

DOI: 10.31636/prmd.v6i1.5

## Arrhythmias in children and adolescents as a cause of chest pain

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**Abstract.** *Arrhythmias are a relatively common cause of chest pain in children and adolescents, which should be considered in the differential diagnosis of pain. The article points to modern ideas about the different etiology of arrhythmias in children and adolescents. It also presents a working classification of arrhythmias based on their pathophysiological mechanisms, a brief diagnosis of arrhythmias including clinical criteria, various instrumental and ultrasound examination methods; described group of life-threatening arrhythmias, which are considered one of the main causes of sudden cardiac death. The characteristics of each type of life-threatening arrhythmia are listed at the end of the article. Treatment includes medical and surgical methods.*

**Key words:** *children's ambulance, chest pain, cardiac arrhythmias, life-threatening arrhythmias, diagnosis, treatment*

### Introduction

**Arrhythmia** — any heart rhythm that differs from the normal rate, regularity of impulse conduction, and sequence of atrial and ventricular activations. The variety of forms of arrhythmias, the difficulty of their diagnosis and treatment is a problem for pediatricians and cardiologists, which today is considered one of the most relevant in pediatric cardiology, competing with congenital heart defects. Arrhythmias occur in all periods of childhood and adolescence, but the greatest risk concerns newborns and infants, 4–5, 7–8 and 12–16 years. There are no exact data on the prevalence of cardiac arrhythmias in children and adolescents, and their statistical evaluation is difficult, because ep-

isodes of arrhythmias can be recorded even in healthy children. According to some authors, wandering pacemaker, bradycardia, accelerated atrial rhythm, extrasystoles, Wolff-Parkinson-White syndrome, 1<sup>st</sup> degree of atrioventricular block [1] are most common in children.

In childhood and adolescence, the course of cardiac arrhythmias is often asymptomatic, which makes early diagnosis difficult and does not allow specifying the duration of the disease and the time of its onset. Therefore, in childhood, we often accidentally detect arrhythmia during preventive electrocardiography (EKG), when changing doctors and during preventive medical

examinations. In some cases, the disease can proceed with the rapid development of heart failure and lead to the death of the patient, especially in newborns and infants.

## Classification of arrhythmias

*In childhood, the following causes of arrhythmias are distinguished:*

### 1. Extracardiac:

- disorders of innervation of the heart in case of damage (primarily perinatal) of the central and autonomic nervous system;
- hereditary inferiority of vegetative regulation;
- trauma, brain tumors;
- neuroinfections;
- psychogenic disorders;
- disorders of neurohumoral (including endocrine) regulation affecting the course of electrical processes in specialized and contractile cells of the heart;
- metabolic shifts (disorders of water and electrolyte metabolism: hypo- or hypercalcemia, magnesium, potassium), effect of drugs, hypo- or hyperthermia.

### 2. Cardiac:

- organic pathology of the heart: congenital malformations (mainly Ebstein's anomaly, atrial septal defect, tetralogy of Fallot, atrioventricular communication, etc.), acquired heart defects and tumors;
- myocardial diseases with damage to electrogenic membranes or destruction of cellular structures: myocarditis, SARS-CoV-2 and newly emerging diseases related to the COVID-19 pandemic [2–12], heart damage in diffuse connective tissue diseases [13, 14], rheumatic fever and chronic rheumatic heart disease, cardiomyopathy, myocardial degeneration in diabetes mellitus, hypothyroidism, thyrotoxicosis, polychemotherapy;
- endocarditis, pericarditis, pulmonary hypertension, arterial hypertension, mechanical influence (for example, during catheterization and angiography);
- heart damage;
- intoxication (alcohol, caffeine, etc.) and electrolyte disorders [15–18];

- hereditary syndromes, congenital anomalies of the conduction pathways of the heart, arrhythmogenic dysplasia of the right ventricle.
3. **Combined:** dysregulatory processes and organic heart pathology.
  4. **Idiopathic:** channelopathy (“electrical heart disease”), primary electrical instability of the myocardium.

