and advanced age, which contributed to the unfavorable course of the new coronavirus infection.

Patients with diabetes mellitus should monitor glucose levels more closely throughout the day and continue taking the blood glucose-lowering drugs recommended by their physician. The presence of diabetes mellitus is a significant risk factor for the rapid progression and poor prognosis of novel coronavirus infection (COVID-19). This group of patients needs priority vaccination against COVID-19 and pneumococcal infection, which can significantly reduce the risk of developing viral-bacterial pneumonia.

## References


1. Kamkin E.G., Kostenko N.A., Karakulina E.A. Vremennye metodicheskie rekomendacii [Temporary methodical recommendations]. Profilaktika, diagnostika i lechenie novoj koronavirusnoj infekcii (COVID-19). Versiya 14 (27.12.2021) [Prevention, diagnosis and treatment of new coronavirus infection (COVID-19). Version 14 (27.12.2021) (In Russ.).]
2. Guan W. et al. Clinical characteristics of coronavirus disease 2019 in China // N. Engl. J. Med. 2020. Vol. 382. P. 1708-1720. DOI: 10.1056/NEJMoa2002032.
3. Wu Z., McGoogan J.M. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese center for disease control and prevention // JAMA. 2020. Vol. 323, №13. P. 1239-1242.
4. Ametov AS, Misharova AP. Slozhnost' vybora saharosnizhayushchej terapii u pacientov s koronavirusnoj infekciej [Difficulty of choosing sugarcoating therapy in patients with coronavirus infection]. Endokrinologiya: novosti, mneniya, obuchenie [Endocrinology: news, opinions, training. 2020; 9 (2): 9-14 (In Russ.).] DOI: 10.33029/2304-9529-2020-9-2-9-145.
5. Ceriello A. Management of diabetes today: an exciting confusion // Diabetes Res. Clin. Pract. 2020. Vol.162. Article ID 108129. DOI: 10.1016/j.diabres.2020.108129.
6. Hussain A., Bhowmik B., Cristina do Vale Moreira N. COVID-19 and diabetes: knowledge in progress // Diabetes Res. Clin. Pract. 2020. Vol. 162. Article ID 108142. DOI: 10.1016/j.diabres.2020.108142


M.S. Savvina, V.M. Argunova, P.A. Sleptsova, S.I. Innokentieva, S.G. Boeskorova, D.R. Danilova, T.E. Burtseva, V.B. Egorova, M.M. Kostik, V.G. Chasnyk

# MULTISYSTEM INFLAMMATORY SYNDROME IN CHILDREN (CLINICAL OBSERVATION)

DOI 10.25789/YMJ.2022.78.35

УДК 616–053.2(571.56)

**SAVVINA Maya S.** – Candidate of Medical Sciences, Senior Researcher, Laboratory for Monitoring Children's Health, YSC CMP; maya_savvina@mail.ru; **ARGUNOVA Vera M.** – doctor of the cardio-rheumatological department of the Pediatric Center of the State Autonomous Institution of the Republic of Sakha (Yakutia) "RB No. 1-NCM; **SLEPTSOVA Polina A.** – head of the cardio-rheumatology department of the Pediatric Center of the State Autonomous Institution of the Republic of Sakha (Yakutia) RH No. 1-NCM, Yakutsk, Sergelyakhskoe highway, 4; cardiorevmatologsakha@mail.ru, **INNOKENTYEVA Sargylana I.** – doctor of the cardio-rheumatology department of the Pediatric Center of the State Autonomous Institution of the Republic of Sakha (Yakutia) RH No. 1-NCM; **BOESKOROVA Sargylana G.** – resident of the Department of Pediatrics and Pediatric Surgery, Medical Institute, M.K. Ammosov North-Eastern Federal University, lanaboeskorova@gmail.com; **DANILOVA Diana R.** – 6th year student of M.K. Ammosov NEFU Medical Institute; **BURTSEVA Tatyana E.** – Doctor of Medical Sciences, Professor of the Department of Pediatrics and Pediatric Surgery, M.K. Ammosov NEFU Medical Institute, bourtsevat@yandex.ru; **EGOROVA Vera B.** – Candidate of Medical Sciences, Associate Professor of the Department of Pediatrics and Pediatric Surgery, NEFU Medical Institute, **KOSTIK Mikhail M.** – Doctor of Medical Sciences, Professor of the Department of Hospital Pediatrics, St. Petersburg State Pediatric Medical University, **CHASNYK Vyacheslav G.** – Doctor of Medical Sciences, Professor, Head of the Department of Hospital Pediatrics, St. Petersburg State Pediatric Medical University.

