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## CORONARY FUNCTION OF CHILDREN FROM THE ARAL SEA REGION LIVING IN CONDITIONS OF CHEMICAL TOXIC SUBSTANCES INFLUENCE

427 children from 7 till 15 years permanently living in the Aral Sea region (the basic group) and 108 children living in the area of relative wellbeing (group of comparison) have been examined. Diseases of cardiovascular system are revealed in 323 children of the basic group - 75,6 %. The structure of cardiovascular pathology of children from the Aral Sea region is represented by congenital anomalies of development (29,7 %) and inflammatory diseases (5,3 %). The leading place is occupied by functional infringement of coronary function revealed in 65 % (210 children).

**Keywords:** children, the Aral Sea region, chemical toxic substances, repolarization infringement, heart failure, echocardiography, electrocardiography.

The Aral Sea region - the territory, adjoining to the dying Aral Sea and undergoing its influence, is the large region with the population of 1 million 529 thousands. The fourth part of the population are children. Children living in the region are exposed to the combined influence of ecologically unfavorable factors of environment. High values of infant mortality rate and children's diseases testify to it. It is necessary to note that there is the growing level of congenital anomalies of development (1) among which the special place are occupied by congenital anomalies of heart development (33,4 %). In the general structure of diseases, which are the reasons of high death and invalidisation rates, the first place remains behind pathology of cardiovascular system, in particular behind the heart failure.

Laboratory of soils technogenic pollution of the Institute of Soil Science of the National Academy of Sciences of Republic of Kazakhstan after investigation of 2500 soil samples tests determined that concentration of lead 6 times higher, cadmium, copper 1,5 times higher, benzopiren 250 times higher, nitrates, nitrites 10-15 times higher, phenols 3 - 4 times higher than maximum permissible concentration of these substances in the soil. Therefore it results to increased contents of these substances in drinking water and food.

Results of scientific researches on studying of chemical toxic substances in the biological substrata of the children's organism, which has been carried out in the scientific centers of Japan and Luxembourg, have shown the high contents of lead, arsenic, santobane, alpha, betta, gamma isomers of hexachlorocyclohexane in blood plasma (2). It is proved by the researchers (3), that practically each harmful chemical substance does not pass heart, reaching its by direct way or other way. In conditions of chronic influence of toxic industrial chemical substances (heavy metals and their organic and inorganic connections, phosphorus, carbon oxide, etc.) on human organism the heart reaction characterizes by disorder of metabolic processes in the cardiac muscle (4).

In this connection, the goal of the research was to estimate of coronary function in children living in the ecologically unfavorable Aral Sea region.

### Material and methods

427 children from 7 till 15 years permanently living in the Aral Sea region (the basic group) and 108 children living in the area of relative wellbeing (group of comparison) have been examined. The following methods of investigation have been used: general clinical, laboratory, instrumental (electrocardiography, echocardiography). During echocardiography research condition of the basic heart functions and duration of electric systole of ventricle is estimated.

Ultrasonic research was carried out for estimation of myocardium contractile function (fraction of emission, shortening of small size of left ventricle in the systole phase (% $\Delta$ S) and speed circular shortening of muscular fiber (Vcf)), condition of intracardiac haemodynamics. Results of the research and discussion

The carried out clinical researches have shown, that in the structure of chronic somatic pathology of children constantly living in the Aral Sea region diseases of cardiovascular system are on the third place. Diseases of cardiovascular system are revealed in 323 children, i.e. in 75,6 % of the total quantity of surveyed children.

The structure of revealed pathology of heart has been represented by congenital anomalies of heart (29,7 %), inflammatory diseases of cardiac muscle (5,3 %) and functional infringements of coronary function (65 %).

In the structure of the revealed pathology coronary functional infringements prevailed and are revealed in 210 children (65 %). The basic diagnostic criterions for determination of this group of children are presence of complaints, characteristic for cardiovascular system pathology. However it has not been revealed any changes during laboratory and instrumental researches, characteristic for congenital anomalies of development and inflammatory diseases of heart, and also clinical signs of heart failure.

