Health & Medical Sciences Volume: 1, Number 2, 2024, *Page*: 1-8

Clinical Characteristics of Vegetative Manifestations in Young Children with Acute Pneumonia

Zhasur Ne'matovich Abdurakhmonov[1], Oliya Askarovna Sharipova[2], Bakhronov Samievich Sherzod[3]*

Samarkand State Medical University, Uzbekistan; bahronovsh@gmail.com

DOI:
https://doi.org/10.47134/phms.v1i2.215
*Correspondence: Bakhronov Samievich Sherzod
Email: bahronovsh@gmail.com

Received: 07-12-2023
Accepted: 15-01-2024
Published: 27-02-2024

Abstract: *60 sick children with acute pneumonia aged from 1 to 3 years were examined. The control group consisted of 30 healthy children of the same age. The experience of the clinic has shown that all children with acute pneumonia have disorders of the autonomic nervous system, which aggravates the course of this disease. The author found that children with acute pneumonia showed characteristic changes in autonomic regulation, manifested by a predominance of hypersympathicotonic initial autonomic tone, which generally indicates a state of overstrain of the body's adaptive capabilities. High tension and disruption of adaptation increase the risk of an unfavorable outcome of the disease. In patients with acute pneumonia who received vegetotropic drugs and a multivitamin complex as part of complex therapy, more pronounced positive dynamics in indicators of autonomic homeostasis were noted.*

Keywords: *Autonomic Nervous System, Pneumonia, Adaptation*

Introduction

Despite the achievements of modern medicine, pneumonia, as before, is a serious disease, is the main cause of death in children all over the world, and has a high risk of various complications (Bobomuratov et al., 2023; Enert et al., 2010; Vein et al., 1991). According to WHO, about 155 million cases of pneumonia in children are registered annually worldwide, with approximately 1.4 million deaths under the age of five (Abduraxmanov et al., 2022). Pneumonia accounted for 740,180 children under five years of age in 2019, accounting for 14% of all under-five deaths, and among children aged one to five years, pneumonia accounted for 22% of all deaths (Baranov et al., 2010).

The prevalence of pneumonia in the general child population according to statistics for Uzbekistan (2015) is 2.91%. A significant role in the development of pneumonia is played by microbial aggression, to which the body is not able to form an adequate response. It is under the influence of nonspecific damaging factors that the body's adaptive capabilities are reduced, which creates conditions for infection of the lung tissue (Vein et al., 1991; World Health Organization, 2019). There is no doubt that the state of the autonomic nervous system (ANS) plays a significant role in the occurrence and development of respiratory pathology (Abdurakhmanov & Sharipova, 2022; Afonina, 2010). One can note the dual

participation of the NS in the formation and development of inflammation: on the one hand, undoubtedly, the influence of the inflammatory process on the nervous system, on the other, the participation of altered reactions of the nervous system in the pathogenesis of inflammation (Vein et al., 1991; World Health Organization, 2019).

The severe course of acute pneumonia among young children and, in most cases, the lack of effect of traditional treatment methods have become the reason for the search for perfect and effective methods, as well as the study of concomitant diseases that affect the child's body (Rabbimova, 2023).

The state of health and illness is currently considered as a manifestation of adaptation and maladaptation, between which there are phases of subadaptation. The final effectiveness of adaptation processes in normal conditions and in pathology is regulated by the autonomic nervous system (ANS), the leading mechanisms of which determine the effectiveness and level of responses of organs and systems to various changes in the external and internal environment of the body under the influence of various stress factors. The problem of autonomic disorders in young children is one of the most pressing in pediatrics. Since physiologists and clinicians established a direct connection between a person's functional state and the ANS, interest in this problem has been constantly growing. Autonomic homeostasis is one of the first to respond to changes in the state of the body when adapting to physiological stress or pathological conditions. According to the literature, in children with somatic pathology, various disorders of autonomic homeostasis are quite common, which are secondary in nature and significantly complicate the course of the underlying disease (Shabunina, 2000). Dysfunction of the ANS in pneumonia occurs secondary and is somatically determined. Also according to Abdool Karim, S.S. (Sharshenova & Mazhikova, 2005) dysfunction of the ANS in diseases is associated with a decrease in the vascular supply of the body, high intensity of anabolic processes and changes in the functional state of both of its parts. According to Wayne A.M. (Sharshenova & Mazhikova, 2005)autonomic dysfunction is a syndrome of somatic diseases, including pneumonia.

