IJACT, Volume 2, Issue 8, 2024 ISSN: 2995-5378
http://medicaljournals.eu/index.php/IJACT

INTERNATIONAL JOURNAL OF ALTERNATIVE AND CONTEMPORARY THERAPY

Characteristics of the Autonomic Nervous System in Infants during Sepsis in Their First Year of Life

Rabbimova Dilfuza Toshtemirovna
DcS, Associate Professor, Head of the Department of Propaedeutics of Paediatric Diseases, Samarkand Medical University, Samarkand, Uzbekistan

Yusupov Fazliddin Tojievich
Candidate of Medical Sciences, Assistant, Department of Therapy 3, Samarkand Medical University, Samarkand, Uzbekistan

Abstract: It has been revealed that children with perinatal CNS lesions have hypersympathicotonia with a significant increase in IN (stress index) compared to healthy children without perinatal lesions of the nervous system.

This causes a greater tension of adaptation mechanisms in children with perinatal CNS lesions, which in turn may constitute a risk group for the development of severe infectious inflammatory diseases, including sepsis.

Keywords: perinatal lesion of the nervous system, autonomic nervous system, sepsis, adaptation, infants.

Introduction. It is widely recognized that both the nervous and immune systems play pivotal roles in maintaining homeostasis and adaptation, crucial for protecting the body from harmful factors. Immunocompetent cells are omnipresent in non-lymphoid tissues, forming a complex cytokine network that regulates immune reactions and the functions of stromal and parenchymal cells, complementing the hormonal and nervous regulation of organ systems. Recent studies have demonstrated the expression and functional roles of immunologically significant receptors on nerve and glial cells, confirming the neurotropic nature of certain immune cells [3,4].

Despite advances, many aspects of the functional state of blood circulation, the establishment of sinus rhythm in infancy, and their potential use in assessing and predicting the status of vital systems in sepsis patients, remain insufficiently explored and warrant further research.

Objective of the study. This study aimed to evaluate the regulatory function of the autonomic nervous system (ANS) in infants with sepsis during their first year of life, using cardiointervalography.

Materials and Methods. A total of 246 infants with purulent septic diseases were studied, including 83 with local purulent infections and 163 with sepsis. The adaptive reactions of the patients were assessed by determining the vegetative tone using cardiointervalography. The parameters measured included the stress index (IN), Mo (c), AMo (%), and Δx.

Results and Discussion:

The study's findings are summarized in Table 1. Analysis of the frequency distribution of types of IVT in the examined patients at admission revealed a significant increase in the incidence of hypersympathicotonic variants of autonomic regulation compared to normative indicators, in both the sepsis (90.2%) and local infection (71.1%) groups. Notably, in infants with sepsis, the eitonic variant was absent, while pronounced vagotonia was observed in 6.1% of patients. In cases of local infection, 24% of patients exhibited the eitonic type, whereas the vagotonic variant was detected in only one

patient (1.2%). These results indicate an overexcitation of the adaptive-compensatory reactions of the sympathetic branch of the ANS, and in some cases, a breakdown of adaptation in infants with sepsis.

Table 1. Frequency distribution of different types of baseline autonomic tone in children with sepsis and localised infection (%)

Types of autonomic Tone	Control, n=30		Local infection, n=83		Septicaemia, n=163	
	abc	%	abc	%	abc	%
	0	0	59	71,1*	147	90,2*^^^
Hypersympathicotonia	6	18,8	3	3,6	4	2,5*
Sympathicotonia	3	9,4	1	1,2*	2	1,2
vagotonia	0	0	0	0	10	6,1^
Vigorous vagotonia	23	71,9	20	24,1*	0	0,0
Eutonia	32	100,0	83	100,0	163	100,0

Note:

Differences relative to the data of the healthy group are significant (* - P<0.05, - P<0.01, * - P<0.001), and differences relative to the data of the local infection group are significant (^ - P<0.05, ^^^ - P<0.001).

