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FUNCTIONAL LUNG VENTILATION FACTORS AND THE CLINICAL IMPORTANCE OF THEM

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Abstract. Functional lung ventilation factors are considered to be an important tool used for the investigation and monitoring of the patients with the respiratory pathology. These factors give important information relating to large and small respiratory tracts, the lung parenchyma, including the sizes and integrity of lung capillaries. Functional lung ventilation factors assist in making a diagnosis and can define the decisions taken for further treatment and surgical intervention. In this review, we describe our usual investigations and discuss their clinical importance.

Keywords: functional tests, spirometry, pneumotachography, spirography, and the vital lung capacity.

Introduction. Recently, a worrisome situation unfolds in Ukraine due to the fact that the health and physical fitness of the teen-agers head downhill. Natural motion activity is progressively impaired; a level of the mental buoyancy is increased and it is backfired on the nervous-&-emotional system of young people. Taking care of the health of young generation is a vital problem of the contemporary Ukrainian

society [1, c. 159].

At the present stage of the development of our society the health condition of the young student community is one of the most important indicators of the healthful potential of the nation therefore the maintenance and improvement of it is of higher priority [2, c. 30].

Objective: The purpose of this review was to describe the functional lung tests that are usually used by our experts and to discuss the clinical importance of them.

Functional examination of the lungs requires the spirometry procedure that combines the pneumotachography and spirography. The pneumotachography (the " flow-to-volume" curve ratio analysis) is the method of the graphic registration of the motion speed of the air flow during the tidal breathing and during certain breathing maneuvers; carrying out the tests with bronchial spasmolytics and provocation bronchoconstriction tests, peakflowmetry, body plethysmography (mainly, the method of investigation of the bronchial resistance by way of comparison of the obtained pneumotachometry data with the data of the mechanical vibrations of the thorax during the breathing cycle; the body plethysmography data are not relating to the conation of the patient and therefore, these are the most objective and some other more complicated tests were also carried out. Spirography is the method of the graphic registration of the changes in lung volumes during respiratory movements. The spirography enables the registration of the breathing factors of a man. Mainly, these are functional factors, i.e. these express the ventilatory lung capacity and not organic disorders. These include static volumes and capacities that reflect the elastic properties of the lungs and of the thoracic wall and also the dynamic parameters that describe the amount of the air ventilated through the airways during tidal breathing per time unit. This type of examination allows the doctor to assess to what extent a disease has changed the lung inflation capacity and the airway conductance capacity during tidal breathing [3, c. 45].

The spirometric examination is indicated for children and adults that suffer from different functional disorders of the respiratory system (frequent bronchitis, first of all obstructive, the lung tissue emphysema, chronic nonspecific lung diseases,

pneumonia, tracheitis and laryngotracheitis, allergic-, infectious-allergic and vasomotor rhinitis, and respiratory diaphragm affections. It is of crucial importance to make this survey in the groups of patients that have a disposition (threat of) to the development of the bronchial asthma for the early diagnosing of this disease and as a matter of fact the early and adequate prescription of the treatment regimen. This examination can also be carried on for healthy people, in particular for the sportsmen in order to define the tolerance to physical loads and to study the ventilation capacities of the respiratory system [4, c. 75].

It should be noted that the spirometry has no absolute counter-indications; however, the maneuver of the forced expiration should be done carefully. The analysis data of the function of the external respiration are given in the form of absolute values and as percentage of appropriate values. All lung ventilation factors are changeable. These depend on the sex, age, weight, height, body position, the state of the nervous system of a patient and some other factors. Therefore, the absolute value of a particular factor is insufficient. It is absolutely necessary to compare the obtained absolute values with appropriate values peculiar for the healthy person of the same age, height, weight and sex, the so-called appropriate factors. Such comparison outcome is expressed as a percentage in relation to the appropriate value. For a healthy person, the deviation from the normal value within 20% is permissible [5, c. 45].

The research done by S. Efimova (2014) showed that the spirometric examination is not only of diagnostic importance it also enables a continuous current monitoring of the patient's state and an efficient therapy of the bronchial asthma and also appropriate curative measures (remedial gymnastics) and other physical activities, respiratory gymnastics, the thorax massage in combination with postural drainage in the childhood [6, c. 8].

A value of the vital lung capacity (VLC) is an important functional factor of the external respiration. It depends on the sex, age, body sizes and the level of training [7, c. 70]. The research done by O. Shevchuk (2016) showed that the teen-agers of both sexes that formed a special medical group recorded a decrease in the

VLC and in the forced vital lung capacity (FVLC) not only in comparison to the basic group, but also to the norm and it can be indicative of the insufficiency of respiratory muscles [8, c. 84].

It was established that the external respiration system limits the capacity of the organism for work in the case of intensive loadings [9, c. 137].

