

Research Article

International Internal Medicine Journal

Age-Related Changes in the Respiratory System and Features of Inflammatory Diseases in Elderly People

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Submitted: 2026, Jun 22 **Accepted:** 2026, Jul 10; **Published:** 2026, Jul 16

Citation: Igorevna, B. E., Ordash, E. V., Romashko, A.Y. (2026). Age-Related Changes in the Respiratory System and Features of Inflammatory Diseases in Elderly People. *Int Internal Med J*, 4(2), 01-07.

Abstract

The respiratory system in elderly and senile individuals undergoes significant morphological and functional changes affecting the chest, airways, lung parenchyma, and pulmonary circulation. These include degenerative-dystrophic changes in the osteo-muscular framework of the chest, reduced chest mobility, bronchial wall atrophy, impaired drainage function, decreased lung elasticity, and alterations in the vascular bed. Such changes lead to a decrease in vital capacity, increased residual volume, impaired bronchial patency, and reduced efficiency of pulmonary ventilation, predisposing to the development of inflammatory diseases [1-3]. Acute and chronic bronchitis, as well as pneumonia in the elderly, are characterized by atypical clinical presentations, frequent complications, and a high risk of transition to a chronic course [4-6]. This article analyzes age-related changes in the respiratory system and the peculiarities of the course, diagnosis, and treatment of the main inflammatory respiratory diseases in elderly and senile patients.

Keywords: Aging, Respiratory System, Elderly, Acute Bronchitis, Chronic Bronchitis, Pneumonia, Obstructive Emphysema, Lung Function

1. Introduction

The aging process is accompanied by significant morphological and functional changes in the respiratory system, which affect the chest, airways, lung parenchyma, and the vascular system of the pulmonary circulation [3]. These changes lead to a decrease in the functional reserves of the respiratory apparatus and create favorable conditions for the development of inflammatory diseases. In elderly and senile individuals, respiratory diseases, particularly bronchitis and pneumonia, are characterized by atypical clinical manifestations, a high frequency of complications, and a tendency toward a protracted and chronic course [4]. A clear understanding of age-related changes in the respiratory system is essential for the correct interpretation of the pathogenesis, clinical picture, diagnosis, and treatment of inflammatory pulmonary diseases in this age group.

1.1. Age-Related Changes in the Respiratory System

The organs of the respiratory system undergo significant morphological and functional changes during aging, which extend to the chest, airways, lung parenchyma, and the vascular system of the pulmonary circulation [7,8]. After the age of 60, degenerative-

dystrophic changes in the osteo-muscular skeleton of the chest are observed: osteochondrosis of the thoracic spine, decreased mobility of the costovertebral joints, calcification of the costal cartilages, waxy and vacuolar degeneration of the muscle fibers directly involved in the act of breathing (intercostal muscles and diaphragm). As a result of these changes, firstly, thoracic kyphosis develops, and the chest is deformed, acquiring a barrel-shaped form with equalization of the anteroposterior and transverse diameters; secondly, the mobility of the chest decreases. All this negatively affects pulmonary ventilation [9,10]. Noticeable changes occur in the airways. The walls of the bronchi are infiltrated with lymphoid and plasma elements; mucus and desquamated epithelium accumulate in their lumen. These processes lead to a decrease in the bronchial lumen. In the bronchial wall, the muscular layer and fibrous elements atrophy. Atrophic processes in the bronchi, combined with the proliferation of tissue around them, cause the formation of bead-like swellings, bulging of the bronchial walls, and uneven narrowing of their lumen [8,11].

