

EFFECT OF MAGNESIUM SULFATE (A LAXATIVE) ON ACCOMMODATION AND CONVERGENCE FUNCTION

BY

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ABSTRACT

Magnesium sulfate ($MgSO_4$), a laxative and over-the-counter drug is abusively used by individuals to relieve constipation, hard and inconsistent stool, and after effect of poor diet. Thirty young volunteers of both sexes were administered 15g of $MgSO_4$ effervescence laxative. The effect of the drug on accommodation, accommodative convergence /accommodation (AC/A) ratio, near point of convergence (NPC) and lateral phoria at far and near were studied by measuring these visual functions pre and post $MgSO_4$ administration. Results showed that there was no effect on accommodation, NPC decreased with a peak percentage decrease of 27.5%, lateral phoria at far had peak percentage decrease of 375.4%, lateral phoria at near had peak percentage decrease of 50.9% and AC/A ratio a percentage decrease of 43.4%. These effects were found to be significant ($P < 0.05$). Eye care practitioners should advise their patients to desist from abusing laxatives and other over-the-counter drugs and should consider its effects during analysis of visual test finding for effective patient care.

KEYWORDS: *Magnesium sulfate, Laxatives, Accommodation, Convergence, Near point of convergence, Lateral phoria.*

INTRODUCTION

Laxatives of various types are widely prescribed and more widely purchased without prescription indicating a cultural pre-occupation with irregularity of intestinal walls and stool¹. They are generally described as over-the-counter (OTC) products².

Laxative drugs that affect the fecal constituent accelerate elimination of stool from the rectum³. They can be used to relieve constipation during pregnancy, in those whose bowel motility has been altered through use of anticholinergic drugs, narcotics, antihelminthic therapy and generally short-term treatment of constipation⁴ and other possible conditions that can lead to constipation like condition within the colon and rectum or externally^{5,6,7}. The external conditions can be as a result of poor dietary habits (most common), medications and psychological factors. Bowel-conscious individuals easily abuse laxatives. Laxatives like other being an OTC drugs, the result may be similar to simple, prolonged diarrhea with symptoms of potassium ion (K^+) depletion, intestinal hypotonus, alkalosis and muscle weakness⁸. The use of laxatives may become habitual and can lead to hyponatremia, loss of the

rectal reflex and laxatives dependent constipation³. Chronic use of laxatives can become habituating leading to the development of a dilated atonic laxative colon, which requires increasing laxative use with little success^{5,6}.

Magnesium sulfate also known as Epsom salt or bitter salt⁹ is a hydrate salt with a chemical name of magnesium sulfate heptahydrate^{9,10}. Chemical formula is $MgSO_4 \cdot 7H_2O$ ¹¹ and trade name is Andrews liver salt.

Dried magnesium sulfate is an osmotic laxative^{4,11} or a saline laxative^{12,13} that acts by increasing the bulk of the stools through attracting and holding large amounts of fluids, the increased bulk results in the mechanical stimulation of peristalsis⁴.

Systemically administered drugs are known to produce effect in the eye when sufficient concentration of the drug reaches its site of action in the eye and can influence various clinical procedures and visual test results.

The adverse effect of $MgSO_4$ in the body system can also affect the eyes hence it is worthwhile that the ocular and visual effects (if any) are known by the primary eye-care practitioners for better patient management.

MATERIALS AND METHOD

Effect of magnesium sulfate on accommodation and convergence functions is a prospective and clinically based study. Abia State University Optometry Clinics (Uturu and Umuahia) were used for the study. Thirty healthy volunteers between the ages of 18 and 34 years were used. Those volunteers with ocular pathology, refractive error and history of systemic abnormalities were screened out as such conditions might jeopardize the test results. Experimental subjects were well fed during the period of the study and they served as their own control.

The visual functions of interest: accommodation (using minus-lens-to-blur method), lateral phoria (using Von-Graefe technique), NPC (using PD rule) and AC/A ratio (using the induced phoria method) were measured pre and post $MgSO_4$ administration. The research lasted for a period of 3 days. Pilot study showed that systemic effects start 2 hours after 15g $MgSO_4$ ingestion, hence, measurement of visual functions started 2 hours post administration of 15g $MgSO_4$ on volunteer subjects. The visual functions were reassessed at intervals of 30 minutes till 2 hours after $MgSO_4$ ingestion and then once daily for the next 3 days. Data obtained were analyzed using tables, figures and Z-test for significance of the result.