In the emergence of extracardiac causes of arrhythmias, unfavorable course of pregnancy and childbirth, prematurity, intrauterine malnutrition, fetal infections, which cause morphogenesis disorders and functional immaturity of the heart's transmission system, play a leading role. Idiopathic causes of arrhythmias are referred to as ion channelopathies because they are caused by mutations in genes encoding the synthesis of cell membrane proteins responsible for transmembrane ion fluxes of potassium and sodium.

Such cardiac arrhythmias include long and short QT syndromes, catecholaminergic polymorphic ventricular tachycardia, and Brugada syndrome.

*Pathogenetic mechanisms causing heart rhythm changes include:*

- impulse generation disorders (nomotopic, associated with a change in the activity of the sinus node and heterotopic — the result of abnormal electrophysiological mechanisms of myocardial excitation);
- conduction disorders;
- disorders of the generation and conduction of the impulse (combined arrhythmias) [19, 20].

*Electrophysiological mechanisms of arrhythmias:*

- triggering (induced, starting) activity — activation of latent conductive pathways during suppression of sinus node activity;
- abnormal automatism — activation of cells that are capable of automatic activity, but do not show it under normal conditions;
- “re-entry” mechanism (from English: *re-entry* — re-starting the wave), when the impulse moves in a vicious circle.

These mechanisms form the basis of the **working classification of arrhythmias**, which was proposed back in 1987, but is still relevant today:

**I. Arrhythmias associated with a disorder of automatism** (nomotopic — sinus arrhythmia, tachycardia and bradycardia, heterotopic — extrasystoles, paroxysmal

and non-paroxysmal tachycardia, flutter and flickering of the atria and ventricles).

II. **Arrhythmias associated with conduction disorders — blockades** (sinoauricular, intraatrial, atrioventricular, intraventricular).

III. **Combined arrhythmias** (sick sinus syndrome — SSS, atrioventricular dissociation, ventricular preexcitation syndrome).

All heart rhythm disorders in childhood can usually be divided into **tachyarrhythmias**, **bradyarrhythmias** and **extrasystoles**.

## Diagnosis of arrhythmias in children and adolescents

Diagnosis of arrhythmias includes identification of such patient complaints as **chest pain**, discomfort, palpitations, shortness of breath, syncope and presyncope states, and others.

Adolescents often complain of a more emotional connotation due to psychovegetative disorders. Such patients suffer from emotionality, irritability, cardialgia, sleep disorders. It is important to underline that at an early age arrhythmias can be asymptomatic, masked by other diseases, cause rapid development of heart failure or sudden cardiac death.

When taking an anamnesis, attention should be paid to the unfavorable course of the perinatal period, family anamnesis in the sense of the occurrence of cardiovascular diseases, recurrent acute diseases, the presence of foci of chronic infection.

During the physical examination, attention is paid to neurological symptoms, psychovegetative disorders, signs of connective tissue dysplasia, retardation of psychomotor development, symptoms of heart failure (shortness of breath, tachycardia, edema, liver enlargement), signs of organic heart damage (deformation of the chest, expansion of heart borders, irregular tones, tachycardia, bradycardia, extrasystoles, pulse deficit, presence of murmur) [20].

Changes on the electrocardiogram serve to confirm cardiac arrhythmias [21–24]. Taking into account the possibility of asymptomatic course of arrhythmias in childhood, the ECG makes it possible to detect a rhythm disorder very quickly — during the examination itself. Holter monitoring of the electrical activity of the heart is useful in diagnosis [25]. If necessary, it is possible to use a retil-implantable device for monitoring heart activity, functioning as an ECG recorder with a monitoring peri-

od of up to three years [26]. According to the indications, an ECG with tests is performed: with physical load, pharmacological and functional tests [21–24]. Electroencephalography is also performed, consultations with a neurologist and genetic examination are prescribed to rule out hereditary disorders in the structure of the membrane channels of cardiomyocytes — channelopathies. In the laboratory, we rule out inflammatory processes and disorders of the internal environment.

Cardiac magnetic resonance and computed tomography are also performed according to indications. If it is necessary to clarify the nature of the lesion and determine management tactics, clinical and laboratory examinations are supplemented by transesophageal stimulation or electrophysiological examination.

