An Analysis of Hypermagnesemia and Hypomagnesemia

Naotaka HASHIZUME and Miko MORI*

Serum magnesium (Mg) was measured in 6,252 patients; in 1,246 (19.9%) the value was abnormal. Hypermagnesemia (serum Mg ≥ 3.9 mg/dl) was observed in 51 patients (0.8%) and hypomagnesemia (Mg ≤ 1.5 mg/dl) in 165 (2.6%). Hypermagnesemia was found in patients with renal failure treated with Mg-containing antacids or cathartics, or with eclamptic convulsions treated with Mg sulfate. The most frequent clinical finding of hypermagnesemia was urinary disturbance, although various other neurological signs and symptoms were observed. Hypomagnesemia was seen in patients with various diseases such as cancer, hepatic cirrhosis, cerebrovascular disease, and generally poor condition. Abnormalities of electrolytes other than Mg were also frequently observed. The most common clinical findings of hypomagnesemia were personality changes and depression. The differentiation from psychiatric disease is important.

Key words: Serum magnesium concentration, Renal failure, Hypokalemia, Hyperkalemia

In recent years, the importance of magnesium (Mg) in clinical medicine has become evident. However, general clinicians still pay little attention to Mg, and the background and clinical manifestations of hypermagnesemia or hypomagnesemia remain unclear. We retrospectively studied serum Mg concentration and the incidences of hypermagnesemia and hypomagnesemia in 6,252 patients. In patients with extreme hypermagnesemia or hypomagnesemia, the underlying disease, associated drugs, other electrolyte abnormalities and clinical signs and symptoms were evaluated.

MATERIALS AND METHODS

Patients (Fig. 1)

The subjects consisted of 6,252 patients (2,130 outpatients and 4,122 inpatients) at Teikyo University Hospital (3,219 males and 3,033 females). Their ages varied from several days (neonates) to 90 years (mean, 54.4 years).

Method of serum Mg measurement

A Hitachi 736-60 automatic analyzer (xylidyl blue method) was used. The normal range of serum Mg differs depending on institutions (1). The normal serum Mg level in our laboratory was 1.8–2.6 mg/dl. Serum Mg concentrations greater than or equal to 3.9 mg/dl were defined as hypermagnesemia and those less than or equal to 1.5 mg/dl were defined as hypomagnesemia.

RESULTS

Histograms of serum Mg concentrations (Fig. 2)

Serum Mg concentration was within the normal range in 5,006 patients (80.1%) and abnormal in the remaining 1,246 patients (19.9%). The serum Mg concentration was 2.7 mg/dl or greater in 502 patients (7.9%), 51 (0.8%, 7 males and 44 females) of whom had hypermagnesemia. The serum Mg concentration was 1.8 mg/dl or less in 774 patients (11.9%), 165 (2.6%) of whom, 88 males and 77 females had hypomagnesemia.

Underlying diseases of patients with hypermagnesemia by hypomagnesemia (Fig. 3)
Hypermagnesemia and Hypomagnesemia

Of the patients with hypermagnesemia, 60% were in the medical department, 20% were in the obstetric department, and 20% were in the pediatric department. As an underlying disease, 60% of the patients had renal failure, 20% had gestational toxicosis and the remaining 20% were neonates whose mothers were treated with Mg sulfate due to eclamptic convulsion.

Of the patients with hypomagnesemia, 38% were at the medical department, 16.3% the neurosurgical department, 8.2% the surgical department, 6.1% the urological department, 4.1% the otolaryngological department, 4.1% the orthopaedic department, 4.1% the ophthalmological department, 2.0% the pediatric department, 2.0% the dermatological department, and 2.0% the radiological department. The underlying disease was malignant tumor in 36.7% of the patients, liver disease in 16.3%, trauma in 8.2%, disseminated intravascular coagulation in 8.2%, sepsis in 6.1%, chronic rheumatoid arthritis in 6.1%, renal failure in 4.1%, empyema in 4.1%, abnormal delivery in 4.1%, and diabetes in 4.1%.

**Drugs associated with abnormal Mg levels**

Drugs that appeared to be associated with hypermagnesemia were Mg sulfate, used in the patients with eclamptic convulsion, and Mg-containing anti-
ulcer agents and cathartics, used in patients with renal failure. Drugs that may have induced hypomagnesemia were cytotoxic drugs, alcohol, diuretics, phenytoin, and polystyrene sulfonate calcium.

Electrolyte imbalances associated with abnormal serum Mg levels (Table 1)

Hyperkalemia was present in 27.5% of the patients with hypermagnesemia. In patients with hypomagnesemia, hypokalemia was found in 25.5%, hypophosphatemia in 20.6%, hypocalcemia in 18.8%, hyponatremia in 14.5%, hypochloremia in 8.5%, and hyperkalemia in 6.1%.