Magnesium sulfate used was manufactured from Glaxo Smith Kline (Nig. PLC) with batch no. 034E.

RESULTS

The test substance, Magnesium sulfate heptahydrate was administered on volunteer subjects and its effect on visual functions of interest was measured. The analysis of the data obtained is presented below. The symbol used in the graphs: Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8, represents 2 hours, 2½ hrs, 3 hrs, 3½ hrs, 4 hrs, 4½ hrs, 24 hrs, 48 hrs, and 72 hrs post ingestion of magnesium sulfate respectively.

Fig. 1 showed that $MgSO_4$ has no effect on Amplitude of Accommodation (A.A). When the data obtained was subjected to statistical analysis, $Z_{tab}(1.96_{0.05})$ was found to be greater than $Z_{cal}(0.32)$ confirming the graphical representation.

NPC decreased gradually from 2 hours after magnesium sulfate intake by 1.32cm, peak decrease was obtained 4 hrs after intake with induced change of -2.8cm and percentage induced change of 27.59%. It started to increase from 24 hrs post ingestion and returned to baseline value

72 hours post ingestion (see fig. 2). $Z_{cal}(8.819)$ was found to be greater than $Z_{tab}(1.96_{0.05})$, hence, it was concluded that ingestion of 15g of $MgSO_4$ had significant effect on NPC. The minus signs showed that the values were less than the baseline value.

Analysis of data obtained showed that lateral phoria at far decreased gradually from 2 hrs after $MgSO_4$ intake by -0.82 ± 0.16 D and had a peak decrease 4 hrs after intake with induced change of -2.29 ± 0.28 D. The peak percentage induced change was 375.4%. It then returned to baseline value 72 hrs post ingestion. Fig. 3 showed the graphical representation of this effect. Statistical analysis showed a significant effect of $MgSO_4$ on lateral phoria at far ($Z_{cal}10.6 > Z_{tab}1.96$ at 96% confidence interval).

Fig. 4 represents the analysis of the $MgSO_4$ effect on lateral phoria at near. Lateral phoria at near decreased gradually from 2 hrs after $MgSO_4$ intake by 0.98 ± 0.18 D. Peak induced change was obtained 4 hrs after intake with induced change of -2.8 ± 0.31 D and percentage induced change of 50.9%. It returned to baseline value 72 hrs post ingestion. Statistically, the effect was shown to be significant ($Z_{cal}7.68 > Z_{tab}1.96$).

From fig. 5, AC/A ratio decreased gradually from 2 hrs after $MgSO_4$ intake by 0.56 ± 0.14 . Peak decrease was obtained 4 hrs after intake with induced change of -1.98 ± 0.26 and percentage induced change of 43.4%. AC/A gradually increased and returned to baseline value 72 hrs post ingestion. Statistically, the induced effect was found to be significant ($Z_{cal}5.89 > Z_{tab}1.96$).

DISCUSSION

Analysis of data obtained as a result of administration of 15g $MgSO_4$, a laxative, on volunteer subjects showed no effect on amplitude of accommodation ($P > 0.05$) but significant effect on NPC, lateral phoria at far and near and AC/A ratio (see figs. 2-5; $P < 0.05$).

These effects can be explained on the stimulation of parasympathetic nervous system in stimulating peristalsis, as the bulk of the stool is increased^{4,7,12,14,15}. Postganglionic parasympathetic fibres stimulate accommodation while preganglionic parasympathetic fibres stimulate convergence. In both the preganglionic and postganglionic parasympathetic fibre stimulation, acetylcholine will be released^{16,17}.

Ingestion of $MgSO_4$ stimulates peristalsis and suppresses myenteric plexus, which is also innervated by the preganglionic parasympathetic

system. The information is sent to the brain stem where the neurons of the reticular activating system processes the information and in turn stimulates the motor part of the vagus nerve and motor part of any other cranial nerve (oculomotor nerve inclusive). Innervations of the motor part of the oculomotor nerve led to stimulation of medial recti muscles of both eyes increasing the tonic convergence which results in decreased values of NPC and lateral phoria (far and near) tending towards esophoria (as shown in figs 2-5).