## Treatment of arrhythmias in children and adolescents

Therapy of cardiac arrhythmias includes non-drug, drug, surgical and interventional methods: installation of artificial pacemakers (from the 2<sup>nd</sup> day of life) and cardioverter defibrillators, radiofrequency ablation, cryoablation, etc.

Medical treatment can be divided into two main areas — emergency therapy and chronic pharmacotherapy.

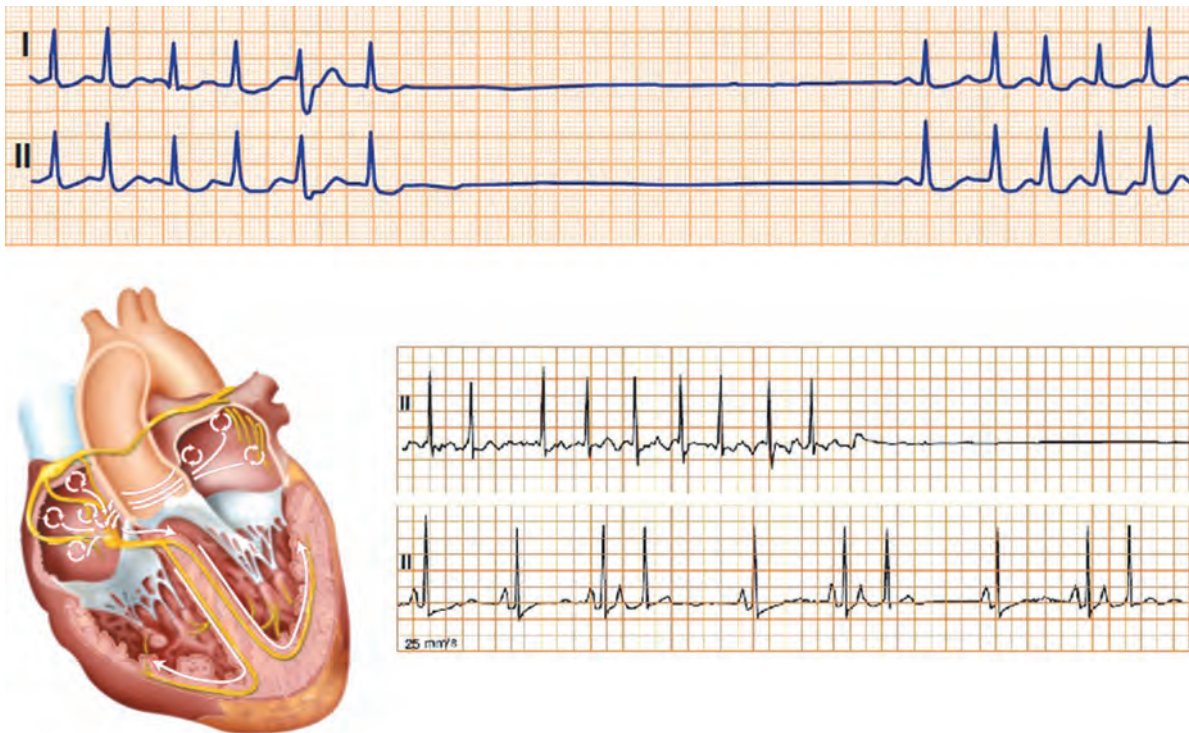
Patients with cardiac arrhythmias at high risk of heart failure, cardiac arrest, and sudden cardiac death require urgent treatment [27–36].

Among the rhythm disorders in children and adolescents, there are also life-threatening arrhythmias associated with a high risk of sudden cardiac death. Sudden death is defined as death within a few minutes to 24 hours of the onset of symptoms due to asystole or ventricular fibrillation in children who were physiologically and psychologically stable until then [19, 20].

## Potentially dangerous cardiac arrhythmias in children and adolescents

*Potentially dangerous heart rhythm disorders include:*

- supraventricular tachycardia;
- ventricular tachycardia;
- complete atrioventricular (AV) block;
- sick sinus syndrome (SSS);
- long QT interval syndrome (LQTS);
- short QT syndrome (SQTS);
- Brugada syndrome (Brugada syndrome, BrS).



