

# **Pediatrics: textbook**

## Про книгу

The national textbook was prepared in accordance with the academic program in pediatrics for pre-graduate training of specialists who major in dentistry. The given materials cover modern aspects of etiopathogenesis, diagnostics, treatment, and prophylaxis of the most common somatic and infectious childhood diseases as well as physiology and pathology of young children. It is recommended for students of dentistry faculties with the English-language form of training of higher medical education institutions of the 4th level of accreditation.

# Pediatrics

Edited by Professor **T.O. KRYUCHKO**,  
Professor **O.Y. ABATUROV**

**SECOND EDITION, REVISED**

Approved by the Ministry of Education and Science of Ukraine as a textbook for students of stomatological faculties of higher education establishments — medical universities, institutes and academies

Published in accordance with the Order of the Ministry of Health of Ukraine No. 502 as of 22 June 2010 as a national textbook for students of higher education establishments — medical universities, institutes and academies

The national textbook "Pediatrics" is recommended for publication by the Higher State Education Institution of Ukraine "Ukrainian Medical Stomatological Academy"

**Kyiv**  
**AUS Medicine Publishing**  
**2017**

UDC 616-053.2

LBC 57.3ya73

P24

*The national textbook "Pediatrics" is recommended for publication by the Higher State Education Institution of Ukraine "Ukrainian Medical Stomatological Academy" (minutes No. 7, 19 February 2014)*

*Approved by the Ministry of Education and Science of Ukraine as a textbook for students of stomatological faculties of higher education establishments — medical universities, institutes and academies (letter No. 1/11-12053, 29 July 2014)*

*Published in accordance with the Order of the Ministry of Health of Ukraine No. 502, 22 June 2010 as a national textbook for students of higher education establishments — medical universities, institutes and academies*

**Authors:**

T.O. Kryuchko, O.Y. Abaturov, T.V. Kushnereva, O.O. Agafonova, V.P. Ostapenko

**Reviewers:**

*O.P. Volosovets* — Doctor of Medical Sciences, Professor, Head of the Pediatrics Chair No. 2 of O.O. Bohomolets National Medical University, Corresponding Member of the National Academy of Medical Sciences of Ukraine, Head of the Section of Science and Innovation of the Coordination Center for Reforms Directorate (Ministry of Health of Ukraine);

*V.H. Maydannik* — Doctor of Medical Sciences, Professor, Head of the Pediatrics Chair No. 4 of O.O. Bohomolets National Medical University, Academician of the National Academy of Medical Sciences of Ukraine;

*M.L. Ariayev* — Doctor of Medical Sciences, Professor, Head of the Chair of Pediatrics No. 1 of Odesa National Medical University, Corresponding Member of the National Academy of Medical Sciences of Ukraine

**P24 Pediatrics** : textbook / T.O. Kryuchko, O.Y. Abaturov, T.V. Kushnereva et al. ; edited by T.O. Kryuchko, O.Y. Abaturov. — 2<sup>nd</sup> edition, revised. — Kyiv : AUS Medicine Publishing, 2017. — 208 p. + 2 p. of color insert.  
ISBN 978-617-505-601-1

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O.O. Agafonova, V.P. Ostapenko, 2016, 2017

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ISBN 978-617-505-601-1

# CONTENTS

<b>Abbreviations</b> .....	6
<b>Preface</b> .....	7
<b>Chapter 1. PHYSICAL AND NEUROPSYCHOLOGICAL DEVELOPMENT OF CHILDREN (T.O. Kryuchko)</b> .....	8
Newborn Children.....	9
Physical Development of Children .....	12
Psychomotor Development of Children.....	24
<b>METHODS OF CLINICAL EXAMINATION OF CHILDREN</b> .....	27
Peculiarities of Examination of Children of Different Age Groups .....	27
General Examination of Newborn Children .....	28
<b>ETHICS AND DEONTOLOGY IN PEDIATRICS</b> .....	33
Questions for Self-Assessment .....	34
Tests.....	35
Cases .....	37
<b>Chapter 2. FEEDING AND NUTRITION OF HEALTHY CHILDREN (T.O. Kryuchko, T.V. Kushnereva)</b> .....	39
Feeding of Children of the First 6 Months of Life.....	39
Feeding and Nutrition of 6—12-Month-Old Children.....	46
Nutrition of 1—3-Year-Old Children.....	49
<b>CHRONIC DIGESTIVE DISORDERS IN YOUNG CHILDREN</b> .....	50
Hypotrophy .....	50
Rickets.....	53
Rachitic Tetany.....	58
Questions for Self-Assessment .....	60
Tests.....	61
Cases .....	64