It is noteworthy that in cases of local infection, ongoing treatment led to a decrease in the activity of the sympathetic division of the ANS and an increase in the tone of the parasympathetic division by the 2nd to 3rd day in children with hypersympathicotonia. In sepsis, while there was a reduction in hypersympathicotonia, complete normalization of this parameter was not observed until the patients were discharged from the hospital. Furthermore, an analysis of the types of initial vegetative tone in the structure of autonomic regulation in sepsis patients revealed that the severity of the patient's condition correlated with a more pronounced hypersympathicotonic response (Tables 2, 3).

Table 2. Frequency of distribution of different types of initial vegetative tone in the structure of body supply of sepsis patients depending on the severity of the condition (%)

Types of autonomic Tone	Sepsis patients by severity of condition						All	
	medium severity, n=24		heavy, n=109		extremely severe, n=29			
	abc	%	abc	%	abc	%	abc	%
	4	2,5	120	73,6*	23	14,1 *	147	90
Hypersympathicotonia	3	1,8	1	0,6	0	0,0	4	2,5
Sympathicotonia	0	0,0	0	0,0	0	0,0	0	0,0
Eutonia	2	1,2	0	0,0	0	0,0	2	1,2
vagotonia	0	0,0	3	1,8	7	4,3	10	6,1

Note: * - differences relative to the data of the moderate severity group are significant (* - P<0.001).

In the hypersympathicotonic form of reactivity, children of the severe category prevailed - 120 (73.6%) patients and with an extremely severe condition – 23 (14%) children. However, 4.3% of the children admitted in extremely serious condition had a pronounced vagotonic effect.

Table 3. Frequency of distribution of different types of initial vegetative tone in the structure of organ supply of sepsis patients by organ lesions lesions (%)

Types of autonomic tone	Number of organs affected						All	
	2 organs, n= 13		3 organs, n=72		4- and more organs, n=78			
	abc	%	abc	%	abc	%	abc	%
Hypersympathicotonia	7	4,3	124	76,1 *	16		147	90,2
Sympathicotonia	4	2,5	0	0	0	0	4	2,5
Eutonia	0	0	0	0	0	0	0	0
vagotonia	2	1,2	0	0	0	0	2	1,2
Vigorous vagotonia	0	0	4	2,5*	6	3,7*	10	6,1

Note: Differences relative to the data of the group with 3-4 organ lesions are significant (* - P<0.05, * - P<0.001).

The KIG indicators were as follows: Mo = 0.53-0.54 s; AMo = 12-15%; Δx = 0.34-0.46 s; IN = 37-32 conl. units. In these patients, a breakdown in adaptation was noted, indicated by a shift from hypersympathicotonia to vagotonia, reflecting a pronounced strain on compensatory mechanisms (Table 4.18). In cases of sepsis, the period of extensive clinical manifestations is characterized by an increase in the IN index by 5.5 times relative to standard values (P<0.001) and by more than 2 times relative to the values in children with local infections. The heightened intensity of adaptive mechanisms in children with sepsis is primarily driven by sympatho-adrenal mechanisms, as evidenced by the increase in AMo indicators relative to both the normative values and those of the comparison group (P<0.001 in both cases).

Table 4. Cardiointervalography parameters on admission, M±m

CIG indicators	Control, n=30	Septicaemia, n= 163	Localised infection, n=83
Mo, s	0,46±0,02	0,3±0,01*	0,39±0,01^^^
AMO,%	44±2,2	64±2,44*	48,5±1,54^^^
ΔX, s	0,10±0,004	0,04±0,001*	0,07±0,002*^^^
IN, units	478±18,5	2668±97,4*	1212±38,9*^^^

Note: Differences relative to the data of the healthy group are significant (- P<0.01, * - P<0.001), and differences relative to the data of the sepsis group are significant (^^^ - P<0.001).

