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Shifts as Markers of Perinatal Damage of the Central Nervous System

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Abstract Perinatal lesions of the Central nervous system occupy a leading place in the structure of morbidity in newborns. In this regard, we set ourselves the task of evaluating the activity of the S100B neurotest as a marker of perinatal CNS damage in posthypoxic syndrome, depending on the severity of asphyxia; compare metabolic shifts with neurotest indicators in dynamics; highlight the correlation between S100B and Ca, Mg serum levels as components of the formation of perinatal lesions of the central nervous system. According to the results obtained from the isolated signs of multiple organ failure, a high level of S100 neurotest in combination with hypoglycemia can be considered a certain clinical and laboratory predictor of the formation of neurological symptoms and long-term consequences against the background of obvious clinical signs. Correlation analysis of the relationship between Ca and Mg showed a high positive statistically significant relationship with neonatal asphyxia, especially with body weight shifts, regardless of the severity of asphyxia, and a moderately and weakly positive and in some cases negative correlation with S100/Ca, S100/Mg, which confirms the predominance of S100 as the leading laboratory neurotest in neonatal asphyxia.

Keywords Newborns, S100 neurotest, Hypocalcemia, Hypomagnesemia

1. Introduction

Hypoxic - ischemic encephalopathy resulting from hypoxia, underlies the delay in psychomotor development in the first year of life, the formation of attention deficit hyperactivity disorder, cerebral palsy, motor and cognitive disorders [6,7].

In this regard, early diagnosis of the severity of hypoxia and the associated CNS damage is of particular importance for the choice of adequate therapy and in the preparation of health procedures and medical correction during further medical examination, taking into account the risk of developing long-term neurological symptoms [1,3,10].

A great role is given to the assessment of the marker of perinatal damage to the central nervous system according to the S100B neurotest. Also, the role of hypoglycemia, hypocalcemia, hypomagnesemia and a decrease in the level of phosphorus in the blood of a newborn is not excluded, as components of the formation of metabolic disorders indirectly creating a background for neurological symptoms [2,4,9].

2. Literature and Methodology

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To accomplish this task, 60 full-term newborns born with a history of asphyxia were examined. Diagnosis according to WHO criteria (2008). Depending on body weight and severity of asphyxia, groups of patients were

I- body weight less than 2500.0 g
II- Normal body weight at birth
III- body weight over 4000g

According to the severity of asphyxia, each group is divided into subgroups: a-moderate asphyxia, b-severe asphyxia.

Research methodology-marker neurotest S100B by ELISA, the level of glucose, calcium, magnesium, phosphorus was determined on the Merilyzer Clini Quant apparatus.

3. Results and Discussion

Of the observed newborns, up to 60% were dominated by boys. Analysis of anamnestic data on maternal health showed the predominance of:

Leading factors of antenatal hypoxia: acute infections of the upper respiratory tract - 80%; anemia - 63%; placental insufficiency - 43%; caesarean section - 40%; thyroid disease - 40%; pathology of the urinary system - 36%; hypertension disorder - 34%; inflammatory diseases of the pelvic organs in women - 28%.

Leading intranatal factors of acute asphyxia: childbirth and delivery, complicated by fetal stress - 80%; cord

entanglement - 40%; premature detachment of the placenta - 36%; violations of labor activity - 35%; severe preeclampsia - 30%; the onset of labor after a 24-hour waterless period - 28%; premature rupture of membranes - 22%. In more than half of the cases, a combination of 2-3 factors was identified. Thus, there is such a picture of a combination of leading factors: deterioration of maternal blood oxygenation 76%; interruption of blood flow through the umbilical cord 45%; violation of gas exchange through the placenta 40%; insufficiency of respiratory efforts of the newborn 28%; inadequate hemoperfusion of the maternal part of the placenta 25%;.

Patients are monitored in accordance with the rule of clinical, instrumental and laboratory monitoring according to indications and to the extent necessary. The neurotest marker S100B was tested in observed newborns in the first hours and on the fifth day of life. (tab. 1)

Table 1. Dynamics of protein S-100 concentration in children in comparison groups

Year day	S-100 ng/l (N 90-105 ng/l)					
	1a gr n=14	**1b gr n=16**	**2a gr n=52**	**2b gr n=18**	**3a gr n=8**	**3b gr n=12**
1-day M±m	247ng/l-313ng/l 285,79±5,89 *p=0,24*	255ng/l-414ng/l 345±11,53 *p=0,46*	160ng/l-187ng/l 174±1,11 *p=0,04*	258ng/l-288ng/l 277±1,99 *p=0,08*	202ng/l-369ng/l 265±22,82 *p=0,91*	247ng/l-505ng/l 360±23,87 *p=0,95*
5-day M±m	96ng/l-102ng/l 99,00±0,43 *p=0,02*	105ng/l-116ng/l 111±0,81 *p=0,03*	91 ng/l 110ng/l 101±0,72 *p=0,03*	94ng/l-118ng/ l105±1,66 *p=0,07*	101ng/l-129ng/l 115±3,30 *p=0,13*	136ng/l-166ng/l 156±2,51 *p=0,10*

