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Original Research Article

Effect of surgical trauma on serum magnesium levels in the early postoperative period

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ABSTRACT

Background: For proper functioning of energy system in the body, magnesium is essential. Deficiency of magnesium leads to hyperactivity of central nervous system and neuromuscular system. During surgery or before surgery or after surgery there can be alterations in the volume of fluid and composition of electrolytes. Objective was to study the effect of surgical trauma on serum magnesium levels in the early postoperative period.
Methods: The present hospital based cross sectional study was carried out for a period of one year among 35 cases of surgical stress and 10 normal as control. Institutional ethics committee permission was taken prior to the start of the study. Individual informed consent was noted from each individual patient from both cases and controls. Data was recorded in the pre-designed pre-tested semi structured questionnaire for the present study. Serum magnesium level was assessed in both the groups and compared.
Results: It was found that the preoperative magnesium levels were more as compared to postoperative levels among both the types of stress groups but the difference was not found to be statistically significant. ($p > 0.05$) Among the mild to moderate stress groups, it was found that the preoperative magnesium levels were more as compared to postoperative levels among all the age groups but the difference was not found to be statistically significant. ($p > 0.05$) Among the severe stress groups, it was found that the preoperative magnesium levels were more as compared to postoperative levels among all the age groups but the difference was not found to be statistically significant. ($p > 0.05$).
Conclusions: Occurrence of postoperative hypomagnesaemia plays a minor role in normal surgical convalescence.

Keywords: Postoperative period, Surgical trauma, Serum magnesium, Surgery

INTRODUCTION

In around 300 enzymes, magnesium acts as a cofactor. These enzymes are involved in many biological reactions. These reactions are vital in cell metabolism, they regulate the blood glucose levels, useful in the synthesis of the proteins, also maintain the health of cardiovascular system etc. Bone contains around fifty percent of total body magnesium. And remaining quantity is found in soft tissues. As for other minerals, the levels of magnesium in the body are governed by excretion rate and absorption rate of the magnesium.

If a person takes more magnesium in the diet, then magnesium absorption is decreased by the body. And if a person takes less magnesium in the diet, then whatever is taken, is absorbed completely and excretion is decreased by the body.[1]

Magnesium regulates neuro hormones levels in the blood, and levels of catecholamine. Now a day, the subject of research interest is metabolism and alteration of electrolytes. Neuro hormones which are regulated by magnesium play a vital role in response to natural stress. Hypomagnesaemia leads to alterations in neuro hormones which lead to oxidative stress. Such a patient who has hypomagnesaemia if undergoes any surgery, then it is said that due to surgical stress, the magnesium levels further goes down. This leads to increased morbidity and mortality among such group of patients.[2]

During surgery or before surgery or after surgery there can be alterations in the volume of fluid and composition of electrolytes. Fluid physiology is affected by surgical trauma. Due to surgical trauma, there is loss of blood and not only that; there is fluid loss via lungs. This leads to pooling of extracellular fluid and plasma at the surgical site. There is also a metabolic response due to injury due to surgery. More the surgical trauma more is the injury. Less the surgical trauma, less will be the alterations.[3]

For proper functioning of energy system in the body, magnesium is essential. Deficiency of magnesium leads to hyperactivity of central nervous system and neuromuscular system. The deficiency signs and symptoms of hypomagnesaemia mimic calcium deficiency. They include tremors of the muscles, exaggerated tendon reflex, tetany with a positive C hvostek's sign. In cases of severe deficiency there can be more serious effects like delirium and convulsions. Not only this, there can be repolarisation alternans and paroxysmal ventricular dysthymias. If physician knows the signs and symptoms of magnesium deficiency, then he can diagnose the condition. Serum magnesium levels test will confirm the diagnosis. If a person undergoing surgery, his serum magnesium levels must be done and supplementation must be done as the deficiency can be easily corrected and this will also prevent the further deficiency of magnesium postoperatively.[4]

With this background present study has been conducted with the aim to study the effect of surgical trauma on serum magnesium levels in the early postoperative period.

METHODS

The present hospital based cross sectional study was carried out for a period of one year among 35 cases of surgical stress and 10 normal as control. Institutional ethics committee permission was taken prior to the start of the study. Individual informed consent was noted from each individual patient from both cases and controls. Data was recorded in the pre-designed pre-tested semi structured questionnaire for the present study. Serum magnesium level was assessed in both the groups and compared.