<b>Chapter 3. RESPIRATORY TRACT, DIGESTIVE SYSTEM AND URINARY SYSTEM DISEASES IN CHILDREN</b>	
( <i>T.O. Kryuchko, V.P. Ostapenko</i> ) .....	66
Respiratory tract diseases in Children.....	66
Anatomy and Physiology of the Respiratory System in Children .....	66
Acute Respiratory Infections .....	67
Bronchitis .....	71
Pneumonia.....	77
<b>DIGESTIVE SYSTEM DISEASES IN CHILDREN</b> .....	82
Anatomy and Physiology of the Digestive System.....	82
Functional Gastrointestinal Disorders.....	83
Gastroesophageal Reflux Disease .....	86
Chronic Gastritis/Gastroduodenitis.....	88
Ulcer Disease of the Stomach and Duodenum.....	89
Chronic Hepatitis .....	95
<b>URINARY SYSTEM DISEASES IN CHILDREN</b> ( <i>T.O. Kryuchko, V.P. Ostapenko</i> )....	99
Anatomy and Physiology of the Urinary System in Children .....	99
Pyelonephritis.....	101
Glomerulonephritis .....	105
Questions for Self-Assessment .....	108
Tests.....	109
Cases .....	112
<b>Chapter 4. CARDIOVASCULAR SYSTEM DISEASES IN CHILDREN. HEMORRHAGIC DISEASES IN CHILDREN</b> ( <i>O.Y. Abaturov</i> ) .....	114
<b>CARDIOVASCULAR SYSTEM DISEASES IN CHILDREN</b> .....	114
Anatomy and Physiology of the Cardiovascular System in Children.....	114
Non-rheumatic Carditis.....	115
Acute Rheumatic Fever.....	120
Congenital Heart Defects .....	124
Acute Heart Failure .....	126
Circulatory Collapse .....	128
<b>HEMORRHAGIC DISEASES IN CHILDREN</b> ( <i>O.Y. Abaturov, O.O. Agafonova</i> )....	130
Hematopoietic System and Hemocoagulation in Children .....	130
Hemophilia.....	133
Idiopathic Thrombocytopenic Purpura .....	136
Hemorrhagic Vasculitis .....	139

## Contents

Questions for Self-Assessment .....	141
Tests.....	141
Cases .....	145
<b>Chapter 5. CHILDHOOD INFECTIOUS DISEASES.</b>	
<b>IMMUNOPROPHYLAXIS OF CHILDHOOD</b>	
<b>INFECTIOUS DISEASES (T.O. Kryuchko, T.V. Kushnereva) .</b>	146
Childhood Infectious Diseases with Exanthema Syndrome .....	146
Measles.....	147
Rubella .....	153
Chickenpox .....	156
Scarlet Fever .....	158
Mumps .....	161
Pertussis .....	164
Diphtheria.....	168
HIV Infection .....	173
Vaccine Prophylaxis of Infectious Diseases.....	178
Questions for Self-Assessment .....	179
Tests.....	179
Cases .....	183
<b>Chapter 6. PEDIATRIC DEHYDRATION. VITAMINS</b>	
(O.Y. Abaturov, O.O. Agafonova) .....	185
Pediatric Dehydration .....	185
<b>VITAMINS AND THEIR IMPORTANCE FOR CHILD DEVELOPMENT.</b>	
<b>SEMIOTICS OF HYPO-/HYPERVITAMINOSIS IN CHILDREN (O.Y. Abaturov) .....</b>	191
Questions for Self-Assessment .....	196
Tests.....	196
Cases .....	199
Answer Keys .....	201
<b>References .....</b>	206

## **PREFACE**

Pediatrics is the science that is continuously developing, and under the present conditions it requires constant search for the new methods of prophylaxis, diagnostics, and treatment of childhood diseases. Among others, the important tasks of the healthcare system include building the adequate level of medical aid delivery to children, which mainly depends on the qualification of regular personnel. The specialist involved in the delivery of medical aid to children must have a perfect sense of social responsibility, meet the child's needs for health and professional help from birth till teenage years. Children are extremely sensitive, with vulnerable psyche and special response to numerous factors, and therefore training of doctors with such qualities as sensibility, feeling of love and respect to the patient, high standards of professionalism, and constant need for self-improvement is very important.