Complaints analysis of children with coronary functional infringements in the surveyed groups (basic and comparison groups) has shown that clinical symptoms, characteristic for asthenic-vegetative syndrome are registered authentically more often ( $P < 0,001$ ) in children of the basic group. The asthenic-vegetative syndrome has been revealed in 80 % of the basic group children, and manifested by: weakness (68 %), fast physical and mental fatigue (78 %), headache (39,5 %) and dizziness (36,1 %), and also decrease of tolerance to exercise stress and stressful situations. Its incidence was 47,2 % in the comparison group children.

Cardiac syndrome such as pain (22,8 %) and unpleasant sensations in the heart field (7,6 %), attacks of palpitation (3,8 %) has been revealed in 22,9 % of the basic group children whereas this syndrome was diagnosed authentically more often ( $P < 0,05$ ) in children of comparison group and its incidence was 35,1 %. Cardiac pain was provoked by fatigue, psychoemotional stress, various stressful situations in part of basic group children, and in the majority of children pain syndrome wasn't provoked by any factors. Cardiac pains were characterized by variety of painful sensations such as whining, pressing, compressing pains of various intensity, duration and localization. Localization of the pain was more often in the field of heart apex (76,1 %). Intensity of the pain varied from insignificant up to sharp, the last was accompanied by symptoms - alarm, anxiety, fear, and sensation of air shortage. Characteristic feature of cardiac

pain of children with functional infringements of coronary function was independency of its genesis.

Subjective sensation of strengthened and speeded up heartbeat, sensation of head vessels pulsation are registered in 3,8 % of children of the basic group, paroxysms of tachycardia characterized by poor clinical symptoms that has been caused by their relative short duration.

Cardiorespiratory syndrome is revealed authentically more often ( $P < 0,05$ ) in children of the basic group and represented by superficial breath and sensation of air shortage (10 %), dyspnoea at moderate exercise stress (37,6 %).

Data analysis of objective examination of children with functional infringements of coronary function has revealed changes, characteristic for pathology of cardiovascular system.

Borders of relative cardiac dullness in children with functional infringements of coronary function in vertical position remained within the age norm limits, however in horizontal position in 24,7 % of children the left border of relative cardiac dullness was displaced.

Auscultation picture of the heart of children with functional infringements of coronary function was characterized by the muffled first tone above the heart apex and above Botkin- Erb 's point in 82,9 % of children. On the background of the weakened first tone in the same projective points functional systolic murmur was listened. Stability of systolic murmur is revealed during dynamic monitoring of patients.

Thus, objective signs of cardiac muscle pathology are found out in examined children with functional infringement of coronary function alongside with various complaints from the heart side. It has served as a basis for carrying out of electrocardiography examination.

Results electrocardiography examination of children (the basic and comparison groups) have revealed. Incidence of heart rhythm and conductivity changes are shown in the table 1.

Table 1 - Incidence of rhythm and conductivity infringements in children of the examined groups.

| Electrocardiogram changes                        | the basic group (n=210) | the comparison group (n=108) |
|--|-------------------------|------------------------------|
| Rhythm infringement                              | 43,3 ± 3,42             | 20,4 ± 3,87                  |
| Conductivity infringement                        | 10 ± 2,07               | 13,9 ± 3,32                  |
| Combined infringement of rhythm and conductivity | 23,8 ± 2,94             | 7,4 ± 2,51                   |
| total  | 77,1 ± 2,89 *           | 41,7 ± 4,74*                 |

\*  $p < 0,001$  certainty of distinctions between incidence of rhythm and conductivity infringement in children of the basic and comparison groups.

In children of the surveyed groups rhythm infringements (43,3 % in the basic group and 20,4 % in comparison group) were revealed more frequently. Isolated infringements of intracardiac conductivity were determined less often (10 %) in the basic group, than in comparison group (13,9 %). Combined infringements of rhythm and conductivity are revealed in 23,8 % of children of the basic group and in 7,4 % of children of the comparison group. Thus, as a result of electrocardiography data analysis it is determined, that rhythm and conductivity infringements are registered authentically more often ( $p < 0,001$ ) in the basic group children than in the comparison group children.