Due to atrophy of the bronchial epithelium and glands, weakening of bronchial peristalsis, and decreased cough reflex, the drainage

function of the bronchi is impaired. As a result, even under normal conditions, bronchial contents in elderly and senile individuals are excreted in insufficient quantities, which predisposes them to the development of pathological processes [3,7]. The connective tissue of the lungs is also subject to age-related changes. These changes are mainly expressed by dehydration of collagen fibers and the formation of cross-links between collagen subunits, which causes a decrease in their extensibility. Fibrosis develops in the pulmonary arteries, manifested by an increase in the amount of collagen and a decrease in elastic tissue. Fibrosis of the intima in arterioles and venules is observed in all individuals after 60 years of age [2,12]. The capillary network is also subject to age-related changes. Lipoid granules are deposited in the endothelium of the capillaries, the lumen of the capillaries changes unevenly, and they become rigid and brittle. Permeability is impaired, and the number of functioning capillaries decreases. The described changes in the vascular system of the lungs, along with the age-related decrease in cardiac output, lead to a reduction in their blood filling with age.

Morphological changes in the respiratory apparatus during aging significantly affect the functional characteristics of external respiration. As a result of a decrease in tidal volume (TV) and especially inspiratory and expiratory reserve volumes, the vital capacity of the lungs (VC) naturally decreases. The age-related decrease in total lung capacity is expressed to a much lesser extent than the decrease in vital capacity [7,9,11]. This is explained by an increase in residual volume with aging. The increase in residual volume and its proportion in total lung capacity, associated with the loss of elasticity of lung tissue, adversely affects the functional capabilities of external respiration. Due to the increase in the amount of air that does not participate in ventilation, its effectiveness may be impaired, which is clearly evident under increased demands on the external respiration apparatus (physical exertion, rarefied atmosphere, etc.). In addition, an increase in residual volume, along with other factors, contributes to impaired gas exchange in the lungs. The indicator that most fully characterizes the mechanical function of the lungs is maximum lung ventilation. Its decrease in old age, reaching significant degrees, explains the ease of occurrence of shortness of breath in the elderly during intense activity [7,8]. Deterioration of bronchial patency is manifested by a decrease in the Tiffeneau index, maximum expiratory flow, and an increase in bronchial resistance. Particular attention should be paid to the violation of the patency of the peripheral airways, manifested by a decrease in the value of respiratory flows corresponding to the exhalation of the final part of VC, and an increase in the closing volume. Despite the indicated disturbances of the external respiration apparatus, gas exchange between the lungs and the environment in elderly and senile age at rest is maintained at a sufficient level, as evidenced by the practically normal value of the partial pressure of oxygen in the alveolar air. The absence of age-related differences in the partial pressure of oxygen is due, to a certain extent, to compensatory mechanisms developing in elderly and old people, for example, an increase in the respiratory rate.

However, the adaptive mechanisms of ventilation during aging are imperfect, as evidenced by an increase in the ventilatory equivalent, reflecting a decrease in the efficiency of pulmonary ventilation. One of the reasons for this is an increase in physiological dead space and a decrease in the proportion of alveolar ventilation in the minute volume of respiration. Another reason is a violation of the uniformity of the distribution of inhaled air due to uneven increases in resistance in the airways, varying degrees of loss of lung tissue elasticity, and the presence of areas of atelectasis in the lungs [1,7]. In elderly and old people, arterial blood oxygen saturation decreases, and arterial hypoxemia develops. When determining the causes of impaired blood oxygenation in the lungs, arterial hypoxemia, and an increase in the alveolo-arterial oxygen gradient in elderly and senile individuals, it is necessary to highlight: 1) uneven ventilation of the lungs; 2) discoordination of ventilation and blood flow in the lungs; 3) an increase in anatomical shunting; 4) a decrease in alveolo-capillary oxygen diffusion [1,7,13]. Thus, the system of external respiration undergoes pronounced morpho-functional changes during aging. These changes must be considered when considering the issues of pathogenesis and clinical picture of lung diseases in the elderly and old people [1,13].

