

## Immunological NBT Test – Indicator of Phagocytic and Metabolic Activity of Neutrophilic Granulocytes in Complications of ENT Organs Diseases

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### ABSTRACT

Infectious diseases associated with diseases of ENT organs are quite common. Therefore, this problem requires detailed study. The main goal of the work is to characterize the immunological NBT test – the index of phagocytic and metabolic activity of neutrophilic granulocytes in cases of complications of ENT diseases. To achieve this goal and study the problem in detail, the authors used experimental methods. The experiment was conducted on 40 patients from 32 to 65 years. The authors found that during the eruptive phase of the disease, the percentage of NBT positive granulocytes and tetrazolium activity significantly increased and amounted to 30-40%, while the control group's data were the following – the activity of the NBT test was 4.9-6.8%. It was also found that the NBT test in patients with otitic meningitis was 26-62%, while in all patients with serous meningitis, the level of the NBT test was low – 6-11.

**Keywords:** Meningitis, immune complexes, bacterial infections, Cytochemical index, staphylococcal sinusitis.

### INTRODUCTION

The threshold of bacterial infections in various regions of the Russian Federation in recent years is characterized by a high percentage, up to 80% of the total number of patients. Especially often patients began to seek treatment already with a complicated course of bacterial infections, which is associated with frequent self-medication and irrational administration of antibiotics. Proceeding

from this, as a rule, there are such complications as prolonged sinusitis, otitis media, otogenous meningitis, orbital cellulitis.

An important indicator of the natural nonspecific immunoreactivity of the body is the functional state of neutrophilic granulocytes responsible for the process of phagocytosis and intracellular digestion of the infectious agent. Due to this, the study of the functional and metabolic



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activity of leukocytes through the reaction with nitroblue tetrazolium, having general regularities with phagocytosis and revealing its biochemical bases, became very important<sup>1,2</sup>.

It is known that the involvement of phagocytes depends on their ability to intracellular digestion of infectious agents. Leading intra-leukocyte microbicidal factors of phagocytes are peroxidase-dependent systems. A biochemical marker of the activity of peroxidase-dependent systems is the restoration of soluble NBT in an insoluble dark-blue formazone, which occurs in a 2-step process. Stimulation of neutrophilic leukocytes and a positive value of the NBT test occurs not only on contact with the bacterial agent, but also with endotoxins. There are also other reasons for the increase in the NBT test: immune complexes, bacillary soluble products or even blood contact with surfaces<sup>3,4</sup>.

Based on systemic cytochemical analyzes, the main clinical and laboratory aspects of the study of the NBT test for diseases of the ENT organs such as sinusitis, otitis media, otogenous meningitis, rhinogenous orbital cellulitis were established.

#### MATERIALS AND METHODS

A total of 40 patients from 32 to 65 years with a complicated course of acute pyogenic otitis media were examined in the Otorhinolaryngological Unit of the SBHI "RKB" of the Ministry of Health of the Kabardino-Balkaria Republic. There were 28 men and 16 women. They formed the main group. 40 healthy volunteers, comparable to the main group by sex and age, were examined as a control

group. The structure of complications is presented in Table 1.

The spontaneous NBT test was performed by the method of I.V. Nesterova (1980). After counting 100 neutrophils, the average cytochemical index (ACI) was derived from the formula:

$$ACI = (0a + 1b + 2c + 3d + 4e) / 100 \quad \dots(1)$$

where a, b, c, d, e – the number of cells, respectively, 0, 1, 2, 3, 4-th degree.

With the help of the presented materials and methods, the authors achieved the main goal. Which consists in the study of the immunological NBT test, which is an indicator of the phagocytic and metabolic activity of neutrophilic granulocytes in the complications of diseases of the ENT organs.

#### RESULTS AND DISCUSSION

Our studies to determine the value of the NBT test in bacterial (staphylococcal) infections, especially their rhinogenous complications (such as orbital cellulitis, meningitis) showed that during the eruptive phase of the disease the percentage of NBT positive granulocytes and tetrazolium activity significantly increased and amounted to 30- 40%, while the control group data were as follows – the activity of the NBT test is 4.9-6.8%.

With otitis media, erysipelalous inflammation of the external ear in the process of antibacterial therapy, with the decrement of clinical signs, there was a friendly decrease in the percentage of tetrazolium-positive cells and tetrazolium activity

**Table 1: Structure of complications of acute pyogenic otitis media**

Sex	Complications					Total
	Facial paresis	Acute mastoiditis	Rhinosinusogenous phlegmon	Otitic meningitis	Erysipelatous inflammation of the external ear	
Men	5	6	8	1	2	22
Women	3	4	4	3	4	18
Total	8	10	12	4	6	40

of granulocytes. Here we can assume the effect of antibacterial therapy on the ability of neutrophils to restore the NBT test<sup>5,6</sup>. In the early recovery stage, after the cessation of antibiotic therapy, the ability of neutrophil granulocytes to restore nitroblue tetrazolium increases again and the percentage of NBT positive neutrophils reaches 47-58%. That said, tetrazolium activity of neutrophils exceeds its level in comparison with healthy people in 5.6-7.5 times.

The cause of increased values of the NBT test in the early recovery stage with staphylococcal sinusitis, otitis media can be related to the circulation of immune complexes in the blood. In patients with staphylococcal sinusitis during the late recovery, the NBT test results significantly decreased and no longer showed any difference ( $p > 0.05$ ) with the level of activity of healthy individuals.

Comparison of clinical and laboratory indicators with the studied test for staphylococcal sinusitis, otitis media, it is established that the NBT test can be a specific test. However, there were low indices of the NBT test on the background of antibacterial therapy in 3 patients with severe course of otogenic meningitis.

The data on the study of the NBT test for otogenous (pyogenic) and viral (serous) meningitises are of considerable interest. A high level of NBT restoring neutrophils is distinct in pyogenic otogenic meningitis caused by gram-negative pathogens (*Pseudomonas aeruginosa*). At the same time, low numbers of the NBT test were obtained with pneumococcal meningitis, viral meningitis.

The NBT test in patients with otitic meningitis was 26-62%, while in all patients with serous meningitis, the level of the NBT test was low – 6-11%. When setting the NBT test with leukocytes of cerebrospinal fluid with pyogenic meningitis and viral meningitis, the level of the NBT test was high (17-44%). These data once again confirm the differential diagnostic significance of the study of the NBT test with meningitis of different nature.

More frequent positive results of the NBT test were obtained with infections of the middle ear

caused by gram-negative bacteria and blue pus bacillus, than with infections of the middle ear caused by gram-positive microorganisms and streptococci, which is especially noticeable in otogenic sepsis, rhinogenous orbital cellulitis, acute otitis media, and mastoiditis. This, apparently, is associated with toxemia in gram-negative bacteria.

## CONCLUSION

1. Determination of the NBT test allows to detect the presence of systemic bacterial infections in the body, identify associated diseases and complications of bacterial nature and differentiate them from fevers of another etiology.
2. An increase in the activity of the NBT test indicates activity of the functional (phagocytic) activity of neutrophilic granulocytes in bacterial infectious diseases.
3. The NBT test is not always an unambiguous indicator of the presence of bacterial infections, it indicates the activation of the leukocyte membrane, which occurs under the influence of various factors.
4. Regular changes in the ability of leukocytes to restore nitroblue tetrazolium in the dynamics of the infectious process of bacterial and viral etiology, simplicity and accessibility in carrying out, high sensitivity and reproducibility of the results allow us to recommend the NBT test for wide clinical use as one of the objective methods for studying the functional state of neutrophilic granulocytes.

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