**Fig. 1.** Sick sinus syndrome (Tachy-Brady syndrome).

Source: ECG book (TECHMED)

**Paroxysmal tachycardia** — a sudden increase in heart rate that lasts for several minutes to several hours or days and then stops suddenly. There are supraventricular and ventricular forms of paroxysmal tachycardia.

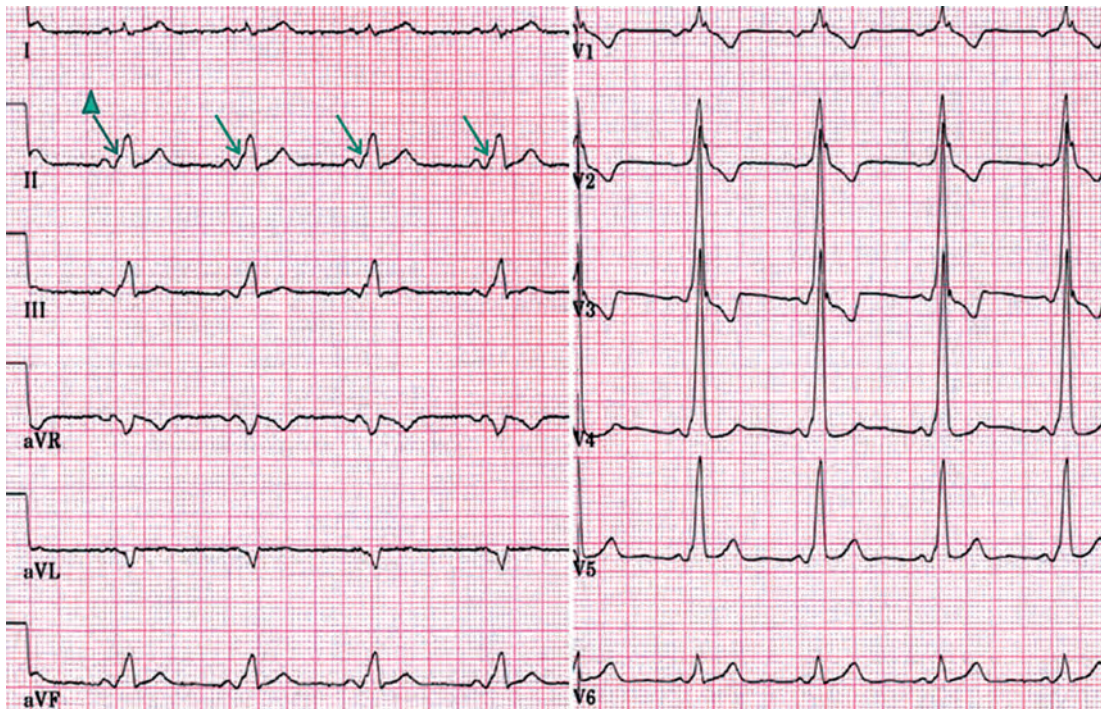
In supraventricular tachycardia, the most severe manifestations are associated with other anomalous impulse conduction pathways (Kent bundle — Wolff-Parkinson-White syndrome, Mahaim bundle — Lown-Ganong-Levin syndrome). In these tachycardias, the source of the rhythm is located above the bifurcation of the bundle of His, in the atria and the atrioventricular node. An increase in the rhythm of more than 200 beats per minute in newborns and children of the first year of life and more than 160 beats per minute in older children is characteristic. The most common cause of this type of arrhythmia is Wolff-Parkinson-White syndrome. Clinical manifestations of tachycardia in young children are characterized by severe anxiety, vomiting, refusal to eat, sudden onset of shortness of breath, pallor and sweating. At an older age, the child may complain of an attack of palpitations, a feeling of “trembling” behind the sternum, in the fingertips, pain near the heart, a feeling of fear. Some patients develop presyncope and syncope.

Seizure therapy begins with vagus tests, which are most effective during the first 25–35 minutes.

