

Functional Changes in the Human Body in the Model of Acute Respiratory Infection

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Abstract

The prevalence of sharp respiratory diseases is very wide. The disease affects all age groups of the population. It is known that every adult man per year is sick of a sharp respiratory disease from 2 to 4 times. This forms a greater danger of complications in the lungs-free and creates a large number of cases of disability, and therefore gives material damage. The effect on the organism of the causative agent of acute respiratory viral infection can vary significantly depending on the etiology, age of the patient, the state of his immune system, and the presence of concomitant diseases. Against the background of the height of the disease, symptoms of intoxication prevail: chills, a sharp headache with overwhelming localization in the frontal region and temples, pain in the muscles and joints, pain when the eyeballs move or when pressure is applied to them, lacrimation, severe weakness, and fatigue. With acute respiratory disease, intoxication, hemorrhagic and respiratory syndromes are developing. The relative benignness and short-term flow of this disease leads to the fact that the majority of patients do not seek medical attention. For this reason, it is far from always possible to diagnose the species affiliation of the pathogen.

Keywords: viruses, respiratory tract, catarrhal phenomena, acute respiratory viral infection

Introduction

The incidence of influenza and acute respiratory viral infections is widespread, with the inclusion of all age groups in the epidemic process (Amelina & Medvedev, 2009). Each adult carries sharp respiratory diseases from 2 to 4 times a year, which is associated with the possibility of pathological and other vital organs (Boldov

et al., 2018), the onset of temporary disability and material damage (Karpov *et al.*, 2018).

A group of sharp respiratory infections is very significant among infectious pathology (Nesreen & Heba, 2019; Pham & Tran, 2019; Skoryatina & Medvedev, 2019; Alzaid, *et al.*, 2020; Georgievna, *et al.*, 2020; Karpov, *et al.*, 2020). The total economic damage from this nosological group increased in Russia from 376 billion rubles in 2014 to 499 billion rubles in 2016 (Makhov & Medvedev, 2018a). In different years, the absolute number of cases ranges from 26 million to 33 million people, among which 20% become temporarily disabled (Makhov & Medvedev, 2018b).

In 2016, more than 34 million cases of infectious diseases were registered in Russia, which is 5.8% higher than the 2015 indicator (Makhov & Medvedev, 2018c; 2018d). During the period 2012-2016, the prevalence of acute respiratory diseases ranged from the population of Russia from 19,818.6 (2012) to 21,658.26 (2016) per 100 thousand population (+ 9.3%). In 2016, 21.6% of the Russian population took sharp respiratory diseases (Mal, *et al.*, 2018a; 2018b).

Objective

Consider functional changes in the human body with acute respiratory infection.

Materials and Methods

The material for this work was published by published articles in open access. The search for literary sources was conducted in the database of the scientific electronic library eLIBRARY.RU, in the science of scientific information Scopus and in the Scientific Information Base of Web of Science. The study applied the following methods for obtaining information: induction and deduction, analysis, synthesis and generalizations.

Results and Discussion

Symptoms of acute respiratory disease can vary depending on the etiology and individual characteristics of a person. During the height of the disease, symptoms of intoxication prevail: chills, a sharp headache with overwhelming localization in the frontal region and temples, muscle aches, sometimes in joints, pain when

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the eyeballs move or when pressure is applied to them, lacrimation, severe weakness and fatigue (Medvedev, 2018a). The main syndromes in acute respiratory disease is considered to be intoxication, hemorrhagic and respiratory (Medvedev, 2018b).

Intoxication syndrome includes the following symptoms: fever, chills, headache, pain in muscles, weakness (Medvedev, 2018c). Respiratory syndrome includes a cough, which may be accompanied by a burning sensation behind the sternum, hoarseness, and mild serous discharge from the nose (Oshurkova & Medvedev, 2018a). Hemorrhagic syndrome is diverse and is characterized by the appearance of hemorrhages on the mucous membranes at the sites of penetration of viruses and nosebleeds (Oshurkova & Medvedev, 2018b).

