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**The use of combined non-invasive optical medical express-technologies in the diagnosis and treatment of ENT-diseases (head and neck diseases)**

**Abstract**

The use of combined optical non-invasive medical express-technologies in the diagnosis of inflammatory and tumor diseases is one of the promising areas of clinical medicine. The possibility of using these technologies in the diagnosis and treatment of ENT-diseases (head and neck diseases) is one of the important components for providing highly sensitive, highly specific, non-invasive express-diagnostics and, as a result, treatment of such diseases in the early stages. The present study demonstrates the prospects of using non-invasive optical express-technologies in the early identification of inflammatory, tumor and precancerous ENT-diseases (head and neck diseases). The aim of the study is to develop the accurate, highly sensitive, highly specific, non-invasive express-method for diagnosing inflammatory and oncological diseases of the ENT-organs in the early stage. In this study 1200 spectra of various ENT-pathology (head and neck pathology) of inflammatory and tumor etiology were analyzed. At the first stage, the tissue spectra were analyzed in vitro. Histological method was used as a comparison method. At the second stage of the study, in vivo spectra were recorded, both in normal and in inflammatory and tumor ENT-diseases (head and neck diseases). At the third stage, the algorithm was proposed for diagnosing inflammatory, precancerous, tumor ENT-diseases (head and neck diseases) using combined optical technologies. The developed method can be used as a non-invasive method for early

express-diagnosis of the above-mentioned diseases and as an additional in the practice of a doctor.

**Introduction.** Today, the diagnosis and treatment of inflammatory and oncological ENT-diseases (head and neck diseases) are important strategic issues in Otorhinolaryngology and Oncology. Every year more and more people die from inflammatory and oncological ENT-diseases (head and neck diseases). Early express-diagnostics of inflammatory and oncological diseases can provide timely treatment of them. Thus, Raman spectroscopy in combination with the phenomenon of tissue fluorescence and machine learning can be attributed to effective diagnostic methods. These effects in combination in the development of special algorithms for the diagnosis and treatment of ENT-diseases (head and neck diseases) allow us to assess the molecular features of the structure of tissues in normal and pathological conditions, to evaluate their morphometric characteristics, to analyze the metabolic component in inflammatory, tumor, precancerous ENT-diseases (head and neck diseases). The developed medical technology based on the use of tissue autofluorescence and the effect of Raman scattering of light can in the future become an additional diagnostic and treatment method in the practice of doctors.

**The aim of this study** is to develop an accurate, highly sensitive, highly specific, non-invasive express-method for the early diagnosis of inflammatory and oncological ENT-diseases (head and neck diseases) using optical technologies.

### **Materials and methods**

During the study, physical methods were used based on the phenomena of fluorescence and Raman scattering, which were implemented through the use of special hardware and software systems certified for clinical use, which allow recording the spectral features of tissues in normal and pathological conditions. In this study the hardware and software complex was used for recording fluorescence and Raman scattering signals, which included a Nd:YAG (2w) solid-state laser with wavelengths of 405-1064 nm and an optical system for focusing and filtering the signal; spectrometer with diffraction grating 1200 lines/mm; CCD-matrix, controller and computer with software. For in vitro-studies, a microscope with a laser and a spectrometer with wavelengths of 405 nm, 532 nm, 637 nm,

1064 nm was used; for in vivo-studies the equipment with a fiber optic light guide was used. Histological method was used as a comparison method. 1200 spectra were analyzed for various ENT-pathologies (head and neck diseases) of inflammatory and tumor etiology.

**Results.** In the study, the spectra of intact tissues and in inflammatory and tumor ENT-diseases (head and neck diseases), both in vitro and in vivo, were analyzed. 1200 individual spectra were obtained in the ENT-pathology (head and neck pathology) of inflammatory and tumor etiology. Algorithms and a combined method for non-invasive express- diagnostics of the above-mentioned diseases have been developed.

**Conclusion.** Differential early diagnosis of inflammatory and oncological ENT-diseases (head and neck diseases) is one of the most important tasks of practical Public Health. The use of Raman spectroscopy in combination with the effect of tissue autofluorescence in the development of special algorithms is a promising direction in Otorhinolaryngology and Oncology. This diagnostic method is highly sensitive, highly specific, accurate, fast, non-invasive and it can be used in clinical practice not only as an “optical biopsy”, but also for express-screening of a tumor, precancerous and inflammatory process in the tissues in case of ENT-diseases (head and neck diseases) at an early stage for preventing complications associated with the spread of the pathological process.