

MAGNESIUM METABOLISM IN VARIOUS MODELS OF EXPERIMENTAL RICKETS

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In rats with experimental rickets the magnesium concentration in the blood is lowered while that in the bones is increased. After treatment with vitamin D for 3 weeks the blood magnesium level rises while that in the bones falls. Addition of citrates to the diet contributes still further to normalization of magnesium metabolism in rachitic rats.

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Previous investigations of magnesium metabolism in rats with experimental rickets revealed that the magnesium concentration in whole blood of affected rats is much lower than in healthy rats. Conversely, the magnesium concentration in the bones of rachitic rats was found to be 5 times higher than normal.

The decrease in the blood magnesium concentration in experimental rickets can be considered as due, not to increased excretion from the body, but to redistribution of magnesium in the body with increased deposition in the bones.

In the present investigation the dynamics of magnesium metabolism was studied in rachitic rats under treatment.

EXPERIMENTAL METHOD

Experiments were carried out on 20 rats. The magnesium level in the blood and bones was determined by a spectrographic method (ISP-28 spectrograph). Rickets was produced in rats by administration of a diet recommended by the Central Research Institute of Vitaminology (90% wheat flour, 5% dry yeast, 3% calcium carbonate, 2% sodium chloride) and distilled water for 3 weeks.

Roentgenograms of the bones of the hind limbs showed that all the rats developed severe rickets. Two rats died in the course of the experiments from severe rickets. The remaining 18 rats were divided into two groups, 9 in each group. From the beginning of treatment all the animals received milk, grain, and ordinary water daily. An alcoholic solution of vitamin D at the rate of 200-300 units per rat was added to the daily ration of milk for the rats of group 1, while the rats of group 2 received vitamin D and a solution of sodium citrate and citric acid at the rate of two tablespoonfuls in the daily ration of water (2% solution).

Treatment continued for 3 weeks. At the end of treatment roentgenograms of the bones of the hind limbs were again taken, confirming that recovery had begun to take place: osteoporosis was reduced and the outlines of the knee joint were clearer. Blood was taken for estimation of the magnesium concentration, after which the animals were sacrificed and the magnesium content of the bones determined.

EXPERIMENTAL RESULTS

Investigation of the blood showed an increase in the magnesium concentration under the influence of treatment, a higher level being found in the group of rats receiving citrates as well as vitamin D (Table 1). In the rats of group 1, for instance, the magnesium level rose to 9.7 ± 0.92 mg%, while in the rats of group 2 it rose to 11.6 ± 0.61 mg% (normal 8.02 ± 0.5 mg%).

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TABLE 1. Magnesium Concentration (in mg%) in the Blood and Bones of Rats with Rickets before and after Treatment

Material examined	Healthy rats	Experimental rickets	Rickets treated with vitamin D	Rickets treated with vitamin D and citrates
Blood	8.02±0.5	3.36±0.39	9.7±0.92	11.6±0.61
Bones	2.44±0.28	11.939±1.52	6.7±0.39	4.2±0.74

The magnesium concentration in the bones (Table 1) of the rats of group 1 was lowered to 6.7 ± 0.39 mg%, i.e., almost by half compared with that observed in severe rickets (11.938 ± 1.52 mg%). Despite the decrease in the magnesium concentration in the bones, its level did not return completely to normal (the magnesium concentration in the bones of healthy rats was 2.44 ± 0.28 mg%).

In the rats of group 2 the magnesium concentration in the bones was lower still, namely 4.2 ± 0.74 mg% at the time of investigation.

Under the influence of treatment with vitamin D and citrates, a tendency was thus observed for the magnesium metabolism in the bones to return to normal.

As a result of treatment of the rachitic rats for 3 weeks, their general condition thus improved, and the magnesium concentration in their blood rose to a higher level than that observed in healthy rats. The rachitic changes in the bones persisted longer, however. At the time when the blood magnesium level showed an increase, its concentration in the bones, although starting to decrease, still remained above normal.

Administration of citrates is useful and justified, for in the animals treated for the same period of time it led to a more marked improvement in the magnesium metabolism in the bones.