A number of authors have identified ANS dysfunction in respiratory diseases in older children and the need for correction of autonomic disorders during their treatment (Abdool Karim & others, 2010; Karimdzhanov, 2016; World Health Organization, 2012).

Studying VNS in chronic obstructive bronchitis, A.B. Shabunina came to the conclusion that underestimation of obvious or hidden disturbances in the activity of the ANS in the clinic complicates the restoration of disorders, maintains a low quality of life for patients and leads to a decrease in the effectiveness of the treatment (Pikuza & Samorodnova, 2013).

Therefore, the study of deviations in the function of the ANS is relevant in terms of identifying pathogenetically significant mechanisms associated with failure of adaptation in children with acute pneumonia. Consequently, there is a need for timely detection of disturbances in the activity of the ANS in order to correct and prevent unwanted complications during the underlying disease.

However, clinical observations on the study of the functional state of the ANS in young children with acute pneumonia in the modern medical literature are few.

In this regard, it is of interest to clarify the characteristics of the functional state of the ANS in young children with acute pneumonia.

Methodology

Objectives of the study

To study the clinical characteristics of vegetative manifestations in young children with acute pneumonia

Materials and methods of research

60 patients with acute pneumonia aged from 1 to 3 years were examined. The control group consisted of 30 healthy children of the same age. Severe pneumonia was observed in 20 (33.33%) patients, moderate in 30 (50%) and mild in 10 (16.67%) sick children. Depending on the type of therapy performed, the patients were divided into two groups: control group - 20 children who received standard treatment; the main one - 40 children who, along with conventional therapy, received Magne B6, 2 ml 2 times a day and Neurocomplex Kids, 1 sachet 2 times a day. The total course of treatment is 4 weeks. After this, for maintenance therapy, it is sufficient to take 2 ml Magne B6 once a day and Neurocomplex Kids 1 sachet once a day for 1–3 months. The diagnosis was formulated in accordance with the classification adopted at a meeting of pediatric pulmonologists held as part of the XVIII National Congress on Respiratory Diseases in Yekaterinburg (December 2008).

To assess the ANS, we used the method of cardiointervalography (CIG) with the calculation of the initial autonomic tone (IVT) and autonomic reactivity (VR). CIG is a nonspecific method for assessing adaptive-compensatory reactions. When examining patients, we adhered to the rules proposed by R.M. Baevsky et al. (1981) and modified by A.M. Wayne (Sharshenova & Mazhikova, 2005) - studies were conducted on an empty stomach or 2 hours after a meal; — in the morning, before intravenous manipulations; — repeated CIG studies were carried out at the same time of day; Registration of cardiac intervalograms (in the amount of 100 complexes in each case) was carried out on a single-channel electrocardiograph EK1T-03M with subsequent computer processing. The following indicators were calculated and evaluated: mode (MO) - the values of the most frequently occurring values of the R-R intervals in the series under study, mode amplitude (AMO) - the percentage of values of the R-R intervals corresponding to the mode; variation range (ΔX) – the difference between the maximum and minimum R-R intervals, IN of regulatory systems, is determined by the ratio of IN (at rest). The voltage index (SI) is directly calculated using the formula AMO (%)/(2 MO×ΔX(s)).

A general clinical and functional examination of sick children was carried out in the children's department of the multidisciplinary clinic of Samara State Medical University.

Result and Discussion

Based on the concept of the leading role of the functional state of the higher parts of the ANS in the implementation of the phase structure and outcomes of pathological

conditions in the child's body, this work analyzes the state of vegetative tone and autonomic reactivity in young children with acute pneumonia (McAllister, 2019). Our studies have shown that a significant proportion of patients with acute pneumonia have disorders of the autonomic nervous system, which aggravates the course of this disease (Alexandrova, 2022). All patients underwent CIG with the calculation of the main indicators of this method, in particular, the vegetative status was assessed using the calculation of IN1 according to the formula, giving a qualitative and quantitative characteristic of the state of adaptation mechanisms, which were carried out in the dynamics of the disease (O'Brien, 2019; T. Zhang, 2020). These indicators reflect the IVT and BP of the body based on the activity of the sympathetic and parasympathetic parts of the central nervous system and humoral mechanisms for regulating homeostasis, as well as the degree of tension in adaptation processes (Baranov et al., 2010).

