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# PREDICTION OF THE COMPLICATED COURSE OF COMMUNITY-ACQUIRED PNEUMONIA IN ADULTS

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✓ ***Resume***

***Significant for the diagnosis of the complicated course of the disease are the data of X-ray examination of the lungs and laboratory parameters, which can be obtained already on the first day of the patient's hospitalization. According to our data, the most significant signs are the level of decrease in the prothrombin index, total protein, albumin, C-reactive protein and lymphocytes.***

***Key words: lymphocyte, pneumonia, C-reactive protein, prothrombin index, total protein, albumin,***

# ПРОГНОЗИРОВАНИЕ ОСЛОЖНЕННОГО ТЕЧЕНИЯ ВНЕБОЛЬНИЧНОЙ ПНЕВМОНИИ У ВЗРОСЛЫХ

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✓ ***Резюме***

***Существенными для диагностики осложненного течения заболевания являются данные рентгенографического исследования легких и лабораторные показатели, получение которых возможно уже в первые сутки госпитализации больного. По нашим данным наиболее значимыми признаками являются уровень снижения протромбинового индекса, общего белка, альбумина, С-реактивного протеина и лимфоцитов.***

***Ключевые слова: лимфоцит, пневмония, С-реактивный протеин, протромбиновый индекс, общий белок, альбумина,***

# КАТТАЛАРДА КАСАЛХОНАДАН ТАШҚАРИ ПНЕВМОНИЯНИНГ АСОРАТЛИ КЕЧИШИНИ БАШОРАТ ҚИЛИШ

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✓ ***Резюме***

***Касалликнинг мураккаб кечишини ташхислаш учун ўпканинг рентгенелогик текшируви ва лаборатория таҳлиллари маълумотлари муҳим аҳамиятга эга, уларни беморни касалхонага ётқизилган биринчи кунида олиш мумкин. Бизнинг таҳлилларимизга кўра, энг муҳим белгилар протромбин индекси, умумий протеин, албумин, С-реактив оқсил ва лимфоцитларнинг пасайиши даражасидир.***

***Калит сўзлар: лимфоцит, пневмония, С-реактив оқсил, протромбин индекси, умумий протеин, албумин.***

## Relevance

Community-acquired pneumonia is one of the most common diseases in humans, which is one of the main causes of death from infectious diseases. In Uzbekistan, more than 1.5 million people fall ill with community-acquired pneumonia annually [2]. Community-acquired pneumonia (CAP) retains its fourth place as a cause of temporary disability of the adult population [1,2]. An important problem today is the increase in the number of deaths among patients with severe CAP. The authors

have different data on the level of mortality: ranging from 2-3 to 25%, and in intensive care units (ICU) - up to 30-40% [3].

The problem of community-acquired pneumonia is one of the most relevant areas of modern infectious pathology and pulmonology [1]. Underestimation by practitioners of clinical diagnostic methods, incorrect interpretation of clinical data

and laboratory and instrumental examination often lead to diagnostic errors [2]. In recent years, methods of mathematical modeling and forecasting have been actively used to solve these problems [4,6]. Modeling of bronchopulmonary diseases allows for more effective prevention, differential diagnosis, and prediction of the occurrence of pulmonary complications [2,9].

The leading mechanism in the pathogenesis of the disease is microaspiration of bacteria that make up the normal microflora of the upper respiratory tract. Thus, pneumonia is the result of a violation of the defense mechanisms of the tracheobronchial tree and (or) a decrease in the resistance of the macroorganism [4]. Of the many microorganisms, only those that have a high virulent ability can cause an inflammatory process when they enter the lower respiratory tract. These pathogens, first, include pneumococcus (Streptococcus pneumoniae), which is detected in 30-50% of cases.

In second place are the pathogens of the so-called "atypical" pneumonia - Mycoplasma pneumoniae, Chlamydophila pneumoniae, Legionella pneumophila, the share of which ranges from 3 to 22%. Rare CAP pathogens include Haemophilus influenzae, Staphylococcus aureus, Klebsiella pneumoniae, and Moraxella catarrhalis (3-5%). Very rarely, CAP can cause 7 Pseudomonas aeruginosa if the patient has bronchiectasis or cystic fibrosis [11].

Recently, rapid tests have been used to detect dissolved antigens of microorganisms in biological fluids, in particular, in urine. They were first recommended by the American Thoracic Society in 2007 as a screening tool to determine the possible etiology of CAP and prescribe appropriate etiotropic therapy [5]. The activity of T- and B-lymphocytes, antibodies and cytokine functions determine the severity of the inflammatory process in the lungs, including including its outcome [11]. Cytokines can play both a protective role and contribute to the destruction of lung tissue, lead to increased inflammation and disruption of the body's defenses [1]. Taking into account the above points is important for predicting the etiology of pneumonia of community-acquired origin, planning the tactics of microbiological examination and supplementing patient management schemes. Insufficiently studied and interpreted ambiguous changes in the immune system with a violation of intercellular interaction factors in the presence of an inflammatory process in the lungs. The issues of the significance of the status and ratio of pro-inflammatory and protective cytokines for diagnosing the severity of pulmonary inflammation, their influence on the course and outcome of the disease remain unclear. Therefore, the study of humoral and cellular immunity factors is important for understanding their influence on the course of the pathological process in community-acquired pneumonia and the patient's individual prognosis.

Diagnosis of microorganisms, treatment and prevention of diseases caused by them are topical, socially important and complex problems. In our country, it is necessary to significantly improve the quality of microbiological diagnostics and ensure the transition of laboratories to work according to modern standards. After analyzing the materials of domestic and foreign literature, we can conclude that it is necessary to further study the pathogenetic aspects of CAP, the significance of humoral and cellular immunity factors in the presence of inflammation in the lung tissue. The ongoing research is aimed at studying the composition of pathogenic microorganisms in order to obtain up-to-date data on the causative agents of CAP.