Pediatrics is a standard educational subject, which is studied in all higher medical education institutions for the purpose of professional training of specialists, including those who major in dentistry. The national textbook was created for the purpose of providing future dental professionals with educational materials that contain up-to-date information on childhood physiology and pathology in the volume provided by the training program.



## Chapter 4

### CARDIOVASCULAR SYSTEM DISEASES IN CHILDREN. HEMORRHAGIC DISEASES IN CHILDREN

#### CARDIOVASCULAR SYSTEM DISEASES IN CHILDREN

##### Anatomy and Physiology of the Cardiovascular System in Children

*The main fetal blood circulation* is placental circulation in which processes of both enrichment of the blood with oxygen and release of CO<sub>2</sub> occur. There is one circle with fetal blood circulation pathway (ductus venosus, ductus arteriosus); tissues receive mixed blood (arterial-venous).

*Blood circulation of the newborn.* After the child is born and makes his/her first breath the lungs spread and fill with blood; the ductus venosus, foramen ovale and the remains of the umbilical vessels close and gradually become obliterated. The large and small circles of blood circulation begin to function in the newborn. Usually by the end of the 6<sup>th</sup> week of life the ductus arteriosus closes, by 2—3 months — the ductus venosus closes, by 6—7 months — the foramen ovale of the atrial septum closes.

The heart of the newborn takes a significant space of the chest; it is spherical and is located higher than in older children. The major axis of the heart is nearly horizontal due to the high position of the diaphragm.

In Table 34 you can see the description of the borders of relative cardiac dullness in children of different age groups.

Table 34

**Borders of Relative Cardiac Dullness in Children of All Ages**

Age, years	The Upper Border of the Heart	The Right Border of the Heart	The Left Border of the Heart
Younger than 2	The second rib	2 cm outward from lin. sternalis dextra	2 cm outward from lin. medioclavicularis sin.
2—6	The second intercostal space	1 cm outward from lin. sternalis dextra	1 cm outward from lin. medioclavicularis sin.
7—12	The top edge of the third rib	0.5 cm outward from lin. sternalis dextra	0.5 cm outward from lin. medioclavicularis sin.
Older than 12	The third rib or third intercostal space	On lin. sternalis dextra	On the line or 0.5 cm from lin. medioclavicularis sin.

*Age characteristics of hemodynamic parameters.* The most labile hemodynamic parameter is heart rate, which changes as the child grows and depends on external and internal factors (heart disease, endocrine disorders, anemia, etc.). Crying, restlessness, increased body temperature, movements can cause increased heart rate in children (Table 35).

Table 35

**Heart Rate in Children of All Ages**  
(Maidannyk V.G., 2009)

Child's Age	Heart Rate, bpm	Child's Age	Heart Rate, bpm
Newborn	140—160	5 years	100
6 months	130—135	8 years	90
1 year	120—125	10 years	80—85
2 years	110—115	12 years and older	70—75
3 years	105—110		

### Non-rheumatic Carditis

**Non-rheumatic carditis** (ICD-10: I40) is an inflammatory disease of the heart which has non-rheumatic and non-coronary nature. The disease arises under the action of various infectious agents, it is characterized by inflammatory infiltration of the myocardium with fibrosis, necrosis and/or degeneration of myocytes. The inflammatory process may involve cardiomyocytes, as well as the interstitial tissue, vessels, conductive system of the heart and pericardium.

*Epidemiology.* Numerous research findings and epidemiological data show an increase in non-coronary diseases of the myocardium, whose incidence is around 7—9 % of all diseases of the cardiovascular system. In Ukraine inflammatory myocardial lesions are detected in 2.3—9.0 % patients with heart diseases.

*Etiology* — see Fig. 28.