All patients underwent CIG with the calculation of the main indicators of this method, in particular, the vegetative status was assessed using the calculation of IN1 using the formula. The data obtained are shown in Table 1. Based on the definition of IN1 and the totality of the examinations described above, we concluded the following distribution of patients according to IVT.

Table 1. Distribution of sick children, taking into account IVT

Sick children	**IVT**		
	Hypersympathicotonia	Sympathicotonia	Vagotonia
Group I	44 (73,3%)	10 (16,7%)	6 (10%)

Based on the definition of IN1 and the totality of the examinations described above, we concluded the following distribution of patients in both groups according to IVT.

The data presented in Table 1 indicate the predominance of hypersympathicotonia, which reflects overstrain of the body's adaptive capabilities in sick young children (García-Salido, 2020). The next most common patients were patients with sympathicotonia (tension of adaptive capabilities), the smallest number of patients were children with vagotonia, reflecting a breakdown in adaptive capabilities (Atanasova, 2022). The study of the features of the functional state of the autonomic nervous system showed a significant range of fluctuations in the parameters of the CIG in Table 2.

The CIG indicators given in Table 2 indicate that the rhythm of the functioning of the ANS of healthy children is characterized by the eutonic type of IVT and normosympathicotonic reactivity, which indicates a satisfactory degree of adaptive and compensatory capabilities of the body. In patients with severe pneumonia, the indicators M0 ($P<0.001$), AM0 ($P<0.001$), IN1 ($P<0.001$) were significantly different from those in healthy children, and the indicators were significantly higher than in the healthy group.

The predominance of initial hypersympathicotonia indicated the presence of activation of sympathoadrenal compensatory mechanisms in children.

Table 2. CIG indicators in patients depending on the severity of the disease

No	CIG indicators	Healthy children n=30	Mild course	Moderate course	Severe course
1	AMo	49.4 ± 2.12	52.7 ±2.25	55.7 ±3.01 P <0,001	60.05±3.12 P <0,001
2	Mo	0.44 ± 0.008	0.45 ±0.007	0.53 ± 0.06 P <0,05	0.59 ± 0.04 P <0,001
3	ΔX	0.08 ± 0.007	0.09± 0.006	0.11 ±0.008 P <0,05	0.13 ±0.04 P <0,001
4	ИН	670 ± 96.8	720.25± 182.05	725± 188.05 P <0,05	729 ±181.06 P <0,001

In the analyzed group, there were high rates of IN (P <0.001) in children with severe pneumonia, which indicates a fairly high level of functioning of the central circuit of heart rhythm regulation (Q. Zhang, 2022). The increase in the intensity of adaptive mechanisms was ensured primarily by reducing the importance of parasympathetic mechanisms.

Clinical manifestations also had their own characteristics in patients with IVT. In sick children with hypersympathicotonia, a severe course of acute pneumonia was observed and was characterized by signs of severe intoxication in response to the introduction of microbes or toxic agents into the body, as well as a sharp increase in heart rate, tachypnea, and pale skin. Parasympathetic signs in 6 (10%) patients were mainly represented by marbling of the skin with hyperhidrosis, normal body temperature reaction, and decreased heart rate.

In general, the intensity of autonomic regulation in children with acute pneumonia depended on the activity and severity of the disease (de Benedictis, 2020; Duan, 2020). Fluctuations in the parameters of ANS dysfunction make it possible to judge not only the course of the disease, but also to predict its outcome. A study conducted on the clinical characteristics of autonomic manifestations in young children with acute pneumonia shows the significant role of autonomic dysfunctions, characterized by the predominance of hypersympathicotonic IVT (Li, 2020; Younus, 2019).