The effect of 15g MgSO₄ on AC/A ratio is a cumulative effect and is supported by Borish's¹⁸ assertion that central nervous depressants decrease AC/A ratio by selectively reducing convergence response without affecting accommodation and that generally, the action of drugs indicate a

synkinesis between accommodation and convergence and the accommodation by MgSO₄ administration can be explained by the fact that ciliary body and iris sphincter muscles involved in accommodative action are supplied by autonomic fibres of oculomotor nerve not the motor fibres of oculomotor nerve which is being affected by MgSO₄.

In conclusion, MgSO₄ effervescence, a laxative and OTC drugs, when abused can lead to over convergence and esophoric conditions which could degenerate to binocularity problem. Primary eye care practitioners should take note of the use of over-the-counter drugs and advice patients against its abuse. They should also consider it while prescribing to the patients as it affects some visual test results.

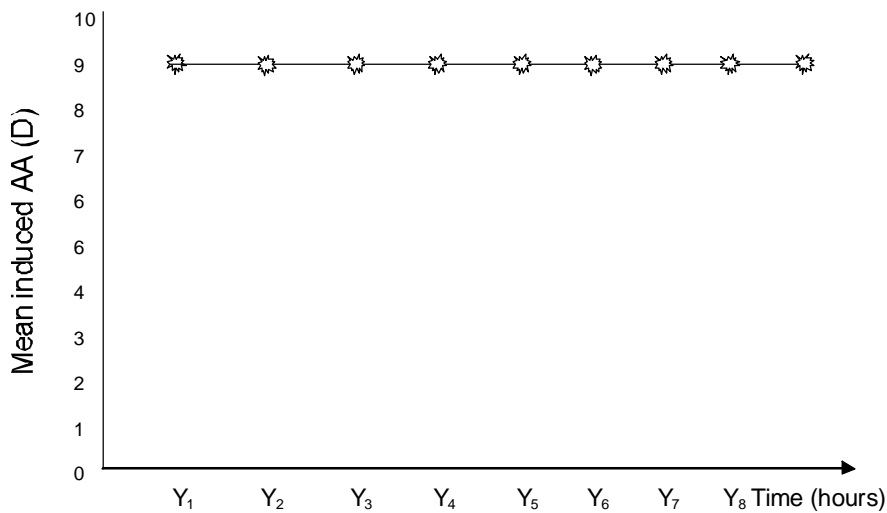


FIG 1: EFFECT OF MgSO₄ ON AMPLITUDE OF ACCOMMODATION (BASELINE A.A = 9.0 D)

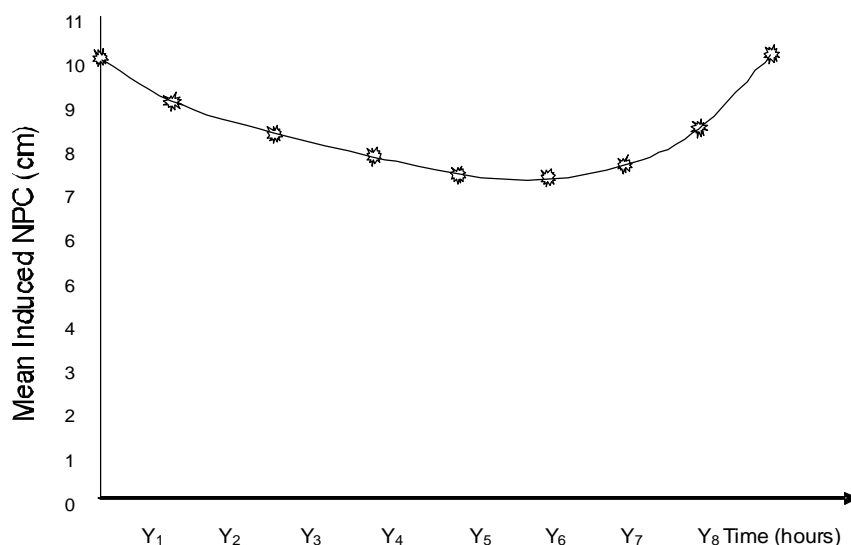


FIG 2: EFFECT OF MgSO₄ ON NPC (BASELINE NPC = 10.15 cm)