The development of hemorrhagic syndrome creates the need for a differential diagnosis with various diseases, not only infectious, with the decision on the nature of the therapy (Stepanova *et al.*, 2018). In influenza, the development of diarrheal syndrome is possible, which is characterized by abdominal pain, nausea, vomiting, infrequent loose or diluted stools without pathological impurities, and is not accompanied by dehydration (Vatnikov *et al.*, 2019).

Laboratory confirmation of acute respiratory disease is carried out in a hospital in children to one year, in pregnant women, in patients with chronic diseases of the internal organs (Vorobyeva & Medvedev, 2019). For the diagnosis, a polymerase chain reaction, a method for isolating a viral culture, and a serological method are used (a diagnostically significant increase in titers of neutralizing antibodies by ≥ 4 times while simultaneously examining paired patient blood serum in standard serological tests - the first on the day of diagnosis, the second after 2-3 weeks), methods of immunofluorescence and enzyme immunoassay (detection of viral antigens in epithelial cells of the nasal passages and conjunctiva) (Arova *et al.*, 2018; Vorobyeva & Medvedev, 2018).

Influenza in a group of acute respiratory viral infections occupies a special place. This is due to the ability of this virus to very strong antigenic variability, which determines the high susceptibility of the population and annual seasonal epidemics of influenza. The influenza virus in the body is able to cause the pathology of almost all organs (Belan & Sadchikova, 2018; Medvedev, 2018d).

The high quality and short duration of the course of the disease contribute to self-medication with alternative and non-prescription drugs, so most patients do not seek medical help and continue to lead their previous lifestyle. The term of an uncomplicated acute respiratory disease reaches 1-1.5 weeks, but without proper treatment can lead to the development of severe complications (Galkin, 2010). Bacterial superinfection often accompanies acute respiratory viral infection, and therefore influenza viruses, respiratory syncytial virus, and some other viral agents determine the incidence of rhinosinusitis and pneumonia. Viral pathology of the lungs often contributes to the exacerbation of chronic pathology of the lungs, which can create the need for a patient's hospitalization (Zhukova, 2010).

Influenza is often characterized by a difficultly predictable course and rapidly developing life-threatening complications. Usually, influenza or influenza-bacterial pneumonia has a severe course, is accompanied by tissue destruction, and is often the cause of death. Bacterial pneumonia against the background of flu often has a favorable course. Often against the background of viral pathology arises acute or aggravation of chronic rhinosinusitis (Zaitsev *et al.*, 2018).

It is very dangerous that the flu can also lead to an exacerbation of any diseases of the cardiovascular system, pancreas, and central nervous system. Flu is especially dangerous for the elderly, newborns, and pregnant women. There is a link between the disease of the flu and hospitalization in connection with the acute myocardial infarction. His risk increases dramatically when infected with the influenza virus type B and type A and other viruses causing respiratory pathology (Komyak, 2015).

Other acute respiratory viral infections can also occur with complications, especially in the elderly, people with chronic diseases, and young children. Acute respiratory diseases of viral etiology lead in 40-50% of cases to pneumonia and in 80% of cases to the exacerbation of the flow of bronchial asthma and in 50-60% of cases to the exacerbation of chronically current bronchitis (Larina *et al.*, 2019).

Given the high incidence and the existing risk of complications of acute respiratory viral infection, in all cases it is necessary to conduct timely diagnostics.

The basic principle for diagnosing influenza and acute respiratory viral infection is to compare the clinical picture of the disease with laboratory diagnostic data. The international classification of diseases-10 provides the code J.11 - "Influenza, the virus is not identified", the diagnosis can be exhibited in the presence of a complex of clinical and epidemiological data. However, in this case, the timely appointment of etiotropic therapy is necessary.

