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Chronic obstructive pulmonary disease as a risk factor for dementia

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) remains a major public health problem. According to data released by the World Bank and the World Health Organization (WHO), it is expected that in 2020 it will be on the 5th place on the damage caused by diseases globally. Pulmonary pathology leads to disruption of cerebral blood flow. Insufficient oxygen supply to the brain at bronchial obstruction negatively affects the brain functions such as memory, attention, thinking. This study aims to identify the state of higher brain functions in patients with chronic obstructive pulmonary disease.

Methods: There were studied 40 patients aged 26 to 87 years (28 men and 12 women) with COPD II, III and IV. Pulse oximetry was used to determine blood oxygen saturation. The study was conducted using the Montreal Cognitive Assessment Scale.

Results: The study showed a significant reduction of memory, attention, thought in 14 patients (35% -<19 points), moderate decline of higher brain functions in 14 patients (35% -20 and 23 points), a slight decrease - in 8 patients (20% -<25 points), and the norm– in 4 patients (10%). At the same time found a direct correlation between cognitive impairment and peripheral oxygen saturation: <95% saturation correlated with cognitive impairment and <85% saturation correlated with dementia.

Conclusion: The present study indicates a significant impact of COPD on higher brain functions.

Keywords: Chronic obstructive pulmonary disease (COPD), Mild Cognitive Impairment, Dementia

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Introduction

Chronic obstructive pulmonary disease (COPD) is a disease of the respiratory system, which is characterized by a persistent blockage of airflow from the lungs. This is an under-diagnosed, life-threatening pulmonary pathology that interferes with normal breathing and is completely incurable. According to the World Health Organization (WHO) (January 2015) the most famous terms 'chronic bronchitis' and 'emphysema' are no longer used; they are now included within the COPD diagnosis [1].

COPD is a major public health problem. According to data released by the World Bank and the WHO, it is estimated that in 2020 it will be on the 5th place on the damage caused by disease globally [2].

COPD is the fourth most common cause of death in the world [3] and represents a serious threat to public health, leading to very significant economic and social burden, and its impact is increasing [4, 5]. In addition, although in recent years COPD attracted more and more attention from the medical community, this disease is relatively unknown or given little importance by the general public, as well as official representatives of health authorities and government agencies [2]. This lack of awarness is reflected by the fact that timely diagnosis occurs only in 25% of cases [6].

At the same time, the number of patients with COPD is increasing every year due to unfavorable environmental conditions, including the high prevalence of smoking. A particularly high figure in developing countries. Currently in North America, 10% of persons over 55 years has been diagnosed with COPD. In the European Union, COPD has been established as an independent factor leading to early disability of patients and reducing natural life expectancy by an average of 8 years. The death rate among patient with COPD ranges from 2.3 to 41.4 per 100,000 [6-9].

COPD is now considered as a systemic disease in which multiple complications occur and with primary changes in body structures with the highest level of metabolic processes, such as the central nervous system. The main mechanism of cognitive impairment in patients with COPD is damaged neuronal structures. Cognitive function is the most complex function of the brain and includes: the perception of information, processing and analysis of information, memorization and storage of information, the exchange of information, construction and implementation of the program of action.

Pulmonary pathology leads to disruption of cerebral blood flow [10, 11]. The expression of vascular disorders increases as the disease progresses. In the development of cognitive deficits in patients with COPD circulatory disturbances in cerebral basin have an important role [12]. On the other hand, when there is bronchial obstruction we can see the chronic hypoxia of the brain, which also has a negative impact on higher mental functions such as memory, attention, thinking. The main damaging factors include hypoxia, hypercapnia, acidosis and hypoxia associated with hyperventilation [13,14].

Abnormal cognitive function was discovered in patients with COPD, even in mild stage I-II disease processes [15]. The studying of cognitive impairment and oxygen saturation of hemoglobin in patients with hypertension combined with COPD raises interest since it shows the dominant role of hypoxia as a major development mechanism of systemic arterial hypertension in patients with COPD [16].

The risk of not amnestic cognitive functions grows by 83% against the background of COPD, while there is an opinion, that the violation of gas exchange and oxygen deficiency in the body at that process affects to the brain's condition. Many patients with COPD suffer from sleep disorders, which also affects the cognitive functions [17].

There were found structural changes in the white matter of the brain using magnetic resonance imaging in patients with COPD [18].

The stage II of the disease is characterized by: moderately for COPD; the ratio of forced expiratory volume (FEV) / forced vital capacity (FVC) <70%. This is the stage at which patients seek medical attention because of dyspnea or worsening of the disease. There is an increase in obstructive disorders (50% <FEV1 <70% of predicted values), as well as growing disease and shortness of breath symptoms appearing during physical exertion. The stage III of the disease is characterized by: severe COPD; FEV / FVC <70%. There is a further increase in airflow limitation (30% <FEV, <50% of predicted value), increase of breathlessness, and frequent exacerbations. The stage IV of the disease is characterized by: very severe COPD; FEV / FVC <70%. At this stage, quality of life deteriorates markedly, and exacerbation can be life-threatening. There is extremely severe airflow obstruction (FEV <30% of predicted values or FEV <50% of predicted values in the presence of respiratory failure). At this stage the possible development of pulmonary heart disease.

