Electric Systol In Acute Complicated Pneumonia Depending On Clinical Syndromes

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Abstract

In the structure of morbidity and especially mortality in young children, the leading place is occupied by acute pathology of the bronchopulmonary system. This problem is complicated by the fact that it is in young children that the highest incidence of pneumonia is noted, which are severe and often require intensive care. In the outcome of acute pneumonia, an important role is played by the reaction of various organs and systems, especially the cardiovascular system.

Keywords. Pathology, obstructive, pneumonia, anatomically.

Introduction

Acute pneumonia is a common infectious disease with obligatory involvement of the lungs in the process. Therefore, the severity of the condition of a sick child with this pathology is determined not only by the extent of lung damage, but also by the degree of involvement of other organs and systems in the process [1].

According to the latest classification of acute pneumonia, there are also types (focal, segmental, croupous, interstitial), severity (not complicated, complicated) and the nature of the course (acute, protracted) [2]. Moreover, it is explained that the severity of pneumonia is determined by the severity of clinical manifestations or complications (toxic, obstructive, cardiorespiratory and circulatory, purulent), the interpretation of which in the diagnosis replaces and specifies the previously used terms "toxic", "toxic-septic", etc. [3].

It is known that the course and outcome of the disease depends not only on the virulence of the pathogen, but also on the immunobiological resistance of the organism and the premorbid background [4].

Most often, various methods are used to objectify the severity of the patient's condition and predict the course of acute pneumonia in young children, characterizing the activity of the cardiovascular system. This is due to the fact that the heart and lungs are anatomically and functionally closely interconnected [5].

Clinicians made an attempt to differentiate cardiac changes in acute pneumonia in young children. Thus, V.K. Tatochenko, during a comprehensive examination of children, revealed hypoxia, acute coronary insufficiency, myocarditis, myocardosis. However, other authors [6] do not differentiate these disorders. In the literature, more often In total there are generalizing concepts: cardiac or cardiovascular syndrome, cardiopathy. Pediatricians offer a number of classifications of severity and damage to the cardiovascular system. F.M. Kitikar, V.A. Erenko [14] divide CVS disorders into 3 degrees depending on the nature and depth of the lesion: 1) no clinical changes, 2) clinically detectable hemodynamic changes, 3) significant circulatory disorders (stagnation, collapse, etc.). More convenient for practice, in our opinion, is the classification of heart failure by N.M. Mukharlyamov [7], according to which the pulse rate varies with 1 degree of heart failure up to 140 beats per minute, breathing up to 60 beats per minute; at 2 degrees, the pulse rate reaches 140-150 beats per minute, breathing - 60-80 per minute, there is a slight increase in the liver; at IIB-III degree, the pulse exceeds 150 beats per minute, the breathing is groaning, more than 80, the liver is significantly enlarged, general pastosity is observed.

The possibility of various clinical changes in the heart in acute pneumonia in children is confirmed by morphological data: impaired capillary blood flow, inflammatory, necrotic and degenerative changes in the
myocardium of hypoxic, metabolic and toxic origin. The most severe variants of heart damage in acute pneumonia are infectious-allergic myocarditis [7,10] and acute cor pulmonale, typical for toxic pneumonia in children during the first months of life [8,].

Along with the classic manifestations of pneumonia, tachycardia and embryocardia, a decrease in blood pressure, impaired microcirculation, a significant increase in the liver, and expansion of the borders of the heart on the right are noted. A serious complication is the development of cardiovascular insufficiency [9].

In the clinic, it can be difficult to distinguish between symptoms caused by a particular pathology, since they often occur simultaneously. However, due to different approaches to the treatment of these conditions, pediatricians [7] on the basis of rich clinical experience identify signs of predominant damage to the heart or blood vessels.