Multisystem inflammatory syndrome is the most severe manifestation of a new coronavirus infection in children. The article presents the clinical case of the multisystem inflammatory syndrome features associated with COVID-19 in a teenager. The purpose of the work is to provide information on this topical clinical problem.

**Keywords:** multisystem inflammatory syndrome (MIS-D), fever, toxic erythema.

**Introduction.** Since April 2020, in some European countries and in the USA, children have been observed with signs of Kawasaki disease and toxic shock syndrome, causing inflammation of the whole body [6,8]. The new disease was given the name - children's multisystem inflammatory syndrome (MIS-D), associated with COVID-19. This disease occurs after infection with COVID-19 and affects mainly school-age children [4,5,6].

MVS-D is an inflammatory response of the body that occurs approximately 3-4 weeks after infection with a coronavirus infection. The initial symptoms of the disease are often manifested as fever, rash all over the body, redness of the eyes, abdominal pain, diarrhea and vomiting. The heart, blood vessels, and central nervous system are also affected, which requires emergency care [2,5].

According to the literature, almost 100% of patients with MVS-D have a fever, in one retrospective study of 21 patients it was reported that all had gastrointestinal symptoms, which usually occurred in the early stages of the disease [7]. Respiratory symptoms such as cough and rhinorrhea were relatively rare. Half of the patients had cardiogenic shock [9,10]. Another study reported that 56% of patients had macrophage activation syndrome (MAS), and Kawasaki-like symptoms were in 16-25% of patients [11].

The pathophysiology of multisystem inflammatory syndrome remains largely unclear. Apparently, it is based on a virus-induced hyperimmune reaction [3,8,5]. The most important role in the pathogenesis is played by the activation of T-lymphocytes, hyperproduction of pro-inflammatory cytokines (TNF-α, interleukins 1, 2, 6, 8, 10, granulocyte-macrophage colony-stimulating factor), deposition of immune complexes in the vascular wall. These mechanisms determine the development of a multisystem inflammatory response and explain most of the clinical and laboratory signs of the syndrome, such as fever, hyperferritinemia, coagulopathy, and an increase in inflammation markers [1,9].

Treatment. In accordance with the CDC (Centers for disease control and prevention) algorithm, therapy depends on the clinical manifestations and severity of the disease. Antibiotics are selected

empirically, at the onset of the disease, they should be prescribed to all patients [2]. Intravenous immunoglobulin is also prescribed at the rate of 1-2 g/kg, acetylsalicylic acid, low molecular weight heparins, infusion therapy, depending on the severity of the condition, glucocorticosteroids and genetically engineered biological preparations [1,2].

Material and research methods. A retrospective analysis of the medical history of a patient who was hospitalized in the cardio-rheumatology department of the Pediatric Center of the SAI RS (Yakutia) "Republican Hospital No. 1 - NCM" was carried out, where an in-depth examination and treatment was carried out according to all standards and clinical recommendations.

Clinical case. Patient A., aged 14, nationality - Sakha, was admitted to the cardio-rheumatology department of the Pediatric Center of the SAI RS (Yakutia) "Republican Hospital No. 1 - NCM" for examination and treatment. Complaints at admission: increased body temperature up to 38.5C - 40C, severe headaches, pain along the spine and in the cervical region when bending the head, turning the head, pain in the muscles of the thighs, legs and arms, rashes on the body, fatigue.

Anamnesis of life. A child from 1 pregnancy, 1 birth, birth weight - 2880g, Height - 50cm. Apgar score - 7/8 points. Development by age. Past illnesses: acute respiratory infections - rarely, atopic dermatitis, residual encephalopathy, recurrent urticaria with annual relapses, more often in winter. Heredity from words is not burdened.

Anamnesis of the disease: fell ill acutely, there was an increase in body temperature up to 38C, bright erythema, pruritus on the body. The temperature did not stop within 3 days, he was examined by the pediatrician of the Gornyi Central District Hospital, inpatient treatment was recommended with a diagnosis of multisystem inflammatory syndrome, toxic erythema. Linked immunosorbent assay for SARS-CoV-2 from 12/18/2020: IgM - 3.1 (norm < 1.0 U / ml); IgG - 13.6 (norm < 10.0 U / ml). Treatment was prescribed: cefotaxime, infusion therapy with saline solutions, antihistamine therapy, corticosteroids, symptomatic treatment. On the 4th day of the disease, no improvement was noted during treatment. After the consultation, he was sent to the cardio-rheumatology department of the Pediatric Center of the SAI RS (Yakutia) "Republican Hospital No. 1 - NCM".

