Molybdenum in the Premature Infant

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Key Words

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Full-term newborns

Abstract

The molybdenum (Mo) levels in the plasma and urine of 30 premature and 15 full-term infants have been compared with the Mo intakes and urine uric acid excretion (uric acid/creatinine ratio) produced by the Mo enzyme xanthine oxidase. The Mo intakes of full-term infants were 41 ± 14 nmol/kg/day (mean $\pm$ SEM). In the premature group breast milk supplied significantly less Mo (4.3 ± 0.4 nmol/kg/day) than infant formulas (101 ± 31 nmol/kg/day) or premature formula (255 ± 13 nmol/kg/day). When fed breast milk, the preterm infants displayed similar or higher plasma and urine Mo and urine uric acid levels than formula-fed infants. For the whole preterm group a significant correlation was determined for urine Mo levels and Mo intakes as well as for plasma Mo and uric acid excretion. The bioavailability of breast milk Mo seems to be higher than formula Mo according to the Mo levels and to their statistical link with uric acid excretion which could be proposed as a functional index of Mo status. These parameters displayed similar values in breast milk-fed prematures and control full-term infants. The Mo needs of formula-fed premature newborns remain to be defined using complete balance trials.

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Introduction

In man, molybdenum (Mo) is the cofactor of metalloenzymes involved in the metabolism of purines toward uric acid (xanthine oxidase) and of sulfur amino acids into sul-fates (sulfite oxidase) [1].

The Mo requirements of the preterm infant have not been precisely defined [2–4]; Casey and Hambidge [3] suggested a supply of 2–3 $\mu\text{g/kg/day}$ (20–30 nmol/kg/day) for formula-fed prematures. Little information is available concerning the relationship between Mo tissue levels and enzyme activities [4]. We assumed that uric acid produced by xanthine oxidase could be used as an index of Mo status; therefore we compared its urinary excretion to the plasma and urine Mo concentrations in premature and full-term infants.

Subjects and Methods

The gestational age of prematures was 32.9 ± 0.5 (mean $\pm$ SEM) weeks. The birth weights of preterm and full-term newborns were $1,780 \pm 70$, and $3,280$

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± 160 g, respectively. When studied prematures and full-term infants were 3.6 ± 0.5 and 4.2 ± 0.5 weeks old, respectively (NS). They had been on the same diet allowing a constant growth for

at least 2 weeks. Premature babies were fed a low birth weight formula. Full-term babies were breast fed or supplied a standard formula. Mo concentrations of formulas used during the study are given in table 1.

Table 1. Mo concentrations of breast milk and formulas given during the study

All Mo concentrations of formulas were measured in our laboratory. The amounts of Mo received by breast milk-fed babies were estimated from a recent study of human milk through the first 2 months of lactation [5]. Plasma, urine and formula Mo concentrations were assayed by atomic absorption spectrometry (Perkin Elmer 3030) as previously described [5]. Urine Mo and uric acid concentrations were expressed as a ratio to creatinine levels.

Statistical analysis used one-way analysis of variance and linear regression.

Mo
content
nmol/dl
Infants

pre-
full-

mature
term
Breast milk1
2-3
10
4
Prégallia®2
177
8
0
Lait Nativale age®3
18
3
3
Lait Galliéva le age®2
204
3
3
Lait Guigoz le age®3
26
1

3

Lait Galliagène TCM®2

184

2

0

Lait Milumel le age®5

55

3

2

1 Estimated from mean

Mo concentrations of

breast milk of same lactation period [5].

2 Gallia®.

3 Guigoz®.

4 Société Française des laits Materna®.

5 Milupa®.

Results

Results are given in table 2.

For the whole preterm group a significant correlation was found between Mo intakes and urinary Mo ($r = 0.44$, $p < 0.02$) plasma and urinary Mo ($r = 0.61$, $p < 0.01$), urinary Mo and uric acid ($r = 0.39$, $p < 0.05$). This correlation is significant only in the formula-fed babies.

Discussion

Mo is known to be a cofactor in three metalloenzymes [1, 4]. However, its importance in human health has been difficult to

Table 2. Mo intakes, Mo levels and urinary uric acid levels of infants (mean $\pm$ SEM)

Intakes, nmol/kg/day

Plasma Mo, nmol/l

Urine Mo, nmol/mmol creatinine

Urine uric acid, mmol/mmol creatinine

Groups sharing the same letter are significantly different: $a, p < 0.05$; $b, c, d, p < 0.01$.

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assess. Deficiency induced by long-term total parenteral nutrition has led to clinical and biochemical symptoms suggesting low sulfite and xanthine oxidase activities [6]. A gout-like syndrome has been described in a population exposed to high Mo dietary levels [1,4].

We report the first data on Mo intakes and levels of neonates since the metabolic balance study of Alexander et al. [7] involving older infants and children.

The concentrations of Mo are lower in human milk [5, 8] than in any type of formula tested.

Breast milk-fed prematures display plasma levels similar to formula-fed prematures whose intakes are 60-fold higher. This suggests that absorption of Mo is higher from human milk than from formulas.

The relationship displayed between intake and urine Mo levels and between plasma and urine Mo levels suggests a poor retention of Mo, with a major part of the absorbed metal being excreted within a few hours [4].

The link observed between Mo and uric acid excretion argues for the role of that trace element in human health. It suggests a relationship between Mo intake and xanthine oxidase activity similar to that previously shown in rats [4].

It can be assumed that uric acid excretion gives some insight into activity of xanthine oxidase in the babies we studied.

Conclusion

Breast milk-fed premature infants display a Mo status similar to normal infants. Formula-fed prematures need a higher Mo supply to reach these levels. A relationship has been shown between the excretion of Mo and

uric acid produced by the Mo enzyme xanthine oxidase. Urinary levels of Mo and uric acid could be useful in further studies to determine the Mo requirements of formula-fed babies.

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