For the younger age group, it involves vagal maneuvers — Valsav’s maneuver (pressure on the root of the tongue), ice pack on the face (immersion reflex) and others. Medical therapy begins with an intravenous bolus of adenosine. The dose in early childhood is 0.15 mg/kg, for children older than one year — 0.1 mg/kg, the maximum dose is 0.3 mg/kg. The initial dose can be repeated two more times with an interval of at least two minutes. If the therapy has no effect, we administer a bolus of amiodarone — 5–10 mg/kg (in the case of a weak (or no) effect, we continue with a dose of 10 mg/kg per day in a 5% glucose solution). Surgical methods of treatment — radiofrequency ablation, cryoablation — are used in the absence of the effect of medical treatment in the presence of indications.

**Ventricular tachycardia** — an accelerated rhythm that includes three or more complexes, the source of which is an impulse that occurs in the bundle of His (Tawar bundles), Purkinje fibers or in the contractile myocardium of the ventricles. The number of heartbeats ranges from 120 to 250 per minute. The most common cause is organic damage to the myocardium. Children may develop syncope and pre-syncope states, pain in the heart area.

Treatment of ventricular tachycardia can be medical and surgical. Synchronized cardioversion is recom-



**Fig. 2.** WPW syndrome (Type A).

Source: ECG book (TECHMED)

mended in an emergency situation. Lidocaine is considered the drug of choice: the initial dose is 1 mg/kg, after 5–10 minutes it is possible to re-administer half the dose. Next, if no effect appears, we use antiarrhythmic III. classes — amiodarone: the initial dose (5–10 mg/kg) is administered intravenously as a bolus over 60 minutes in a 5% glucose solution, then we can switch to a maintenance dose. Propranolol (0.01–0.02 mg/kg, maximum 0.2 mg/kg) is used intravenously, slowly. If there are indications, radiofrequency ablation is performed [29].

**Complete atrioventricular block** — absence of conduction of the impulse from the atria to the ventricles. The blockage can be congenital or acquired. Clinical symptoms are poor and characterized by reduced exercise tolerance, dizziness and syncope — Morgagni-Adams-Stokes seizures. The cause of loss of consciousness is episodes of asystole.

The treatment is surgical — implantation of a pacemaker. In urgent cases, atropine sulfate can be used to stop severe bradycardia (0.02–0.04 mg/kg, the dose can be repeated after 5 minutes to the maximum total dose: 1 mg in children and 2 mg in adolescents) [27].

**Long QT interval syndrome** — a hereditary disease in which a prolonged QT interval is detected on the elec-

trocardiogram. It is manifested by loss of consciousness, which is related to ventricular arrhythmias (most often — ventricular tachycardia of the “pirouette” type) and sudden cardiac death syndrome. Clinical manifestations vary — from asymptomatic to syncope. Provocative factors are physical activity, swimming, emotional stress, noise.

Beta-blockers are recommended as lifelong medical treatment for long QT syndrome. These drugs are indicated for asymptomatic patients and patients with syncope or tachycardia. Propranolol, nodalol, atenolol are used. In some indicated cases, implantation of a cardioverter-defibrillator is recommended [30].

## Conclusion

Despite the achievements and development of medicine in recent decades, the treatment of cardiac arrhythmias (and differential diagnosis of chest pain) is one of the most difficult problems in pediatrics. This is due to the child’s physiology, development mechanisms and the variety of forms of arrhythmias.

## Conflict of interest

The authors declare no conflict of interest.

