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MEDICINE

ANALYSIS OF RHINOMANOMETRIC DATA IN THE DIAGNOSIS OF RHONCHOPATHY

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Abstract. *The peculiarity of the rhinomanometric method for testing the softness of the muscle in the muscular tone is that, with an increased secretion in the nasal cavity, there is a significant dephasing between the pressure and airflow signals in the respiratory cycle to a quarter of the period, which makes it difficult both for automatic and for interactive determination of the effective values of the measured values. Accordingly, such patients before evacuation are shown evacuation of the contents of the nasal cavity. Physiological reaction to reduce air conduction of the upper respiratory tract is the change in the regime and rhythm of breathing, as well as the transition to respiration with the mouth. As a rule, in patients with rhonchopathy during the daytime when awake, there is a slowing and deepening of respiratory movements of compensatory and decompensatory nature.*
Keywords: *rhonchopathy, rhinomanometry, nasal breathing, nasal cavity.*

Introduction. Rhonchopathy is a chronic progressive disease manifested by obstruction of the upper respiratory tract and chronic respiratory failure, which subsequently leads to syndromal changes in the body of a compensatory and decompensatory nature. The disease is characterized by three degrees of severity of snoring and can lead to death in severe cases. In Ronchopathy, a disruption of nasal aerodynamics due to pathological changes in the geometric characteristics of the upper respiratory tract is characteristic. The change in aerodynamic parameters during wakefulness only partially explains the violation of ventilation in the upper parts of the respiratory tract.

Physiological reaction to reduce air conduction of the upper respiratory tract is the change in the regime and rhythm of breathing, as well as the transition to respiration with the mouth. As a rule, in patients with rhonchopathy during the daytime when awake, there is a slowing and deepening of respiratory movements of compensatory and decompensatory nature.

The cause of rhonchopathy is most often the change in the muscle tone of the structures of the soft palate. Therefore, it is expedient to develop a method that is simple enough to be used in clinical practice, which allows not only to assess the degree of obstruction of the upper respiratory tract, but also based on the study of the muscle tone of the soft palate [1-4].

The main method of testing nasal breathing at the present time is active rhinomanometry. The method of posterior active rhinomanometry from the measured differential pressure Δp (between the nasopharynx and the vestibule of the nose) and the corresponding air flow Q allows us to evaluate the aerodynamic resistance of the upper respiratory tract by formula

$$A = \Delta p / Q$$

and is measured in Pa divided by l / c. The layout of the pressure transducers for the back active rhinomanometry is shown in Figure 1, with p1 measuring the pressure drop across the venturi-type flowmeter, p2 - pressure difference between the nasopharynx and the environment, p3 - pressure drop in the pore space in the run-up to the nose and p4 - with exhalation [5-6].

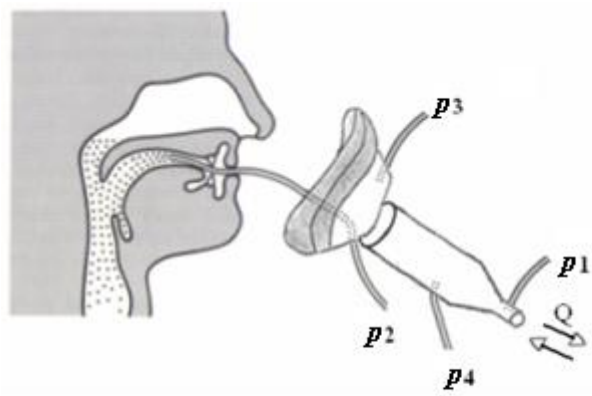

Fig. 1. The layout of the pressure transducers (p1, p2, p3, p4) with the posterior active rhinomanometry

Results of the study. The above method of testing nasal breathing is inspiratory - measurements are taken during the inspiratory phase. The diagram of respiratory cycles according to the data of the back active rhinomanometry (in accordance with the scheme of placement of the transducers in Fig. 1) is shown in Fig. 2.

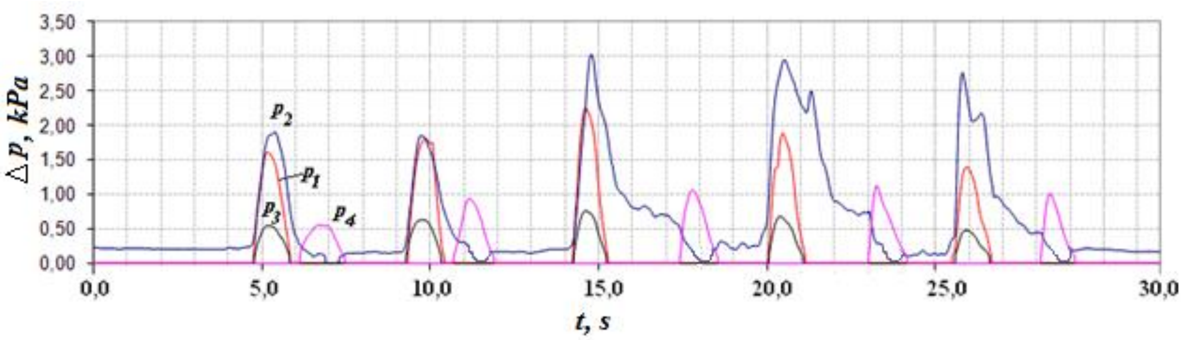

Fig. 2. Diagram of respiratory cycles from data of the posterior active rhinomanometry

In the study of this diagram, the value of the residual pressure p_2, between the inspiratory cycles, which can be designated as $\Delta p_{d.b}$.. is of interest.