The pulse in pneumonia, especially in its severe form, is often accelerated. However, some patients may develop bradycardia and extrasystole, characteristic of children with intracranial birth trauma. A number of researchers note the possibility of paroxysmal tachycardia [2]. It is important that changes in the cardiovascular system in acute pneumonia in children are constant, although it is not always possible to catch them clinically. In these cases, as well as in the differentiation of acute pneumonia, instrumental research methods help [2]. The most common ECG changes in acute pneumonia in young children are sinus tachycardia and tachyartnia, less often bradycardia, lengthening of the electrical systole, an increase in the systolic index, a decrease in the voltage of the QRST complex teeth, its serration, deviation of the electrical axis to the right, and signs of subendocardial ischemia [2]. Various conduction disturbances, atrioventricular blockade, blockade of the right bundle branch block, etc. are also recorded [21]. However, M.B. Kogan [5, 6,] believes that rhythm disorders, a decrease in the voltage of the teeth and conduction disturbances are not typical for young children.

One of the most frequent and constant on the ECG are changes in the T wave and the ST segment, caused by dystrophy of hypoxic, metabolic and toxic origin [2]. hours, as well as a change in the shape of cardiac complexes and the duration of intervals in the ECG structure [11].

The course of moderate pneumonia is characterized by a slight change in the transcapillary exchange of fluid and protein; therefore, a number of researchers consider these signs as a compensatory adaptive response of the terminal part of the circulatory system to the inflammatory process in the body [13].

In severe pneumonia in the initial phase of toxicosis, there is a sharp spasm of precapillaries and a tendency to desolation of capacitive microvessels, a decrease in the number of functioning capillaries, a pronounced activity of shunt blood flow, an increase in the flow of fluid and protein from the terminal channel into large veins, that is, there is a centralization of blood circulation with a predominant provision of vital functions. The increase in toxicosis is accompanied by a decrease in precapillary resistance: the spasm of arterioles decreases, the number of functioning capillaries increases, the movement of blood through them slows down, there is a tendency to overflow of the terminal channel, fluid and protein retention in it increases, which indicates decentralization of blood circulation and a tendency to deposit blood [15].

Materials and research methods. The present work is based on the analysis of the results of a comprehensive dynamic examination of 130 children with acute complicated pneumonia treated in the pulmonology and resuscitation departments of the Bukhara Regional Children’s Multidisciplinary Medical Center. The comparison group consisted of 30 sick children with acute uncomplicated pneumonia and 60 healthy children of the same age who visited the office of a healthy child of the children’s polyclinic No. 4 in the city of Bukhara. In total, 220 children were observed in the dynamics of the survey table 1

<table>
<thead>
<tr>
<th>Table 1 Distribution of children by age and sex</th>
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<td>Children's age</td>
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<td>Up to 1 year</td>
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<td>Total</td>
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As can be seen from the table, boys predominate among sick infants 52.1%, although we do not have convincing data explaining the predominance of the disease in boys. However, frequent diseases in infants can be explained by the anatomical and physiological characteristics of the respiratory system at this age, poor living conditions, unbalanced monotonous nutrition, and the lack of hardening of children.

When making a diagnosis, we proceeded from modern ideas about acute respiratory diseases in children. An in-depth collection of anamnesis data was carried out, including questioning the parents, a conversation with the local pediatrician who was watching the child. To examine children, such instrumental methods as electrocardiography, echocardiography, chest and skull radiography according to indications, echoencephalography according to indications were used, and biochemical parameters of blood were determined. The development included patients only with clinical and radiological confirmed diagnoses. The division of pneumonia, depending on the severity, nature of the course and syndrome, was carried out in accordance with the classification adopted at the plenum of the board of the All-Union Society of Pediatric Doctors and the Scientific Council for Pediatrics at the presidium of the Academy of Medical Sciences in November 1978. This classification is currently being revised and approved in November 1995. At the Symposium of Pediatric Pulmonologists of Russia together with the Problem Committee on Pediatric Pulmonology. However, it should be noted that the group of patients with pulmonary complications of acute pneumonia with obstruction included mainly patients suffering from recurrent obstructive bronchitis, which was joined by pneumonia. Based on the results of the examination, it was found that 40 patients with acute pneumonia had a history of recurrent bronchitis. In 45 patients, the disease was complicated by circulatory insufficiency cardiopulmonary syndrome, and in 45 patients toxicosis appeared mainly as signs of damage to the central nervous system, referred to in the literature [3] as encephalitic syndrome.

