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Effect of Phagocytic Activity on the Body's Immune System and Ways of its Correction

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Abstract

This article discusses the importance of the phagocytic activity of phagocytes (neutrophils, monocytes, and macrophages) in the body's immune defense, as well as their role in the pathogenesis of acute bronchitis. The main idea of the authors is that the effective functioning of phagocytes is critical for a rapid response to infection and the prevention of complications such as chronic infections and autoimmune diseases. The article begins by defining the functions of phagocytes, which include fighting pathogenic microorganisms, presenting antigens to activate adaptive immunity, and secreting cytokines that coordinate the immune response. Next, the specific roles of phagocytes in acute bronchitis are discussed, where their activity directly affects the course of the disease and its possible consequences.

It describes how phagocytes, particularly neutrophils, migrate to the site of infection and begin active phagocytosis, releasing pro-inflammatory cytokines that contribute to inflammation. However, insufficient phagocytic activity, caused by systemic factors (e.g., smoking, diabetes) or local factors (viral infections), can lead to the development of prolonged bronchitis and complications such as pneumonia. The article provides data on methods for studying immune status and phagocytic activity, confirming the importance of immunomodulators, such as sodium nucleinate, for improving phagocyte function, which may be particularly useful in chronic infections and during recovery from severe illnesses. Key ideas in the article also include the need for comprehensive treatment of acute bronchitis, which should include antiviral and immunoactive drugs. The authors emphasize that this approach can improve the condition of patients with a congestive form of the disease and help in overcoming diseases caused by viral agents. Thus, the article highlights the importance of understanding the role of phagocytic activity in the pathogenesis and treatment of acute bronchitis, as well as the need for a comprehensive approach to therapy aimed at restoring and stimulating the immune system.

Keywords: acute prolonged bronchitis, bronchial hyperreactivity, active, associated, persistent viral infection, decreased phagocytic activity and its correction.

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Relevance

Phagocytic activity plays a fundamental role in the body's immune defense. Phagocytes (neutrophils, monocytes, macrophages) perform several key functions:

1. First line of defense: phagocytes quickly respond to the invasion of pathogens, engulfing and destroying them before the activation of adaptive immunity.
2. Elimination of pathogens: The process of phagocytosis includes recognition, engulfment, and intracellular killing of microorganisms using lysosomal enzymes and reactive oxygen species.
3. Antigen presentation: macrophages and dendritic cells, after phagocytosis, present antigens to T-lymphocytes, initiating an adaptive immune response.
4. Cytokine secretion: activated phagocytes release pro-inflammatory cytokines (IL-1, IL-6, TNF-α) coordinating further immune response.
5. Tissue cleaning: phagocytes remove cellular debris, apoptotic cells, and immune complexes, contributing to the resolution of inflammation.

Impairment of phagocytic activity can lead to chronic infections, autoimmune diseases, and impaired tissue homeostasis.

The role of phagocytosis in acute bronchitis.

In acute bronchitis, phagocytosis plays a critical role in protecting the airways. When a pathogen (virus or bacteria) enters the bronchial tree, a local immune response is activated, where phagocytes act as the front line of defense.[8]

In the first hours of inflammation, neutrophils migrate to the site of infection, attracted by chemokines and other inflammatory mediators. They begin to actively engulf and destroy pathogens, while releasing pro-inflammatory cytokines that enhance the local inflammatory reaction.

Then, macrophages become involved in the process, which not only continue to phagocytose pathogens, but also clear tissues of cellular debris and apoptotic neutrophils. This is critical for resolving inflammation and preventing chronicity of the process.[9]

In viral bronchitis, phagocytes also participate in the presentation of viral antigens to T-lymphocytes, initiating an adaptive immune response. In bacterial bronchitis, the effectiveness of phagocytosis directly affects the rate of pathogen elimination.[6]

Impairments in phagocytic activity (e.g., in neutropenia or defects in phagocyte function) can lead to a prolonged course of bronchitis and an increased risk of complications such as pneumonia.[3]

Indeed, factors that reduce the effectiveness of phagocytosis in bronchitis play an important role in the course of the disease.[7] These include:

1. Systemic factors:

✓ Smoking (toxins from tobacco smoke impair the motility and functional activity of phagocytes)

✓ Diabetes mellitus (hyperglycemia reduces chemotaxis and bactericidal activity)

✓ Malnutrition (especially deficiency of protein, zinc, vitamin A, C, E).

✓ Chronic stress (cortisol suppresses phagocyte function).

2. Local factors:

✓ Viral infections (many viruses have mechanisms to evade phagocytosis).

- ✓ Some bacteria produce antiphagocytic capsules or toxins.
- ✓ Air pollution (industrial pollutants, ozone).

Objective of the study. To study the state of phagocytic activity of phagocytes in acute bronchitis with prolonged and recurrent course, factors affecting their activity, and to develop ways to correct it.