On admission: the patient is in a serious condition, feeling low, correct phy-

Eruptions in a patient with multisystem inflammatory syndrome

**Table1**

**Biochemical parameters of blood serum in dynamics**

| Serum index | 19.12.2020 | 29.12.2020 | 11.01.2021 | Reference values |
|---|---|---|---|---|
| ALT (u/l) | 12.56 | 138.10 | 33.30 | 0-27 |
| AST (u/l) | 25.26 | 61.10 | 19.90 | 0-29 |
| Urea (mmol/l) | 4.61 | 8.40 | 5.80 | 1.8-6.4 |
| Bilirubin total (μmol/l) | 9.11 | 6.00 | 10.70 | 3.4-17.1 |
| Creatinine (μmol/l) | 60.66 | 51.64 | 47.81 | 27-62 |
| Albumin (g/l) | 43.26 | 36.20 | 38.20 | 38-54 |
| Total protein (g/l) | 72.30 | 77.60 | 72.10 | 60-80 |
| Glucose (mmol/l) | 7.01 | 4.11 | 4.73 | 3.3-5.6 |
| GGTP (gamma-glutamyl transpeptidase) (u/l) | | 27.90 | 25.80 | 0-45 |
| Phosphorus (mmol/l) | | 1.49 | 1.65 | 0.87-1.45 |
| Lactate dehydrogenase (u/l) | | 175.70 | 139.40 | 0-250 |
| CPK (u/l) | | 20.30 | 9.99 | 0-270 |
| Calcium total (mmol/l) | | 2.34 | 2.41 | 2.1-2.55 |
| Sodium (mmol/l) | | 135.50 | 138.10 | 138-145 |
| Potassium (mmol/l) | | 4.49 | 4.05 | 3.4-4.7 |

**Table2**

**Complex ultrasound of the heart (M-and B-mode, TsDK, dopplerography)**

| Date | Conclusion |
|---|---|
| 19.12.2020 | MK regurgitation of the 1st degree. The cavities of the heart are not dilated. EF - 76%. Separation of pericardial sheets along the posterior wall of the left ventricle - 3 mm. |
| 21.12.2020 | Expansion of the coronary arteries. Ectopic attachment of PSMK chords with minimal regurgitation. Regurgitation on TC 1 degree. Separation of the sheets of the pericardium. The cavities of the heart are not dilated. EF 69.7%. |
| 28.12.2020 | Ectopic attachment of mitral valve chords with minimal regurgitation. Regurgitation of the tricuspid valve 1 degree. Additional trabecula in the cavity of the left ventricle. The pressure gradient at the isthmus of the aorta is 14.0-15.0 mm Hg. The cavities of the heart are not dilated. PV - 69%. Splitting of the sheets of the pericardium along the posterior wall of the left ventricle up to 3 mm, in the region of the apex - up to 4.9 mm, along the anterior wall of the right ventricle - up to 2.5 mm. |
| 12.01.2021 | Expansion of the coronary arteries. Ectopic attachment of PSMK chords with minimal regurgitation. Separation of the sheets of the pericardium. The cavities of the heart are not dilated. EF - 71%. |

sique, moderate nutrition. On the skin of the neck, chest, abdomen, upper and lower extremities, there is an erythematous diffuse spotty rash that does not rise above the skin (Fig. 1-2). Palpated small submandibular and inguinal lymph nodes, painless. Tongue with prominent papillae. Respiration is vesicular. Heart tones are clear, rhythmic, rough systolic murmur with a maximum in the 2-3 intercostal space to the left of the sternum. The abdomen is soft and painless. Hyperesthesia. Blood pressure - 90/60, heart rate - 76 beats per minute, respiratory rate - 18 per minute.

**Research results.** Complete blood count dated 12/25/2020: neutrophilia - 10.2x109 / l and an increase in ESR - 45 mm / h. In the biochemical blood test dated 12/29/2020: signs of cytolysis and an increase in the level of urea (Table 1). Immunological blood test dated 12/21/2020: CRP - 59.3 mg / dl (norm - up to 1.0), ASLO - 150 IU / ml (norm - up to 150.0).

In the dynamics of the ECHO-KG, an increase in the ejection fraction is observed. The separation of the sheets of the pericardium is preserved (table 2).

Chest X-ray dated 12/19/2020: no focal and infiltrative changes in the lung parenchyma were detected. Electroencephalography from 12/28/2020: Focal and epileptic activity was not detected. MRI of the brain from 12/21/2020: no pathological changes in the brain were detected.

Based on clinical and anamnestic data, laboratory and instrumental studies, the main diagnosis was established: Multisystem inflammatory syndrome associated with COVID-19 (M 35.8). Complications: Toxic erythema. Condition after acute coronavirus infection (asymptomatic).

Treatment was carried out: intravenous immunoglobulins ("Privigen"), cefotaxime, dexamethasone, clexane, aspirin, diacarb, asparkam.