The present study was undertaken on 35 patients admitted in surgical ward for elective surgical operations. Apart from this, serum magnesium level in ten normal individuals as judged from their general appearance and clinical examination amongst the hospital staff was done as control. On admission, a general survey of patients' general condition was done particularly diet and blood pressure recorded. The routine blood examination as to the hemoglobin percentage, erythrocyte sedimentation rate, total and differential count was done. Urine was examined for the presence of sugar and albumin. Serum sodium and serum potassium estimation were done in cases of surgical stress.

On the day of operation, patient's pre-operative diagnosis was noted. During the operation, the type of anaesthesia and duration of anaesthesia was recorded. In the postoperative period, the complications of altered serum magnesium in the form of hypomagnesaemia or hypermagnesemia were noted. Hypomagnesaemia in the form of irritability, personality changes, muscular weakness, vertigo, tremors, convulsions and tetany (indistinguishable from hypocalcemia tetany clinically) was noted. Hypermagnesemia in the form of depression of nervous system from mental confusion to coma.

For the study, surgical stress was classified into two groups: mild to moderate and severe depending on duration of surgery, type of anaesthesia and IV fluids and blood given. Mild to moderate stress was considered if duration of surgery was less than 60 minutes, type of anaesthesia was local, spinal or general and IV fluid or blood was given only when needed. Severe stress was considered only when duration of surgery was more than 60 min, type of anaesthesia was general and IV fluid or blood was given during or after surgery.

Five blood samples were collected. First within 24 hours before surgery, second on first postoperative day, third on second postoperative day, fourth on third postoperative day, and fifth on seventh postoperative day.

The data of the present study was recorded in the semi structured pre-tested questionnaire. The data was entered in the Microsoft Excel Worksheet. Mean and standard deviation values were calculated. Proportions were used in case of absolute numbers. Students't test was used in case of mean values. P value of less than 0.05 was considered significant.

RESULTS

Table 1 shows distribution of study subjects as per their age. The subjects were divided into two groups as per the stress level i.e. mild to moderate stress group and severe

stress group. Maximum patients i.e. 40% each belonged to 46-60 years of age. This was followed by 40% belonging to 31-45 years of age in severe stress group and 35% belonging to 16-30 years of age group.

Table 1: Distribution of study subjects as per their age.

Age group (years)	Mild to moderate stress group		Severe stress group	
	Number	Percentage	Number	Percentage
1-15	0	0	01	05
16-30	06	35	03	15
31-45	04	25	07	40
46-60	07	40	07	40

Table 2: Distribution of study subjects as per their sex.

Sex	Mild to moderate stress group		Severe stress group	
	Number	Percentage	Number	Percentage
Male	15	85	09	50
Female	02	15	09	50
Total	17	48.6	18	51.4

Table 2 shows distribution of study subjects as per their sex. In both the groups i.e. mild to moderate stress group maximum were males i.e. 85% and only 15% were females. In the severe stress group, both males and females were equal i.e. nine each.

Table 3: Distribution of study subjects as per type of anaesthesia used.

Type of anaesthesia	Mild to moderate stress group		Severe stress group	
	Number	Percentage	Number	Percentage
Local	02	11.8	00	00
Spinal	11	64.7	00	00
General	04	23.5	18	100
Total	17	48.6	18	51.4

Table 3 shows distribution of study subjects as per type of anaesthesia used. In the mild to moderate stress group maximum i.e. 64.7% underwent spinal anaesthesia followed by general anaesthesia among 23.5% of patients. Only 11.8% underwent local anaesthesia. In the severe stress group, all underwent general anaesthesia.

Table 4: Comparison of serum magnesium levels preoperatively and postoperatively among the stress groups.

Groups	Preoperative	Postoperative	T value	P value
Mild to moderate stress group	1.73±0.5	1.66±0.3	0.7102	0.4800
Severe stress group	1.67±0.4	1.55±0.3	1.4199	0.1602

Table 4 shows comparison of serum magnesium levels preoperatively and postoperatively among the stress groups. It was found that the preoperative magnesium levels were more as compared to postoperative levels among both the types of stress groups but the difference was not found to be statistically significant. ($p > 0.05$).

Table 5 shows comparison of serum magnesium levels preoperatively and postoperatively among the mild to

moderate stress groups as per their age. It was found that the preoperative magnesium levels were more as compared to postoperative levels among all the age groups but the difference was not found to be statistically significant. (p > 0.05).

Table 5: Comparison of serum magnesium levels preoperatively and postoperatively among the mild to moderate stress groups as per their age.