The methods of clinical and laboratory diagnosis of respiratory infections recommended in Russia include the epidemiological (Misyuk *et al.*, 2019). A comparison is made with official epidemiological information on circulating strains of viruses, the emergence of new pathogens, and the timing of the onset of the epidemic. The clinical method is used - the collection of complaints and anamnesis, an objective examination of the patient. Molecular biological methods of diagnostics are used - polymerase chain reaction - diagnostics, based on detection of ribonucleic acid or deoxyribonucleic acid of viruses, immunofluorescence and enzyme immunoassay, radioimmunoassay, hemagglutination inhibition test, the reaction of the complement of the back smear from the nasal cavity or for rapid diagnosis of influenza directly during the examination of the patient, as well as rapid diagnosis of beta-hemolytic streptococci, as well as microbiological culture with the determination of the sensitivity of microflora to antimicrobial agents (Selkov, 2019; Glagoleva & Medvedev, 2020).

The severity of the clinical symptoms of the disease is determined by the degree activity of immune reactions during which effector cytolytic potential for virus-infected target cells using physiologically active microbicidal mediators actions - cationic proteins: enzyme (myeloperoxidase, lysozyme, elastase) and non-enzymatic (lactoferrin, ferritin, dipensins), carrying out a violation of the integrity of the cell membrane of the pathogen and blockade of key metabolic processes in it, thanks to the action neutrophil secreted arachidonic acid metabolism products the pericellular space, stimulating the formation of free radicals and nitric oxide, also necessary for inactivation of the pathogen.

Strengthening oxygen tissue consumption is a protective reaction, but also causes an increase in the level of free radicals, and first of all, the superoxide radical, which damages the tissue and the phagocytes themselves. In reactions involving free radicals, the processes of lipid peroxidation, proteolipids, proteins of cellular structures, and even nucleic acids are enhanced (Mal *et al.*, 2020). The process of disruption of the lipid layer of the cell membranes of the epithelium of the upper respiratory tract and lungs, its surfactant layer, the matrix and barrier properties of intracellular membranes are violated, their permeability increases and disorganization of cell activity develops. The activity of free radical generation is associated, mainly mutagenesis, proteolytic activity, and cytopathic effect viral infection (Bespalov *et al.*, 2018a; Makhov & Medvedev, 2020a).

The change in metabolism and cell function during infection is largely determined by the activation of proteolysis processes in all organs, but especially in lung tissue due to the release of large amounts of proteinases from neutrophilic granulocytes at the borders with air. Violations in the proteolytic control system and a significant increase in the formation of reactive oxygen species are interrelated processes (Bespalov *et al.*, 2018b; Makhov & Medvedev, 2020b).

Conclusion

The effect on the body of an acute respiratory disease varies greatly due to its etiology and individual characteristics of the patient. The main in respiratory diseases are symptoms of intoxication. The main syndromes in acute respiratory disease are considered intoxication, hemorrhagic and respiratory syndromes. The relative short-term course of the disease suggests that most patients do not seek medical help. For this reason, it is far from always possible to diagnose the species affiliation of the pathogen.

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References

- Alzaid, A., Alosaimi, M., Alkahtani, K. F., Alshehri, B. A., Asiri, A. E., Asiri, A. M., Althibait, S. A. S., Aldrees, W. S., Althwaiqub, A. K., Almakhayitah, O. A., et al. (2020). Saudi Parents' Knowledge, Attitudes, and Practices Regarding Antibiotic use for Upper Respiratory Tract Infections in Children. *International Journal of Pharmaceutical Research & Allied Sciences*, 9(1), 115-20.
- Amelina, I. V., & Medvedev, I. N. (2009). Transcriptional activity of chromosome nucleolar organizing regions in population of Kursk region. *Bulletin of Experimental Biology and Medicine*, 147(6), 730-732.
- Arova, A. A., Kramar, L. V., Nevinsky, A. B., & Larina, T. Yu. (2018). Diagnosis, etiotropic and pathogenetic treatment of acute respiratory viral infections in children. *Medicinal Bulletin*, 12(4 (72)), 48-56.
- Belan, E. B., & Sadchikova, T. L. (2018). Acute respiratory viral infections: a current look at the problem and a modern approach to treatment. *Russian Medical Journal. Medical Review*, 2(11), 60-64.
- Bespalov, D. V., Medvedev, I. N., Mal, G. S., & Makurina, O. N. (2018b). Functional activity of the vascular endothelium in patients with initial signs of atherosclerosis against the background of regularly dose-related exercise stress. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(2), 1020-1024.
- Bespalov, D. V., Medvedev, I. N., Mal, G. S., & Polyakova, O. V. (2018a). Physiological Capabilities of the Vascular Endothelium with the Developing Arterial Hypertension in People of Different Ages who Had Long Had Low Physical Activity. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(2), 972-976.
- Boldov, A., Karpov, V., & Gusev, A. (2018). Study on the level of physical development and physical fitness in students of university of psychology and education. 34th International Scientific Conference on Economic and Social Development / 18th International Social Congress (ISC). Moscow, RUSSIA. International Scientific Conference on Economic and Social Development, 354-366.
- Galkin, V. A., Galkin, V. A., & Galkin, V. A. (2010). Influenza and acute respiratory viral infections. A role of a polyclinic therapist in timely diagnosis and treatment. *Therapeutic Archive*, (1), 5-7.
- Georgievna, P. O., Andreevna, K. M., Tokhiriyon, B., Aleksandrovna, D. L., & Mikhaylovich, P. V. (2020). The Effectiveness and Functional Properties of the Plant-Based Dietary Supplement in Complex Respiratory System Diseases Therapy. *International Journal of Pharmaceutical Research & Allied Sciences*, 9(3), 66-70.
- Glagoleva, T. I., & Medvedev, I. N. (2020). Physiological features of aggregation of the main formed elements of blood in calves at the beginning of early ontogenesis 00161.