Discharged with improvement on the 25th day of illness. The condition is satisfactory, feeling does not suffer. Body temperature - 36.1, heart rate - 80 beats per minute, respiratory rate - 20 per minute, blood pressure - 112/60 mm Hg. The skin is clean, the lymph nodes are not palpable, the pharynx is calm, the tongue is clean. Respiration is vesicular. Heart sounds are muffled, rhythmic, not coarse systolic murmur. Follow-up with a district pediatrician at the place of residence is recommended. Dispensary registration - at least 5 years. Examination by a cardiologist in a month.

**Conclusion.** This clinical case demonstrates a severe course of multisystem inflammatory syndrome in a teenager who had a new coronavirus infection in an asymptomatic form. A feature of the manifestation of the disease is the long-term preservation of changes in the cardiovascular system (dilation of the coronary vessels, separation of the sheets of the pericardium).

Thus, heart damage in multisystem inflammatory syndrome is the main symptom of the disease [3]. Based on diagnostic criteria, it is important to recognize the disease in a timely manner, differentiate from Kawasaki disease, and prescribe adequate therapy to prevent serious complications.

## References


1. Aleksandrovich Yu.S., Baibarina E.N., Baranov A.A. [et al.]. Vedenie detej s zabolevaniem, vyzvannym novoj koronavirusnoj infekciej [Conducting of children with a disease caused by a new coronavirus infection]. Pediatricheskaya farmakologiya [Pediatric pharmacology. 2020; 17 (2): 103-118 (In Russ.).]

2. Kantemirova M.G., Novikova Yu.Yu., Ovsyannikov D.Yu. [et al.]. Detskij mul'tisistemnyj vospalitel'nyj sindrom, associirovannyj s novoj koronavirusnoj infekciej (COVID-19): aktual'naya informaciya i klinicheskoe nablyudenie [Children's multisystem inflammatory syndrome associated with a new coronavirus infection (COVID-19): current information and clinical observation]. Pediatricheskaya farmakologiya [Pediatric pharmacology]. 2020; 17(3): 219-229 (In Russ.).]

3. Kostik M.M., Bregel L.V., Avrusin I.S. [et al]. Vovlechenie serdca v mul'tisistemnyj vospalitel'nyj sindrom, associirovannyj s COVID-19 u detej: retrospektivnye dannye mnogocentrovoj kogorty [Heart involvement in multisystem inflammatory syndrome associated with COVID-19 in children: retrospective data from a multicenter cohort]. Front. Pediatr. – 2022. – 10:829420 (In Russ.).]

4. Kubanov A.A., Deryabin D.G. Novyj vzglyad na patogenez COVID-19: zabolevanie yavlyaetsya generalizovannym virusnym vaskulitom, a voznikayushchee pri etom porazhenie legochnoj tkani – variantom angiogennogo oteka legkogo [A new look at the pathogenesis of COVID-19: the disease is a generalized viral vasculitis, and the resulting damage to the lung tissue is a variant of angiogenic pulmonary edema]. Vestnik RAMN [Bulletin of the Russian Academy of Medical Sciences. 2020; 75(2): 115-117 (In Russ.).]

5. Bavishi C, Bonow RO, Trivedi V [et. al.]. Special article-acute myocardial injury in patients hospitalized with COVID-19 infection: a review. Prog. Cardiovasc. Dis. 2020; 63: 682. - 9.

6 Figueiredo Neto JA, Marcondes-Braga FG, Moura LZ. Coronavirus disease 2019 and the myocardium. Arg. Braz. cardiol. 2020; 114: 1057: 7.

7. Huang C, Wang Y, Li X [et al.]. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020; 395: 497-506.

8. Pouletty M, Borocco C, Ouldali N. et al. Pediatric myltisystem inflammatory syndrome temporally associated with SARS-CoV-2 mimicking Kawasaki disease (Kawa-COVID-19): a multicentre cohort. Ann. Rheum. Dis. 2020; 79: 999-1006.

9. Riphagen S, Gones X, Gonzales-Martines C [et.al.]. Hyperinflammatory shock in children during COVID-19 pandemic. Lancet. 2020; 395 (10237): 1607-1608.

10. Valverde I, Singh Y, Sanchez-de-Toledo J [et al.]. Acute cardiovascular manifestations in 286 children with multisystem inflammatory syndrome associated with COVID-19 infection in Europe / I. Valverde, Y. Singh, J. Sanchez-de-Toledo et al. Circulation. 2021; 143: 21-32.

11. Whittaker E. Clinical characteristics of 58 children with a pediatric inflammatory multisystem syndrome temporally associated with SARS-CoV-2. JAMA. - 2020. - 324: 259-69.