Note. P<0.05 significance of intragroup differences

As can be seen from Table 1, in the first hours of life in low-weight newborns and those with large body weight, S100B increases sharply by almost 5 times compared to healthy newborns; in patients with normal body weight, neurotest markers increase moderately up to 2.5 times. On the 5th day of life in heavy newborns, although the S100B values gradually decrease, they remain 1.5 times high compared to healthy newborns; in other groups, the neurotest values are reduced to normal or closer to normal. Against this background, hypoglycemia is observed from 52% in group IIb, to 60-62% in groups IIIb and Ib.

Given the role of the S100B neurotest as a marker of perinatal CNS damage in newborns, and neurological symptoms are pronounced in our observations, the neurotest with the indicated S100B marker was performed in the first hours of life and in dynamics on the 5th day. In the group of small children and large children, S100B increases sharply above the norm 5 times, in children with normal body weight, the indicators increase moderately by 2.5 times. On the 5th day of life in overweight patients, although the S100B values gradually decrease, they remain 1.5 times high compared to healthy newborns; in other groups, the neurotest values are almost reduced to normal or already within the range of indicators in healthy newborns. Against this background, we observe hypoglycemia from 52% in group IIb, to 60-62% in groups IIIb and Ib. In parallel with these changes, which aggravate the neurological status in asphyxia of newborns, we observe a sharp decrease in the level of phosphorus in the blood in all groups of newborns with asphyxia, a decrease in the level of magnesium and ionized Ca in all groups, a sharp decrease in plasma Ca in groups Ib and IIIb, namely in newborns with changes in body weight (table 2).

It is well known that phosphorus is involved in neuron myelination, hypocalcemia and hypomagnesemia indirectly aggravate the state of vascular wall permeability and muscle tone. It is believed that neonatal hypoglycemia can lead to immediate and long-term neuropsychiatric disorders, the later it is detected, the more likely these complications are [5,8].

Table 2

Group	Ca/Mg	Ca/S100		Mg/S100	
	r	r		r	
		1 day	5 day	1 day	5 day
1 a gr	0,967	0,35	0,388	0,244	0,219
1 b gr	0,973	0,11	0,044	0,22	-0,043
p<0,05					
2 a gr	0,008	0,072	-0,103	-0,018	-0,092
2 b gr	0,805	0,44	-0,082	0,32	-0,152
p<0,05					
3 a gr	0,973	-0,15	-0,122	0,131	-0,182
3 b gr	0,993	-0,06	0,453	0,005	0,48
p<0,05					

Note. p<0,05 significance of intragroup differences

Comparing these features, it is clear that the S100B marker is the leading neurotest in assessing perinatal CNS damage, but the presence of hypocalcemia, hypomagnesemia, hypoglycemia, and a decrease in phosphorus levels. Given the activity of these metabolites in the structure of the cell membrane and neuron myelination, it serves as an aggravating background in the formation of perinatal CNS damage in newborns.To confirm this relationship between the neurotest marker S100B, Ca and Mg, the correlation dependence of these indicators was assessed. A high positive relationship was noted statistically significant S100 Ca / Mg in all groups of patients, regardless of the severity of asphyxia, except for group IIa, where the relationship is weakly positive.

Indicators S100/Ca in underweight patients and patients with normal weight on the first day of life from a weakly positive to moderately positive correlation, and in patients with a large body weight, the correlation is negative and weak. On the 5th day of life in underweight patients, the correlation remains weak in severe asphyxia and moderate direct statistically significant. In patients with normal body weight, the correlative relationship is negative, weak, statistically significant, in large children with moderate asphyxia, the relationship is inversely weak, and in severe asphyxia, the relationship is direct moderate. The relationship S100/Mg is mostly inverse, weak, statistically significant.

4. Conclusions

Of the identified signs of multiple organ failure, a high level of S100 neurotest in combination with hypoglycemia can be considered a certain clinical and laboratory predictor of the formation of neurological symptoms and long-term consequences against the background of obvious clinical signs.

Correlation analysis of the relationship between Ca and Mg showed a high positive statistically significant relationship with neonatal asphyxia, especially with body weight shifts, regardless of the severity of asphyxia, and a moderately and weakly positive and in some cases negative correlation with S100/Ca, S100/Mg, which confirms the predominance of S100 as the leading laboratory neurotest in neonatal asphyxia.

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