Children aged from 1 day to 19 years, who present with rapidly developing dilatation of the left ventricle and its dysfunction, show viral genome in 68 % of cases: enterovirus is found in 30 % of cases, adenovirus — in 58 %, herpesvirus — 8 %, cytomegalovirus — 4 %.

## Chapter 4

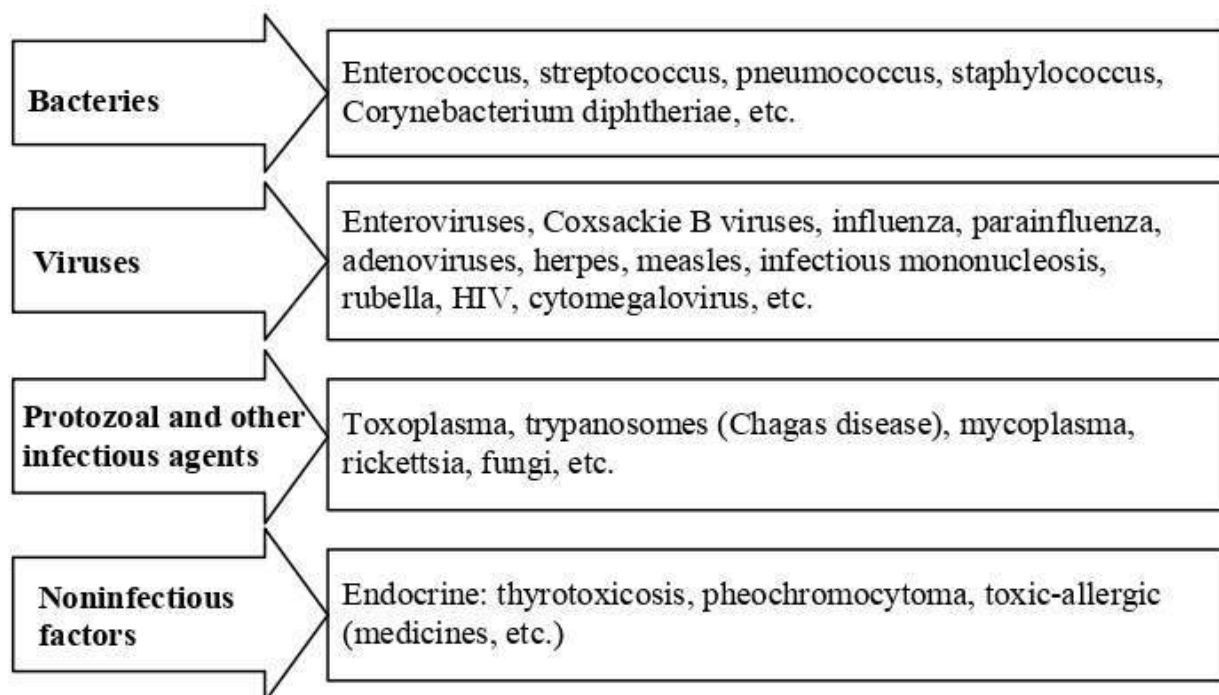


Fig. 28. Etiological factors of non-rheumatic carditis in children

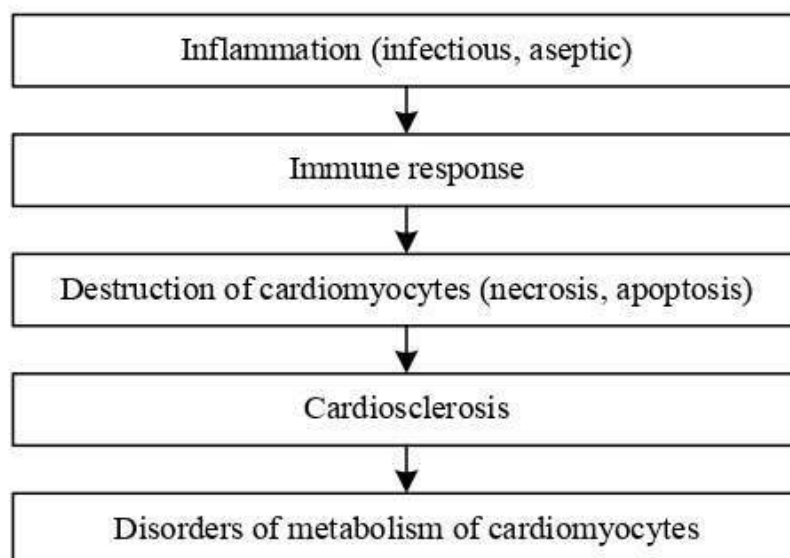
*Classification* — see Table 36.

