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MODERN METHODS OF OLFACTOMETRY DIAGNOSTIC

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In this paper we consider the most popular methods for evaluating the degree of olfactory disorders. Most of the methods to evaluate olfactory disorders have a wide range of uses for the diagnosis of various diseases, including mental disorders, brain damage, and nervous system. However, within our problem, it is necessary to consider olfactory dysfunction in connection with the problem of the air passage in the human olfactory system. Therefore, it is necessary to develop a highly specialized method of assessing olfactory – respiratory disorders, which would have a high degree of objectivity for use in clinical practice of otolaryngologists.

Key words: smell; nose; olfactometry; mucous; odor dysfunction; stimulus

ACTUALITY OF WORK. Olfaction plays a major role in our interaction with the environment. The olfactory system not only acts for the detection of potential dangers in the environment, such as smoke, gas or dusts, but also influences our nutrition, social behavior, and well-being [1]. For human beings, it also has a crucial function for better life quality. Moreover, because many patients with olfactory dysfunction have often complained of their olfactory functions as well as reported of chronic pain, olfactory dysfunction must not be neglected anymore. In addition, the olfactory function has been considered to be one of the biological markers associated with various diseases, such as Alzheimer’s disease, Parkinson disease, multiple sclerosis, and brain tumor. Thus, the evaluation of olfactory function will shed some light to understand the function of the human olfactory system as well as assess the olfaction value in day-to-day life [2]. The structure of the olfactory analyzer is a complex anatomical and physiological structure. Violation of olfactory function may be due to both, mental disorders and diseases affecting the nervous system, and otorhinolaryngological diseases.

Violations of olfactory function in the broadest sense can be divided into three categories:

- dysfunction of brain regions associated with olfactory information processing;
- disruption of conduction paths (central nervous system), i.e. blocking the signals in the way of the olfactory receptors to the appropriate areas of the brain;
- respiratory-olfactory disorders, blocking of odorants getting into areas of the nasal mucosa, containing olfactory receptors.

It may be necessary a consultation for the patient with various specialists during examination of olfaction - neurologists, neurosurgeons, endocrinologists, psychiatrists and others. In particular, it occurs in the situations when the patient with clear violation of smell is no conclusive clinical signs of diseases of the nose and paranasal sinuses [3].

MATERIAL & RESULTS. Recent fundamental studies of the physiological mechanisms of olfaction showed that the process of olfactory reception occurs as follows:

1) olfactory reaction occurs as a result the dissolution odorant molecules in an aqueous-fat medium of membrane, covering the olfactory receptors;

2) each substance in accordance with the theory of matrices, stimulates nerve endings mainly those to which it is closest in meaning their physical and chemical properties, i.e. odor molecule as it is imprinted in its type of olfactory receptor matrix;

3) activator of the formation of the smell is nasal mucus;

4) characteristic of smell depends on its adsorption properties;

5) olfactory sensation in a qualitative sense is the result of summation of the olfactory and trigeminal nerves reaction receptor stimulation, which receptors of which are located throughout the surface of nasal mucosa.

Purposeful study of olfactory function allows to determine the criteria for the diagnosis of local destruction of various parts of the analyzer. According to researchers Woo Seop Kim, Dong Pyo Jang, In Young Kim the methods for assessing the olfactory function are largely divided into electrophysiological and psychophysical methods. Electrophysiological tests evaluate olfactory function based on objective measurement such as biosignals and medical imaging [4]. For example, the total number of physiological parameters such as galvanic skin response, electrocardiogram data, pneumogram we evaluate olfactory dysfunction. On the basis of physiological parameters there is a method of evaluation of smell, which includes the registration of the background level of pupillary reaction parameters in response to the light signal (pupillography) and in comparison with pupillogram made after olfactory stimulation by odorants. The method of estimating the human olfactory activity includes the determination of olfactory function on the results of the subjective assessment of odorous substances in superthreshold solution. It is necessary to provide the registration of background potentials of the brain conduct in a relaxed state at half reclining position of a body examinee with closed eyes in 40 s after the beginning of registration of the background potentials of the brain.
Using the inhaler Maholda we represent the olfactory stimulus lavender essential oil in a concentration of 1: 100 for 8 seconds and 70 seconds later. The psychophysical inspections are methods mostly based on questionnaires or simple apparatus. Normally, the evaluator presents a fragrance and then evaluates subjectively the subject’s awareness of smelling [5]. On the basis of subjective feelings and recognize odors the method of the threshold olfactometry has been built. The essence of this method is to use the three olfactory substances, valerian tincture, acetic acid and ammonia.