## References

5. Janson CM, Millenson ME, Okunowo O, Dai D, Christmyer Z, Tan RB, et al. Incidence of life-threatening events in children with Wolff-Parkinson-White syndrome: Analysis of a large claims database. *Heart Rhythm* [Internet]. 2022 Apr;19(4):642–7. Available from: <http://dx.doi.org/10.1016/j.hrthm.2021.12.009>
6. Dobrovanov O, Furková K. Multisystem inflammatory syndrome in children (MIS-C) in clinical practice (case report) [Multisystémový zápalový syndróm u detí: kazuistika]. *Pediatrica (Bratisl.)* [Internet]. 2022;17(4):195–8. Available from: <https://www.amed.sk/?amedController=magazine&amedMethod=content&amedId=9982> [In Slovak]
7. Dobrovanov O, Kráľinský K. Cardiovascular risks of COVID-19 in pediatric patients: PIMS-TS / MIS-C [Kardiovaskulárne riziká COVID-19 u detských pacientov: PIMS-TS/MIS-C]. *Kardiológia* [Internet]. 2021;4(1):23–7. Available from: [https://lekarskenoviny.sk/wp-content/uploads/2021/05/KAR\\_23\\_27\\_2021.pdf](https://lekarskenoviny.sk/wp-content/uploads/2021/05/KAR_23_27_2021.pdf) [In Slovak]
8. Kralinsky K, Pisarchikova M, Dobrovanov AE, Babela R. Protocol for the diagnosis, management and treatment of pediatric patients with COVID-19 according to the recommendations of the Slovakian Pediatric Society. *Rossiyskiy Vestnik Perinatologii i Pediatrii (Russian Bulletin of Perinatology and Pediatrics)* [Internet]. 2020 Nov 22;65(5):93–9. Available from: <http://dx.doi.org/10.21508/1027-4065-2020-65-5-93-99>
9. Dobrovanov O, Furková K, Repáková M, Vajdová L, Balandová L, Birková K, et al. What did COVID-19 give us? Case report (a “COVID” rash) [Čo nám doprial COVID-19? Kazuistika („covidový“ exantém)]. *Pediatrica (Bratisl.)* [Internet]. 2020; 15(3): 210–213. Available from: <https://www.amed.sk/?amedController=magazine&amedMethod=content&amedId=8885> [In Slovak]
10. Dmytriiev D, Dobrovanov O, Kralinsky K, Dmytriiev K, Melnychenko M. A case report of successful experience of using adaptive support ventilation in the pediatric patient with viral interstitial pneumonia COVID-19 positive. *Lek. Obzor* [Internet]. 2021;70(3): 119–23. Available from: <https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/pt/covidwho-1227412>
11. Dmytriiev D, Dobrovanov O. Post-COVID-19 pain syndrome. *Anaesth. pain intensive care* [Internet]. 2021;25(4):505–12. Available from: <https://www.apicareonline.com/index.php/APIC/article/view/1582/2508>
12. Dobrovanov O, Dmytriiev D, Prochotsky A, Vidiscak M, Furkova K. Pain in COVID-19: Quis est culpa? *Electronic Journal of General Medicine* [Internet]. 2023 Jan 1;20(1):em435. Available from: <http://dx.doi.org/10.29333/ejgm/12672>
13. Dobrovanov O, Furková K. The COVID-19 pandemic: current affairs [Pandémia COVID-19: actuality]. Bratislava: HERBA spol. s.r.o. Bratislava; 2022. 64 p. [In Slovak]
14. Dobrovanov O. Post-COVID syndrome in the practice of a pediatric gastroenterologist [Postkovidový syndróm v praxi detského gastroenterológa] VIII. Kongres Slovenských a Českých pediatrických gastroenterológov, 29.9.-1.10.2022 (Danube, Bratislava); 2022. p. 34–35. DOI: 10.13140/RG.2.2.25669.93925 [In Slovak]
15. Dobrovanov O. Post-covid syndrome [Postkovidový syndróm]. *Lekárnické listy*. 2022;24(6):30–32. [In Slovak]