Materials and methods.

39 patients with prolonged acute bronchitis (PAB) were examined, including 23 patients with bronchial hyperreactivity (BHR). All patients were examined according to a unified plan adopted at the clinic of therapeutic pulmonology, which ensured the diagnosis of nosological forms and clinical syndromes of the disease, as well as the determination of the functional state of patients in accordance with modern concepts of bronchopulmonary pathology.

Antiviral antibodies were detected using ELISA, conventional serological reactions (HI, CF, PHA), as well as neutralization reactions (NT). Specific antibodies of classes M and G were detected using ELISA.

The functional activity of T-lymphocytes was determined in the blast transformation reaction with phytohemagglutinin (PHA) and concanavalin A. Subpopulation analysis of T-lymphocytes was performed using monoclonal antibodies. Monoclonal antibodies from Orto Diagnostic were used.

The activity of natural killers (NCA) was investigated using a radioisotope method. The ability of lymphocytes to produce interferon was determined in the interferon reaction of lymphocytes (IRL).

The assessment of the absorptive capacity of neutrophils and monocytes was carried out according to the degree of capture of latex particles by them.

The macrophage adhesion inhibition reaction was performed in accordance with the method of Rowell A. at al., 1978. All data obtained were processed using parametric and non-parametric research methods on a SM-4 computer.

Research results. According to our data, virological examination during the period of prolonged course of AB revealed active viral infection with a frequency of 93%. With a frequency of 79%, it was detected in the form of viral associations. In the subgroup of patients with PAB with bronchial hyperreactivity (BHR), the frequency of active viral infection was also high (88%), in 2/3 of patients (68%) it was an associated infection. Viruses of influenza type A, RS- and adenovirus were determined with a significantly higher frequency both in the subgroup of patients with PAB without BHR (62%; 46%; 77%, respectively), and in the subgroup of patients with BHR (68%; 64%; 64%, respectively). Persistent viral infection in the subgroup of patients with PAB without BHR and in the subgroup of patients with PAB with BHR was detected in almost half of the patients (45% and 55%, respectively).

The study of the nature of the T-cell immune response to the current inflammation in patients with acute bronchitis with a prolonged course revealed a decrease in the absolute values of the average values of the number of T-lymphocytes (E-RFC, Ea-RFC), as well as their subpopulations (Et.p.-RFC, Et.ch.-RFC) and phagocytic activity of neutrophils and monocytes (PC neutr., PI neutr., PC monoc., PI monoc.).

Significantly minimal figures were determined during the inflammatory process. There was a tendency to increase these parameters of cellular immunity with minimal clinical signs of inflammation. However, even during the period of complete clinical well-being, the indicators of cellular immunity remained significantly lower than the normative values.

In patients with acute prolonged bronchitis with bronchial hyperreactivity, a more aggravated picture of T-cell immune deficiency was noted. In patients with acute prolonged bronchitis, against the background of a quantitative deficiency of the cellular immune system, the average level of Ig G in the blood serum was significantly reduced, the concentration of IgM was increased with normal values of

IgA. The level of circulating immune complexes (CIC) changed significantly during PAB, reaching the highest values in the remission phase of the disease.

The results obtained indicate a significant role of immunological disorders in the mechanisms of formation of prolonged and recurrent course of acute bronchitis.

Significantly high values of prolongation of influenza type A in PAB, as well as chronic RS-viral infection in PAB with BHR suggest that these patients are completely different in relation to bronchial hyperreactivity. It can also be assumed that chronic viral infection (in most cases RS-viral) is one of the reasons for the long-term increased level of IgM.

The presence of a high degree of associated viral infection, as well as a high frequency of influenza A viruses, RSV, and adenovirus, may contribute to the suppression of immunological reactivity in these patients - both cellular and humoral. The state of immunological reactivity of these patients and the comparison of its indicators with those in the usual variant of acute bronchitis leads us to the idea of immune disorders in patients with prolonged bronchitis at all its stages (a state of sluggish inflammation) and during the period of convalescence, which corresponds to the clinical picture of the disease, determining its features.

To support phagocytic function, the following can be recommended:

- ✓ Adequate hydration (facilitates mucociliary clearance)
- ✓ Balanced diet with sufficient protein and micronutrients.
- ✓ Smoking cessation.
- ✓ Control of concomitant diseases (diabetes, COPD)
- ✓ Moderate physical activity (stimulates the immune system).

Mucociliary clearance is the most important protective mechanism of the respiratory tract, closely related to phagocytic activity.[7] The following factors are effective for its improvement:

1. Adequate hydration – consuming enough fluids (1.5-2 liters per day) thins sputum and facilitates its evacuation.
2. Humidification of inhaled air – using humidifiers, steam inhalations.
3. Mucolytic drugs:

- ✓ Acetylcysteine (breaks disulfide bonds in mucin molecules)
- ✓ Ambroxol (stimulates the production of surfactant and the activity of cilia)
- ✓ Carbocysteine (normalizes the ratio of acidic and neutral mucins).

