

Characterization of the Magnesium Status of Elderly People with Congestive Heart Failure, Hypertension and Diabetes Mellitus by the Magnesium-Load Test

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Zusammenfassung

100 Patienten, nämlich 70 Männern und 30 Frauen von 70–80 Jahren mit kongestiver Herzinsuffizienz, erhöhtem Blutdruck und Diabetes, wurde eine intravenöse Magnesiumdosis verabreicht. In 75% der Fälle wurde ein mehr oder weniger starker Magnesiummangel festgestellt. In 25% der Fälle lag ein gesicherter Mangel und in 50% ein wahrscheinlicher Mangel vor. In 25% der Fälle war die Magnesiumkonzentration ausreichend.

Summary

The i.v. magnesium-load test was performed in 100 patients, 70 males and 30 females, 70–80 years of age. The patients had congestive heart failure, hypertension and diabetes mellitus. 75% of the patients had some degree of magnesium deficiency, 25% had definite magnesium deficiency, 50% had probable magnesium deficiency and 25% were magnesium sufficient.

Résumé

Nous avons réalisé une épreuve de charge en magnésium par voie intraveineuse chez 100 malades (70 hommes et 30 femmes, âgés de 70 à 80 ans) souffrant d'insuffisance cardiaque congestive, d'hypertension artérielle et de diabète. Nous avons constaté une carence plus ou moins marquée en magnésium dans 75% des cas: carence certaine dans 25% des cas et carence probable dans 50% des cas; dans 25% des cas, la concentration en magnésium était suffisante.

Introduction

Dietary intake, nutrient density, balance studies or blood levels alone were found to be inadequate to determine or predict magnesium status in healthy elderly people [1]. Functional indices of magnesium status such as load retention studies and/or supplementation intervention studies may be more appropriate to help characterize the magnesium status of elderly people [1].

In the following study a parenteral magnesium load test was performed on hospital admission in 100 patients aged 70–80 years. Magnesium deficiency was found in 75% of these patients.

Patients and Methods

One hundred edema-free patients, 70 males and 30 females, 70–80 years of age, were included in the study. Since the magnesium load test is contraindicated in renal insufficiency disturb-

ances of cardiac conduction and advanced respiratory insufficiency [2] such cases were not included in the study. Endogenous creatinine clearances corrected for body surface area were found to be within the normal range for the specific age group under study [3]. The magnesium load test is not valid when magnesium depletion is due to inability of the kidney to conserve magnesium (intrinsic renal disorder or extrarenal disturbance influencing renal magnesium handling) [2]. Drugs influencing renal magnesium handling were withheld for 3 days before the test and readministered after termination of the test. 70% of the patients suffered from congestive heart failure and were treated with digoxin, furosemide and slow K. 40% had hypertension treated with diuretics and β -blockers. 15% had diabetes mellitus treated with insulin. All patients granted their informed consent.

The intravenous magnesium load test: An intravenous loading dose of 0.5 mEq magnesium per kilogram body weight as $Mg SO_4 \times 7H_2O$ (8.13 mEq/g elemental magnesium) in 125 cm³ D5W is infused at a rate of

3.5 mEq magnesium per hour, and the amount of magnesium excreted in the urine within 24 h is measured by atomic absorption spectrophotometry. It is generally stated that the normal retention is 20% or less. However precise control data for different age groups are needed. The retention of more than 20% of an intravenous load of magnesium is consistent with magnesium deficiency even in the presence of normal serum magnesium [2].

Calculation of magnesium retention: The afterload excretion must be corrected for the basal output because of the close relation between these two parameters. During the day of the study some magnesium is contributed through intestinal absorption since the subjects are not restricted in their diet during the study period. As the amount absorbed in persons in magnesium balance is closely correlated to the amount excreted, the total absorbed magnesium may for practical purposes, be considered equal to the urinary output. Thus, the total magnesium load given may be approximated as the intravenous given amount plus the value obtained from the urinary basal output.

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The retention is then calculated as the difference between the total load and the excreted amount after loading, expressed as percentage of the total magnesium load [4].

Criteria for magnesium deficiency:

>40% retention at 24 h = definite deficiency.

>20% retention at 24 h = probable deficiency.

Results

Serum magnesium concentrations were found to be within the normal range (1.5–1.9 mEq/l). In the 70 male patients' group, 20 patients retained more than 40% magnesium (definite deficiency), 30 patients retained more than 20% magnesium (probable deficiency), and 20 patients retained less than 20% magnesium (magnesium sufficient).

In the 30 female patients' group, 5 patients retained more than 40% magnesium, 20 patients retained more than 20% magnesium, and 5 patients retained less than 20% magnesium.

75% of the 100 patients participating in the study had some degree of magnesium deficiency, 25% retained more than 40% of magnesium (Tab. 1).

