

Department of Biochemistry and Molecular Biology, Medical University of Lublin
2nd Neonatal and Infantile Pathology Clinic, Medical University of Lublin

BOLESŁAW FLORIAŃCZYK, MARIA KARSKA, ANNA BEDNAREK

*The level of magnesium in the serum of children hospitalized
for severe respiratory infections*

Viral respiratory diseases continue to be among the most frequently met infantile and early childhood infections. Conditions favourable to them are, apart from anatomic and physiological incompatibilities of the respiratory system, the imperfect immunological mechanisms and the immaturity of the central nervous system. Among some of the external factors increasing the number of respiratory infections there is undoubtedly the environmental pollution (9). The increase of health hazards and the exposition of the respiratory tract to viral infections may lead to magnesium homeostasis disturbances in the organism.

Magnesium is an element crucial to the harmonious course of a cell's metabolism, especially in the growing and developing body of a child. Magnesium belongs to a group of trace elements which play an important role in the growth and development of a young organism. The essential mechanism of the functioning of magnesium is based on its participation in the structure of macro element compounds and its activation of numerous enzymes. The element is fundamental in producing high-energy compounds (ATP, GTP) in a cell. It is also indispensable in many processes utilising these compounds. Therefore, the role of magnesium in such processes as glycolysis, biosynthesis of the lipids, nucleic acids and proteins, the stabilisation of the membranes, the functioning of the ionic pumps, the maintaining of the electric potential in the nervous system and the stimulation of the immunological system only partly illustrates the importance of this element (1, 2, 4, 5, 13, 14).

The objective of our studies was the evaluation of the level of magnesium in the serum of the children hospitalized for severe respiratory infections.

MATERIAL AND METHODS

The study involved 50 children at the age of 2 – 18 months hospitalised for pneumonia (n = 21) and obturative bronchitis (n = 29) at the 2nd Neonatal and Infantile Pathology Clinic of the Medical University of Lublin during the years 1997-98. There were examined only these children who were not taking micro elements as a supplement. The material was the serum obtained within the first 24 hours of hospitalization.

The weighed samples of each blood serum were subjected to dessication for 72 hours at 80°C, ashed at 450°C, and then dissolved in concentrated HCl, which had been mixed 1 : 1 with H₂O (v/v).

Concentrations of magnesium were determined by spectrophotometric method using spectrophotometer Pye Unicam (SP-192) – 12.

The results were analyzed statistically using Wilcoxon test accepting the differences as significant at the significance level $p < 0.05$.

RESULTS AND DISCUSSION

Table 1 shows the content of magnesium in the serum of the children hospitalised for severe respiratory infections depending on the overall condition of the child at the time of admittance to the hospital. The criterion for the evaluation of the level of magnesium in the serum of the children hospitalised for severe respiratory infections were the following parameters: the overall condition of the child at the time of admittance to the hospital; its feeding pattern and also the co-existing retarded psychosomatic development in the case of children admitted for respiratory infection.

Table 1. Magnesium concentration in blood serum of children admitted in medium general condition and in bad general condition

Number of subjects	General condition at the admission time	Magnesium concentration (mmol/l) min. - max.	Mean (x) and standard deviation (s) $\bar{x} \pm s$	Correlation coefficient (r) and intrinsicity level (p)
19	medium*	0.73 - 1.35	1.02 ± 0.21	
31	bad**	0.58 - 0.80	0.69 ± 0.07	$r = 0.89$ $p < 0.0001$

* Marked respiratory insufficiency symptoms: shortness of breath at the expiration with the characteristic wheeze; tachypnoea and tachysphygmia, rhinorrhoea and co-existing nasal passage obstruction; obsessive dry cough, and sucking difficulties in babies.

** With distinctive respiratory and circulatory failure symptoms: increasing respiratory insufficiency, shortness of breath at the expiration (so-called wheezing breath, gasping – "fighting for breath" and panting, with periods of apnoea. The dyspnoea is accompanied by the activity of ancillary muscles: the upward movement of ala nasi, funnel chest, the collapsing of the lower part of the chest on inhaling the air and also frequent funnelling of the intercostal, supraclavicular, suprasternal and subcostal space. Peripheral cyanosis is present (its characteristic sign is the so-called cyanotic triangle around the mouth). Other symptoms comprise: tachypnoea (20-40 above normal for this age group) and high fever of 30°C and more.