The method of examining patients in this case consists of the following stages:

a patient's examination is carried out using the procedure of back active rhinomatometry with forced breathing in a dynamic mode - with the definition of respiratory cycles by constructing breath cyclograms (see Fig. 1). The standard procedures for preliminary processing and analysis of rhinomatometric data (pressure difference and air flow) are then carried out to calculate the aerodynamic nasal resistance coefficient to determine the degree of total nasal breathing disturbance. In this case, only the method of back active rhinomatometry is used, for example, with a nasal breathing device, in which the pressure transducers p_1 and p_3 (see Fig, 1) measure the air pressure drop in inhalation (discharge) and exhalation (excessive pressure), respectively, and in fact identify the phases (p_1 - inspiratory and p_3 - expiratory) of respiratory cycles, and p_2 determines the difference in air pressure between the nasopharynx and the submask (external) space (nasopharyngeal air pressure drop).

In the case of back active rhinomatometry with forced breathing, the patient is offered to perform a dynamic respiratory test (with forced inhalation and exhalation with a long respiratory delay for several seconds between them) (delay of breathing is evidently fixed by zero indices of pressure differences p1 and p3 and absence of air flow).

Further, according to the corresponding cyclograms of breathing in the phase of respiration (see Fig. 3), an analysis of the difference in air pressure between the nasopharynx and the submucosal space is performed and determine the absence of a violation of muscle tone of the soft palate with a nonzero pressure drop ($\Delta p_{d.b.} > 0$) between the nasopharynx and the submucosal space with respiration delay (see Fig. 3), otherwise (with $\Delta p_{d.b.} = 0$), as illustrated in Fig. 4, a violation of muscle tone of soft palate is recorded. The specific value of this indicator is selected based on the measurement error of the pressure transducers used in the diagnosis, and is usually in the range of 10 ... 150 Pa.

These results in the overwhelming majority of respiratory cycles were obtained from statistical treatment (with a prevalence of rhinopathy of 50 %, a sensitivity of 87 % and a specificity of 81 %) nasal breathing testing in 146 patients of the Otorhinolaryngology Branch of the CSTD and MK "Kharkiv Regional Clinical Hospital" and explained by the free movement of structures soft palate and the possibility of hermetic fitting of the nasopharynx from the submicroscope (outer) space in the normal, and flabby, insufficient for the sealed obturation of the overlap of epifaring with soft structures idnebinnya in violation of its muscle tone, which can be used as an additional diagnostic method ronhopatiyi and in choice of treatment of snoring and obstructive sleep apnea syndrome.

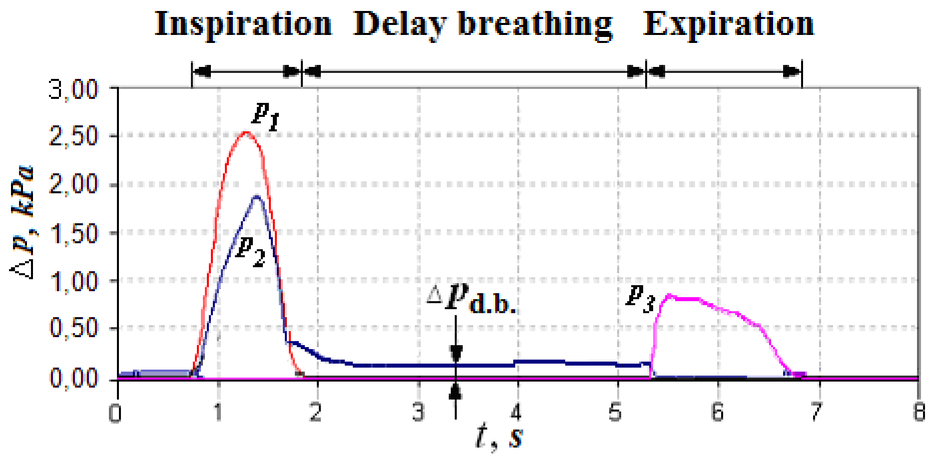

Fig. 3. Illustration of the presence of residual nasopharyngeal pressure $\Delta p_{d.b.} = 120$ Pa in the respiratory cycle