In sepsis patients, the importance of parasympathetic mechanisms and humoral factors in adaptive processes decreases. This is evidenced by a reduction in the values of Δx and Mo, both relative to standard values (P<0.001 for both indicators) and to the values of the comparison group (P<0.05, P<0.001, respectively). Summarizing the data on the magnitude of CIG in infants with sepsis, it is evident that there is a several-fold increase in the intensity of adaptive mechanisms, primarily driven by the sympathoadrenal structures of the ANS.

The study of ANS regulatory function in infants with sepsis revealed a high prevalence of hypersympathicotonic conditions. Notably, children with perinatal central nervous system (CNS) damage predominated in this group, exhibiting significantly higher ANS stress indices compared to healthy infants, reflecting greater tension in adaptation mechanisms. This positions these children in a high-risk group for developing sepsis. The causal relationship between sepsis and ANS dysregulation in infants remains unclear. The data indicate that hypersympathicotonia is prevalent among children with CNS damage, who also suffer from severe infectious and inflammatory diseases, including sepsis.

The study results show that 87.6% of the examined children had a history of perinatal CNS damage, primarily due to factors leading to acute and chronic hypoxia. Analyzing the initial vegetative tone

distribution frequency among these children, as well as among children with sepsis without a history of perinatal lesions, revealed that in the CNS + PP group, 92.9% exhibited a hypersympathicotonic vegetative support contour, while 7.1% had pronounced vagotonia. In contrast, in the CNS - PP group, 71.4% were hypersympathicotonics, with no cases of pronounced vagotonia.

Further analysis of individual CIH indicators found that patients with perinatal pathology (Table 5) showed increased AMo (P<0.001) compared to children without perinatal pathology, indicating heightened sympathetic ANS activity. The IN increased by more than three times, while parasympathetic ANS activity decreased (Δx = 0.10±0.006, P<0.001).

Table 5. Cardiointervalography indices in children with perinatal pathology pathology, M±m

CIG indicators	+ CNS PP (without sepsis)	- PP CNS	P
Mo, s	0,43±0,02	0,46±0,02	>0,05
AMO, %	63±2,1	44±1,9	<0,001
ΔX, s	0,06±0,003	0,10±0,006	>0,05
IN, units.	1285±26	478±17	<0,001

Conclusion. The findings indicate that hypersympathicotonia is prevalent among children with central nervous system damage, as evidenced by significantly higher IN values compared to healthy children. This elevated IN reflects the greater strain on adaptation mechanisms in these children, placing them at higher risk for developing severe infectious and inflammatory diseases, including sepsis.

References:

1. Matics T.J., Sanchez-Pinto L.N. Adaptation and validation of a pediatric sequential organ failure assessment score and evaluation of the Sepsis-3 definitions in critically ill children. JAMA Pediatr., 2017, vol. 171, p. 17 -23
2. Шарипов А.М. Оценка эффективности экстракорпоральной детоксика-ции при сепсисе у детей // Инфекция, иммунитет и фармакология. – Ташкент, 2017. - №3. – С.41-45
3. ШамсиевА.М., Раббимова Д.Т., Алимов А.В. Роль цитокинов в формировании сепсиса у младенцев //Проблемы биологии и медицины.- Самарканд 2016.-№4.- с. 7-9
4. Шамсиев А.М., Раббимова Д.Т., Шамсиев Ж.А. Дифференцированный подход к реабилитации младенцев, перенесших сепсис// Детская хиркргия. – Москва, 2018.-№5.- с. 269-271
5. Абдукадирова Н. Б., Раббимова Д. Т., Хаятова З. Б. Роль дисплазий соединительной ткани в развитии патологии различных систем организма //Journal of Siberian Medical Sciences. – 2020. – №. 3. – С. 126-135.
6. Раббимова Д. Т. и др. Особенности распределения HLA-антигенов у младенцев с сепсисом //Вопросы науки и образования. – 2019. – №. 27 (76). – С. 32-39.
7. Раббимова Д. Т., Юсупов Ф. Т. Роль анаэробной инфекции в этиологической структуре гнойно-септических заболеваний у детей раннего возраста //ЖУРНАЛ ГЕПАТО-ГАСТРОЭНТЕРОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ. – 2022. – Т. 3. – №. 3.
8. Раббимова Д. Т., Юсупов Ф. Т. СОСТОЯНИЕ ИММУННОЙ СИСТЕМЫ И РАЗВИТИЕ ПОСТТРАНСФУЗИОННЫХ ОСЛОЖНЕНИЙ У БОЛЬНЫХ ГЕМОФИЛИЕЙ //Journal of cardiorespiratory research. – 2022. – Т. 3. – №. 2. – С. 77-80
9. Раббимова Д. Т., Юсупов Ф. Т. ЭФФЕКТИВНОСТЬ СОЧЕТАННОЙ ДЕКОНТАМИНАЦИИ И НЕЙРОПРОТЕКЦИИ В ЛЕЧЕНИИ СЕПСИСА У ДЕТЕЙ ПЕРВОГО ГОДА ЖИЗНИ //ЖУРНАЛ ГЕПАТО-ГАСТРОЭНТЕРОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ. – 2022. – Т. 3. – №. 3.