Research results. The control group consisted of 60 healthy children under the age of three, comparable in age and sex. The study was carried out mainly in the functional diagnostics room for children at polyclinic No. 4 in the city of Bukhara. We considered practically healthy those examined who had no acute or chronic diseases of the internal organs, infections or intoxications. The criterion for selecting practically healthy children was the presence of a normal ECG. The study began after a 3-5 minute stay of the child on the couch, and the ECG was recorded in all conventional leads - standard enhanced unipolar from the limbs and non-polar chest from V1 to V6. The QT interval was calculated on average over five cardiac cycles of the 2-standard lead.

A change in the duration of the electrical systole (its discrepancy with the duration of the cardiac cycle) by more than 0.03 s indicates a violation of the functional state of the myocardium, in particular, changes in metabolic processes in the heart muscle [12].

The results of studying the duration of the electrical systole and its parameters depending on the duration of the cardiac cycle in healthy children under the age of three years were compared according to M.K. Oskolkova [8] (Table 3).

Among young children, 47 (76.6%) had a regular sinus rhythm, 8 (13.3%) had sinus tachycardia, and only 4 (6.7%) had sinus arrhythmia. The tachycardia was mostly moderate and reached 150 beats per minute.

The average heart rate was 131.3±22.61 beats per minute in children under 1 year old and 116.68±18.24 beats per minute in children aged 1-3 years, and there was a clear dependence of heart rate on the functional state myocardium. In 41 (68.3%) children, the normal position of the electrical axis of the heart was noted. 12 (20%) have a vertical position, 7 (11.7%) have a horizontal position.

The duration of the electrical systole averaged 0.25 ± 0.03 s in children under 1 year of age and 0.26 ± 0.03 s in children aged 1 to 3 years, depending on the heart rate.

Table 3 Electrical system and its parameters in healthy young children (M ± m)

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<th>QT options and rhythm</th>
<th>Sick children aged</th>
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<td>Up to 3 years according to Oskolkova</td>
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<tr>
<td>R-R c</td>
<td>0.46±0.5</td>
</tr>
<tr>
<td>ЧСС , min</td>
<td>130.06±26.21</td>
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<tr>
<td>Q-T .c</td>
<td>0.25±0.03</td>
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As our studies have shown, the electrical systole in children with a cardiac cycle duration of 0.35-0.50 s is +0.01-0.02 s longer than the theoretical values calculated according to the Bazzetta formula. Therefore, with tachycardia and normal heart rate, when applying the equation, overestimated values of electrical systole are obtained - more by 0.01 s. Comparison of the studied values with the calculated ones obtained using the Bazett formula shows that with tachycardia and normal heart rate, the actual values of the QT interval are close to the calculated ones, and with bradycardia, the difference in the actual and calculated data reaches 0.02 s.

It was impossible to systematize the degree of ECG deviations. However, in each individual observation, the study of the ECG was of great practical importance, as it helped to identify and clarify the causes of the disordered state, and, consequently, to prescribe the appropriate treatment.

The functional state of the myocardium to a certain extent characterizes the value of the systolic index: in all children, an increase in the systolic index was observed (mainly children under 1 year old), but in most cases this increase did not exceed +5%.

In order to deepen the assessment of the functional state of the myocardium, we conducted a separate study of the duration of some phases of the electric systole according to M.K. Oskolkova (77). Our studies showed that in the majority of healthy infants (16 out of 26 or 61.5 percent) the QT1 interval was greater than the T1–T interval; in 2 patients, these intervals were equal, in 19 (56%) of 34 children older than a year, the Q- interval T1 was longer than the T1 - T interval. In other cases, these intervals were equal or the T1- T interval was greater than the Q-T1 interval. With an increase in heart rate, the time of myocardial excitation changed, that is, with an increase in the heart rate, the QT interval was shortened, and T1-T did not change.