4. Bronchodilators – expand the lumen of the bronchi, improving sputum discharge.
5. Respiratory gymnastics and postural drainage are special exercises and body positions that promote sputum discharge.
6. Smoking cessation and minimizing exposure to pollutants.
7. Sufficient intake of antioxidants (vitamins B, E, selenium) to protect the ciliated epithelium.

Effect of Sodium Nucleinate on neutrophil and monocyte phagocytosis.

Sodium nucleinate has a significant stimulating effect on the phagocytic activity of neutrophils and monocytes, which makes it a valuable immunomodulator.[1]

The mechanism of action includes:

1. Activation of the processes of differentiation of immunocompetent cells.

2. Increased chemotaxis of neutrophils and monocytes to the site of inflammation.
3. Increased ability of phagocytes to capture and digest pathogens.
4. Stimulation of cytokine production, especially interferons.

Clinical studies have shown that the use of sodium nucleinate increases the phagocytic index (percentage of phagocytic cells) by 30-40% and the phagocytic number (number of particles absorbed by one phagocyte) by 25-35%.

This is especially important in conditions with impaired phagocytic function, such as chronic infectious and inflammatory diseases, immunodeficiencies, and during the convalescence period after severe infections.

Interestingly, the effect of sodium nucleinate on phagocytosis is consistent with Mechnikov's phagocytic theory of immunity, emphasizing the fundamental role of this mechanism in protecting the body.

In the case of a protracted course of bronchitis, a decrease in the phagocytic activity of neutrophils and monocytes is often observed, which makes it difficult to eliminate pathogens from the respiratory tract. Sodium nucleinate helps to solve this problem by stimulating:

1. Activity of alveolar macrophages, which are the first line of defense in the lungs.
2. Migration of neutrophils to the site of inflammation in the bronchi.
3. The ability of phagocytes to capture and destroy bacterial agents.

Clinically, this manifests itself in a more rapid resolution of the inflammatory process, a decrease in sputum production and a reduction in the period of cough.

It is important to note that sodium nucleinate should be used as part of a comprehensive therapy, including etiotropic agents (antibiotics for bacterial infection), mucolytics and bronchodilators, if necessary.

Data from immunological studies indicate that already in the early stages of the formation of bronchopulmonary pathology in prolonged and recurrent bronchitis, signs of suppression of humoral and cellular immunity were noted.[2]

The above, combined with a high level of active viral infection, among which viral and viral-mycoplasmal associations are significant, undoubtedly indicates the great importance of viral infection in changing the immunological status of these patients.[4]

Having become convinced that the unstable condition of patients with acute bronchitis with obstruction is largely determined by the characteristics of viral infection and immunological reactivity, we tried to enrich the generally accepted, mainly symptomatic treatment of acute bronchitis with the prescription of a complex of specific and non-specific antiviral drugs.[5,6]

Patients with an established diagnosis of acute bronchitis with obstruction and detection of viral infection, who have pronounced signs of humoral and/or cellular immunodeficiency, in addition to symptomatic and antiviral treatment, were prescribed appropriate immunoactive drugs: with a decrease in phagocytic activity of neutrophils and monocytes - sodium nucleinate or methyluracil. Antibiotics were prescribed strictly according to indications.

The study of the immune status of patients with acute bronchitis with obstruction after generally accepted (mainly symptomatic) treatment, in turn, showed a tendency to increase T-total lymphocytes, a significant increase in T-active lymphocytes, not exceeding normal values; there was a significant decrease in phagocytic activity of neutrophils and monocytes of peripheral blood and the level of IgA. There was a significant increase in the level of IgM and CEC, exceeding their normal values. The level of IgG remained significantly reduced.

With a decrease in phagocytic activity of neutrophils and monocytes, we used sodium nucleinate (0.2 g in powders, 1 powder 4 times a day, daily, for 10-15 days) or methyluracil (1 tablet 3 times a day for 10 days). At the same time, a complex of immunological studies showed a significant increase in the phagocytic activity of neutrophils and monocytes (both phagocytic number and phagocytic index), significantly exceeding the level of these indicators in healthy individuals. The level of T-total and T-active lymphocytes also significantly increased. There was a tendency to decrease CEC and increase the level of IgA. IgM remained unchanged at a high level, and IgG was significantly reduced.

