The Annals of the “Ştefan cel Mare” University of Suceava.
Physical Education and Sport Section. The Science and Art of Movement
eISSN 2601 - 341X, ISSN 1844-9131

ADAPTIVE MECHANISMS OF THE RESPIRATORY SYSTEM TO MAINTAIN HEALTH IN SENESCENT PEOPLE

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Keywords: adaptive mechanisms, respiration, health, senescence, deconditioning

Abstract: The present work is the result of an analysis aimed at preserving the function of the respiratory system and at achieving a prophylactic approach that allows senescent people to adopt a healthy lifestyle. The physiological processes of deconditioning in senescent people are slow to establish themselves, have an upward dynamic and are irreversible. It is also in this context that we believe that the autonomic mechanisms of breathing regulation are able to ensure a sufficient oxygen supply to sustain a healthy status, if all the factors involved in the activity of the respiratory apparatus are properly managed.

Introduction

In order to understand the regulatory mechanisms of respiratory function and the effects of the deconditioning processes that occur with the age of presenescence, we will present some specific aspects of the pathophysiology of this phenomenon. We will therefore also consider factors that limit respiratory function and therefore exercise capacity in the elderly. Changes in the respiratory system with advancing age are due to the following main processes: progressive deterioration of lung tissue; increased stiffness of the rib cage; reduction of respiratory muscle stretch.

At the same time we will mention a number of factors that can negatively influence respiratory function: the continuous functioning of the lung is considered a significant factor of wear and tear, in addition to breathing in a polluted environment (dust, toxic gases, tobacco); lung diseases that do not heal; physical and chemical bacterial microtrauma that have varying effects depending on their specificity and the body's response; the altering action of radiation with a fibrosing effect.

Age-related lung changes affect both parenchyma and interstitial tissue. In the parenchyma the characteristic feature is enlargement of the alveolar system. Research has established that in the elderly there is a widening of the alveolar ducts and high-grade respiratory bronchioles, concomitant with a decrease in depth and a widening of the underlying alveoli. The chest wall changes with age, it undergoes a reduction in rib mobility through costo-vertebral arthrosis, calcification of cartilage and joints. In addition to this hypomobility, there are many cases of skeletal deformity (kyphosis, kyphoscoliosis) due to decalcification of the vertebral bodies.

This alters the mobility and elasticity of the ribcage, making it rigid, with repercussions on the lung, which already has a low elasticity. [4]

The elements of deconditioning that are installed in the senescent lung are as follows:

- reduction of the elastic retraction force is the fundamental factor in pulmonary involution and is evidenced by criteria; functional (increased RV and RV/CPT ratio); clinical, (enlarged thorax - increased lung loudness); radiological, (hyperluminosity, enlarged retrocardiac and retrosternal spaces, enlarged intercostal spaces)
- increased thoracic rigidity evidenced by, decreased CV; clinical, decreased respiratory amplitude, thoracic deformities; radiological, costo-vertebral arthrosis, compensatory increased diaphragmatic widening;
- lack of obstructive phenomenon evidenced by signs; functional, normal pulmonary flow resistance; clinical, lack of dyspnea [4, 8]

From the aspects presented above, some irreversible morphological changes of the anatomical structures supporting the respiratory function can be observed, namely the respiratory apparatus and the thoracic cavity with all its constituent elements. [1] Respiration can be defined as the set of chemical processes that ensure gaseous exchanges between the human body and the external environment, that is, external respiration consisting of O_2 intake and CO_2 removal as well as internal respiration consisting of gaseous exchanges between cells and their interstitial environment. [5, 9]

Respiration is a function that ensures CO_2 removal and O_2 intake to the body's cells. Lung gas exchange is achieved by the rhythmic sequence of two processes: inspiration and expiration. In inspiration, atmospheric air enters through the airways to the pulmonary alveoli, and in expiration, part of the alveolar air is expelled to the outside by the same route, this process is called pulmonary ventilation and is the first stage of the tissue-phase respiration, the third stage of gas exchange - internal respiration. The second stage is pulmonary (alveolar-capillary diffusion)