In the structure of rhythm infringements of the surveyed groups incidence of arrhythmia, caused by infringement of sinus nodule automatism function or nomotopical arrhythmia (sinus tachycardia, sinus bradycardia and sinus arrhythmia, migration of the rhythm source), is prevailed.

In 52,8 % of children with functional infringements of coronary function various kinds of intracardiac conductivity disorders are revealed. Electrocardiography syndrome considered as ventriculonector's right part partial block is observed with high incidence (32 %) in all surveyed groups. The syndrome is revealed in all age groups with approximately identical incidence.

The syndrome of premature excitation has been revealed in 14,3 % of the basic group children and in 11 % of the comparison group children. Incomplete intraatrial blockade and AV - blockade of 1st degree have been revealed in 5,2 % and in 1,4 % of the basic group children accordingly whereas in comparison group such kinds of intracardiac conductivity disorders has not been revealed.

Alongside with various kinds of cardiac rhythm and conductivity disturbance in children of surveyed groups such infringements of repolarization processes of ventricles myocardium as ventricular complex final part changes are revealed in examined children. Incidence of final part of ventricular complex changes is submitted in the table 2.

Table 2 - Incidence of wave T and segment ST changes on the electrocardiogram in children of the surveyed groups.

| Electrocardiogram segment | basic group (n=210) | comparison group (n=108) |
|---------------------------|---------------------|--------------------------|
| Wave T                    | 76,7 %*             | 24,1 %*                  |
| Segment ST                | 55,2 %              | 9,2 %                    |

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$P < 0,001$  certainty of distinctions between incidence of wave T amplitude changes in children of the basic and comparison groups.

Changes of wave T are registered authentically more often ( $P < 0,001$ ) in 76,7 % of the basic group children. In accordance with S.A.Abakumov (1988) and M.S.Kushakovsky (2000) opinion change of ventricular complex final part is important and authentic sign of myocardium ischemia caused by coronary blood circulation insufficiency. However, according to S.S.Ostropolets and L.I.Zolotova data, the main reason of such electrocardiography changes in children is myocardium metabolic processes infringement in combination with hypersympathicotonia.

The received results of electrocardiographical examination of children are corresponded to some electrocardiography-syndromes described by Isakov I.I. et al. (1974).

Tachycardiac syndrome characterized by interval R-R shortening is diagnosed as in the basic group (26,7 %) and in the comparison group (13,9 %).

Vagotonical syndrome characterized by interval R-R increase is observed less often in the basic group children -18,6 % and in the comparison group children - 6,5 %. Isakov I.I. with co-authors have described dystrophic syndrome characterized by changes of repolarization processes in the ventricles myocardium. Prevalence of dystrophic syndrome is determined authentically more often ( $P < 0,001$ ) in children of the basic group (76,7 %) whereas in the comparison group its incidence is 24,1 %.

Analyzing the received results, it is necessary to note, that tachycardiac and vagotonical syndromes authentically more often diagnosed in the basic group. The syndromes are convertible changes and are regarded as compensatory reaction to influence of unfavorable factors of environment.

The revealed dystrophic changes are more predictably unfavorable according to the literature (V.H.Vasilenko, C.B, Feldman, 1989) and in adults they result in decrease of myocardium functional condition. Taking into account, that dystrophic changes of myocardium in accordance with the electrocardiography examination data are registered three times more often in children living in ecologically unfavorable region than in children from relative wellbeing area, it is possible to think about cardiotoxic effect of environmental chemical toxic substances on the myocardium.

Thus, comparison of received electrocardiography parameters of the basic group children and the comparison group children has shown, that higher incidence and expressiveness of myocardium basic functions infringements (automatism, excitability, conductivity) in combination with repolarization processes changes are revealed in children living in ecologically unfavorable region.

Echocardiography examination was carried out for estimation of myocardium functional condition of children, living in ecologically unfavorable area. The examination allowed estimating parameters of myocardium contractile ability, central haemodynamics and also morphometrical parameters.

During echocardiography examination in 10,4 % of children with functional infringements of coronary function deviations from age norms has not been revealed. The following changes of echocardiogram parameters have been determined in 89,6 % of children: parameters of myocardium contractile ability (90,6 %), parameters of intracardiac haemodynamics (86 %), morphometrical parameters (65,1 %).