Age groups (years)	Preoperative	Postoperative	T value	P value
16-30 years group	1.72±0.6	1.66±0.4	0.4922	0.6241
31-45 years group	1.78±0.8	1.70±0.7	0.4452	0.6567
46-60 years group	1.70±0.6	1.65±0.4	0.3307	0.7419

Table 6 shows comparison of serum magnesium levels preoperatively and postoperatively among the severe stress groups as per their age. It was found that the preoperative magnesium levels were more as compared to postoperative levels among all the age groups but the difference was not found to be statistically significant. (p > 0.05).

Table 6: Comparison of serum magnesium levels preoperatively and postoperatively among the severe stress groups as per their age.

Age groups (years)	Preoperative	Postoperative	T value	P value
1-15 years group	1.55±0.2	1.49±0.2	1.2550	0.2138
16-30 years group	1.68±0.6	1.59±0.3	0.7937	0.4301
31-45 years group	1.74±0.7	1.63±0.5	0.7565	0.4520
46-60 years group	1.62±0.2	1.55±0.9	0.4492	0.6547

DISCUSSION

It was found that the preoperative magnesium levels were more as compared to postoperative levels among both the types of stress groups but the difference was not found to be statistically significant. (p > 0.05) Among the mild to moderate stress groups, it was found that the preoperative magnesium levels were more as compared to postoperative levels among all the age groups but the difference was not found to be statistically significant. (p > 0.05)

Among the severe stress groups, it was found that the preoperative magnesium levels were more as compared to postoperative levels among all the age groups but the difference was not found to be statistically significant. (p > 0.05)

Lambe SD et al in their study found that serum magnesium levels among the cases decreased significantly having normal preoperative serum magnesium levels, on 3rd and 6th day but became normal on 9th day after surgery which was planned in comparison to control group.[2]

Among cases undergoing emergency surgery, they found that serum magnesium levels decreased significantly on 3rd day, 6th day and on 9th day. Thus, they found that cases undergoing emergency surgery were more vulnerable to hypomagnesaemia compared to patients undergoing elective surgery.

Singh RR et al concluded from their study that alterations in the electrolytes were found to be directly proportional to the degree of trauma.[3] They further added that in such cases, the body tries to retain sodium and chloride but cannot prevent the magnesium loss.

Toppo S et al found that serum magnesium on 10th day after surgery was lower.[4] So, they had given the magnesium therapy to these cases. They did not find any significant differences on magnesium levels across age and sex groups.

Frankel H et al studied incidence of hypomagnesaemia among injured cases.[5] They also studied degree of injury and serum magnesium levels. Thus, they observed that though hypomagnesaemia was common among the injured cases but they did not find any correlation with degree of injury or levels of ethanol.

Simsek T et al observed that trauma after surgery can lead to reduced synthesis of proteins, degradation of proteins up to some extent.[6] Hence glucose is given to

these cases to prevent proteolysis. Objective of therapy should be to reduce the catabolic response. Hence the author added that for such reasons, details of metabolic response due to trauma should be known.

Luckey AE et al concluded that physicians should be familiar with the mechanisms that maintain water and electrolyte balance and hence give proper and adequate treatment for the elderly population.[7]

Holden MP et al divided the patients into two groups; one group undergoing heart valve replacement and other undergoing non-perfusion thoracic surgery.[8] They found that all patients in both the groups had low levels of serum magnesium after surgery. But this was more in first group undergoing heart valve replacement surgery. They concluded that further studies are required to explain this.

Fraser WD et al investigated patients undergoing cholecystectomy which was planned and among patients undergoing heart surgery.[9] They found that electrolytes and minerals concentration reduced after surgery and in cases of some minerals and electrolytes, it came back to normal few days after surgery.

Cordova Martinez A et al carried-out investigations among patients before and 3-45 days postoperatively.[10] They found that on 3rd and 9th days, the zinc concentration fell significantly but by the end of 45 days, it came back to normal levels. But for copper, the serum levels increased postoperatively till 45 days.

Corodova A found that serum levels of magnesium and zinc are changed by trauma, injury, surgery or inflammation.[11] They noted that postoperatively, serum magnesium level increased slightly on 3rd and 9th day. It came back to normal on 27th and 45th day postoperatively. Thus, they concluded that magnesium and zinc levels are related to fatigue. Hence their estimation can be used as a guide to the status of fatigue among patients after surgery.

CONCLUSION

Thus, study conclude that occurrence of postoperative hypomagnesaemia plays a minor role in normal surgical convalescence. However, the possibility of magnesium deficiency should be kept in mind particularly while treating borderline cases and those who are vulnerable to abnormal losses of body fluids from gastrointestinal tract and patients on IV therapy for longer periods receiving magnesium free IV fluids.

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