Table 36

## Classification of Non-rheumatic Carditis in Children

Etiology	Clinical Presentation	Prevalence	Course	Pathogenesis	Anatomical Features
<ul style="list-style-type: none"> <li>— Viral</li> <li>— Bacterial</li> <li>— Allergic</li> <li>— Parasitic</li> <li>— Protozoan</li> </ul>	<ul style="list-style-type: none"> <li>— With rhythm disturbances</li> <li>— With pain syndrome</li> <li>— With heart failure</li> <li>— With thromboembolism of the lung artery</li> <li>— Oligosymptomatic</li> </ul>	<ul style="list-style-type: none"> <li>— Focal</li> <li>— Diffuse</li> </ul>	<ul style="list-style-type: none"> <li>— Acute</li> <li>— Subacute</li> <li>— Chronic</li> </ul>	<ul style="list-style-type: none"> <li>— Primary infection</li> <li>— Infectious-allergic</li> <li>— Toxic-allergic</li> </ul>	<ul style="list-style-type: none"> <li>— Parenchymal</li> <li>— Interstitial</li> </ul>

*Pathogenesis* — see Fig. 29.

**Cardiovascular System Diseases in Children. Hemorrhagic Diseases in Children**


**Fig. 29. Pathogenesis of non-rheumatic carditis in children**

*Clinical manifestations* — see Table 37.

*Table 37*

**Clinical, Laboratory, and Instrumental Manifestations  
of Non-rheumatic Carditis in Children**

<b>Clinical Data</b>
Malaise, unexplained muscle weakness, hypodynamia
Pain in the heart, sometimes intense, palpitations, interruptions, breathlessness
In some cases mild joint pain
Body temperature is often low-grade or normal
Blood pressure often decreases
Arterial hypertension is practically not found
Tachycardia
Expansion of the boundaries of relative dullness of the heart
Diffused and non-resistant apex beat
Weakened I heart sound
Systolic murmur at the apex of the heart
Symptoms of either left ventricular heart failure or total heart failure
Important, but not permanent signs of myocarditis are disturbances of heart rhythm (tachycardia, rarely bradycardia, ectopic arrhythmia) and conductivity, gallop rhythm
Paleness of the skin, cyanosis of the nasolabial triangle

## Chapter 4

*Diagnostics* (Table 38). The criteria for clinical diagnosis of myocarditis have been proposed by the New York Heart Association (NYHA) (Table 39). The diagnosis is considered confirmed in the presence of a previous infection in combination with one major and two minor criteria.

Table 38

## Laboratory and Instrumental Data for Non-rheumatic Carditis

Laboratory Data
ESR acceleration, neutrophilic leukocytosis, increase of C-reactive protein, sialic acids and seromucoid
Data of Instrumental Examinations
X-ray: cardiothoracic ratio increase
Electrocardiogram (ECG): reduction of the voltage of QRS complexes during the first 2—3 weeks of the disease; further — signs of disturbances of repolarization processes, overload of the left ventricle, perhaps — AV block, rhythm disturbances
Ultrasonography: dilation of the left ventricular cavity, rarely of the left atrium and right ventricle, decrease in the indexes of pumping and contractile function of the myocardium

Table 39

## Diagnostic Criteria for Non-rheumatic Carditis (NYHA)

<i>Major criteria</i>	Pathological ECG changes (signs of ischemia, hypertrophy of the heart chambers)
	Cardiomegaly — an increase in the overall size of the heart or cavities (usually the left ventricle)
	Congestive heart failure or cardiogenic shock
	Increase of blood cardiac-specific enzymes (lactate dehydrogenase, malate dehydrogenase, creatine phosphokinase) and cardiac-specific proteins (troponin T, I, etc.)
<i>Minor criteria</i>	Tachycardia
	Weakening of the I heart sound
	Gallop rhythm

*Treatment.* Hospitalization, bed rest in the acute period; its duration depends on the severity of carditis: in moderate forms — from 3 to 5 weeks, in severe — 8 weeks or more. The diet enriched with potassium (raisins, dried apricots, nuts, bananas, baked potatoes, buckwheat). In the acute phase the

foods that cause stimulation of the cardiovascular system should be eliminated: coffee, strong tea, fried food, etc. It is recommended to limit salt and fluid in heart failure.