1.2. Bronchitis

1.2.1. Acute Bronchitis

Acute bronchitis is a disease characterized by diffuse damage to the mucous membrane of the bronchial tree. In elderly and senile individuals, bronchitis usually has a viral etiology (adenoviruses, rhinoviruses) and almost always occurs as a result of an acute respiratory disease (ARD) or influenza. The influence of factors that weaken the body's resistance, primarily hypothermia, cannot be denied. Predisposing factors also include chronic foci of infection in the paranasal sinuses (sinusitis, maxillary sinusitis), tonsillitis, smoking, alcohol consumption, impaired breathing, kyphoscoliosis, and circulatory insufficiency with congestive phenomena in the lungs [3,14]. Clinical picture and diagnosis. In acute bronchitis, the patient experiences malaise, a burning sensation, tightness in the chest, and a feeling of tickling along the bronchi. Body temperature in most patients is normal or subfebrile. A dry cough appears, often of a painful nature. Subsequently, mucopurulent sputum joins. In old age, especially in weakened patients, the process can spread to the bronchioles (bronchiolitis). In this case, the general condition sharply worsens, intoxication, adynamia, tachycardia, and hypotension develop. Respiratory failure is sharply expressed. Symptoms of heart failure quickly join [14,15]. Physical examination of the lungs reveals dry whistling and buzzing rales, indicating bronchial damage and the presence of viscous secretion in their lumen. The percussion sound over the lungs is usually unchanged. In bronchiolitis, tympany and numerous moist fine bubbling rales are detected in some areas. The X-ray picture in patients with bronchitis shows no changes; in bronchiolitis, numerous foci are usually detected [14,15].

The type of virus that causes the disease often influences the clinical manifestations of the disease. In influenza etiology, against the background of the influenza clinic, soreness and pain

behind the sternum appear already on the 1st–2nd day due to the involvement of the trachea in the inflammatory process. General weakness, lethargy, herpetic eruptions on the lips, inflammation of the mucous membrane of the pharynx and oropharynx with serous plaque and pinpoint hemorrhages, shortness of breath, and blood streaks in the sputum are noted. Hard breathing with a mass of buzzing and often moist rales is heard. The developing bronchitis is characterized by necrotic changes in the mucous membrane of large and medium caliber bronchi; panbronchitis with pronounced peribronchitis often develops. Blood streaks in the sputum are characteristic. Leukopenia with a left shift, sometimes monocytosis, is noted. Expressed bronchitis is observed in 20–73% of patients with acute respiratory infection of adenoviral etiology. Morphologically, a pronounced exudative component with involvement of the mucous membrane of the respiratory tract and eyes, and a reaction of lymphoid tissue is characteristic. Conjunctivitis, more often unilateral, allows recognition of the nature of bronchitis. The general condition of patients is almost not disturbed, and intoxication is mild, although elevated body temperature is noted for up to 7–10 days. The mucous membranes are swollen and pale; pharyngitis, rhinitis with abundant serous discharge, and tonsillitis in the form of lacunar or follicular angina are observed. In parainfluenza, tracheobronchitis is expressed to a relatively mild degree. A distinctive symptom is the spread of the process to the mucous membrane of the larynx with the development of laryngitis and the appearance of hoarseness up to aphonia. Rhinitis is a constant companion of the disease. Dyspeptic disorders may appear 2–3 days after the onset of the disease. The onset of the disease is gradual, intoxication is weak, and body temperature is slightly elevated [14,15].

In acute respiratory disease caused by the respiratory syncytial virus, the lower parts of the respiratory tract are more often affected. The virus has a primary damaging effect on the epithelium of the bronchial mucous membrane and alveolar cells. The most common symptom is difficulty breathing, sometimes suffocation, occurring at the beginning of the disease and lasting 3–4 days. The disease occurs acutely, beginning with rhinitis with scanty discharge; body temperature is subfebrile or normal. In mycoplasma infection, all parts of the respiratory tract are affected, predominantly the small bronchi. Bronchitis is often complicated by pneumonia. Treatment. The severe condition of the patient is an indication for bed rest. Usually, to avoid blockage of small bronchioles and improve sputum discharge and breathing, it is recommended that the patient engage in active movement in bed. Massage, therapeutic breathing exercises, and an elevated or semi-sitting position of the patient in bed contribute to improved lung ventilation [15]. Considering the frequent complications in patients of older age groups (pneumonia, transition to chronic bronchitis), antibacterial drugs (antibiotics, sulfonamides) should be included in the complex of therapeutic measures for acute tracheobronchitis for prophylactic purposes. Sulfonamides of long-term action (biseptol, sulfadimethoxine), semisynthetic penicillins (ampicillin, erythromycin, oleandomycin phosphate) are usually used [14]. In mild cases of the disease, symptomatic therapy can be limited to. Antipyretic and analgesic agents are indicated (acetylsalicylic acid 0.25–0.5 g 3–4 times a