Incidence of clinical manifestations of hypermagnesemia (Fig. 4)

The most frequent clinical finding was dysuria (40%) followed by malaise (30%), articulation disorders, ataxia, apathy, nausea and vomiting, muscle weakness, and muscle rigidity (20% each), and fever, anorexia, constipation, numbness, headache, tremor, somnolence, reduced tendon reflex, skin flushing, and oral dryness (10% each). Choreo-athetosis was observed in 1 patient.

Incidence of clinical manifestations of hypomagnesemia (Fig. 5)

The most frequent clinical finding in patients with hypomagnesemia was personality change (32.7%), followed by depression and tachycardia (22.4%), stupor (20.4%), convulsion, nausea and vomiting, and anorexia (14.3% each), dementia and hallucina-
tion, disorientation, tremor, abdominal pain, sweating, numbness, and malaise (10.2% each), articulation disorders, diarrhea, constipation, and ataxia (8.2% each), muscle weakness and dizziness (6.1%), muscle pain and muscular rigidity (4.1%), and muscle twitch and increased tendon reflex, sensory disturbances, nystagmus, athetosis, and facial flushing (2%).

**DISCUSSION**

Of the 6,252 patients evaluated, 1,246 (19.9%) had an abnormal serum Mg level. As there are almost no clinical signs or symptoms observed at a serum Mg level of 2.7–3.8 mg/dl or 1.8–1.6 mg/dl, clinicians should be aware of the possibility of asymptomatic Mg disturbances. We defined serum Mg levels of 3.9 mg/dl and greater as hypermagnesemia and those of 1.5 mg/dl or less as hypomagnesemia because the incidence of clinical manifestations is high at these levels. Most of the doctors in charge of the patients with hypermagnesemia or hypomagnesemia considered that the clinical manifestations were due to aggravation of the underlying disease or general condition and were not associated with the Mg abnormality. Although hypermagnesemia was observed in 51 patients (0.8%), a description of the hypermagnesemia was not noted in the clinical records of 80% of these patients. Since serum Mg is affected by serum protein, the diagnosis of hypomagnesemia should be made cautiously in the presence of hypoproteinemia. Although the xylidyl blue method for Mg measurement has this disadvantage, hypomagnesemia was detected in 165 patients (2.6%). There was no description of hypomagnesemia in the clinical records of 50% of these patients.

The primary factor associated with hypermagnesemia was the administration of Mg-containing antacids or cathartics to patients with renal failure. Antacids and cathartics have been widely used for many years. Recently, Gerard and Bashi (2) and Gren and Woolf (3) reported cases of hypermagnesemia leading to coma following the excessive administration of a Mg-containing cathartic. When Mg-containing cathartics are administered for a long period, a periodic examination of the serum Mg is necessary. Particularly in patients with renal failure, special attention should be paid when Mg is administered, even at a routine dosage level.

The clinical manifestations of extreme hypermagnesemia were primarily neurological signs and symptoms (Fig. 4). Dysuria was the most frequently observed symptom, therefore, hypermagnesemia should be suspected in patients who develop dysuria. Choreoahtetosis occurred in a 60-year-old male who underwent hemodialysis 3 times weekly for renal failure and diabetic nephropathy and received an antacid and cathartic containing Mg (3 mg/day). Choreo-athetosis developed at a serum Mg level of 5.6 mg/dl, but the signs and symptoms disappeared at a serum Mg level of 3.0 mg/dl. In contrast, choreoahtetosis has been reported in the presence of hypomagnesemia (4, 5). Therefore, the etiology of this patient's choreoahtetosis may be due to hypermagnesemia, but a conclusion of causality must await study of more cases.

The patients with hypomagnesemia were treated at various departments. The underlying diseases in these patients varied widely compared with hypermagnesemia. The causes of hypomagnesemia were inadequate Mg intake, cytotoxic drugs, and diuretics. Abnormality of other electrolytes often complicated the hypomagnesemia. Hypomagnesemia was generally observed in patients with poor general condition. Chernow et al (1) reported a high incidence of hypomagnesemia in post-surgical patients. In post-surgical patients, management of not only the 3 major nutrients but also trace elements is necessary.

Patients with hypomagnesia manifested various neurological signs and symptoms (Fig. 5). However, since other electrolyte abnormalities were also present, the manifestations due to hypomagnesemia alone were difficult to identify.

In this study, personality changes, depression, tachycardia, and stupor were frequently observed. Shils (6) and Massry and Seeling (7) also reported psychological signs and symptoms as clinical characteristics of hypomagnesemia. It is possible that these psychological manifestations are misdiagnosed as mental disease or depression secondary to the underlying disease. For example, a 47-year-old male with cancerous peritonitis got on his hands and knees on a bed and defecated, saying that it smelled nice.
These changes in personality, unsuccessfully treated by psychiatrists, did not improve. However, as the serum Mg level improved from 1.5 mg/dl, these manifestations disappeared. The measurement of Mg may be important in patients with poor general condition.

This paper was reported at the 5th International Magnesium Symposium in 1988 (Kyoto, Japan).

REFERENCES


