamethonium with and without MgSO4 pretreatments. Result is presented as mean ± SD.

	Group A n=42	Group B n=42	P-value
Baseline (0 min)	3.65±0.31	3.74±0.42	0.02
5 minute after	3.99±0.37	3.77±0.34	0.001
Mean difference	0.34±0.33	0.03±0.35	0.00
t-value	6.67	0.53	
P-value	0.00	0.60	

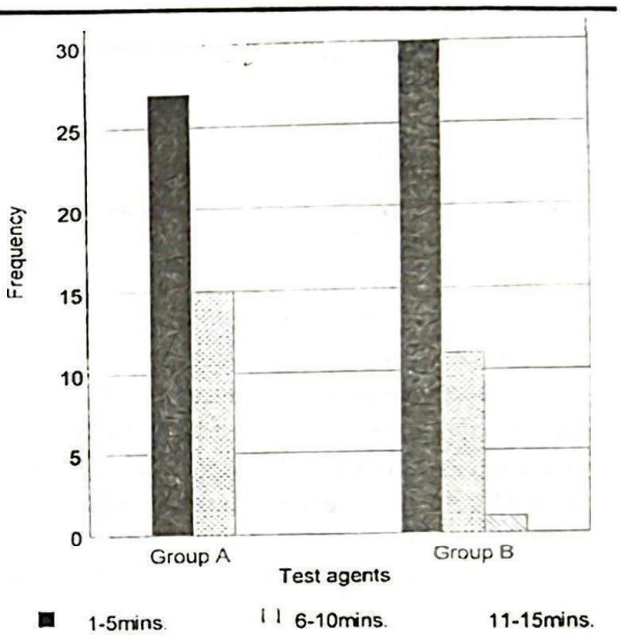

Fig. 1 Bar chart showing duration of apnoea in (minutes) among groups A and B following administration of test agents

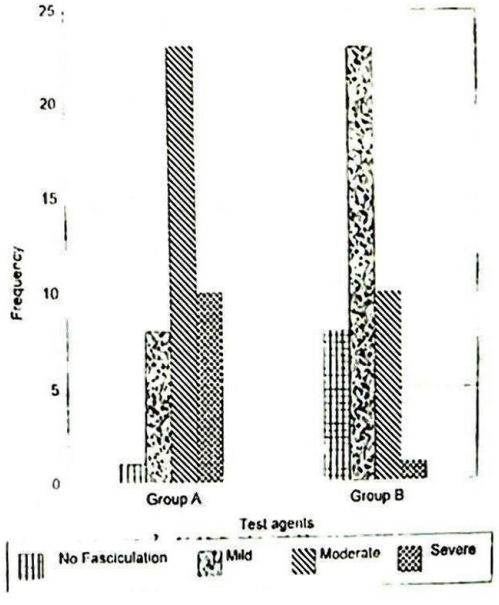

Fig. 2: Bar chart showing degree of fasciculation among groups A and B following administrtion of test agents

Fig. 2. showed majority of the patients in the magnesium pretreatment group had absent (19%) or mild (54.8%) fasciculation while those without magnesium pretreatment had moderate (58.4%) to severe (23.8%) fasciculations(χ^2 value 30.55, P-value= 0.00).

There was no life threatening dysrrhythmias observed on any of the eighteen patients that had continuous 3-lead ECG monitoring. Six patients (14.3%) felt heat or warmth immediately after iv magnesium sulphate.

Discussion

In an effort to reduce the incidence of fasciculations and hyperkalaemia using magnesium sulphate, this study showed a statistically significant difference between the study group (Group B) and the control group (Group A). The average increase in serum potassium of Group A patients was 0.34mmol/L from baseline value (p-value 0.00) while the average increase in group B was of a magnitude of 0.03mmol/L which was not statistically significant (p-value 0.60). This showed that pretreatment with magnesium sulphate significantly prevented the increase in serum potassium associated with suxamethonium (p-value 0.00). The clinical relevance of the use of magnesium sulphate to prevent suxamethonium–induced hyperkalaemia is still controversial [5,6] However available evidences [1,3,5] have shown that bolus administration of magnesium sulphate before intravenous suxamethonium prevent the release of potassium provoked by suxamethonium. This study supports other established evidences [1,3] that magnesium sulphate pretreatment significantly reduces suxamethonium-induced hyperkalaemia.

Fasciculations are increased muscle activities resulting from depolarization initiated by suxamethonium binding to prejunctional receptor at the neuromuscular junction. This study has also demonstrated that patients who received magnesium sulphate pretreatment had the intensity of fasciculations significantly attenuated or abolished (χ2 value 30.55, P-value= 0.00). The result of this study is in agreement with a similar study by Aldrete *et al* [3] who recorded significant attenuation of suxamethonium-induced fasciculation using 2g of magnesium sulphate pretreatment in normal patients. Similarly, pretreatment with atracurium, pancuronium, rocuronium, diazepam, lidocaine and taming with subparalysing dose of suxamethonium, have all demonstrated low incidence of fasciculations following suxamethonium [2,4].

The clinical effect of suxamethonium is manifested by apnea which is of rapid onset (<30secs) and short duration (<5min). Magnesium sulphate pretreatment may interact with suxamethonium to cause antagonism or potentiation of this effect of suxamethonium [6,7,8]. This study did not find significant difference in the duration of apnea between magnesium pretreatment group and those without magnesium pretreatment (χ^2 value 1.77, P-value=0.41). This study agrees with the clinical finding of Baraka *et al* [8] and Yap *et al* [9] who found no prolongation of the action of suxamethonium during induction of general endotracheal anaesthesia. Several factors [6,9,10] such as dosage, other drugs, plasma cholinesterase activity, gender and ethnicity may affect the duration of neuromuscular block produced by suxamethonium.

The feelings of heat or warmth after administration of magnesium sulphate by six patients (14.3%) have been reported in similar studies [1,3] and are due to the vasodilatation that follows magnesium administration. The absence of abnormal ECG tracing other than tachycardia in the eighteen patients studied could be explained by the choice of stable patients and the relatively low dose of magnesium sulphate (one gram) for this study. Aldrete *et al* [3] did not report any dangerous dysrrhythmias with two grams of magnesium sulphate while Hirsch *et al* [11] reported no association between frequency and severity of intraoperative dysrrhythmias with preinduction and postinduction potassium levels. The only factor that correlated with intraoperative dysrrhythmias was preoperative dysrrhythmias [11,12].

Conclusion

Magnesium sulphate pretreatment has significantly reduced suxamethonium-induced hyperkalaemia and fasciculations in the patients that were studied. We therefore, strongly advocate magnesium pretreatment in all patients at risk of such complications.

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