In healthy children, regardless of the heart rate, the corrected electrical systole remained almost constant. For children under the age of 1 year, it averaged 0.38 ± 0.04 s, for children aged 1–3 years - 0.39 ± 0.05 s. We could not compare these results with data from literature sources, because such studies have not been conducted in relation to the specified age groups of children. Based on this provision, we can assume that the values of the QTc electrocardiogram index obtained by us are the initial values for young children.

An individual analysis of this indicator found that in 7 patients aged 1 to 3 years, QT was within ± 0.03 s, that is, it was typical for the age norm. There was no shortening of the QT interval in children of this group (Figure 3).
Figure 3. The duration of the QT interval, calculated by the Buzzet formula, in the early period of CRS in infants. 
a) children under the age of 1 year (n=35); 
b) children under the age of 1 to 3 years (n=100).

Therefore, in 10 (22.2%) children with cardiorespiratory syndrome, there was an increase in the QT interval exceeding ±0.03 s. Individual observation of these children showed that QT prolongation to an average of +0.03, +0.04 s was observed in 6 (60%) out of 10 children, in the rest the prolongation was in the range of 0.05-0.06 s. This indicates that the frequency of QT prolongation corresponds to the severity of the cardiorespiratory syndrome. A clear correlation was found between the incidence of long QT syndrome and the severity of circulatory failure. Thus, the frequency of elongation of the electrical systole in patients with NK I degree was 20%, in patients with NK II and IIIst 80%; therefore, the greater the violation of blood circulation, the longer the interval of electrical systole.

A separate study of the positiveness of the phases of the electrical systole revealed that in 19 (54.2%) children under the age of 1 year, the phase of the onset of ventricular excitation was somewhat longer (0.02 s) than the phase of cessation of ventricular excitation, in 10 children (28.6%) T1 - T was longer than the excitation phase of the ventricles by an average of 0.01 s; in 6 (17.2%) sick children, these intervals were equal (Fig. 5).
We could not compare the results obtained with literature data. In the studies of M.K. Shard (67) in healthy children aged 3 to 15 years in 93% of the interval QT1 > T1-T, in 7% of T1-T < QT. In our studies, the duration of the period of cessation of excitation depended on the heart rate, and the width of the T wave in 28.6 percent of cases was greater than the excitation phase. In 6 (60%) children aged 1 to 3 years, the excitation phase of the ventricles was longer than the phase of termination of excitation by 0.04 s, that is, there was a large fluctuation (P<0.05), which is associated with the lengthening of the electrical systole due to the severity of the condition due to circulatory failure. The discovered phenomenon significantly prevailed in children with a very serious condition.

Significant shifts in our studies in relation to the phases of the electrical systole led to the conclusion that in CRS in young children, disturbances in the structure of the electrical systole occur mainly due to the “phase of the onset of excitation”, which apparently has a metabolic origin.

Conclusions.

1. In 2/3 of healthy infants, the process of myocardial excitation is longer than the duration of the “cessation of excitation” period within 0.02 s, and the corrected QT interval is no more than 0.38 ± 0.04 s.

2. In acute complicated pneumonia, even with a normal duration of electrical systole, 27.4% of patients have a violation of the temporal relationships of its main phases. In 17.7% of patients, a secondary syndrome of lengthening the QT interval is not recorded.

3. With pneumonia complicated by cardiovascular insufficiency, 22% of patients have changes in the main parameters of the electrical systole, indicating a violation of the processes of ventricular repolarization. There is a correlation between the incidence of secondary QT interval prolongation syndrome and the degree of clinical severity of circulatory disorders.

4. Prolongation of the QT interval in children with infectious-toxic shock, clinically appeared encephalitic syndrome, is detected 1.5 times more often and it occurs mainly due to the “phase of the onset of excitation”, which indicates that clonic tonic convulsions may be a risk factor for development secondary long QT interval syndrome.

REFERENCES