The symptoms of circulatory insufficiency are: anxiety, tachycardia, megalocardia, hepatomegaly, dilated and pulsating jugular veins.

As follows from Table 1, the increased magnesium concentration was noted in children admitted to the hospital who were in a median general condition (with marked symptoms of respiratory insufficiency) and this concentration was higher by 47% than the middle content of Mg in the group of children admitted with poor general condition. Between the average values within the studied groups statistically meaningful differences are noted.

The lower values of magnesium within the group of the children in a poor general condition are probably the result of systemic changes caused by an inflammatory process going on in the respiratory tract. These changes cause an impairment of magnesium homeostasis, which is, in addition, coupled by the stress connected with the illness and hospital environment (2,10). Within the group of the children admitted with median general condition, the scope of obtained magnesium value in the serum slightly rises above the concentration value accepted as normal for this age group (6). The reason for this may also be acidosis accompanying the inflammatory changes within the respiratory tract. Acidosis in children may also be the cause of increased concentration of magnesium in the serum (11).

Table 2 shows the concentrations of magnesium in the serum of the children depending on the feeding pattern. Within the group of the breastfed children, the concentrations of magnesium were slightly higher than normal value for magnesium concentration in the serum for this age group.

Table 2. Magnesium concentration in blood serum of breast and formula fed children

Number of subjects	Kind of nutrition	Magnesium concentration (mmol/l) min. - max.	Mean (x) and standard deviation (s) $\bar{x} \pm s$	Correlation coefficient (r) and intrinsicity level (p)
15	breast nutrition	1.06 - 1.35	1.21 \pm 0.10	
35	formula nutrition	0.58 - 0.90	0.77 \pm 0.07	r = 0.16 p = 0.56

According to the literature breastfed children are indicated to have had higher concentration values of magnesium as stated mainly by defining its level in the hair (3, 7, 8).

Such estimate seems to be a more reliable manifestation of the concentration of this element in the organism. The higher values of magnesium in the serum of the breastfed children obtained in individual studies may follow from an ongoing disease process in the respiratory tract. However, higher levels of magnesium in the serum of breastfed children obtained in individual studies are an argument for breastfeeding in the diet of babies and young children.

In Table 3 there was compared the level of magnesium in children with lower air passage inflammation and retarded psychosomatic development with the level of this element in children with regular psychosomatic development.

As follows from the data demonstrated in the table, the higher level of magnesium was observed in children with regular psychosomatic development. The median level of magnesium in the serum of the children with normal psychosomatic development was 0.99 mmol/l. Lower levels of magnesium in the serum of the children with backward psychosomatic development as obtained in individual studies may also be a result of the co-existing disease process going on in the lower air passage (15). A characteristic feature of the inflammatory process is, among other things, its destructive role in the magnesium metabolism.

Table 3. Magnesium concentration in blood serum of children with air passages inflammation and with regular and backward psychosomatic development

Number of subjects	A child's psychosomatic development	Magnesium concentration (mmol/l) min. - max.	Mean (x) and standard deviation (s) $\bar{x} \pm s$	Correlation coefficient (r) and intrinsicity level (p)
39	regular*	0.79 – 1.35	0.99 ± 0.19	
11	backward**	0.58 – 0.79	0.67 ± 0.07	r = 0.25 p = 0.44

* Regular psychosomatic development: eutrophic children with body mass proper to their age, and with normal height. In all the children we noted a proper locomotive development and correct posture control (so-called major motor activity) proper for this age group; adequate visual-motoric co-ordination (so-called minor motor activity) and good speech and social contact.

** Backward psychosomatic development: dystrophic children with low body mass and abnormal height regarding their age and growth norm. These children had major and minor motor activity disorders, speech and social contact dysfunction. Neurological and specialist check-up confirmed the existing abnormalities regarding central nervous system functioning.

CONCLUSIONS

1. Ongoing inflammatory process influences in a substantial way the level of magnesium in the serum.

2. The results obtained favour the theory of breastfeeding in the diet of babies and young children.

3. Magnesium deficiency in children hospitalized for severe respiratory infections is notable in children with backward psychosomatic development.