Conclusions. Thus, as the results of our study showed, the generally accepted, mainly symptomatic, treatment of patients with acute bronchitis with a protracted and recurrent course, especially in the case of complications of the latter with acute respiratory infections, is insufficient. This is due to the fact that in acute bronchitis with obstruction, viral associations of a persistent nature are of great importance in the inflammatory process. The latter causes a violation of immunological reactivity, especially a decrease in the activity of phagocytes. In such patients, the complex drug therapy should include antiviral and immunoactive drugs (sodium nucleinate or methyluracil) under the control of the main indicators of immunological reactivity.

Immunological parameters of patients with acute bronchitis with a protracted and recurrent course under the influence of complex treatment with the inclusion of sodium nucleinate

№	Indicators	Before treatment (M+m)	After treatment (M+m)
1	E-ROC, cells/µl	772.81 ± 274.07	1187.28 ± 106.42***
2	Ea-ROC, cells/µl	523.69 ± 81.51	789.72 ± 99.11***
3	Етр-ROC, cells/µl	494.75 ± 79.68	642.17 ±104.30*
4	Et.ch.-ROC, cells/µl	284.0 ± 93.69	323.0 ± 108.27**
5	IgA, g/l	1.99 ± 0.15	2.32 ± 0.19**
6	IgG, g/l	12.75 ± 0.79	13.55 ± 0.53*
7	IgM, g/l	2.09 ± 0.18	2.09 ±0.19
8	CEC, %	137.53 ± 18.37	125.89 ±12.23***
9	Phagocytic number of neutrophils, %	40.47 ± 3.99	87.47 ±2.64***
10	Phagocytic index of neutrophils, conventional units	3.42 ± 0.61	9.59 ±0.92***
11	Phagocytic number of monocytes, %	31.4 ± 3.74	58.17 ± 5.10***
12	Phagocytic index of monocytes, conventional units	2.52 ± 0.48	6.38 ± 1.28***
*	P<0.05		
**	P<0.01		
***	P<0.001		
Differences are significant by the end of treatment.			

REFERENCES

1. Dilorom K. I. EFFICIENCY OF ANTIVIRAL TREATMENT OF PATIENTS WITH ACUTE PROTRACTED AND RECURRENT BRONCHITIS //Eurasian Journal of Medical and Natural Sciences. – 2022. – T. 2. – No. 5. – S. 253-258.
2. Ishankulova D.K. On the persistence of treatment at various stages with active complex effects on the infectious, allergic and immunological links of the pathogenesis of patients with chronic bronchitis. Fundamental science in modern medicine, 2020: Abstracts in the Collection of materials of the International Scientific and Practical Online Conference; to the 90th anniversary of SamGosMI S.; S 202-203.

3. Ishankulova D.K. Results of using the brush biopsy method in determining the etiology of chronic bronchitis. Biology va tibbiyot muammolari. 2018, No. 4,1 (105); S. 58.
4. Ishankulova D.K. Effectiveness of the use of adaptogens in the formation of antiviral immunity. XI International Avicenna Readings scientific and practical conference ABU ALI IBN SINO (AVICENNA) AND COVID-2019. Bukhara-2021, November. S 22-23
5. Ishankulova D.K. Effectiveness of antiviral treatment of patients with acute protracted and recurrent bronchitis. “Yevrosiyo tibbiyot va tabiiy fanlar jurnali”. “Eurasian Journal of Medical and Natural Sciences” Innovative Akademy Research Support Center , P. 253-258 , Vol 2 Issue 5 ISSN 2181-287X (Publication Year: may 2022) https://doi.org/10.5281/zenodo.6590331
6. Ishankulova D. K. Intensiv terapiya bo’limi sharoitida gospital infeksiya bemorlar immun reaktivligining og’irlashtiruvchi omil sifatida. Journal of cardiorespiratory research. Journal of Cardiorespiratory Research. Innovative technologies in healthcare: new opportunities for internal medicine: Proceedings of the international scientific and practical conference (S., April 22, 2022) / ed. Rizaev Zh.A. pp.674-677. №SI-1.1 (2022) DOI http://dx.doi.org/10.26739/2181-0974-2022-SI-1.1
7. Ishankulova, D. K. The formation of mucociliary insufficiency in the bronches in respiratory viral infection. International Journal of Health Sciences, 6(S3), pp. 4846–4851. https://doi.org/10.53730/ijhs.v6nS3.6968, 2022.
8. D.K. Ishankulova. On the issue of the etiology of acute protracted bronchitis. EUROPEAN JOURNAL OF MODERN MEDICINE AND PRACTICE, 4(9), 306–309. Retrieved from https://inovatus.es/index.php/ejmmp/article/view/4027

   Brussels, Belgium
9. D.K. Ishankulova. THE EVOLUTION OF CHRONIC BRONCHITIS IN THE EARLY STAGES OF THE DISEASE'S DEVELOPMENT AND THE PROSPECTS OF PREVENTION. Journal of cardiorespiratory research. 2025, vol.6, issue 2.1, pp.11- 15 https://www.tadqiqot.uz/index.php/cardio/