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MONITORING OF BIOCHEMICAL PARAMETERS IN PRETERM INFANTS ON SPECIAL REGIME FEEDING

PRAĆENJE BIOHEMIJSKIH PARAMETARA KOD PREVREMENO ROĐENE DECE NA SPECIJALNOM REŽIMU ISHRANE

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Summary: Enriched human milk may stimulate gain weight in preterm infants during the neonatal period. Aim is the biochemical assessment of preterm infants, fed by mother's milk fortificated with the special domestic formula ^{pre}Impamil during the first month of life. 80 preterm infants (45 male and 35 female), up to 36 weeks of gestation, BW less than 2500 g, started enteral intake in the first three days of life. Total volume intake was in range from 70 mL/kg first day, to 170–200 mL/kg after a 10^{th} day of life. Mother's milk fortification was prepared as a 5% mixture solution of ^{pre}Impamil. The dynamics of biochemical analyses started on the first day of study and was repeated once a week. We analysed levels of: total protein, albumin, prealbumin, transferin, urea, Ca ionised, P and alkaline phosphatase using standard biochemical methods. Statistical analyses were completed by ANOVA test, one-factorial analyses of variance. During monitoring the total protein level increased in the second week of life ($p<0.01$), as well as albumin ($p<0.01$). Prealbumin level increased, as well as transferin (p-*NS*). Initial level of ionised fraction of Ca was significantly lower ($p<0.01$) at the beginning of the study, compared to the rest. Serum level of P increased, as well as the level of alkaline phosphatase at the end of first and second week ($p<0.01$). Conclusion is that biochemical parameters, such as levels of protein and albumin, are important in the growth assessment of preterm infants on special feeding regimes.

Keywords: feeding of preterm infants, fortificated mother's milk, biochemical parameters, anthropometric parameters.

Kratak sadržaj: Obogaćeno humano mleko može da stimuliše napredovanje u telesnoj masi prevremeno rođene dece za vreme neonatalnog perioda. U radu su praćeni i procenjivani biohemijski parametri iz seruma ovih beba hranjenih majčinim mlekom obogaćenim specijalnom domaćom formulom ^{pre}Impamil, za vreme prvog meseca života. Kod 80 prevremeno rođenih beba (45 muškog i 35 ženskog pola) ispod 36 gestacionih nedelja, TM ispod 2500 g, početak je enteralni unos u prva tri dana života. Ukupni volumni unos je bio u rasponu od 70 mL/kg prvog dana, do 170–200 mL/kg posle 10. dana života. Majčino mleko pripremano je kao mešavina sa 5% ^{pre}Impamila. Biohemijski parametri su određivani 1. dana studije i ponavljani jednom nedeljno. Određivani su: totalni proteini, albumini, prealbumin, transferin, ureja, jonizovani kalcijum, fosfor i alkalna fosfataza, korišćenjem standardnih biohemijskih metoda. Od statističkih metoda primenili smo ANOVA test jednofaktorske analize varijanse. U praćenom periodu do 4. nedelje, nivo proteina i albumina pokazuje najveći skok u 2. nedelji života ($p<0,01$). Nivoi prealbumina i transferina su viši (p-*NS*). Inicijalni nivo jonizovanog kalcijuma je signifikantno niži ($p<0,01$) u odnosu na kasniji period. Nivoi serumskog fosfora kao i alkalne fosfataze značajno su viši na kraju prve i druge nedelje ($p<0,01$). Dobijeni rezultati ukazuju na to da su praćeni biohemijski parametri, a naročito proteini i albumini, važni u procesu napredovanja prevremeno rođene dece na specijalnim režimima ishrane, što dokazuje i paralelno praćenje antropometrijskih parametara.