day; amidopyrine 0.25–0.5 g 3–4 times a day; analgin 0.25–0.5 g 2–3 times a day; phenacetin 0.25–0.5 g 2–3 times a day, often in combination with caffeine 0.05–0.1 g per dose). For dry, painful cough at the beginning of the disease, antitussive drugs are prescribed. The advantage of modern antitussive agents (glaucine 0.05 g 2–3 times a day, libexin 0.1 g 2–3 times a day) is the absence of narcotic effect and addiction, as well as antispasmodic action. To facilitate sputum discharge, expectorant agents (infusion of thermopsis herb, sodium iodide solution, infusion of marshmallow root, decoction of istod root several times a day), mucolytic agents (mucaltin, bromhexine, acetylcysteine, proteolytic enzymes), and warm inhalations with the addition of terpin hydrate drops, eucalyptus oil, and alkaline inhalations are prescribed. For acute bronchitis, external distracting agents are indicated: cupping, mustard plasters, pepper plaster, and alcohol compress on the chest [14,15].

1.2.2. Chronic Bronchitis

Chronic bronchitis is characterized by diffuse damage to the mucous membrane and deeper layers of the bronchial wall. It is the most common chronic respiratory disease in the elderly and senile individuals. The main cause of chronic bronchitis is prolonged exposure of the bronchial mucosa to harmful impurities in the inhaled air, primarily components of tobacco smoke. Occupational factors (dust and gas pollution at workplaces) are also significant, while general air basin pollution plays a lesser role. Pathology of the ENT organs and impaired conditioning function of nasal breathing play a major role in the development of chronic bronchitis [4,6]. Clinical picture and diagnosis. The clinical picture depends on the level of damage to the bronchial tree. It is currently accepted to divide chronic bronchitis into proximal (with predominant damage to large bronchi) and distal (with predominant involvement of small bronchi). Proximal bronchitis usually manifests as a cough with sputum, followed by the addition of shortness of breath as obstruction develops. Auscultation reveals harsh breathing and low-pitched dry rales. Isolated distal bronchitis is characterized by shortness of breath, to which cough is added later. High-pitched dry whistling rales, especially on expiration, attract attention.

It is fundamentally important to divide bronchitis into obstructive and non-obstructive types. The following signs of impaired bronchial patency can be identified: 1) the appearance of shortness of breath during physical exertion; 2) shortness of breath under irritating influences (going from a warm room to the cold, inhalation of tobacco smoke, chemical irritants); 3) hacking unproductive cough with the separation of a small amount of sputum after significant efforts; 4) prolongation of the expiratory phase; 5) dry whistling rales on expiration, especially during forced breathing; 6) the presence of obstructive pulmonary emphysema. The results of functional studies, a decrease in the one-second forced expiratory volume, the Tiffeneau index, and an increase in bronchial resistance reflect obstruction of the large airways. Impairment of the patency of the peripheral bronchi does not affect these indicators. It should be noted that instrumental research methods (spirometry, pneumotachography, etc.) allow not only to establish the presence of obstructive disorders but

also their severity. Based on pharmacological tests, it is possible to select the most adequate bronchodilator [4,6]. The mechanisms underlying impaired bronchial patency in chronic bronchitis include thickening of the mucous and submucous membranes due to hyperplasia of the epithelium and mucous glands, edema and inflammatory infiltration; fibrotic changes in the walls, accompanied not only by stenosis but in some cases by poor obliteration of the smallest bronchi and bronchioles; excess bronchial secretion; bronchospasm; and expiratory collapse of the airways [7,9]. A factor that largely determines the clinical picture of chronic bronchitis is respiratory failure. The main clinical criterion is shortness of breath. Three degrees of respiratory failure are distinguished. In degree I respiratory failure, shortness of breath occurs with physical loads exceeding everyday ones, cyanosis is not detected, fatigue occurs quickly, and accessory respiratory muscles do not participate in ventilation. In degree II, shortness of breath occurs with everyday loads, cyanosis is mild, fatigue is pronounced, and accessory muscles are involved in breathing during exertion. In degree III, shortness of breath is observed at rest, cyanosis and fatigue are sharply expressed, and accessory respiratory muscles constantly participate in breathing [4,15].