Thus, it seems relevant to conduct a comprehensive analysis of morphological, clinical, microbiological and immunological parameters in patients with community-acquired pneumonia.

**The purpose** of this work was to develop a mathematical model for early diagnosis (the first day of hospitalization) of possible complications in patients with pneumonia for timely correction of treatment and reduction of the length of stay of patients in hospital; comparison of the optimality of the practical application of two- and three-stage division of the severity of community-acquired pneumonia using the cluster analysis method.

## Material and methods

We observed 137 patients aged 22-65 years who were hospitalized for out-of-hospital pneumonia in 2014-2020. Verification of the diagnosis was carried out on the basis of a complex of clinical, laboratory and instrumental indicators, radiological methods of initialization of pulmonary inflammation.

All examined patients according to the classification of the European Respiratory Society (ERS 1998, 2005); "Practical recommendations for the diagnosis, treatment and prevention of community-acquired pneumonia in adults" of the Ministry of Health of the UZR 2003; Order of the Ministry of Health of the UZr No. 300 "On approval of standards for diagnosis and treatment of patients with nonspecific lung diseases" were divided into two degrees of severity. When dividing patients according to the degree of respiratory insufficiency, we were guided by the indicators of the gas composition of the blood. Patients with mild pneumonia accounted for 45,7% (64), with severe pulmonary inflammation — 52,2% (73). In addition, among patients with severe pulmonary inflammation, we identified a group of patients with a complicated course — 48 people (34%). In all patients, pneumonia was community-acquired, no concomitant diseases were detected. To objectively assess the severity of the inflammatory process, we used C-reactive protein. It was determined by a CORMAY kit and examined at the beginning of the disease (acute period). The level of C-reactive protein not exceeding 0.5 mg/l was considered normal [1,8,10].

Using statistical processing methods, we determined the average values of the results of laboratory and instrumental studies, found the desired functions and their errors. The differences were considered statistically significant when the achieved significance level was $p \leq 5\%$. To build mathematical models, we used the procedures of discriminant analysis of the software package "Statistica 6.0" (manufacturer StatSoft Inc., USA, 2011). The informative value of the symptoms contained in the observation matrix was evaluated according to Fischer's F-criterion [1,7].

To solve the tasks we have developed a database of medical data. The application software package used the divisional clustering method (K-means clustering), which allows the initial set of objects to be divided into communities with a certain unity of features. Informative syndromes, symptoms and laboratory indicators were used as signs, taking into account the correlation coefficient and the similarity coefficient [1,11].

## Result and discussion

As a result of our study, it was revealed that the early reliable indicators distinguishing the complicated and uncomplicated course of pulmonary inflammation were: crepitation (23%), changes in percussion pulmonary sound (95,9%), arterial hypotension (54%) and tachycardia (58%). At the same time, it is important to note that in complicated forms of the disease, in 54,1% (26) of cases, infiltration was radiologically noted mainly in three or more segments, and somewhat less often in two segments (33,3%). A retrospective assessment of laboratory parameters showed that in the early stages of the course of pulmonary inflammation there are statistically significant differences characteristic of the complicated and uncomplicated course of community-acquired pneumonia in young people. Thus, in complicated pneumonia, we noted a more than two-fold decrease in the level of lymphocytes, hemoglobin, total protein and prothrombin index. These changes were similar to those in severe pulmonary disease.

Predicting the course and assessing the severity of community-acquired pneumonia is possible only on the basis of a comprehensive examination of the patient using mathematical modeling [1,4, 8,9].

With the help of discriminant analysis of the clinical and laboratory data obtained by us, taking into account the Fisher criterion, eight most informative indicators were identified, which were included in the mathematical model.

The mathematical model developed by us included indicators with the condition of the possibility of diagnosis and their early response to changes in the course of the disease.

The model is a formula based on informative signs, constants and coefficients of the equations of the most significant symptoms.

The highest value of the total amount will indicate the predicted complication of pulmonary disease. The developed model

the prognosis of the complicated course of community-acquired pneumonia is statistically significant ($p<0,00001$) and has a fairly high prognostic ability (86,1%). In the group of patients with complicated pneumonia, it ensures that the predicted outcome coincides with the real result in 70,8% of cases (34 out of 48 treatment results coincide). In the group of patients "without complications" — in 94,3% (coincidence of results in 84 patients out of 89).

The use of system analysis methods has shown that the division of community-acquired pneumonia into three degrees of severity is appropriate, since it allows you to more accurately attribute the patient to a

particular degree of severity based on available clinical and laboratory indicators and instrumental data and prescribe adequate therapy.

**Conclusions**

1. Essential for the diagnosis of a complicated course of the disease are the data of X-ray examination of the lungs and laboratory parameters, which can be obtained already on the first day of hospitalization of the patient. According to our data, the most significant signs are the level of decrease in the prothrombin index, total protein, albumin, C-reactive protein and lymphocytes.

2. The use of system analysis methods has shown that the division of community-acquired pneumonia into three degrees of severity is appropriate, since it allows you to more accurately attribute the patient to a particular degree of severity based on available clinical and laboratory indicators and instrumental data, as well as to determine the tactics of his hospital management.

3. A comprehensive analysis of information about the patient, the clinical picture of the disease, with the mandatory use of the entire available arsenal of reliable clinical and laboratory data, is a rational approach to solving forecasting issues.

4. The obtained mathematical models make it possible to apply the totality of information obtained during a traditional examination, systematize clinical and laboratory data into a single algorithm and predict the development of a complicated course in patients with community-acquired pneumonia on the first day of hospitalization.

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