Anti-inflammatory therapy is carried out for 3—5 weeks, depending on the course of the disease. The main NSAIDs and their dosage in the treatment of non-rheumatic carditis:

- diclofenac 2.5—3 mg/kg/day in 3—4 doses;
- ibuprofen 30—40 mg/kg/day in 3—4 doses;
- indomethacin 2.5—3 mg/kg/day in 3—4 doses.

In a severe course of carditis accompanied by cardiomegaly, heart failure, pericarditis it is necessary to prescribe prednisolone, 0.8—1.5 mg/kg per day for 2—3 weeks. In a protracted course of carditis quinolines should be prescribed (chloroquine or hydroxychloroquine in the dosage of 5—8 mg/kg/ day) for 6—9 months because of the risk of autoallergic reactions (Fig. 30).

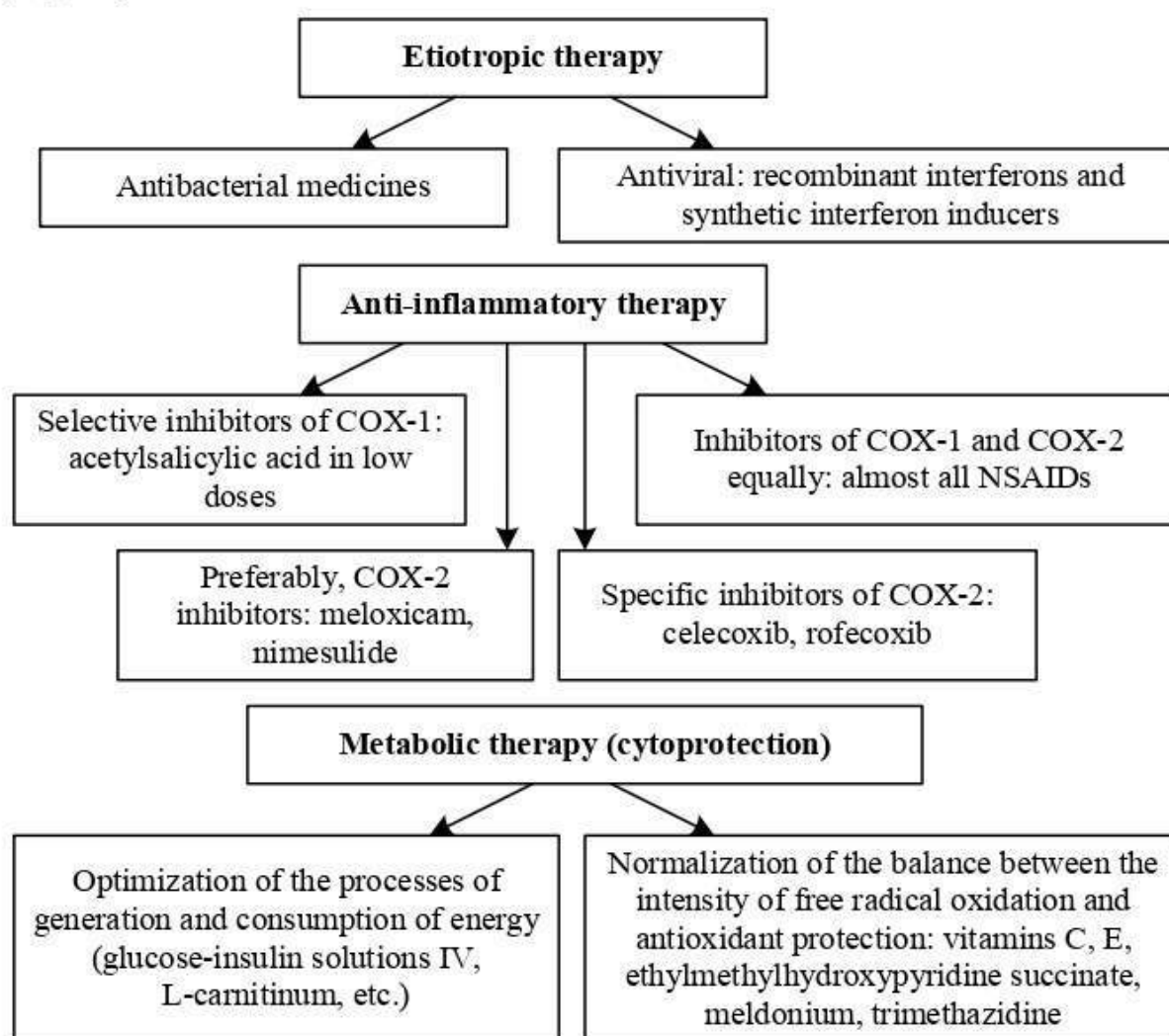


Fig. 30. The principles of medical treatment of non-rheumatic carditis in children



## Chapter 4

Metabolic therapy for myocarditis concerns cytoprotection and optimization of cardiomyocyte metabolism under conditions of myocardium inflammation. Cardonat, trimetazidine and L-carnitine are administered. The average duration is 4 weeks. Therapy should be combined with ATP, Espalipon, riboxin. The second direction of the cytoprotective therapy for myocarditis is normalization of the balance between free radical oxidation and antioxidant protection. It is recommended to use natural antioxidants (vitamins C, E) or xenobiotics which inactivate free radicals.