One of the frequent complications of respiratory diseases at this age is focal pneumonia, which in most cases does not have pronounced symptoms, temperature reaction, or blood changes. The only manifestation is a sharp deterioration in the general condition, increased shortness of breath, the appearance of tachycardia, adynamia, and often delirious states. The clearest radiological manifestations of chronic bronchitis are reticular pneumosclerosis and signs of pulmonary emphysema. Reticular pneumosclerosis is a honeycomb or reticular deformation of the pulmonary pattern. It is more often localized in the lower parts of the lungs. Reticular pneumosclerosis is caused by peribronchial sclerosis around small bronchi and sclerosis of interacinar, interlobular, and intersegmental septa. Large-cellular deformation of the pulmonary pattern associated with the development of bronchiectasis is also distinguished. Focal shadows are usually a reflection of joined focal pneumonia or atelectasis. Treatment. Therapeutic measures are primarily based on the nature and phase of the disease and the presence of complications. During an exacerbation of chronic bronchitis, treatment is primarily aimed at: 1) eliminating the inflammatory process in the bronchi; 2) improving bronchial patency; 3) combating hypoxia; 4) increasing the protective properties of the body; 5) eliminating factors that cause or maintain the disease. In this period, sulfonamide drugs are usually prescribed. Long-acting sulfonamides are used (biseptol, sulfadimethoxine, sulfapyridazine, sulfalene). In the absence of effect or in severe cases, purulent bronchitis, antibiotics are added, considering the sensitivity of the sputum and bronchial content microflora. For endobronchial inflammation, penicillin, streptomycin, oleandomycin, and kanamycin are prescribed in the form of aerosols in combination with injectable administration. Endobronchial administration of antibacterial drugs is particularly effective. The duration of antibacterial therapy is determined based on the presence of signs of activity of the inflammatory process in the lungs [4,15].

An important role in treatment is played by the fight against bronchial obstruction. Purine derivatives, cholinolytics, ephedrine, and β -adrenostimulators are most commonly used. Among purine derivatives, euphylline is the most common (5–10 ml of 2.4% solution intravenously or 1.0 ml of 24% solution intramuscularly 2 times a day); among cholinolytics — atropine (0.25–1.0 ml of 0.1% solution subcutaneously 1–2 times a day), platyphylline (1–2 ml of 0.2% solution subcutaneously 2 times a day); among sympathomimetics — ephedrine (0.4–1.0 ml of 5% solution subcutaneously 2 times a day or 0.025–0.05 g orally 2–3 times a day), isadrine (0.005–0.01 g 3–4 times a day sublingually), berotec (0.0002 g 2–3 times a day as an aerosol) [4,15]. To improve the drainage function of the bronchi, better clearance of secretions, and restoration of ventilation, agents that stimulate respiration (corazole, cordiamine) should be used. Desensitizing therapy is necessary: antihistamines (tavegil, diazolin, dimedrol, diprazine, suprastin, etc.), calcium preparations, acetylsalicylic acid. In case of pronounced bronchospastic syndrome, glucocorticoid drugs are prescribed. Important aspects in the treatment of patients with chronic bronchitis are oxygen therapy and general strengthening measures. Attention should be paid to therapeutic physical culture, especially a set of breathing exercises. Physiotherapeutic effects are prescribed as indicated. Sanitation of infection foci is indicated during remission. During anti-relapse treatment, which is recommended 2–3 times a year, general strengthening therapy, desensitizing drugs, therapeutic physical culture, and physiotherapeutic procedures are prescribed. Aerosols of garlic juice, onion, furacilin, iodinol, and aloe should be used. In the presence of signs of bronchospasm, bronchodilators are added to the inhalation. When sputum is discharged, inhalations of antibiotics and sulfonamide drugs (a two-week course) are added [4].