The solution is prepared with intervals of concentrations of olfactory substance by 2-2.5 times.

Each of the prepared solutions is placed in a glass bottle of glass tubes with volume about 100 ml with cross-sectional area of the neck 0.64 cm2; olfactometry research is carried out at room temperature of solutions 18-22°C and in the following order: tincture of valerian, acetic acid, ammonium chloride. The next and one of the most popular around the world method for assessing of violations of the olfactory function is Sniffing Sticks test. In the first stage to determine the olfactory threshold n-butanol of 16 solutions is used (orange, leather, cinnamon, peppermint, banana, lemon, licorice, turpentine, garlic, coffee, apple, clove, pineapple, rose, anise, fish). In assessing the ability to discriminate odors odorants triplets are used in superthreshold dilution, while the patient is asked to choose which smell is different from the other two [5]. In determining the subject's ability to identify the smell – the patient is proposed in the superthreshold concentration of the odorant and four possible answers. At each stage of the study the patient can gain a maximum of 16 points, that is, for the time of the study - a maximum of 48 points. This index is defined as threshold discrimination identification score (TDI). If TDI patient scores 15 or less, that he is believed to have a functional anosmia. When TDI from 17 to 30 points we conclude the presence of the patient hyposmia. TDI 30 points and above is considered normal [5]. The UPSIT comprises forty different smells released by scratching a panel of microencapsulated odorants using a pencil lead. For each of the forty smells, participants must choose an answer from four possible options; only one is correct. Booklets containing the smells, four, each with ten smells, are in sealed envelopes and a pencil provided.

Data collected on the USA population showed that participants' score out of forty was dependent on gender, age and smoking status. A diagnostic ladder was drawn up and six categories devised for olfactory diagnosis depending on score. This test is occasionally judged to have an American cultural bias. There have British, Chinese, French, German, Italian, Korean and Spanish UPSIT versions made. There are called the Brief (Cross-Cultural) Smell Identification Test.

It evaluates olfactory functions uses 12 odor capsules that are familiar with people from other cultures [3]. The advantages of the test are: reliability, low cost, ease of use, the possibility of testing in all conditions, even the self-test at home or in the field. The T&T olfactometer (Daichi-Yukuhin, Tokyo, Japan) consists of five test odorants. Each odorant was diluted into eight log-step concentration series with either propylene glycol or liquid paraffin (grade 5 to 2). The detection threshold is the weakest concentration at which the stimulus is firstly noticed. The concentration at which a qualitative sensation is first recognized is recorded as the recognition threshold. Thus, pulse ejection for scent presentation is able to minimize odor elimination. Measurement algorithm uses binary search. Therefore, might measure the detection threshold at 192 levels in total by changing the number of stimulus ejections and ejection time. For measurement result, might be able to quantify the detection threshold. Furthermore, only 5 min is needed to measure the detection thresholds. In this article we are considered the most popular methods for evaluating the degree of olfactory disorders. There are some other methods as well, but in most cases they differ only by odorants, their concentration and the number of repetitions of test studies.

CONCLUSIONS. Various methods and devices (olfactometer) are used to diagnose olfactory analyzer, but they all have a number of drawbacks: the long duration of the study, the use of objective evidence of the subjects, the use of olfactory substances that affect the end of the threefold nerve, determination of olfactory dysfunction or only quantitatively or qualitatively only. There are, most of the methods to evaluate olfactory disorders have a wide range as well of uses for the diagnosis of various diseases, including mental disorders, brain damage, and nervous system. However, within of our problem, olfactory dysfunction is necessary to consider with the problem in connection of the air passage in the human olfactory system. Therefore, it is expedient to develop a highly specialized method of assessing olfactory - respiratory disorders, which would have a high degree of objectivity for use in clinical practice of otolaryngologists. Thus, in the perspective of further research it seems necessary to develop a method of assessment of olfactory function on the basis of respiratory parameters derived from rinomanometry research that will improve the objectivity of conducted researches.

REFERENCES