Discussion

The RDA (recommended daily or dietary allowances or amounts) are to be understood as the level of intake of essential nutrients considered, in the judgement of the appropriate committee, to be adequate to meet the known natural needs of practically all healthy

persons. The RDA may be understood as the minimum amount of an element below which there is a specific deficiency disease or as the amount which maintains the nutritional status quo, or as the quantity that is associated with a minimal risk for certain diseases linked to the nutrients mode of action [5,6]. Since there are no reliable non-invasive techniques for determining magnesium status, balance studies appear to be the only practical method for estimating magnesium requirement in humans, and such studies have been faulted. *Mertz* [7] has concluded that using balance studies to help to determine requirements and then adding an increment as a safety factor results in an unrealistically high recommendation that would be difficult to implement. He also stated that a balance study does not determine the requirement for a mineral, but rather the intake required to maintain the existing pool size. The minimal pool size consistent with health remains to be determined.

In the 10th edition of the RDA (USA) the subcommittee concluded that insufficient data existed to establish separate RDA values for people 70 years of age and older. The committee recognized that the elderly represent such a diverse and heterogeneous group, with altered requirements for some nutrients, that it will be difficult to establish cut-off points. Therefore the RDA values for adults are divided into two categories: 25–50 years and from 51 years upward. The RDA for magnesium in men 51 and older is set at 350 mg/day while for women at 280 mg/day [6].

The magnesium loading test serves as a guide to the adequacy of the magnesium stores but does not quantitate the deficiency. At present it is difficult to relate the percentage retention to the total body deficit of magnesium [2].

The i. v. magnesium load test was performed by *Cohen et al.* [8] in twenty untreated and apparently healthy male patients, 70–80 years of age. Different degrees of magnesium deficiency were demonstrated in 85% of the patients. 35% of this group of patients retained more than 50% of magnesium. Poor intake was the most plausible cause of this deficiency.

75% of the 100 patients participating in our study had some degree of magnesium deficiency and 25% retained more than 40% of magnesium. On the top of the above suggested poor magnesium intake, congestive heart failure with periods of anaerobic metabolism during stress, congested splanchnic vessels resulting in malabsorption, presence of hepatic dysfunction, presence of hyperaldosteronism, and poor intake of magnesium due to anorexia all contribute to magnesium depletion [9]. The use of digoxin and magnesium-losing diuretics by interfering with magnesium reabsorption in the kidneys lead to magnesium wastage in the urine [9]. Glycosuria by acting as an osmotic diuretic has the same effect.

The use of magnesium-sparing diuretics (*Aldactone*, *Amiloride*) is therefore strongly indicated in congestive heart failure.

Many patients with congestive heart failure have constipation; this is due in part to inactivity [10]. Because of the increased incidence of pulmonary embolization in this condition prevention of straining at stool is warranted. Administration of magnesium oxide in the appropriate dose to produce one loose stool daily will take care of the constipation and act at the same time as a magnesium supplement in this magnesium deficient state.

References

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Tab. 1: % Mg retention at 24 h.

	n	% retention
Males	70	
	20	>40% definite deficiency
	30	>20% probable deficiency
	20	<20% Mg sufficient
Females	30	
	5	>40%
	20	>20%
	5	<20%

n = number of patients; Mg = magnesium

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Abstract

Summary

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The aim of this study was to determine the prevalence of magnesium deficiency in elderly people. The study was conducted in a geriatric ward of a hospital. The subjects were 100 elderly people (50 men and 50 women) aged 65-85 years. The study included a clinical history, physical examination, and laboratory tests. The results showed that 30% of the subjects had a low magnesium status. The prevalence of magnesium deficiency was significantly higher in women than in men. The study also showed that the prevalence of magnesium deficiency was significantly higher in subjects with a history of chronic diseases than in subjects without a history of chronic diseases.

Introduction

Determination of serum or plasma magnesium concentrations have been the mainstay for the investigation of electrolyte disorders. The serum electrolyte levels, however, do not reflect the total body magnesium content. The measurement of the intracellular magnesium content is particularly the case for magnesium. Abnormalities in cellular magnesium metabolism activity has been specifically reported in chronic schizophrenic patients. A significant decrease in magnesium and an increase in calcium to phosphorus ratio were found in the plasma of schizophrenic patients. The range, median, 25% and 75% quantiles were 0.75, 0.70, 0.65 and 0.60 mmol/L, respectively.

Materials and Methods

Sixty three patients with chronic schizophrenic disorder were included in the study. They were 34 females and 29 males. The ages ranged from 53 to 85 years. The study was conducted in a geriatric ward of a hospital. The subjects were 100 elderly people (50 men and 50 women) aged 65-85 years. The study included a clinical history, physical examination, and laboratory tests. The results showed that 30% of the subjects had a low magnesium status. The prevalence of magnesium deficiency was significantly higher in women than in men. The study also showed that the prevalence of magnesium deficiency was significantly higher in subjects with a history of chronic diseases than in subjects without a history of chronic diseases.

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Results

The prevalence of magnesium deficiency was significantly higher in women than in men. The study also showed that the prevalence of magnesium deficiency was significantly higher in subjects with a history of chronic diseases than in subjects without a history of chronic diseases.

Discussion

The study showed that the prevalence of magnesium deficiency was significantly higher in women than in men. The study also showed that the prevalence of magnesium deficiency was significantly higher in subjects with a history of chronic diseases than in subjects without a history of chronic diseases.

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