1.3, Pneumonias

Acute pneumonias in elderly people are usually of bacterial or bacterial-viral origin. The role of pneumococcus as an etiological factor in pneumonia has decreased, while the importance of other microorganisms has increased, primarily streptococci and staphylococci. Pneumonia caused by *Klebsiella pneumoniae* (Friedländer's bacillus) is observed almost exclusively in the elderly and the senile age. Currently, in the etiology of pneumonia in elderly people, along with bacterial flora, fungi, rickettsiae, and viruses are of certain importance [6,16]. Predisposing factors for the development of pneumonia in elderly and old people include a decrease in the body's protective mechanisms, age-related changes in the lungs (impaired cough reflex, activity of the ciliated epithelium, bronchial drainage function, atrophy of lymphoid tissue, decreased ventilation, loss of lung tissue elasticity, limited chest mobility, etc.) [5,17,18].

Pneumonia in elderly and old people often occurs during prolonged bed rest due to: cardiovascular insufficiency; impaired consciousness (as a result of cerebral circulation insufficiency, drug intoxication, etc.); ARD; surgical interventions on the abdominal or thoracic organs, as well as aspiration of mucus, vomit, food

particles and other foreign substances into the lungs, and the presence of chronic inflammatory processes in the lungs (chronic bronchitis is especially dangerous in this regard). The concept of primary and secondary pneumonia is generally accepted. Primary pneumonia is considered a disease that occurs in a person with healthy respiratory organs and in the absence of pathology of other organs and systems that led to pneumonia or contributed to its development. Secondary pneumonia occurs against the background of chronic respiratory diseases, as a complication of infectious diseases, including viral respiratory diseases, as a complication of cardiovascular system diseases, and in persons with chronic diseases of various organs and systems (kidneys, blood, metabolism, etc.) [6,16,18]. Clinical picture and diagnosis. The course of pneumonia in elderly and senile age is a vivid example of changes in the picture of any disease under the influence of age. In most cases, pneumonia does not have a pronounced onset. General symptoms predominate in the clinical picture: general weakness, apathy, lack of appetite, and consciousness is often impaired (the patient is distracted, disorganized, and deep prostration may develop). These disorders resemble delirium in young people but occur without a febrile state and can mislead an inexperienced doctor. Vomiting and diarrhea are often observed. Chills and chest pain, cough are often absent. The temperature reaction in most patients is weakly expressed.

Objective examination reveals cyanosis of the skin of the face and lips, rapid shallow breathing as a result of developing pulmonary insufficiency. Due to pulmonary emphysema and the presence of rapid shallow breathing in most patients, physical examination data are not very informative. It is especially difficult to detect a small focus of inflammatory infiltration. Shortening of percussion sound, changes in vocal fremitus, and bronchial breathing are often absent. Breathing is most often harsh. The most constant auscultatory symptom is dry, fine bubbling and crepitating rales, which are heard in a limited area over the affected area and, most importantly, have a sonorous character. These changes, along with the general condition of the patient, are the main ones for establishing the diagnosis. Due to decreased immunobiological reactivity, pronounced leukocytosis is not observed. An increased ESR is the most constant finding [5,16]. The cardiovascular system is often affected in the elderly and older people. Degenerative changes (myocardial dystrophy) and sometimes inflammatory changes develop in the heart muscle. Along with damage to the heart muscle, vascular tone in both the pulmonary and systemic circulation is impaired in elderly and older people. This leads to frequent development of acute vascular insufficiency during pneumonia. Given that elderly people usually have pronounced atherosclerosis of cerebral vessels, the high frequency of cerebral disorders during pneumonia, which usually intensify at night, becomes clear.

The age-related decrease in immunological reactivity and impaired lung ventilation contribute to the transition to a chronic process and protracted course of pneumonia. The reverse development of inflammatory infiltrates is delayed up to 4–5 weeks or more.

