

Chronic obstructive pulmonary disease: an urgent problem of health saving of modern medicine

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Abstract

Chronic obstructive pulmonary disease is one of the most urgent problems of the modern medical community. Despite the introduction of constantly updated schemes of early diagnosis and treatment into practical medicine, there is still an upward trend in the number of cases, under-examined persons, and prognostically unfavorable outcomes. The review highlights the findings of epidemiological studies confirming the widespread prevalence of the disease, accompanied by rapid disability progression, high mortality, and significant economic damage. The review lists the main exogenous and endogenous risk factors for the development of chronic obstructive pulmonary disease, including occupational etiology. Attention is drawn to the possibility of disease prevention in a professional environment with the proper motivation of the patient and the application of economic efforts. The article discusses the main causes of underdiagnosis and late diagnosis of the disease. Lifestyle modification makes an undeniable contribution to the prevention of chronic obstructive pulmonary disease and improving prognosis in the developed disease. Certain psychological characteristics that reduce adherence to treatment of such patients should be considered in organizing the management of this category of persons and creating special schools. It is important to create a classification of “endotypes” of chronic obstructive pulmonary disease, as well as sufficient public awareness about this disease with the aim of the earliest possible diagnosis.

Keywords: chronic obstructive pulmonary disease, occupational chronic obstructive pulmonary disease, prevalence, risk factors, review.

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The prevalence of chronic bronchopulmonary diseases represents a serious problem for the global medical community. According to the Federal State Statistics Service and the Ministry of Health of Russia, the number of patients with newly registered respiratory diseases increased from 46,170 to 52,833 from 2000 to 2018 [1].

Chronic obstructive pulmonary disease (COPD) currently ranks first in the range of various pathologies of the respiratory system. In the Russian Federation, COPD ranks first (55%) in the structure of the prevalence of respiratory diseases, significantly ahead of bronchial asthma (19%) and pneumonia (14%) [2]. According to the Burden of Obstructive Lung Disease Study project and data from other large-scale epidemiological studies, 384

million COPD cases are registered worldwide [3]. However, this figure can reach 600 million according to several epidemiological studies [4], and the COPD incidence continues to grow worldwide despite the ongoing complex of preventive therapeutic and diagnostic measures.

An increase in life expectancy in developed economic countries will naturally lead to an increase in the duration of exposure to risk factors on the body and a further increase in COPD incidence [5]. Among all regions of the World Health Organization, the highest COPD prevalence is recorded in the Americas (14.53%), and the lowest prevalence is detected in the Southeast Asia and Western Pacific regions (8.80%) [6] and Europe (12%) [5, 7].

The results of local studies performed in the regions of the Russian Federation confirm the high incidence of this pathology. In the Samara region, the COPD prevalence among the population >30 years old was 14.5% (18.7% and 11.2% among men and women, respectively) [8]. In the Irkutsk region, men in the 18–49-year-old age group comprised 3.1% and 6.6% of the urban and rural population, respectively, and COPD was detected in 10.1% and 22.6% of men in the urban and rural population, respectively, in the 50–69-year-old age group. However, the disease was detected in almost every second man >70 years old living in rural areas [9]. In Nizhny Novgorod, COPD was diagnosed in 12.8% and 4.9% of men and women, respectively, examined [10].

Several studies simultaneously prove that these data do not present the real picture [11]. In 2017, 2.5 million COPD patients were registered in Russia, but, according to experts, the real number may be several times higher and reach 16 million people [12].

On the initiative of the Global Alliance against Chronic Respiratory Diseases project and with the support of leading regional scientific and research centers, 7,164 volunteers from 12 regions of the Russian Federation were interviewed in 2010. According to the data obtained, the COPD prevalence among people with respiratory symptoms and in the general population was 21.8% and 15.3%, respectively, which is more than nine times higher than the official statistical data [13].

Such discrepancies in the COPD prevalence may be due to the difficulty in diagnosing COPD and the lack of patient registration at an early stage, as well as insufficient awareness of the population about this disease [11]. Thus, conducting population longitudinal studies to investigate COPD prevalence and incidence in different population groups is advisable.

The COPD incidence in people of working age is a significant socioeconomic problem. In addition to the economic losses associated with the disability of the population with this pathology, the annual costs of the healthcare system for diagnostic and therapeutic measures for this category of patients are of great economic importance.

In 2010, the total national expenditure associated with COPD and its consequences amounted to \$36 billion in the USA [14]. COPD patients of working age account for 41% and 82% in Spain and the USA, respectively [15]. In addition, Russia is characterized by a high incidence of disability, reaching half of all the diseases in some regions [12]. The economic burden of COPD in Russia in 2016 amounted to 170.3 billion Russian rubles, which is 18.8% of all expenditures incurred due to

respiratory diseases [16]. The rapid progression of the disease and the impossibility of a complete cure lead to a rather early patient disability.