The research done by T.Y. Shevchuk (2014) proved that the women that spent a lot of time working on PC showed a decrease in the volumetric indices of the external respiration and it is indicative of the disorders in the airway conductance [10, c. 127]. The alveolar ventilation serves as an indicator of the respiratory efficiency. The frequent breathing and the surface respiration will mainly provide the ventilation of the dead space. Such breathing is observed in the case of the circulatory shock and it is a bad symptom. The lung ventilation is disturbed due to the pathological changes in the respiratory tract. For clinical purposes, the three types of ventilation disturbances are marked out: restrictive, obstructive and mixed. The restrictive type of ventilation disturbances includes all the pathological states that result in the decreased respiratory excursions of the lungs. Such disturbances occur as a result of the parenchyma affection (the lung fibrosis) or in the case of pleural adhesions. The obstructive type of ventilation disturbances is conditioned by the airway constriction, i.e., by an increase in the aerodynamic resistance. Such a state is observed in the case of the mucus accumulation in the respiratory tract, the mucous membrane inflammation, the spasm of bronchial muscles (bronchial asthma and asthma-like bronchitis). The pathological state that is characterized by the excessive lung protraction and structural changes (a decrease in the number of elastic fibers of alveolar septum and /or the reduced capillary network) is called the lung emphysema [11, c. 36].

A decrease in the vital lung capacity is indicative of the restrictive ventilation disorder. The volume of air that is released by the lungs during the forced expiration, i.e. the forced expiration volume (FEV) is indicative of the obstructive ventilation disorders. A maximum ventilation of the lungs is reduced both in the case of the restrictive and obstructive ventilation disorders. To detect the latent respiratory

failure the tests are used with the graduated exercise and breath-holding. The respiratory factors bounce back to normal after three to five minutes. The latent respiratory-, cardio- and pulmonary heart diseases are characterized by a slowly increased respiratory minute volume (RMV), i.e. the bradypnea is observed and the refresh rate is longer than 5 minutes. Breath-holding tests are done using the second meter. The inspiration breath-hold (Stange's test, 1913) normally exceeds 45 s. The expiration breath-hold (Genchi test, 1925) normally exceeds 30 s. A decrease in these indices can be indicative of the disorder of the functional state both of the respiratory system and cardiovascular system. The pulmonary failure can be primary and secondary. The reasons for the pulmonary failure can be the factors of a central or peripheral origin: the cerebral hemorrhage, cerebral tumors, brain injuries, infectious brain diseases, chemical intoxication, spine injuries, hemopneumothorax, thrombembolia, asthma, and/or the lung emphysema. In the clinic, the acute respiratory failure and the chronic respiratory failure are distinguished [11, c. 37].

The broncho-obstructive syndrome is the pathological bronchi condition that is manifested in the disturbance of the airway conductance (the expiration clearance of the airways is smaller than the inspiration clearance) of a functional or organic origin. A luminal narrowing of small bronchi requires an increased positive introthoracic pressure to make expiration possible [12, c. 60].

It was established that the computation of the flow rate indices is of great importance for the detection of the symptoms of the bronchial obstruction. Thus, a decrease in the Tiffno index and FEV1 (the forced expiration volume in the first second) is a peculiar feature of the diseases that are accompanied by a decrease in the bronchial permeability, in particular bronchial asthma, chronic obstructive lung diseases, bronchiectatic diseases, etc. [13, c. 24]. So, the Harpreet Ranu's research established that the 20% fall in FEV1 in response to small doses of inhaled bronchoconstrictors such as methacholine is indicative of asthma [14, c. 86].

The research done by M. Sabadosh (2016) showed that the children suffering from the recurrent bronchitis have poorer performances of the functional state of the respiratory system, especially those with a reduced Tiffno index [15, c. 87].

The research done by K.O. Boychyk (2019) established that the cerebrum stimulation by the simulated acoustical signal of a native alpha-rhythm of the patient resulted in the changes of the indices of the respiratory function and that is the key point in the diagnosing of the broncho-obstructive syndrome [16, c. 65].

It was established that the patients complaining of the sleepiness (as measured by the Epworth Sleepiness Scale) and the snoring with the apnea or without it should be examined as to obstructive apnea asleep using the night-time oximetry, including the polysomnography [14, c. 88].

Conclusion: Hence, the use of functional tests is an inseparable valuable step in the early detection of the respiratory diseases when managing the patients in question. Functional tests have also an important curative and diagnostic significance; these allow the doctor to correctly evaluate the treatment dynamics and the choice of subsequent medical and preventive care arrangements. The use of the functional tests is also of great importance for the complete physical examination of the patients that expect the major surgery. The interpretation of the data of functional tests calls for the basic training in the field of the respiratory physiology and the availability of appropriate professional expertise.

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