Analysis of the received parameters of myocardium contractile ability has revealed the following changes: decrease of emission fraction (83,7 %), decrease of myocardium fibers circular shortening speed (69,7 %), decrease of systolic contractibility of left ventricle myocardium (67,4 %).

Change of central haemodynamics parameters is revealed in 86 % of surveyed children. Analysis of the received central haemodynamics parameters of children has revealed changes of all investigated parameters: increase of left ventricle final diastolic (48,8 %) and final systolic (62,7 %) volumes, decrease of stroke output (39,5 %).

Thus, 1/3 of children with functional infringements of coronary function have decrease of stroke output, but at the same time they have increase in residual volumes of the left ventricle.

Change of morphometrical parameters is revealed in 65 % of children. Studying of morphometric parameters of the heart has revealed increase of final diastolic (30,2 %) and final systolic (51,1 %) sizes of left ventricle, left ventricle back wall thickness (21 %), among them changes of left ventricle final systolic size are revealed authentically more often ( $P < 0,05$ ).

Thus, myocardium contractile ability suffers first of all in children with functional infringements of coronary function. Haemodynamic and morphometric deviation testifies to exhaustion of the myocardium reserve opportunities.

High incidence of functional infringements of coronary function (65 %) is registered in children living in ecologically unfavorable area. Data of electrocardiography researches testify, that myocardium metabolic disorders (infringement of repolarization processes) are diagnosed authentically more often ( $p < 0,001$ ) in surveyed children in comparison with children from relative wellbeing region. Echocardiography research of children with myocardium metabolic disorders has revealed decrease of myocardium contractile ability. Decrease of the parameters describing pump and contractile functions of myocardium is possible to consider as preclinical manifestation of the heart failure in children living in ecologically unfavorable Aral Sea region.

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#### З.Г. ДАВЛЕТГИЛЬДЕЕВА

##### ТОКСИКАЛЫҚ ЗАТТАРДЫҢ ХИМИЯЛЫҚ ӨСЕР ЕТУ ЖАҒДАЙЫНДА АРАЛ ӨңІРІ БАЛАЛАРЫНДАҒЫ ҚАН АЙНАЛУ АҒЗАЛАРЫНЫҢ ФУНКЦИОНАЛДЫ ЖАҒДАЙЫ

**Түйін:** Арал апат аймағында тұратын 7 мен 15 жас аралығындағы 427 бала тексерілді және экологиясы таза Алматы облысында тұратын 108 бала тексерілді. Негізгі тобындағы 323 балада (яғни 75,6%) жүрек – қан тамырлар жүйесінің патологиясы туа біткен ақаулармен (29,7%) және қабыну аурулармен (5,3%) көрсетілген. 210 балада (яғни 65%) жүрек қызметінің функционалды бұзылыстар бар.

**Кілт сөздер:** балалар, Арал өңірі, химиялық токсикалық заттар, миокард реполяризациясының бұзылысы, жүрек жетіспеушілігі, электрокардиография, эхокардиография.

#### З.Г. ДАВЛЕТГИЛЬДЕЕВА

##### ФУНКЦИОНАЛЬНОЕ СОСТОЯНИЕ ОРГАНОВ КРОВООБРАЩЕНИЯ У ДЕТЕЙ ПРИ АРАЛЬЯ, В УСЛОВИЯХ ХИМИЧЕСКОГО ВЛИЯНИЯ ТОКСИЧНЫХ ВЕЩЕСТВ

**Резюме:** Было обследовано 427 детей от 7 до 15 лет, постоянно проживающие в регионе Аральского моря (основная группа) и 108 детей, проживающих в зоне относительного благополучия (группа сравнения). Поражение сердечно-сосудистой системы выявлены у 323 детей основной группы - 75,6%. Структура выявленной патологии со стороны сердца у детей из района Аральского моря была представлена врожденными аномалиями развития сердца (29,7%), воспалительными заболеваниями (5,3%). Ведущее место занимают функциональные нарушения сердечной деятельности 65% (210 детей).

**Ключевые слова:** дети, Приаралье, химические токсические вещества, нарушение реполяризации в миокарде, сердечная недостаточность, электрокардиография, эхокардиография.