Radiological signs of infiltration may persist for up to 2 months. Complications of pneumonia in elderly and old people are more frequent compared to young people: kidney damage with proteinuria, cylindruria, microhematuria, and intestinal paresis [5,17,18]. Due to the atypical course, X-ray examination plays a major role in the diagnosis of pneumonia in the elderly and the senile age. However, it should be remembered that in this age period, most patients have emphysema of varying degrees, against which the clarity of foci and inflammatory infiltrates is lost. Therefore, typical homogeneous darkening of lung tissue on X-ray in elderly patients with pneumonia is rare and may be associated with the presence of pleural effusion or atelectasis caused by a lung tumor.

Treatment. The main importance is antibacterial therapy (mainly antibiotics and sulfonamides), which is carried out considering the sensitivity of the microbial flora to the prescribed drugs. However, based on the principle of possibly early treatment of patients with pneumonia, antibacterial therapy should be prescribed initially without considering bacteriological sensitivity testing, since isolating the pathogen and determining sensitivity requires a certain amount of time (at least 2 days). In this case, the following principles of empirical antibiotic selection are recommended [5,16,18]. When immediate administration of antibacterial agents is necessary, preference should be given to bactericidal broad-spectrum antibiotics with good diffusion into lung tissue (semisynthetic penicillins, cephalosporins). Before obtaining an antibiogram, microscopy of a Gram-stained sputum smear will help in making an approximate etiological diagnosis in some patients. These data are used to choose the antibiotic. For pneumococcal or streptococcal pneumonia, benzylpenicillin is most effective (200,000–300,000 IU intramuscularly every 4 hours). In case of staphylococcal nature of the disease, semisynthetic penicillins are indicated (ampicillin 0.5 g 4–6 times a day, methicillin 0.5–1.0 g 6 times a day intramuscularly; oxacillin 0.5–1.0 g 4–6 times a day orally or intramuscularly). In case of resistance of staphylococci to semisynthetic penicillins, lincomycin (0.5 g 2–3 times a day intramuscularly or 0.5 g 4 times a day orally) in combination with gentamicin (0.04 g intramuscularly 2 times a day) gives a positive result [15,18].

For pneumonia caused by *Haemophilus influenzae*, ampicillin is advisable, and if resistant, tetracyclines (tetracycline 0.2–0.3 g every 4 hours, methacycline 0.3 g 2 times a day). If the causative agent is *Klebsiella pneumoniae*, streptomycin (0.5 g 2 times a day intramuscularly), kanamycin (0.5 g 2–3 times a day intramuscularly), and gentamicin in combination with chloramphenicol or tetracyclines are most effective. For pneumonia caused by *Pseudomonas aeruginosa*, gentamicin or its combination with carbenicillin is recommended. For anaerobic flora, penicillin, lincomycin, or chloramphenicol is prescribed. Patients with viral, especially influenza, pneumonia are prescribed a combination of broad-spectrum antibiotics and semisynthetic penicillins [15]. Antibacterial drugs must be taken regularly throughout the entire course of treatment, as sufficient saturation of the body over a

certain period is necessary for their action. It is advisable to use combinations of antibacterial drugs, which allows achieving a positive result with a lower dose of each [15]. Moreover, combined treatment reduces the possibility of the formation of resistant microorganisms to the drugs used. Combined use of antibiotics has its own rules. Examples of effective combinations are given above. At the same time, some combinations of antibiotics are inappropriate. Thus, combinations of bactericidal antibiotics (penicillins, cephalosporins, aminoglycosides) with bacteriostatic ones (tetracyclines, macrolides) should be avoided. It is not allowed to prescribe two aminoglycoside antibiotics simultaneously or to use one aminoglycoside immediately after discontinuation of another representative of this group [15].