Ključne reči: ishrana prevremeno rođene dece, obogaćeno humano mleko, biohemijski parametri, antropometrijski parametri

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Introduction

In the newborns it is essential to assess the obtained intrauterine fetal growth according to gestational age. Comparing to full-term infants, nutrition of the premature infants is very complex, and it de-

pends on the organs immaturity as well as on the special energetic and nutritional needs of these infants. Real needs of preterms are also greater than in full-terms. For that reason, nowadays, we use a plan of a nutritional supplement identical to the intrauterine. In that way we try to reach a growth at the same dynamics as it was intrauterine. Sometimes, feeding the premature infants with human milk is not caloric enough, so it is necessary to increase intake of proteins and essential fatty acids using human milk fortifie or specialized formulas (1, 2).

Material and Methods

In the Institute of Neonatology a prospective study was conducted which included monitoring of the biochemical and anthropometric parameters in two groups of premature infants. One group of infants was fed with human milk, and the other with the specialized formula ^{pre}Impamil. In the study that lasted four months, we successively included infants (gestational age less than 36 weeks and body mass less than 2500 g) to whom it was possible to apply complete parenteral intake in the first 3 days of life.

In the study period of 4 weeks, we evaluated the tolerance of the formula and infant growth according to body length, as well as the head and thorax circumference.

At the same time, biochemical, hematological and blood gas analyses were followed-up in infants during the investigated period.

The study included 80 infants (45 male and 35 female), gestational age 32–36 weeks, having organized enteral feeding in the first 3 days of life. 48 infants were eutrophic and 32 were with intrauterine growth retardation. Apgar score and gestational age were the basic prognostic factors in making the decision about the right time for starting enteral feeding.

Control group consisted of 24 infants being fed only with mother's milk, and, depending on the maturation of the infants, they were fed by gastric tube or with bottles (*Table I*).

Table I Anthropometric parameters of investigated groups.

Parameter	Mother's milk	^{pre}Impamil
BM (g)	1818	1962
Length (cm)	41.5	42.6
Head size (cm)	30.2	30.6
Gestation (week)	32.9	33.1
Number	24	80

Table II Comparative components of mother's milk and examined formula.

Parameter, Units	Mother's milk	^{pre}Impamil (16%)
E, Kcal/100 mL	67	79.2
Osmolality, mOsmol/L	300–308	315
Carbohydrates, g/100 mL	7.0	9.0
Proteins, g/100 mL	1.2	2.4
Ca, mg/100 mL	34	108
P, mg/100 mL	14	63.2

We made a comparison of the human milk components from mothers having premature birth with the components of specialized formula ^{pre}Impamil, which we used to fortify mother's milk.

We also investigated the osmolality of each meal prepared from required amounts of ^{pre}Impamil added to mother's milk to obtain 5–12% mixture, reaching in that way the recommended values for caloric and nutritive intake in infants. In this way, infants received high energetic and nutritive intake in smaller volume with permitted optimal osmolality 244–315 mOsmol/L. (Osmolality was measured by the cryoscopy method) (*Table II*).

Feeding was organized as full volume intake in mL/kg/day, from 70 mL/kg/day at the beginning of the feeding, up to 150 mL/kg/day at the 5th day of feeding, and 170–200 mL/kg/day at the 10th day. At the beginning of the study (P_0) and once per week (P_1-P_4) we performed:

- Blood gas analyses from »arterialized« capillary blood on ABL 625 Blood Gas System-Radiometer.
- Hematological status through values of hemoglobin, hematocrit, erythrocite and platelet count on COBAS MICROS OT-ROCHE-ABX.
- Biochemical monitoring included: proteins (colorimetric Biuret method), albumin (BCG-Bromcresol green), urea (UV-kinetic method), ionized calcium (ion selective electrode), phosphorus (UV-method with ammonium molybdate), and glucose level (GOD-PAP method).

At the beginning and at the end of the study, for the evaluation of nutrition effects, we measured the values of prealbumine and transferine by the nephelometric »end-point« immunoprecipitation method (test »Orion-Diagnostica«).

For all analyses mentioned above, we used 300 μL of serum, and 150 μL of blood.

All data have been statistically analyzed using descriptive and parametrical testing and ANOVA testing one-factorial analyses of variance.

Results

Investigated infants improved in body mass 10–75 g/day, and during the whole study 600–800 g. Initial decrease in body weight in 7–9% of birth weight was physiological, and time for gaining weight at birth was statisticaly less significant in ^{pre}Impamil group ($p<0.01$) comparing to the control one (*Table III*).

