

Half-Life of Leu-Enkephalin in the Serum of Infants of the First Year of Life on Different Types of Feeding: Relationship with Temperament

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The half-life of leu-enkephalin in the serum of infants aged under 1 year is significantly shorter than in adults. In girls leu-enkephalin half-life is significantly longer than in boys. The half-life of leu-enkephalin is different in infants on breast and formula feeding. Nine characteristics of temperament in infants of the first year of life were determined using EITQ and ITQ questionnaires. Serum leu-enkephalin half-life directly correlated with temperament characteristics (activity, perception, threshold), but not with the level psychomotor development.

Key Words: *infants aged 0-1 year; feeding type; enkephalins; enkephalinases; temperament*

Harmonic development of a child is a key problem in pediatrics. The type of feeding is a crucial factor determining the growth and development of infants during the first months of life. Breast milk is a unique product providing optimal physical and psychomotor development (PMD) of children. The rate of nervous and mental development of breast-fed infants is higher than in infants receiving formula feeding [2,7]. Hence, the type of feeding is essential for organization of metabolic processes, functioning of the neuroendocrine, immune, and other systems of the growing organism. On the other hand, the relationship between the type of feeding and status of the priority neurochemical regulatory systems of infants is little studied. The role of these systems in PMD of infants and formation of constitutional characteristics is unclear.

We studied the parameters characterizing the endogenous opioid system (EOS). This system was chosen because it is characterized by a wide spectrum of biological effects, including adaptogenic and antinociceptive activity, regulation of the emotional sphere, beha-

avior, learning, and memory. Moreover, little is known on the role of EOS in child development during the early postnatal period. The lifetime of opioid peptides, in particular, enkephalins is an important indicators of EOS status. In the serum these peptides exist within several minutes and their lifetime is determined by activity of enkephalin-degrading enzymes [1,6].

We studied the relationship between serum enkephalinase activity and PMD and temperament parameters in infants aged 0-1 year on different types of feeding.

MATERIALS AND METHODS

A total of 93 healthy infants (50 boys and 43 girls) aged 0-1 years were examined. Thirty-three infants received breast feeding and 60 received formula feeding. The infants were examined using quantitative method for evaluation of PMD parameters in infants differentially evaluating the development of motor, speech, and mental functions in the norm and during psychomotor retardation [3]. The summary score corresponding to a variant of normal-for-age PMD was 27-30. Three groups were distinguished on the basis of clinical examination: 1) norm; 2) risk of CNS dis-

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ease (score 23-26); and 3) delayed PMD (score 22 and lower).

The temperament of infants aged 0-1 year was evaluated using EITQ and ITQ, developed by W. B. Carey *et al.*, in the Russian adaptation of I. A. Kel'manson [5]. The scores quantitatively characterizing 9 studied aspects of the temperament were determined.

Serum enkephalinase activity was evaluated by the rate of accumulation of radioactive ^3H -leu-enkephalin degradation products [6]. The products of leu-enkephalin hydrolysis were separated by thin-layer chromatography on silica gel plates (Silufol) in 2-butanone:tretbutanol:ammonia:water (2:2.4:1:1) system (R_f for leu-enkephalin 0.8, for tyrosine 0.6, for other products 0.2-0.4). The spots corresponding to the markers were scraped and their radioactivity was measured on a MiniBeta liquid scintillation spectrometer (LKB). The results were processed using STATISTICA software.

RESULTS

Leu-enkephalin half-life ($t_{1/2}$) in the serum of children aged 0-1 year is 2.37 ± 0.05 min, which is significantly lower ($p < 0.001$) than $t_{1/2}$ determined previously for adults (3.10 ± 0.05 min) [6]. This probably reflects higher intensity of metabolic processes in children in comparison with adults. In girls serum leu-enkephalin $t_{1/2}$ was significantly higher than in boys (2.51 ± 0.08 and 2.26 ± 0.06 min, respectively, $p < 0.01$).

A relationship between leu-enkephalin $t_{1/2}$ and type of feeding was detected. The mean $t_{1/2}$ in breast-fed children was significantly lower than in children receiving formula feeding (2.17 ± 0.05 and 2.48 ± 0.07 min, respectively, $p < 0.01$).

Early onset of formula feeding is a metabolic stress [2]. Presumably, the system of endogenous opioid peptides mediates the effects of stress factors of different

nature and increased stress tolerance. The increase in serum leu-enkephalin $t_{1/2}$ in children receiving formula feeding probably reflects the compensatory role of opioids in metabolic stress.

No significant correlation between $t_{1/2}$ and PMD was detected in the examined infants. Analysis of leu-enkephalin $t_{1/2}$ in different groups of infants distinguished by their PMD also showed no significant differences. On the other hand, significant differences in $t_{1/2}$ related to feeding type and sex were observed in group 1. In this group leu-enkephalin $t_{1/2}$ in breast-fed infants was significantly shorter than in infants on formula feeding (2.27 ± 0.10 and 2.56 ± 0.08 min, respectively; $p < 0.05$), and shorter in boys than in girls (2.29 ± 0.07 and 2.61 ± 0.10 min, respectively; $p < 0.05$). No differences of this kind were detected in groups 2 and 3. It can be hypothesized that unfavorable factors of the ante- and postnatal period led to disorders in PMD and had an impact on EOS formation. This, presumably, leveled the differences in leu-enkephalin $t_{1/2}$ in these groups.

Nine temperament characteristics were studied using EITQ and ITQ giving the most complete description of infant behavioral features. Serum leu-enkephalin $t_{1/2}$ in infants aged 0-1 year directly correlated ($p < 0.05$) with activity, perception, and threshold, and showed a trend to correlation ($p = 0.06$) with intensity (Table 1).

Temperament is an important factor determining the reaction to the environment. However, some components of temperament are not yet interpreted. Positive correlation between activity and leu-enkephalin $t_{1/2}$ is in line with the data on the capacity of opioid peptides to stimulate motor activity [4,8]. Perception to a certain measure corresponds to extrovert type, which, as we showed previously, correlates with leu-enkephalin $t_{1/2}$ in adults [6]. Correlation of the threshold parameter with $t_{1/2}$ confirms the data that opioids

TABLE 1. Relationship between Temperament Parameters According to Kel'manson and Leu-Enkephalin $t_{1/2}$ in the Serum of Infants Aged 0-1 Year ($n=20$)

Temperament parameter	Spearman correlation coefficient
Activity (physical and motor)	$R=0.47$, $p=0.04$
Regularity (regularity of sleeping and awakening periods and feeding schedule)	$R=-0.07$, $p=0.78$
Perception (initial reaction to new external stimuli)	$R=0.48$, $p=0.03$
Adaptation capacity (easiness of adaptation to environmental changes)	$R=0.16$, $p=0.49$
Intensity (of any reaction, irrespective of its quality and direction)	$R=0.44$, $p=0.06$
Mood (total ratio of behavioral reactions over 24 h)	$R=0.17$, $p=0.47$
Persistence (duration of certain activity and capacity to continue it in spite of obstacles)	$R=-0.07$, $p=0.77$
Distraction capacity (easiness of changing behavior in response to new situations)	$R=0.29$, $p=0.22$
Threshold (minimum force of external exposures inducing reaction of the infant)	$R=0.56$, $p=0.01$

modulate not only pain sensitivity, but also general reactivity of the nervous system [4].

Hence, a relationship between EOS status of infants aged 0-1 year and type of feeding, but not PMD level was revealed. A relationship between infant EOS and some temperament characteristics was demonstrated.

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