When prescribing antibiotics to elderly and senile people, one should always remember the possibility of developing diseases caused by yeast-like fungi of the genus *Candida*. To prevent and treat these complications, antibiotics should be combined with nystatin, levorin, and multivitamins. The success of treatment is based on intensive therapy of the circulatory system, as the largest number of complications in elderly patients occurs from the cardiovascular system. For prophylactic purposes in severe cases, it is advisable to include cardiac glycosides and vascular agents (camphor, cordiamine, corazolum) in the complex of therapeutic measures, even in the absence of signs of cardiovascular insufficiency. Expectorant agents, drugs that thin sputum, and, in case of bronchospasm, significantly worsening pulmonary ventilation, bronchodilators should be prescribed [17,18]. To stimulate the immunobiological properties of the body and its reactivity, which is of particular importance in the treatment of pneumonia in the elderly and senile age, biogenic stimulants are used: placenta extract and suspension, ACS, aloe extract, FiBS, etc. In pneumonia with pronounced intoxication, the introduction of protein solutions and blood substitutes is effective, significantly reducing intoxication and increasing the body's protective capabilities. To improve protein metabolism and increase resistance, anabolic steroids are recommended. Oxygen therapy is advisable [5,18]. Food should be easily digestible and vitamin-enriched. Patients should be given a sufficient amount of fluid — up to 1.5 liters per day, as the body of elderly people is very sensitive to disturbances in water-salt balance. Prolonged bed rest (hypodynamia) can worsen lung ventilation conditions. In this regard, an elevated position and turning the patient from one side to the other are recommended. The patient should be sat up in bed as early as possible [17].

Therapeutic physical culture plays an important role in the complex therapy of patients with pneumonia. Physiotherapeutic methods are widely used in the treatment of pneumonia. The simplest and most common are cupping massage, mustard plasters, warming compresses on the chest, and pepper plaster. These procedures reflexively cause improved blood circulation in the lungs and thereby contribute to faster resolution of the inflammatory focus [17,18]. They are recommended after the acute manifestations of pneumonia subside. After normalization of body temperature, hardware physiotherapy is used. In large-focal lesions in the stage of

slow resolution, diathermy is preferable, and in concomitant arterial hypertension, inductothermy or UHF. For small-focal pneumonia, electrophoresis with dionine, euphylline, calcium, ascorbic acid, heparin, papaverine, and lidase is the method of choice. Chest massage contributes to improving the drainage function of the bronchi, sputum expectoration, and stimulation of resolution [4]. Special attention is required for the treatment of severe forms, in particular the so-called fulminant pneumonia. In this case, a combination of antibiotics in maximum permissible doses is used, including intravenous administration if necessary, including into the subclavian vein. Antibacterial treatment should be combined with specific immunotherapy (hyperimmune staphylococcal plasma, antistaphylococcal gamma-globulin, blood transfusion from a convalescent donor, donor anti-influenza gamma-globulin), intensive infusion detoxification therapy, correction of acid-base status, and measures to maintain cardiovascular activity and pulmonary gas exchange [5]. Prevention. Timely treatment of ARD, chronic bronchitis, circulatory insufficiency, avoidance of hypothermia, hardening, prophylactic use of antibiotics (for example, in all cases of acute cerebrovascular accident, myocardial infarction, influenza, in the postoperative period) [5,6,16].

2. Conclusion

Age-related changes in the respiratory system significantly reduce its functional reserves and create favorable conditions for the development and severe course of inflammatory diseases in elderly and senile people. Degenerative-dystrophic processes in the chest, airways, lung parenchyma, and vascular bed lead to impaired ventilation, decreased bronchial drainage function, and deterioration of gas exchange, which contributes to the frequent occurrence of acute and chronic bronchitis, as well as pneumonia [7-9,11]. In elderly patients, these diseases are characterized by an atypical clinical picture, erased symptoms, a high risk of complications (respiratory and heart failure, transition to a chronic course), and diagnostic difficulties. Timely diagnosis, considering age-related features, early initiation of comprehensive treatment (antibacterial, bronchodilator, expectorant, oxygen therapy, and rehabilitation measures), and adequate prevention play a decisive role in improving outcomes. A deep understanding of the morphofunctional features of the aging respiratory system is necessary for effective prevention, diagnosis, and treatment of inflammatory pulmonary pathology in elderly people [5,17,19,20].

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