Pulmonary gas exchange is achieved due to the difference in the partial pressures of PaO_2 and $PaCO_2$ in the two media separated by the alveolar-capillary membrane: alveolar air and blood in the pulmonary capillaries. In alveolar air the O_2 pressure is much higher (100 mm Hg) than in venous capillary blood (40 mm Hg), so O_2 will pass from alveolar air into blood until O_2 in alveolar air equilibrates. The oxygenation of blood in the pulmonary capillaries is called pulmonary haematosis. The blood stage (transport of gases in the blood), blood transport of O_2 is 1% in dissolved form in plasma and the rest in the form of a combination of haemoglobin (Hb) called oxyhaemoglobin (HbO_2). A small 8% of blood CO_2 transport is in dissolved form in plasma and most of it is in the form of a chemical combination called carbohemoglobin. CO_2 resulting from cellular oxidations reaches the interstitial fluid by diffusion. Tissue stage (cellular respiration) At the level of tissue capillaries, arterial blood releases O_2 necessary for cellular activities and is loaded with CO_2 resulting from cellular metabolism, which diffuses from the interstitial fluid (60 mm Hg) and into the capillary blood (40 mm Hg). HbO_2 dissociation depends on several factors: partial pressure of O_2 and CO_2, temperature and pH. In the interstitial fluid the O_2 pressure is about 40 mm Hg and in capillary blood 97 mm Hg, this pressure gradient favouring HbO_2 dissociation. [3] Respiratory regulation is the adaptation of pulmonary ventilation to the variable needs of the body, and is achieved by mechanisms that continuously regulate ventilation by changing the frequency and amplitude of breaths..

Regulation of respiratory function: breathing is an involuntary act, but it is determined by muscles under voluntary control. There are four types of breathing regulation: automatic breathing regulation; reflex breathing regulation; chemical breathing regulation and cortical breathing regulation. Changes in one or more of the factors that condition respiratory processes cause disturbances in tissue O2 supply, a respiratory failure known as hypoxia. Therefore we will establish the 3 types of impairment: disturbance of oxygen supply; disturbance of oxygen transport; disturbance of the O_2 utilisation process by tissues. The onset of the manifested phenomena of respiratory failure occurs only after all compensatory mechanisms related to the respiratory, cardiovascular, blood-tissue, regulatory systems, etc. have been exhausted [6, 9]. Respiratory failure occurs due mainly either to lung failure resulting in hypoxaemia or pump failure resulting in alveolar hypoventilation and hypercapnia. Hypercapnic respiratory failure may be the result of mechanical defects, central nervous system depression, imbalance of energy demands and supplies and/or adaptation of central controllers. [2]

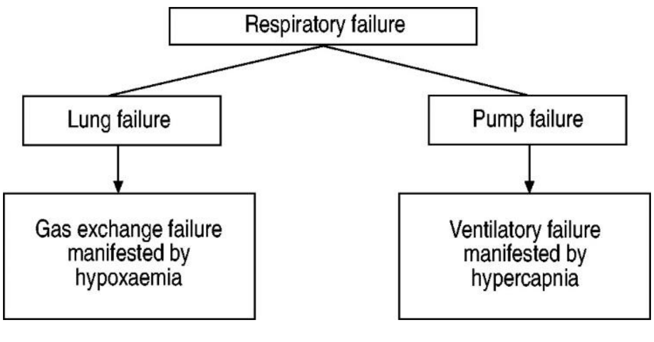

Fig. no.1. – Types of respiratory failure. The respiratory system can be considered as consisting of two parts: 1) the lung; and 2) the pump. [10]

Aim and objectives of the study:

The aim of this study is to identify specific aspects of respiratory pathophysiology in the elderly and to combat them.

Research objectives:

– to study the literature on the mechanisms of pathophysiology in the elderly and their influence on health status;
– to identify the elements of respiratory pathophysiology that can be addressed prophylactically.

Materials and methods: Based on the information presented in the literature and experience in clinical practice, we will develop a model of investigation that mainly includes elements of etiopathogenesis, pathophysiology but also mechanisms to prevent the onset of respiratory failure in the age segment studied, namely senescence.