16. Dobrovanov O. Postcovid syndrome and its treatment [Postkovidový syndróm a jeho liečba]. *Farm. Obzor*; 2022,XCL(3):57–64. [In Slovak]
17. Dobrovanov O., Kráľinský K. Cardiovascular risks of COVID-19 in pediatric patients: PIMS-TS / MIS-C [Kardiovaskulárne riziká COVID-19 u detských pacientov: PIMS-TS/MIS-C]. *Kardiológia* [Internet]. 2021;4:23–7. Available from: [https://lekarskenoviny.sk/wp-content/uploads/2021/05/KAR\\_23\\_27\\_2021.pdf](https://lekarskenoviny.sk/wp-content/uploads/2021/05/KAR_23_27_2021.pdf) [In Slovak]
18. Dobrovanov O, Kráľinský K. Benign parainfectious myositis in children as complications of viral infection. Abstracts of lectures [Benigné parainfekčné myozitídy u detí ako komplikácie vírusovej infekcie. Abstrakty prednášok]. 13. Slovenský pediatrický kongres s medzinárodnou účasťou (Banská Bystrica, 6–8 Jun 2019). *Pediatrica (Bratisl.)*. 2019;S2(14/2019). [In Slovak]
19. Dobrovanov O, Kráľinský K. Carbon monoxide intoxication and its possible complications - case report [Intoxikácia oxidom uhoľnatým a jej možné komplikácie – kazuistika]. *Pediatr. prax*. 2017. 18(4):166–167. [In Slovak]
20. Dobrovanov O, Kráľinský K, Furková K. Intoxication with carbon monoxide - collective report [Intoxikácia oxidom uhoľnatým - súborný referát]. *Pediatrica (Bratisl.)*. 2017; 12(3): 147–150. [In Slovak]
21. Dobrovanov O, Kráľinský K. Pseudoperitonitis and acidosis of the central nervous system in diabetic ketoacidosis. Case reports [Pseudoperitonitída a acidóza centrálnej nervovej sústavy pri diabetickej ketoacidóze]. *Kazuistiky. Pediatr. prax*. 2019; 20(4): 173–6. [In Slovak]
22. Dobrovanov O, Kralinsky K, Krčméry V. Start of the respiratory infection season and initial antibiotic therapy [Začiatok sezóny respiračných infekcií a iniciálna antibiotická terapia]. *Pediatrica (Bratisl.)*. 2018;13(5):245–50. [In Slovak]
23. Schwartz PJ, Ackerman MJ, Antzelevitch C, Bezzina CR, Borggrefe M, Cuneo BF, et al. Inherited cardiac arrhythmias. *Nature Reviews Disease Primers* [Internet]. 2020 Jul 16;6(1). Available from: <http://dx.doi.org/10.1038/s41572-020-0188-7>
24. Park JK. Palpitations and Arrhythmias and Sudden Cardiac Arrest/Sudden Cardiac Death in Children and Adolescents. *Pediatric Annals* [Internet]. 2015 Dec;44(12). Available from: <http://dx.doi.org/10.3928/00904481-20151109-01>
25. Sheldon RS, Grubb BP, Olshansky B, Shen W-K, Calkins H, Brignole M, et al. 2015 Heart Rhythm Society Expert Consensus Statement on the Diagnosis and Treatment of Postural Tachycardia Syndrome, Inappropriate Sinus Tachycardia, and Vasovagal Syncope. *Heart Rhythm* [Internet]. 2015 Jun;12(6):e41–63. Available from: <http://dx.doi.org/10.1016/j.hrthm.2015.03.029>
26. Karadeniz C. Importance of electrocardiographic markers in predicting cardiac events in children. *Biomarkers in Medicine* [Internet]. 2020 Dec;14(17):1663–73. Available from: <http://dx.doi.org/10.2217/bmm-2020-0391>
27. Uygur özgün. Normal Electrocardiogram Values of Healthy Turkish Children. *Türk Pediatri Arşivi* [Internet]. 2019; Available from: <http://dx.doi.org/10.14744/turkpediatriars.2019.04568>
28. Drago F, Battipaglia I, Di Mambro C. Neonatal and Pediatric Arrhythmias. *Cardiac Electrophysiology Clinics* [Internet]. 2018 Jun;10(2):397–412. Available from: <http://dx.doi.org/10.1016/j.ccep.2018.02.008>