The results of pH and BE during the investigated period show no statistically significant differences proving the stable acidobase status, which is a good point for the tolerance of ^{pre}Impamil. This study has not shown appearance of the postacidotic syndrome (*Table IV*).

During the growth, there was a statistically significant decrease in hemoglobin concentration (Hb), erythrocite (Er) and hematocrit (Hct), $p<0.001$, and a statistically significant increase in platelet count (PLT), $p<0.001$. These changes in hematological values are physiological for premature infants, so there is a recommendation for addition of Fe in formulas, with continuous follow-up of parameters for anemia assessment in the first six months of infant's life (*3*) (*Table V*).

Biochemical parameters estimated once a week show no significant differences in glucose level, while the fraction of ionized calcium was significantly lower, so calcium was added parenteraly. Values of phosphorus and alkaline phosphatase were significantly higher ($p<0.01$) at the end of the first and second week (*4*) (*Table VI*).

Level of protein fraction has been analyzed by measuring values of proteins, albumin, prealbumine, transferine and urea (*Table VII*).

Values of total proteins and albumin fraction were statistically significantly higher ($p<0.01$) in the second study week, when the beginning of growth

Table III Variable of body mass.

Parameter	Mothers milk	^{pre}Impamil (16%)
Initial decrease of BM (%)	8.7 ± 3.1	7.02 ± 1.89
Gaining birth BM (day)	26 ± 1.7	12.48 ± 5.34*
Improvement (g/day)	11.4 ± 4.4	24.88 ± 5.79*
Increase in length (cm)	2.2 ± 0.2	3.68 ± 1.7*

* $p < 0.01$

Table IV Acidobase parameters.

Measurement	pH	BE
P_0	7.37	–1.29
P_1	7.39	–0.01
P_2	7.39	0.04
P_3	7.39	0.32
P_4	7.40	0.42

Table V Hematological status.

Measurement	Hb	Er	Hct	PLT
P_0	183	5.14	0.53	260
P_1	146	4.44	0.43	424
P_2	136	4.09	0.39	450
P_3	129	3.97	0.37	413
P_4	121*	3.79*	0.35*	424*

* $p < 0.001$

Table VI Biochemical monitoring.

Measurement	Glucose mmol/L	Ca^{+2} mmol/L	P mmol/L	Alkaline phosphatase, U/L
P_0	3.77	1.14*	2.11	55.36
P_1	4.01	1.21	2.41*	57.68*
P_2	3.84	1.22	2.43*	56.44*
P_3	3.77	1.16	2.22	54.56
P_4	4.09	1.14	2.29	54.49

* $p < 0.01$

Table VII Monitoring of protein fractions.

Measurement	Proteins, g/L	Albumin, g/L	Prealbumine, g/L	Transferin, g/L	Urea, mmol/L
P_0	55.36	35.01	0.103	0.998	4.77
P_1	57.68*	37.03*			3.52
P_2	56.44	36.80			3.23
P_3	54.56	36.47			3.31
P_4	54.49	36.76	0.171	1.078	3.48

* $p < 0.01$

effect is obvious (5). Concentrations of prealbumin and transferin increase with growth, but with no statistically significant differences. There was a decrease of urea value during the investigated four weeks within the reference ranges, showing good protein intake.

Discussion

Human milk fortified with the special domestic formula ^{pre}Impamil stimulates growth in premature infants during the neonatal period.

Time necessary for gaining birth weight is statistically significantly shorter in infants fed with ^{pre}Impamil.

Gaining in body weight (g/day) and length (cm) is statistically significantly increased in infants fed with ^{pre}Impamil.

Human milk fortified with ^{pre}Impamil is characterized with good peroral tolerance and absence of digestive disturbances, which is proved by the stable acidobase status.

Biochemical monitoring, especially of proteins and albumin, is of great importance in the process of evaluating the growth of premature infants on special feeding program, proved by paralel monitoring of anthropometric parameters.

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