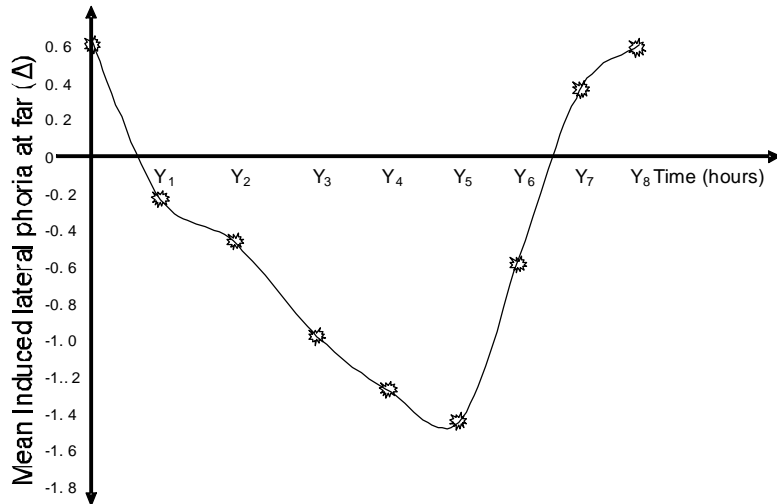


FIG. 3: EFFECT OF MgSO₄ ON LATERAL PHORIA AT FAR (BASELINE = 0.61Δ)

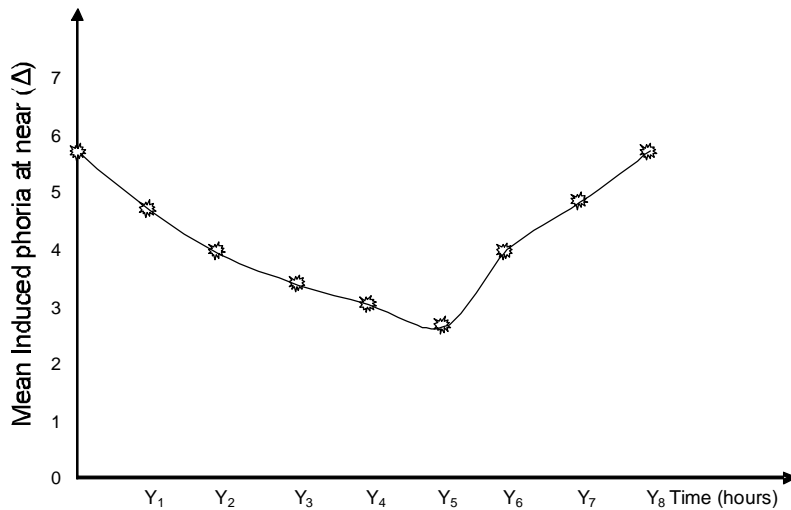


FIG. 4: EFFECT OF MgSO₄ ON LATERAL PHORIA AT NEAR (BASELINE VALUE = 5.5Δ)

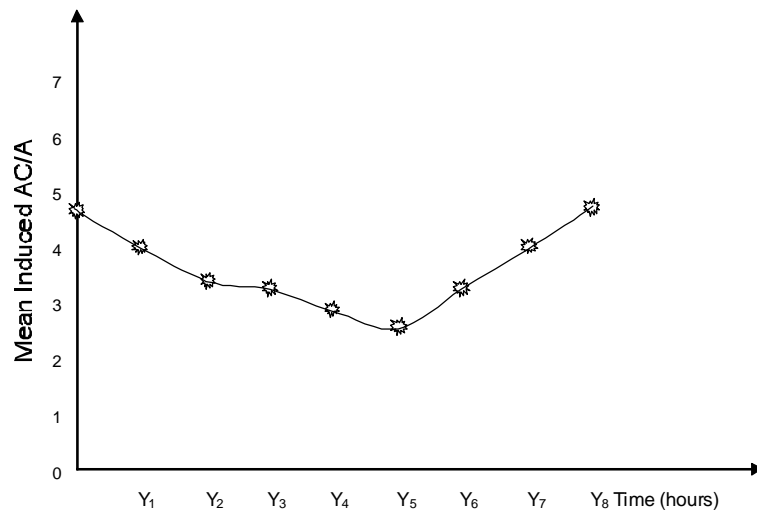


FIG. 5: EFFECT OF MgSO₄ ON AC/A RATIO (BASELINE AC/A = 4.56/1)

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