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doi:10.1051/bioconf/20201700161
- Karpov, V. Yu., Medvedev, I. N., Dorontsev, A. V., Svetlichkina, A. A., & Boldov, A. S. (2020). The State of Cardiac Activity in Greco-Roman Wrestlers on the Background of Different Options for Weight Loss. *Bioscience Biotechnology Research Communications*, 13(4), 1842-1846.
- Karpov, V. Yu., Pilosyan, N. A., Stepanova, O. N., & Bakulina, E. D. (2018). Physical rehabilitation of preschoolers with cerebral paralysis by means of hippotherapy. International Conference on Research Paradigms Transformation in Social Sciences. Tomsk Polytechnic Univ, Tomsk, RUSSIA. *European Proceedings of Social and Behavioural Sciences*, 35, 529-535.
- Komyak, Ya. F. (2015). Acute respiratory viral infections in children. *The World of Medicine*, (1), 12-14.
- Larina, V. N., Zakharova, M. I., Benevskaya, V. F., Golovko, M. G., & Soloviev, S. S. (2019). Acute respiratory viral infections and influenza: etiology, diagnosis and treatment algorithm. *RMJ. Medical Review*, 9, 18-23.
- Makhov, A. S., & Medvedev, I. N. (2018a). Functional Mechanisms to Ensure the Reactivity of the Organism. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 924-929.
- Makhov, A. S., & Medvedev, I. N. (2018b). Physiological Basis of Maintaining the Body's Reactivity. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 825-830.
- Makhov, A. S., & Medvedev, I. N. (2018c). The Effect of Physical Activity on Neurophysiological Processes in Students. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 968-972.
- Makhov, A. S., & Medvedev, I. N. (2018d). The Physiological Reaction of the Body of Adolescents to the Classroom. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 947-951.
- Makhov, A. S., & Medvedev, I. N. (2020a). Physiological and morphological peculiarities of children with Down's syndrome: A brief review. *Bali Medical Journal*, 9(1), 51-54. doi:10.15562/bmj.v9i1.1099
- Makhov, A. S., & Medvedev, I. N. (2020b). Parent's motivations on sports participation of their children with Down's syndrome in Russia. *Bali Medical Journal*, 9(1), 47-50. doi:10.15562/bmj.v9i1.1111
- Mal, G. S., Kharitonov, E. L., Vorobyeva, N. V., Makhova, A. V., & Medvedev, I. N. (2018a). Functional Aspects of Body Resistance. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 60-65.
- Mal, G. S., Medvedev, I. N., & Makurina, O. N. (2020). The Prevalence of Extreme Severity of Autoaggression Among Residents of Russia. *Bioscience Biotechnology Research Communications*, 13(4), 2125-2129.
- Mal, G. S., Vorobyeva, N. V., Makhova, A. V., Medvedev, I. N., & Fayzullina, I. I. (2018b). Features of Physical Rehabilitation after Myocardial Infarction. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 280-285.
- Medvedev, I. N. (2018a). Functional Features of Intravascular Platelet Activity in Adolescents with High Normal Blood Pressure, Overweight or a Combination of Them Against the Background of Regular Physical Exertion. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 1258-1265.
- Medvedev, I. N. (2018b). Physiological Response of Intravascular Platelet Activity in Boys with High Normal Blood Pressure to Regular Physical Exercise. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 1244-1250.