The identified violations of the regulatory mechanisms of the ANS necessitate the inclusion of vegetotropic therapy in the complex treatment of children with acute pneumonia. All this predetermined the development of combined treatment regimens for children with acute pneumonia, depending on the state of their IVT, including Magnesium B6 and the kids neurocomplex against the background of conventional therapy (Degtyareva, 2022; Dolgikh, 2023). In the dynamics of the main parameters of the ANS, significant differences were obtained depending on the therapy in the study groups. Analysis of the initial autonomic tone at the end of treatment in children with acute pneumonia showed a relative normalization of the studied indicators.

Cardiointervalographic studies in the main group against the background of vegetative treatment showed positive dynamics of the studied indicators (Berce, 2019). The initial hypersympathicotonia was determined with normosympathicotonic IVT, leading to an improvement in sympathoadrenal reactions on the part of the VNS, and the priority of the parasympathetic and neurohumoral mechanisms was created. The most significant differences are in the stabilization of the AMO value as an indicator of sympathoadrenal

activity ($P < 0.05$). The differences in the stabilization of the Mo and Δx indicators are not so significant, but nevertheless, in children of the main group, their limits began to tend to normalize, although they did not reach the normative level (P from <0.05 to <0.01). These shifts in the dynamics of the functional activity of the leading mechanisms of the ANS in children of the main group contribute to the improvement of sympathoadrenal reactions on the part of the ANS and the creation of priority for the parasympathetic and neurohumoral mechanisms (Williams, 2022). However, the moderately pronounced changes in CIG that remained in them even after treatment indicated the need to continue vegetotropic therapy, both medicinal and non-medicinal, even after the end of the main treatment on an outpatient basis.

Conclusions

1. In patients with acute pneumonia, characteristic changes in IVT were noted, manifested by a predominance of hypersympathicotonic initial autonomic tone, which generally indicates a state of overstrain of the body's adaptive capabilities. High tension and disruption of adaptation increase the risk of an unfavorable outcome of the disease.
2. Combination therapy of children with acute pneumonia by including vegetative drugs in complex treatment, taking into account the characteristics of their autonomic reactivity, leads to a reduction in complications of the disease.

References

Abdool Karim, S. S., & others. (2010). Timing of initiation of antiretroviral drugs during tuberculosis therapy. *N. Engl. J. Med.*, *362*, 697–706.

Abdurakhmanov, J. N., & Sharipova, O. A. (2022). Mechanisms of neurovegetative regulation in bronchopulmonary diseases in children. *British Medical Journal*, *4*, C–3–C–9.

Abduraxmanov, J. N., Sharipova, O. A., & Bobomuratov, T. A. (2022). The importance of vegetative control in the pathogenesis of broncho-pulmonary diseases. *Journal of CARDIORESPIRATORY RESEARCH*, *Special issue 1.1*, C–213–C–219.

Afonina, N. A. (2010). The incidence of respiratory diseases in children as a medical and social problem (literature review). *Russian Medical and Biological Bulletin Named after. Academician I.P. Pavlova*, *4*, 157–162.

Alexandrova, E. A. (2022). Dynamics of vegetative, insomnia and neuropsychological manifestations during the treatment of post-COVID syndrome. *Meditsinskiy Sovet*, *2022*(2), 76–84. https://doi.org/10.21518/2079-701X-2022-16-2-76-84

Atanasova, S. (2022). Interaction between vegetative and reproductive manifestations in raspberry candidate cultivar 'Magdalena.' *Bulgarian Journal of Agricultural Science*, *28*(6), 1099–1104.

Baranov, A. A., Sharkov, S. M., & Yatsyk, S. P. (2010). Reproductive health of children of the Russian Federation: problems and ways to solve them. *Ros. Pediatrician. Magazine*, *1*, 4–7.

Berce, V. (2019). The Usefulness of Lung Ultrasound for the Aetiological Diagnosis of Community-Acquired Pneumonia in Children. *Scientific Reports*, *9*(1). https://doi.org/10.1038/s41598-019-54499-y

Bobomuratov, T. A., Sharipova, O. A., & Abduraxmanov, J. N. (2023). o'tkir pnevmoniyasi bo'lgan erta yoshdagi bolalarda vegetative asab sistemasi faoliyatini KIG orqali baxolash. *Academic Research in Educational Sciences*, *1*, 41–45.

de Benedictis, F. M. (2020). Complicated pneumonia in children. *The Lancet*, *396*(10253), 786–798. https://doi.org/10.1016/S0140-6736(20)31550-6