COPD ranks fourth in the range of mortality rate of the population [17, 18]. According to the World Health Organization, about 2.75 million people expire from COPD every year, which is 4.8% of all causes of lethal outcomes [17]. Mortality from COPD comprises 18.6 (USA) cases per 100,000 of the population, 2.3 (Greece, Sweden, Iceland, and Norway) to 80 (Romania) cases per 100,000 of the population in Europe [5], and 16.2 cases per 100,000 of the population in Russia [19]. The highest mortality rates were noted in China (131.5 cases per 100,000) and India (102.3 cases per 100,000 population) [20]. Despite the ongoing complex of preventive, therapeutic, and diagnostic measures, the mortality rate from COPD has increased three and 15 times in men and women >75 and >55 years old, respectively, in Russia over the previous 20 years [21].

Despite the relevance of the pathology, data on the prevalence and mortality from COPD in the Russian Federation are very scarce and poorly reflect the true situation. One of the reasons for this is the underestimation of the importance of this disease in the regions as an independent nosological unit and cause of lethal outcomes. The high mortality rate in COPD patients is because the disease is diagnosed during the late stages when treatment does not influence the steadily progressing pathological process. According to experts, COPD will rank third among all causes of mortality from non-infectious pathology by 2030 [18].

COPD is currently defined as a disease with persistent respiratory symptoms and airflow restriction due to bronchoalveolar impairment caused by damaging particles or gases [3]. Moreover, cigarette smoke is the most important among various air pollutants. The prevalence of the disease is facilitated by an increase in the consumption of tobacco products, water pipes, and electronic cigarettes, which are also recognized as risk factors for COPD [22–24]. The habit of smoking is often already formed in adolescence [25].

COPD has been established to develop only in 15%–20% of smokers even if tobacco smoking is one of the main risk factors for COPD development [26]. In addition, 25%–45% of COPD patients have never used tobacco products, and their disease onset may be associated with exposure to harmful occupational factors, environmental influences, as well as endogenous causes [27, 28].

COPD development is greatly contributed by long-term contact with industrial aerosols containing dust particles as components of a dispersed

system and irritative chemical and biological agents [29, 30]. In Russia, COPD was included in the list of occupational diseases only in 2012 (order of the Ministry of Health and Social Development of Russia dated 27 April 2012 No. 417n “On approval of the list of occupational diseases”). Underground workers, miners, shaftmen, grinders, polishers, gas–electric welders, workers of livestock farms and complexes, grain storage facilities and elevators, crop breeders, firefighters, as well as persons employed in the petrochemical, metallurgical, textile, and food industry are listed in the group of professions most threatened with COPD development [31].

With the advent of new activity types, the study of the influence of occupational factors on COPD risk under modern conditions is becoming one of the urgent problems in medicine [3, 32]. As a result of the analysis of 25 studies published in PubMed, the effect of nitrogen oxides, benz[*a*]pyrene, formaldehyde, carbon monoxide, hydroxybenzene and its derivatives, and solid suspended particles of various fractional compositions on the respiratory function in COPD patients has been proved [33]. However, no unified standardized approach to diagnosing COPD of occupational genesis has been currently noted [32].

Another main risk factor for COPD development is the climatic and geographical region of residence. Critical ambient temperatures trigger mechanisms leading to disruption of the regulation processes, ensuring the functioning of the respiratory system at an optimal level [34, 35].

Endogenous risk factors of COPD include genetic predisposition, bronchial hyperreactivity, bronchial asthma [36], and a history of severe respiratory infections [3]. One of the types of genetic pathology that predisposes to COPD development is congenital α_1 -antitrypsin deficiency [3]. It is a rather rare autosomal recessive hereditary disorder, occurring in <1% of the population [37]. However, the enzyme deficiency in people working in contact with irritant gases and toxic aerosols is an unfavorable prognostic sign of an earlier onset and rapid disease progression with the development of emphysema, fibrosis, and respiratory failure.

A decrease in lung function and a greater risk of developing COPD have also been shown in people with *null* genotypes of τ_1 -glutathione-S-transferases and μ -class glutathione-S-transferases [38]. Another study showed that a single nucleotide polymorphic substitution in MMP12 (rs2276109) is associated with a positive effect on lung function in children with asthma and smokers as well as also reduces the COPD risk in adult smokers [39].

COPD is often diagnosed late in people who are classified in the profession with risk factors for

the development of bronchopulmonary pathology. This is contributed by insufficient attention to own health and lack of awareness of the aspects of the clinical course of the disease and the first COPD symptoms [40].