REFERENCES

1. Dorup I.: Magnesium and potassium deficiency: its diagnosis, occurrence and treatment in diuretic therapy and its consequences for growth, pretein sythesis and growth factors. Acta Physiol. Scand., 150 (Suppl. 618), 7, 1994.
2. Durlach J.: Magnez w praktyce klinicznej, PZWL, Warszawa 1991.
3. Durcka G. et. al.: Ocena stężenia magnezu i ołowiu we włosach niemowląt w zależności od sposobu żywienia. Biul. Magnezol., 2/3, 171, 1977.
4. Floriańczyk B.: Pierwiastki śladowe w metabolizmie ustroju. Med. Og., 65, 561, 1996.
5. Floriańczyk B.: Pierwiastki śladowe w cukrzycy. Post. Med. Klin. Dośw., 5, 473, 1996.
6. Górnicki B. et. al.: Vademecum pediatrii. PZWL, Warszawa 1993.

7. Kalita-Drybańska A., Durska G. et al.: Wpływ sposobu karmienia dzieci w pierwszym roku życia na zawartość magnezu i wapnia we włosach. *Biul. Magnezol.*, 7, 5, 1996.
8. Kozielec T. et. al.: Wpływ sposobu karmienia na zawartość wybranych biopierwiastków we włosach u niemowląt. *Ped. Pol.*, 71, 405, 1996.
9. Marcinkowska-Suchowierska E.: Metabolizm magnezu w zdrowiu i chorobie. *Homeostaza magnezowa - część I. Post. Nauk Med.*, 4, 86, 1991,
10. Marcinkowska-Suchowierska E.: Metabolizm magnezu w zdrowiu i chorobie. *Zaburzenia homeostazy magnezowej – część II. Post. Nauk Med.*, 4, 90, 1991.
11. Maszkiewicz W. et. al.: Gospodarka Mg u zdrowych i chorych noworodków. *Przegl. Ped.*, 3, 389, 1993.
12. Pinta M.: *Absorpcyjna spektrometria atomowa.* PWN, Warszawa 1977.
13. Rude R.: Magnesium metabolism and deficiency. *Endocrin. Metab. Clin. North Amer.*, 22, 377, 1993.
14. Wacker W. et. al.: Magnesium metabolism. *New Engl. J. Med.*, 45, 658, 1986.
15. Zdrójkowska B. et. al.: Magnez w profilaktyce zdrowotnej. *Żyw. Człow. Metab.*, 3, 169, 1996.

2001.02.14

SUMMARY

The objective of the studies was evaluation of the level of magnesium in children hospitalized for severe respiratory infections (mainly pneumonia and bronchitis). The criterion for the evaluation of the magnesium level in the serum of the children hospitalized for severe respiratory infections were the following parameters: general condition of the child at the time of admittance, feeding pattern and psychosomatic development in the children with respiratory infection.

The level of magnesium in the serum of the children admitted with median general condition was higher than that of the children admitted with poor general condition. The level of magnesium in the serum of breastfed children and those with correct psychosomatic development was higher than the level of magnesium in children fed artificially and representing backward psychosomatic development.

Poziom magnezu w surowicy krwi u dzieci hospitalizowanych z powodu ostrych infekcyjnych chorób układu oddechowego

Celem badań była ocena poziomu magnezu w surowicy krwi u dzieci hospitalizowanych z powodu ostrych infekcyjnych chorób układu oddechowego (głównie zapalenia płuc i oskrzeli). Kryterium oceny dla poziomu magnezu w surowicy krwi u dzieci hospitalizowanych z powodu ostrych infekcyjnych chorób układu oddechowego stanowiły następujące parametry: stan ogólny dziecka w chwili przyjęcia do kliniki, rodzaj karmienia oraz rozwój psychoruchowy u dzieci z chorobą infekcyjną układu oddechowego.

Poziom magnezu w surowicy krwi u dzieci przyjętych w stanie ogólnym średnim był wyższy niż u dzieci przyjętych w stanie ogólnym ciężkim. Poziom magnezu w surowicy krwi u dzieci karmionych piersią i dzieci z prawidłowym rozwojem psychoruchowym był wyższy od poziomu magnezu u dzieci karmionych sztucznie i z opóźnionym rozwojem psychoruchowym.