10. Абдукадирова Н. Б., Раббимова Д. Т., Хаятова З. Б. The role of connective tissue dysplasias in pathology of various body systems //Journal of Siberian Medical Sciences. – 2020. – №. 3. – С. 126-135.
11. Toshtemirovna R. D., Tozhievich Y. F. The effect of therapeutic cryoapheresis on clinical and biochemical parameters of hemophilia patients. – 2022.
12. Раббимова Д. Т. Состояние регуляции вегетативной нервной системы у младенцев с сепсисом //Science and Education. – 2023. – Т. 4. – №. 2. – С. 229-238.
13. Раббимова Д. Т., Юсупов Ф. Т. ВЛИЯНИЕ ЛЕЧЕБНОГО КРИОАФЕРЕЗА НА КЛИНИЧЕСКИЕ И БИОХИМИЧЕСКИЕ ПОКАЗАТЕЛИ У БОЛЬНЫХ ГЕМОФИЛИЕЙ //Miasto Przyszłości. – 2024. – Т. 47. – С. 410-417.
14. Раббимова Д. Т., Юсупов Ф. Т. УЛУЧШЕНИЕ ЛЕЧЕНИЯ СЕПСИСА У ДЕТЕЙ МЛАДШЕГО ВОЗРАСТА //Miasto Przyszłości. – 2024. – Т. 47. – С. 404-409.
15. Раббимова Д. Т. Характер распределения HLA-антигенов у младенцев с сепсисом //Science and Education. – 2023. – Т. 4. – №. 2. – С. 87-92.
16. Toshtemirovna R. D., Mansurovna S. G. THE ROLE OF CLOSTRIDIUM DIFFICILE IN THE DEVELOPMENT OF ANTIBIOTIC-ASSOCIATED DIARRHEA IN EARLY-AGED CHILDREN //International Journal of Medical Sciences And Clinical Research. – 2024. – Т. 4. – №. 06. – С. 12-17.
17. Mukhitdinovich S. A., Tashtemirovna R. D. Comprehensive approach to the problem of rehabilitation of infants submitted sepsis //Вопросы науки и образования. – 2017. – №. 10 (11). – С. 152-156.
18. Rabbimova D. Bacteriological investigation and method of antigen connected lymphocytes (ACL) in defining etiological structure of sepsis in children in the early age //Medical and Health Science Journal. – 2010. – Т. 4. – С. 51-54.
19. Toshtemirovna R. D., Tozhievich Y. F. The effect of therapeutic cryoapheresis on clinical and biochemical parameters of hemophilia patients //Web of Scientist: International Scientific Research Journal. – 2022. – Т. 3. – №. 5. – С. 1003-1007.