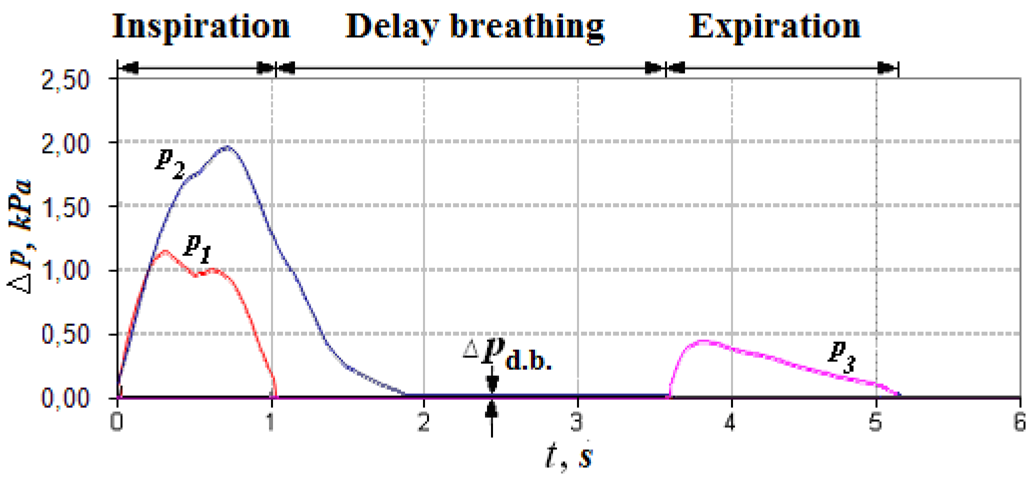

Fig. 4. An illustration of the absence of residual nasopharyngeal pressure ($\Delta p_{d.b.} = 0$) in the respiratory cycle

The analysis of the preliminary clinical tests of the TNDA device revealed some features of the operation of the means for the functional diagnostics of nasal breathing disorders and develop the corresponding practical recommendations listed below.

The peculiarity of the rhinomanometric method for testing the mild tonus of the soft palate is that, with an increased secretion in the nasal cavity, there is a significant dephasing between the pressure and airflow signals in the respiratory cycle up to a quarter of the period, which makes it difficult both for automatic and for interactive determination of the effective values of the measured values. Accordingly, such patients before evacuation are shown evacuation of the contents of the nasal cavity.

Significant errors in determining the tone of the soft palate result in an insufficiently tight grip of the mouthpiece, leading to air leakage between it and the lips of the patient, or opening the mouth - leakage of air from the corners of the mouth in the posterior rhinomanometry, significantly reduces the pressure drop in the nasal cavity (see Fig. 1, 2 - pressure transducer p_2 shows close to zero pressure values). It is necessary to provide a thin mouthpiece and a corresponding dense elastic obturator.

Conclusions. Closing the mouth of the mouthpiece with the tongue in the oral cavity at the back of the rhinomanometry or strong compression of the mouthpiece with teeth or lips (with its excessive flexibility) leads to a distortion of the pressure drop in the nasal cavity (usually in the direction of decreasing the index).

It is necessary to provide a rigid mouthpiece and visually control in real time the process of rhinomanometric measurements.

It is necessary to point out and take into account in the protocol of the study of patients using the rhinomanometry method the air flow regimes and the boundary regions of the change in the air flow regimes.

It is necessary to take into account not only the maximum coefficient of aerodynamic nasal resistance, but also the values of pressure drop and air flow in the region of transition to turbulent quadratic flow regime.

REFERENCES

1. Nosova Ya. The use of statistical characteristics of measured signals to increasing the reliability of the rhinomanometric diagnosis "/ Ya. Nosova, N. Shushliapina, S. V. Kostishyn, L. G. Koval, Z. Omiotek, et al. // Proc. SPIE 10031, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments. – 2016. – 100312M – doi:10.1117/12.2248364
2. Farouk H. Comparison Discriminate Characteristics Between Modern TNDA-PRH Rhinomanometer and Previously Methodology / H. Farouk, O. Avrunin // International Journal of General Engineering and Technology (IJGET). – 2013 – Vol. 2, №. 2. – P. 39–50.
3. Ya. Nosova, O. Avrunin, V. Semenets. Biotechnical system for integrated olfactometry diagnostics. Innovative technologies and scientific solutions for industries. 2017. No. 1 (1) p.64 – 68.
4. Farouk H. Analysis of Changes of the Hydraulic Diameter and Determination of the Air Flow Modes in the Nasal Cavity/ H. Farouk, A. Khaleel, O. Avrunin// Advances in Intelligent and Soft Computing: Image Processing and Communications Challenges 3. – Springer, 2011. – Vol. 102. – P.303-310.
5. Farouk H. An attempt of the Determination of Aerodynamic Characteristics of Nasal Airways/ H. Farouk, O. Avrunin, A. Khaleel //Advances in Intelligent and Soft Computing: Image Processing and Communica-tions Challenges 3. – Springer, 2011. – Vol. 102. – P. 311-322.
6. Nosova Ya. V., Avrunin O. G., Shushliapina N. O., Ibrahim Younouss Abdelhamid. Aerodynamic features of the olfactory area in nasal breathing. Science Review 7(7), December 2017 Vol.1 RS Global S. z O.O., Warsaw, Poland, 2017 P.27-30

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