In recent years, research highlights the importance of the quality of life parameter caused by many components, including the severity of cognitive disorders. COPD is a systemic disease with a variety of extrapulmonary manifestations, among which, according to recent studies, an important role belongs to cognitive impairment. Cognitive dysfunction is found in 77% of patients with hypoxemic COPD and is associated with high mortality and disability [19]. These disorders are linked with one of the worse prognosis in patients with COPD. The problem of cognitive impairment and dementia is not only medical but also social, since it further affects the quality of life of patients and results in large economic losses. However, despite the importance of this issue, the understanding of the processes associated with cognitive deficits in COPD and causing it remains incomplete [20]. Despite the fact that the problem of cognitive impairment in patients with COPD has a long history, to date there is no single clear understanding of its

many aspects, and not all authors acknowledge the existence of cognitive disorders in patients with COPD [21].

This study aims to assess the state of cognitive functions in patients with COPD.

Methods

The study involved 40 patients aged 26 to 87 years (28 men and 12 women) with COPD II degree (4 people), III of degree (11 people) and IV (15). 67.5% were patients aged 50–70 years who had been diagnosed for 6–8 years; 15% were >70 years diagnosed for 10–11 years; 12.5% were 30–50 diagnosed for 4–5 years; others, up to 30 years, were diagnosed for about 2 years. Patients were asked to perform several tasks: to connect letters and numbers in alphabetical order, to redraw the cube, to draw a clock indicating the time, to name the animals, to repeat the words, numbers forward and backwards, to give a sign when heard of certain letter from researcher's pronunciation of series of letters, the Kripelin's test (to take away 7 from 100 to obtain a minimum number), to repeat the complex sentences, to name as many words beginning with a specific letter in 1 minute, to find similarities between the words, to revise for memory the words spoken at the beginning of the test, to name the date, day of the week, the location of the patient, including the city. The study was conducted using the Montreal Cognitive Assessment Scale (MoCA), which includes all of the above tasks, which was designed as a rapid means of assessment in mild cognitive dysfunction. It assesses different cognitive: attention and concentration, executive functions, memory, language, visual-constructive skills, abstract thinking, and through orientation. Time for MoCA is approximately 10 minutes. The maximum number of points -30; 26 points or more is considered normal.

This test measured the blood oxygen saturation by pulse oximetry. Pulse oximetry characterizes the provision of peripheral tissue oxygenation. Indicative information on the degree of hypoxemia was obtained by pulse oximetry using a portable pulse oximeter NIKSY MD 300C1, designed for non-invasive measurement of a sample of hemoglobin oxygen saturation of arterial function (SpO2).

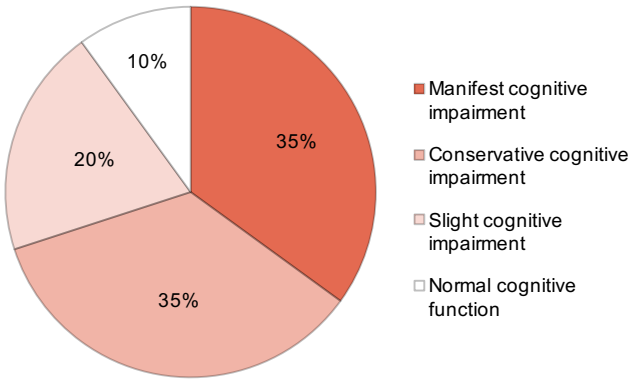

Figure 1. The frequency of cognitive impairment in patients with COPD.

Table 1. The relationship between saturation and MoCA test

(SpO2)%	70	84	85	86	88	92	93	94	95	96
Points of MoCA test	13	10	18	10	12	22	20	25	23	27

Results

The study showed a significant reduction of memory, attention, thought in 14 patients (35% of the 30 points scored between 10 and 19 points), moderate decline of higher brain functions in 14 patients (35% of the 30 points scored between 20 and 23 points), a slight decrease in 8 patients (20% of the 30 points scored 24-25 points), and the norm in 4 patients (10% of the 30 scored from 26 to 28 points). Percentage frequency of cognitive impairment shown in **Figure 1**.

There were particularly evident errors in the samples in the visual-constructive praxis, attention, memory, as well as a significant decrease in the speed of the job, counting operations. So, in the samples at the expense of speed serial assignments exceeds the norm by more than 2.5 times.

All patients underwent pulse oximetry, designed for non-invasive measurement of a sample of hemoglobin oxygen saturation of arterial function (SpO2). **Table 1** shows the relationship between the oxygen saturation in the blood and indicators of cognitive functions in points according to the test.

A relationship between cognitive impairments and peripheral oxygen saturation was observed: saturation <95% was detected in light and mild cognitive impairment, saturation <85% in manifest cognitive impairments, which supports the reasoning for the development of the syndrome of dementia in patients with COPD.

Discussion

Thus, this study indicates a significant impact of COPD on the human cognitive function. After analyzing the impact of hypoxia on cognitive disorders in patients with COPD, it can be hypothesized that the reduction in hemoglobin oxygen saturation to 85% may contribute to cognitive disorders until the dementia, with a predominance of memory impairment, attention, counting, orientation and perception. All of this dictates the need for continued study of cognitive function in patients with COPD as a possible risk factor for dementia.

In conclusion, these results emphasize the importance of COPD as a possible risk factor for the development of mild cognitive impairment and later dementia, which calls for further study of cognitive function in these patients.

Abbreviations

COPD: Chronic obstructive pulmonary disease; FEV: Forced expiratory volume; FVC: Functional vital capacity; MoCA: Montreal Cognitive Assessment Scale; WHO: World Health Organization References:

Competing interests

The authors declare no conflict of interest.

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