Degtyareva, E. A. (2022). Cardiac and vegetative manifestations of long-COVID in children. *Voprosy Prakticheskoi Pediatrii*, *17*(5), 75–82. https://doi.org/10.20953/1817-7646-2022-5-75-82

Dolgikh, O. V. (2023). Features of neuroimmune and genetic profile in men with clinical manifestations of vegetative vascular dystonia of hypertensive type. *Kazan Medical Journal*, *104*(6), 813–821. https://doi.org/10.17816/KMJ321738

Duan, Y. n. (2020). CT features of novel coronavirus pneumonia (COVID-19) in children. *European Radiology*, *30*(8), 4427–4433. https://doi.org/10.1007/s00330-020-06860-3

Enert, A. V, Samoilova, Yu. G., Ivanov, S. N., & Filippov, G. P. (2010). Features of autonomic regulation in children and adolescents with type 1 diabetes. *Pediatrics*, *89*(5), 40–46.

García-Salido, A. (2020). Severe manifestations of SARS-CoV-2 in children and adolescents: from COVID-19 pneumonia to multisystem inflammatory syndrome: a multicentre study in pediatric intensive care units in Spain. *Critical Care*, *24*(1). https://doi.org/10.1186/s13054-020-03332-4

Karimdzhanov, I. A. (2016). Diagnosis and treatment of community-acquired pneumonia in children. *Child's Health*, *1*, 133–138.

Li, H. (2020). The profile of peripheral blood lymphocyte subsets and serum cytokines in children with 2019 novel coronavirus pneumonia. *Journal of Infection*, *81*(1), 115–120. https://doi.org/10.1016/j.jinf.2020.04.001

McAllister, D. A. (2019). Global, regional, and national estimates of pneumonia morbidity and mortality in children younger than 5 years between 2000 and 2015: a systematic analysis. *The Lancet Global Health*, *7*(1). https://doi.org/10.1016/S2214-109X(18)30408-X

O'Brien, K. L. (2019). Causes of severe pneumonia requiring hospital admission in children without HIV infection from Africa and Asia: the PERCH multi-country case-control study. *The Lancet*, *394*(10200), 757–779. https://doi.org/10.1016/S0140-6736(19)30721-4

Pikuza, O. I., & Samorodnova, E. A. (2013). Modern Features community-acquired pneumonia in young children. *Practical Medicine*, *6*, 35–41.

Rabbimova, D. T. (2023). The state of regulation of the autonomic nervous system in infants with sepsis. *Science and Education*, *2*, 229–238.

Shabunina, A. B. (2000). *Autonomic regulation in chronic obstructive bronchitis and its dynamics during the treatment of patients with ipratropium bromide* (p. 20).

Sharshenova, A. A., & Mazhikova, E. J. (2005). Age-related features of adaptation mechanisms of the autonomic nervous system in children in the middle mountains. *Pediatrics*, *3*, 110–113.

Vein, A. M., Voznesenskaya, T. G., Golubev, V. L., & others. (1991). *Diseases of the autonomic nervous system*. M.

Williams, D. J. (2022). Short-vs Standard-Course Outpatient Antibiotic Therapy for Community-Acquired Pneumonia in Children: The SCOUT-CAP Randomized Clinical Trial. *JAMA Pediatrics*, *176*(3), 253–261. https://doi.org/10.1001/jamapediatrics.2021.5547

World Health Organization. (2012). *Fact Sheet No. 331*.

World Health Organization. (2019). *Fact Sheet No. 235*.

Younus, A. (2019). Evaluation of some immunological markers in children with bacterial meningitis caused by streptococcus pneumoniae. *Research Journal of Biotechnology*, *14*, 131–133.

Zhang, Q. (2022). Recessive inborn errors of type I IFN immunity in children with COVID-19 pneumonia. *Journal of Experimental Medicine*, *219*(8). https://doi.org/10.1084/jem.20220131

Zhang, T. (2020). Detectable SARS-CoV-2 viral RNA in feces of three children during recovery period of COVID-19 pneumonia. *Journal of Medical Virology*, *92*(7), 909–914. https://doi.org/10.1002/jmv.25795