*Prognosis.* Complete recovery for the majority of patients during the first year of the disease is common. However, besides recovery, carditis consequences are possible: dilated cardiomyopathy, myocardiosclerosis, sudden death.

### Acute Rheumatic Fever

**Acute rheumatic fever** (ICD-10: I00-I02) is a systemic inflammatory disease of the connective tissue, mainly affecting the cardiovascular system (rheumatic heart disease), joints (migratory polyarthritis), nervous system (chorea), skin (annular erythema, rheumatic nodules) and other organs with toxico-immunological mechanism of development in children with genetic predisposition, on the infection background with group A beta-hemolytic streptococcus.

*Epidemiology.* Rheumatic diseases rank third among other types of pathology in adults. The morbidity of children with acute rheumatic fever in Ukraine is 0.04 per 1000 children.

*Etiology.* The only etiological pathogen of ARF is group A beta-hemolytic streptococcus.

*Pathogenesis* — see Fig. 31.

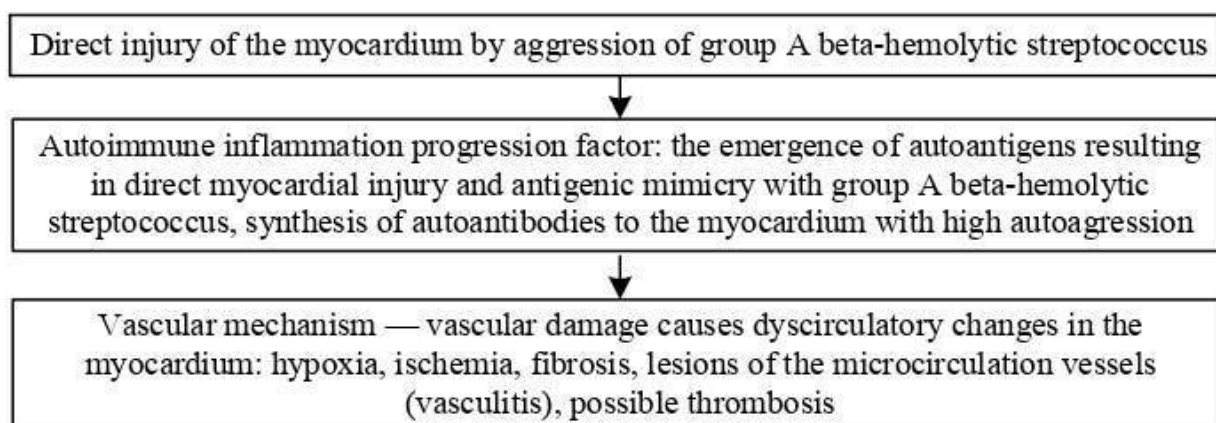


Fig. 31. Pathogenesis of acute rheumatic fever

*Classification* of rheumatic fever (Table 40) was offered by the Institute of Rheumatology (2001) and modified by the Ukrainian Association of Rheumatologists (2004).