- Medvedev, I. N. (2018c). The Physiological Properties of Platelets in People 18-35 Years Old, Trained in the Section of General Physical Training. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 1277-1283.
- Medvedev, I. N. (2018d). Dynamics of Functional Parameters of Platelet Hemostasis in Young People with Hemodynamic and Metabolic Disorders on the Background of Regular Physical Activity. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 9(6), 1217-1222.
- Misyuk, L. F., Yakubova, L.V., & Kashuy, A.V. (2019). Actual issues of prevention and treatment of acute respiratory viral infections and influenza on an outpatient basis. *Medical Business: Scientific and Practical Therapeutic Journal*, 3(67), 32-37.
- Nesreen, G. El-N., & Heba, A. A. (2019). Respiratory training efficacy on quality of life and functional capacity in patients with Leukemia. *Journal of Advanced Pharmacy Education and Research*, 9(2), 46-52.
- Oshurkova, Ju. L., & Medvedev, I. N. (2018a). Functional Features of Platelets in Newborn Calves Ayrshire Breed. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 313-318.
- Oshurkova, Ju. L., & Medvedev, I. N. (2018b). Physiological indicators of platelets in Ayrshire calves during the dairy feeding phase. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 171-176.
- Pham, T. T. K., & Tran, D. T. (2019). Respiratory Distress Associated with Dengue Hemorrhagic Fever on Paediatric Patients: Learning from a Provincial Hospital in Southern Vietnam. *Archives of Pharmacy Practice*, 10(3), 92-98.
- Selkov, S. A. (2019). Flu and acute respiratory viral infections. *Infection and Immunity*, 9(1), 216.
- Skoryatina, I. A., & Medvedev, I. N. (2019). Correction of aggregation level of basic regular blood elements in patients with hypertension and dyslipidemia receiving rosvastatin and non-medicinal treatment. *Bali Medical Journal*, 8(1), 194-200.
- Stepanova, O. N., Stepanova, D. P., Pirogova, A. A., & Karpov, V. Yu. (2018). Women's weight lifting as sport discriminated against on grounds of gender. International Conference on Research Paradigms Transformation in Social Sciences. Tomsk Polytechnic Univ, Tomsk, RUSSIA. *European Proceedings of Social and Behavioural Sciences*, 35, 1325-1332.
- Vatnikov, Yu., Rudenko, A., Rudenko, P., Kulikov, Ev., Karamyan, A., Lutsay, V., Medvedev, I., Byakhova, V., Krotova, E., & Molvhanova, M. (2019). Immune-

- inflammatory concept of the pathogenesis of chronic heart failure in dogs with dilated cardiomyopathy. *Veterinary World*, 12(9), 1491-1498.
- Vorobyeva, N. V., & Medvedev, I. N. (2018). Physiological features of platelet functioning in calves of Holstein breed during the newborn. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 129-135.
- Vorobyeva, N. V., & Medvedev, I. N. (2019). Functional activity of platelets in new-born calves of black-marked breed. *Bulgarian Journal of Agricultural Science*, 25(3), 570-574.
- Zaitsev, A. A., Akimkin, V. G., Tutelyan, A. V., & Maryin, G. G. (2018). Actual issues of epidemiology, pharmacotherapy, and prevention of acute respiratory viral infections. *Russian Medical Journal. Medical Review*, 2(11), 53-57.
- Zhukova, L. (2010). Differential diagnosis, treatment, and prevention of acute respiratory viral infections. *Doctor*, 10, 2-6.