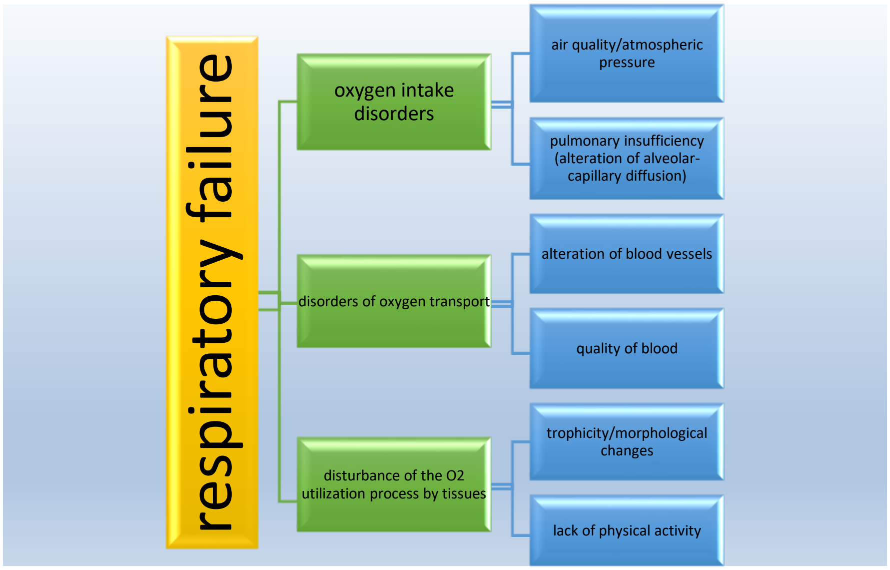

Fig. no. 2. investigation model

Results and discussions: As previously stated, most of the morpho-functional changes that accompany respiratory function are progressive and irreversible. The causes may only be physiological, the deconditioning processes that accompany senescence, or pathological in nature. We therefore believe that identifying the factors that disrupt respiratory function and limiting them can be beneficial in maintaining health. This does not exclude certain vulnerabilities and traumas that may trigger pathologies in the respiratory system, these will be investigated and treated accordingly. However, we will list some aspects that can limit the deconditioning process that can occur in the respiratory system.

For this we will use the proposed investigation model on the onset of respiratory failure. The first aspect relates to disturbances in oxygen intake, which can be managed by controlling air quality and gradually training exercise capacity to achieve optimal alveolar-capillary diffusion and better alveolar oxygen uptake. Also in this context keeping the airways at optimal parameters will allow better air circulation. With regard to blood circulation, we can recommend careful monitoring of vascular health and maintaining blood parameters according to physiological values through proper nutrition and medication where appropriate. As for the maintenance of trophic status and physical activity, these are the responsibility of kinetoprophylaxis, adapted leisure programmes or other types of activities will be able to maintain a balance between the elderly person's effort capacity and the demands imposed. We believe that adapted physical activity carried out under controlled conditions and monitored by specialists will transmit to the respiratory system, through sensory perception mechanisms, sufficient afferents to allow optimal regulation in order to maintain a healthy status.

Conclusions:

- the elements of deconditioning that occur in the senescent lung are as follows: reduction in elastic retraction force; increase in thoracic rigidity; lack of obstructive phenomenon;
- changes in one or more of the factors conditioning respiratory processes cause disturbances in tissue O_2 supply, a respiratory failure known as hypoxia;
- the onset of the manifest phenomena of respiratory failure occurs only after all compensatory mechanisms of the respiratory, cardiovascular, blood-tissue, and regulatory systems have been exhausted;
- adapted physical activity induces in the respiratory apparatus, through sensory perception mechanisms, sufficient afferents to allow optimal regulation in order to maintain a sanogenic status.

Bibliography:

[21]. Clement Baciu, (1981), Aparatul Locomotor, Anatomie funcțională, biomecanică, semiologie clinică, diagnostic diferențial), Editura Medicală, București, pag. 530;

[22]. C. Roussos & A. Koutsoukou. (2003). Respiratory failure. European Respiratory Journal, 22(47 suppl), 3s. https://doi.org/10.1183/09031936.03.00038503;

[23]. Constantinescu Mihai, (2018), Kinetoterapia în Afecțiuni cardio-respiratorii, Caiet de lucrări practice, Editura Universității „Ștefan cel Mare" Suceava pag.10-15;

[24]. Constantinescu Mihai, (2018), Kinetoterapia în Geriatrie-Gerontologie, Caiet de lucrări practice, Editura Universității „Ștefan cel Mare” Suceava pag.36,37;

[25]. Corneliu Borundel (1995), Manual de medicină internă pentru cadre medii, Editura ALL, București, pag.202-204;

[26]. Domnișoru Leonard, (2004), Compendiu de medicină internă, Editura Național, București, pag.69-71;

[27]. Mircea Dumitriu (1982), GERIATRIE, Editura Medicală, București, pag. 46;56;

[28]. Pârvulescu V. N., Trăistaru Rodica, (2013), Semiologie și noțiuni de patologie medicală pentru kinetoterapeuți, Editura Universitaria Craiova, pag.159-162;

[29]. Romel Barbu, (1980), Fiziopatologie, Editura Didactică și Pedagogică, București pag. 329-331;

[30]. https://erj.ersjournals.com/content/22/47_suppl/3s.(vizitat 03.12.2023)