Hypomagnesemia in Relation to Diabetic Retinopathy

It has been suggested that hypomagnesemia may be a risk factor in the development of ischemic heart disease.[1,2] Moreover, a recent study of McNair and co-workers[3] has demonstrated a definite hypomagnesemia in a group of insulin-treated diabetic individuals who had had the disease for 10 yr. In addition, diabetic subjects with severe retinopathy had significantly lower serum magnesium than diabetic subjects without evidence of that complication. The authors suggested the hypomagnesemia was an additional risk factor in the development and progress of diabetic retinopathy.

We wondered whether the degree of diabetic control, evaluated by the determination of glycosylated hemoglobin (HbA_1), which is thought to reflect the integrated glucose concentrations during the previous 3–4 wk,[4] could influence the concentration of serum magnesium. We studied 56 diabetic patients (aged 25–70, mean 41 ± 5 yr), selected by the criteria of McNair,[3] and 30 normal controls (aged 24–69, mean 40 ± 4.5 yr). Twenty-one diabetic patients were on insulin therapy, while the other 35 took oral tablets. The whole group of diabetic patients was divided according to the presence of retinopathy. Twenty-four diabetic patients had signs of retinopathy (microaneurysms, exudates, hemorrhages), while the remaining 32 did not present such signs. Plasma glucose was determined by a glucose-oxidase method; HbA_1 was measured using the methods of Welch et al.[5] (normal range 5–7%); serum calcium and magnesium were determined on a Beckman Trace III Autoanalyzer (Beckman Instruments, Inc., Fullerton, California). All the determinations were made in duplicate on venous blood samples drawn after an overnight fast period and abstinence from smoking at least since midnight. The intraassay coefficients of variation for HbA_1, magnesium, and calcium were 0.7%, 1.2%, and 1.1%, respectively.

The whole group of diabetic patients had concentrations of magnesium significantly lower than those of controls (Table 1). Moreover, diabetic patients with retinopathy had significantly lower serum magnesium than that observed in diabetic patients without retinopathy. There was no significant correlation between HbA_1 values and serum magnesium concentrations. However, when the diabetic patients were divided according to their HbA_1 values, those with levels of HbA_1 below 7% (in the normal range) presented higher concentrations of magnesium than those diabetic patients with levels of HbA_1 above 7% (Table 2).

Thus, diabetic patients, regardless of therapy, have lower concentrations of serum magnesium than healthy people (matched for age). Diabetic subjects with retinopathy have the lowest concentrations of magnesium. Finally, serum magnesium concentrations seem to be influenced by the degree of diabetic control; the better the control, the higher the concentration of magnesium. Since magnesium depletion may cause atherosclerosis in experimental animals and possibly in man,[1] the achievement of satisfactory metabolic control in diabetic individuals once again appears to be a hopeful goal for delaying the progression of diabetic vascular complications.

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TABLE 2
Serum magnesium concentrations in diabetic patients with levels of HbA_1 below or above 7%*

	$HbA_1 < 7\%$	$HbA_1 > 7\%$	P <
Diabetic patients (56)	1.92 ± 0.05 (30)	1.75 ± 0.04 (26)	0.01
Diabetic patients without retinopathy (32)	2.04 ± 0.03 (20)	1.89 ± 0.02 (12)	0.05
Diabetic patients with retinopathy (24)	1.88 ± 0.03 (10)	1.66 ± 0.04 (14)	0.01

* Values are means ± SEM. Numbers of subjects are in parentheses.

TABLE 1
Concentrations of glucose, HbA_1, magnesium, and calcium in the diabetic patients and in healthy controls*

	Controls (30)†	Diabetic patients (56)†	Diabetic patients without retinopathy (32)†	Diabetic patients with retinopathy (24)†
Glucose (mg/dl)	82.3 ± 1.6	132.6 ± 8.2	140.1 ± 11	135.2 ± 7.7
HbA_1 (%)	6.33 ± 0.14	7.5 ± 0.15	7.15 ± 0.17 <0.025	8.02 ± 0.23
Mg (mg/dl)	2.23 ± 0.06 <0.001	1.88 ± 0.06	2.0 ± 0.03 <0.001	1.72 ± 0.03
Ca (mg/dl)	9.25 ± 0.15	9.48 ± 0.21	9.24 ± 0.18	9.56 ± 0.14

* Values are means ± SEM. Significant differences were evaluated by Student's *t* test for unpaired samples.
† Numbers of subjects are in parentheses.

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No Association Between NIDD and Kidd

Hodge et al.[1] reported linkage between insulin-dependent diabetes (IDD) and Kidd (erythrocyte antigens). We have found an association of IDD with Kidd antigen Jk^b.[2] These findings seem to confirm genetic heterogeneity of IDD. We and others[3] have also found some evidence for a possible genetic relationship between IDD and non-insulin-dependent diabetes (NIDD). Since HLA is not the common genetic denominator of such possible relationship, we deemed it of interest to study Kidd in NIDD. As part of the University of Minnesota Diabetes Genetic Study, we studied Kidd in 52 NIDD patients. The relative risk for our population versus normals[4] for any one Kidd type is not significant (Table 1). One would expect in a sample of this size to be able to detect a significant difference ($P < 0.05$) with 80% power if there were an actual difference of 30% or more. Thus, Kidd does not seem to be a marker for NIDD.

TABLE 1
Kidd phenotype frequencies and relative risks in NIDD patients and controls

Population	Kidd phenotype		
	a+ b−	a+ b+	a− b+
NIDD	15 (29%)	27 (52%)	10 (19%)
Control	28%	49%	23%
Relative risk	1.04	1.12	0.79

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