29. Sharma S, Drezner JA, Baggish A, Papadakis M, Wilson MG, Prutkin JM, et al. International Recommendations for Electrocardiographic Interpretation in Athletes. *Journal of the American College of Cardiology* [Internet]. 2017 Feb;69(8):1057–75. Available from: <http://dx.doi.org/10.1016/j.jacc.2017.01.015>
30. Aman R, Qureshi AU, Sadiq M. Yield of 48-hour Holter monitoring in children with unexplained palpitations and significance of associated symptoms. *J Pak Med Assoc* [Internet]. 2017 Jul;67(7):975–979. PMID: 28770871. Available from: <https://pubmed.ncbi.nlm.nih.gov/28770871/>
31. Akca T, Uysal F, Bostan OM, Genc A, Turkmen H. The Role of External Loop Recorders in Arrhythmia-Related Symptoms in Children: A Single Center Experience. *Pediatric Cardiology* [Internet]. 2022 Jan;43(1):147–154. Available from: <http://dx.doi.org/10.1007/s00246-021-02705-y>.
32. Cetta F, Bell TJ, Ros SP. Emergency department evaluation of an infant with chaotic atrial tachycardia. *Pediatric Emergency Care* [Internet]. 1997 Apr;13(2):120–2. Available from: <http://dx.doi.org/10.1097/00006565-199704000-00010>
33. Cohen MI. Frequent premature ventricular beats in healthy children. *Current Opinion in Cardiology* [Internet]. 2019 Jan;34(1):65–72. Available from: <http://dx.doi.org/10.1097/hco.0000000000000581>
34. Grolleau R, Messner P, Leclercq F, Carabasse D, Voisin M. Ventricular tachycardia in children [Les tachycardies ventriculaires de l'enfant]. *Arch Mal Coeur Vaiss*. 1993 May;86(5 Suppl):789–99. [In France]
35. Dobrovanov O, Dmytriiev D, Prochotsky A, Vidiscak M, Furkova K. Chronic pain in post-COVID syndrome. *Bratislava Medical Journal* [Internet]. 2023;124(02):97–103. Available from: [http://dx.doi.org/10.4149/blj\\_2023\\_014](http://dx.doi.org/10.4149/blj_2023_014)
36. Alders M, Bikker H, Christiaans I. Long QT Syndrome. 2003 Feb 20 [updated 2018 Feb 8]. In: Adam MP, Mirzaa GM, Pagon RA, Wallace SE, Bean LJH, Gripp KW, Amemiya A, eds. *GeneReviews*® [Internet]. Seattle (WA): University of Washington, Seattle; 1993–2023.
37. Semenkovich Y, Dmytriiev D, Dobrovanov O, Vidiščák M, Šupinová M. Acute and chronic pain in children. A modern view of the issue. *Lek. Obzor*. 2022;71(9):338–42.
38. Dobrovanov O. Vitamins - the way to your health [Vitamíny – cesta k vášmu zdraviu]. Bratislava: Herba, spol. s.r.o.; 2023. 172 p. [In Slovak]
39. Kim CW, Aronow WS, Dutta T, Frenkel D, Frishman WH. Catecholaminergic Polymorphic Ventricular Tachycardia. *Cardiology in Review* [Internet]. 2020 Jan 2;28(6):325–31. Available from: <http://dx.doi.org/10.1097/crd.0000000000000302>
40. Elkattawy S, Younes I, Alyacoub R, Fichadiya H, Dhanoa P, Kotys J, et al. A Rare Presentation of Sick Sinus Syndrome: Generalized Seizures. *Cureus* [Internet]. 2022 Mar 29;14(3):e23631. Available from: <http://dx.doi.org/10.7759/cureus.23631>

### Аритмії у дітей та підлітків як причина болю в грудній клітці

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**Резюме.** Аритмії є відносно частою причиною болю в грудній клітці у дітей та підлітків, що слід враховувати при диференціальній діагностиці болю. У статті вказуються сучасні уявлення про різну етіологію аритмій у дітей та підлітків. Також представлено робочу класифікацію аритмій, засновану на їх патофізіологічних механізмах, коротку діагностику аритмій, що включає клінічні критерії, різні інструментальні та ультразвукові методи дослідження; описано групу життєво загрозованих аритмій, які вважаються однією з основних причин раптової серцевої смерті. Характеристики кожного виду небезпечної для життя аритмії перераховані наприкінці статті. Лікування включає медикаментозні та хірургічні методи.

**Ключові слова:** педіатрія, біль у грудях, порушення серцевого ритму, життєво загрозована аритмія, діагностика, лікування