Table 40

#### Acute Rheumatic Fever Classification

Clinical Manifestations		Degree of Activity	Stages of Circulatory Disorders	NYHA Functional Class
Main	Additional			
— Carditis — Arthritis — Chorea — Annular erythema — Rheumatic nodules	— Fever — Arthralgia — Abdominal syndrome — Serositis	III — high II — moderate I — minimal	0, I, IIA, IIB, III	0, I, II, III, IV

*Clinical manifestations* — see Table 41.

Table 41

#### Peculiarities of Acute Rheumatic Fever in Children

Decreased severity of the disease; catastrophic variants of the disease have virtually disappeared
Predominance of primary morbidity in older children (12—18 years)
Decreased exudative inflammation due to a moderate degree and minimum activity that leads to reduction of pancarditis, polyserositis and visceritis
In childhood nervous system involvement occurs in the form of small chorea
During recurrent attacks of ARF, carditis is most common
Among children extracardiac manifestations of the disease in the form of polyarthritis, annular erythema, rheumatic nodules are more common than among adults
There are new clinical forms of ARF such as autoimmune neuropsychiatric disorders associated with streptococcal infection
Children show a more prominent effect from timely rational therapy than adults

*Diagnostics.* We use the diagnostic criteria for rheumatic fever (Kisel—Jones) supplemented by A.I. Nesterov, reviewed by the American Heart Association (1992), and modified by the Association of Rheumatology (2003).



## Chapter 4

The presence of two major or one major and two minor criteria indicate a high probability of ARF (Table 42).

Table 42

## Diagnostic Criteria of Acute Rheumatic Fever

Major Criteria	Minor Criteria
Carditis	Arthralgia
Polyarthrititis	Fever
Annular erythema	Increased level of the acute phase reagents (ESR, CRP)
Chorea	Prolongation of the PR interval on ECG
Subcutaneous rheumatic nodules	Symptoms of mitral and/or aortic regurgitation with Doppler echocardiography
	Data confirming GAS infection: beta-positive streptococcal culture, taken from the oropharynx, or rapid determination of streptococcal antigen positive test; elevated titers of antistreptococcal antibodies (antistreptolysin O, anti-DNA-polymerase B) twofold or more

*Treatment.* First stage — hospitalization. The regimen in the acute phase is bed rest (on average 3—6 weeks). Activity is increased gradually. Diet with a high content of protein, vitamins, restriction of salt and carbohydrates.

The second stage of treatment involves staying in hospital for further treatment to achieve full remission within 30—45 days.

The third stage — clinical observation, follow-up observation, and *preventive treatment*.

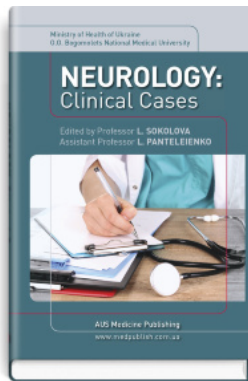
Medical therapy is aimed at two main links of the pathogenesis — the infectious agent and immunopathological inflammatory reaction (Table 43).

Table 43

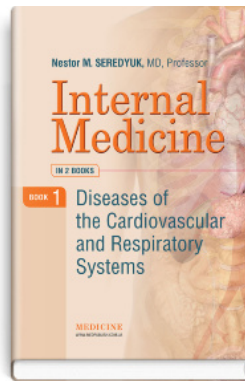
## Acute Rheumatic Fever Treatment

Therapy	Name and Dose of the Drug	Indications
<i>Antibacterial for primary treatment and prevention</i>	Penicillin G 20000—50000 IU/kg/day, 4 times a day, during 10—14 days, intramuscularly	The first attack of ARF and its recurrences

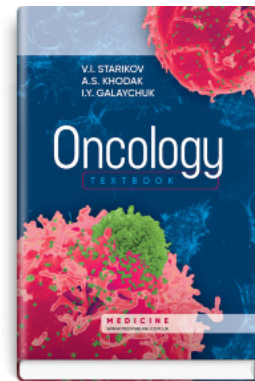
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