The workers associated the symptoms (e.g., coughing and sputum discharge) with other causes, more often with smoking, considering it a *normal* phenomenon [41]. COPD patients seek medical help already in the late stages of the disease when the possibilities of therapy are significantly limited [2]. In addition, <6% of patients were informed at the hospital visit that they had an early COPD stage [4]. Another reason for the late COPD diagnostics is deliberate concealment of the symptoms that have appeared due to fear of losing their job [42]. Furthermore, doctors, especially during mass regular medical examinations, underestimate the data of physical and instrumental research methods [43].

Thus, high-quality preliminary and periodic medical examinations are of paramount importance in the system of COPD prevention of professional genesis.

On 1 April 2021, the order of the Ministry of Health of the Russian Federation of 28 January 2021 No. 29n “On approval of the procedure for conducting mandatory preliminary and periodic medical examinations of workers, stipulated in part four of Article 213 of the Labor Code of the Russian Federation, a list of medical contraindications for work with harmful and (or) hazardous factors of production, as well as work during which mandatory preliminary and periodic medical examinations are performed” came into force. According to which, medical examinations provide for a more in-depth collection of information about the health status of the subject, the introduction of the opportunity to interact regularly with a primary care medical facility that monitors the subject, and the transfer of the examination data to the Social Insurance Fund.

Questioning employees ≥ 18 years old during examination became mandatory to collect anamnesis and identify burdened heredity, complaints, and symptoms characteristic of several noncommunicable diseases and conditions, including COPD. An additional aim of medical examinations was introduced, i.e., the formation of risk groups for occupational diseases [44].

In the present stage, the accuracy and adequacy of assessing COPD prevalence in a population are determined both by the correct interpretation of the COPD concept and by the methods chosen for diagnostic testing.

Previously, the COPD abbreviation was deciphered as *chronic obstructive pulmonary disease*

[45] and included diseases of different pathogenesis and clinical manifestations, combined together due to the presence of partially reversible progressive airway obstruction. This definition included chronic obstructive bronchitis, pulmonary emphysema, severe forms of bronchial asthma, chronic obliterating bronchiolitis, bronchiectasis disease, cystic fibrosis, and byssinosis. This generalized approach significantly hindered the epidemiological studies, the development of diagnostic criteria, and the principles of therapy due to the differences in the pathogenesis of the nosologies included in the COPD concept.

A uniform approach to COPD diagnostics is currently required because conclusions based on different assessment criteria and the use of different diagnostic procedures lead to distortions of the true prevalence of this pathology, i.e., underdiagnosis. Spirometry remains one of the most common methods for confirming the diagnosis and assessing COPD severity in many medical institutions in Russia [46]. An important addition to the already existing diagnostic capabilities can be attributed to body plethysmography which enables to objectively assess the impairment of the ventilation capacity of the lungs [47, 48].

Early COPD diagnostics is of particular importance to prescribe adequate therapy to preserve the health of the population. The improvement of diagnostics is facilitated by a competent combined assessment of clinical, anamnestic, and epidemiological data in combination with the results of instrumental studies typical for this bronchopulmonary pathology.

The patients' high awareness of the possible COPD occurrence and its consequences is of great importance in maintaining the ability to work and their quality of life.

One of the main obstacles to successful treatment of COPD exacerbations, which is associated with the greatest economic damage [49], is the lack of trusting partnerships between the doctor and the patient, which results in the patient's underestimation of the importance of medical recommendations and, as a result, nonadherence to the medication regimen. In addition, COPD patients have certain psychological characteristics (i.e., low motivation, impaired ability to perceive and process information, and low psychosocial status), which must be considered when organizing the management of these patients [50].

Intensifying the explanatory work with patients by creating special schools for COPD patients is necessary to prevent COPD development, as well as to prevent the progressive course of the disease. Currently, in European countries, a program for

the rehabilitation of COPD patients is successfully used to monitor the patient's condition and prescribe adequate therapy [51]. Sedentary patients and those living in remote areas participate in similar programs using telemonitoring tools [52]. Rehabilitation with the use of telemedicine is actively implemented in the Russian Federation, ensuring control of therapy efficiency and contributing to mortality reduction from COPD [53].

To improve the quality of diagnostic and treatment and preventive measures, including programs aimed at raising awareness of COPD risk factors, early disease symptoms, as well as physical, laboratory, and instrumental criteria for making a diagnosis, which is especially important in occupational pathology to preserve the ability to work and improve professional longevity in workers, is important in the process of training physicians, especially in primary care. Moreover, realizing that COPD is a rather heterogeneous disease in which subjective complaints may not correspond to the degree of bronchial obstruction is important. Therefore, the creation of a classification of COPD *endotypes*, as well as sufficient awareness of the population about this disease, is of great importance to diagnose it as early as possible.

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