

Application and possibilities of fluorescence spectroscopy method for intraoperative analysis of abdominal cavity organs tissues during minimally invasive interventions

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Currently, the number of patients with malignant tumors of hepatopancreatoduodenal area is growing. These pathologies have high level of complications and mortality and are hard to be detected at early stages. This is one of the most important problems of surgery of the abdominal cavity due to the high level of complications and mortality. Currently, the minimally invasive interventions are becoming more widespread as a main method of treatment of various pathologies of the abdominal organs. In this regard, there is a necessity to develop and implement new diagnostic methods and criteria for more detailed monitoring of the tissues state during treatment.

Optical non-invasive diagnostic methods are becoming widespread in clinical practice. One of them is fluorescence spectroscopy (FS). This method is based on analyzing the autofluorescence specters of endogenous fluoroforesin biological tissues induced with optical radiation [1,2]. It is known that one of consequences of cells functioning violation are changes in a respiratory chain of mitochondria, which result in changes in accumulation of NADH and FAD coenzymes. Oncological processes can also be accompanied by structural changes in collagen fibers in the hollow organs stroma. Potentially, all these changes can be assessed in vivo by means of the FS method [3].

Thus, the aim of this work is to study the possibility of applying fluorescence spectroscopy to assess metabolic activity of the abdominal cavity organs tissues in diseases of hepatopancreatoduodenal area.

Experimental measurements were conducted using the fluorescence channel of specially designed fiber-optic system with a laparoscopic optical probe (SPE "LAZMA" Ltd, Russia). A 365 nm and 450 nm radiation sources were used for fluorescence excitation. A total of 25 patients of Orel Regional Clinical Hospital department of X-ray-surgical methods of diagnosis and treatment aged 66 ± 10 years were engaged in the research. Areas of interest were distal and proximal parts on common bile duct, neck, body and fundus of gallbladder, wall and cavity of hepatic abscess and pancreas. Fluorescence spectra were recorded during primary and repeated minimally invasive interventions.

As a result, fluorescence spectra for each excitation wavelength and each area were obtained and normalized to the backscattered source signal. Processing of the data has shown that intensity of fluorescence and backscattered radiation can greatly vary in different areas of interest. It was observed in different points of one area as well. A number of factors causes it: the state and kind of tissue changes, the phase development of pathological processes, the stage of treatment, the presence of blood, pus and other substances. The differences with respect to the healthy tissues were associated with the presence of tumour or inflammation.

Thus, the results of the work show that fluorescence spectroscopy can be used for assessing the state of tissues during minimally invasive interventions in vivo. Obtained data show high sensitivity of this method to a number of factors. That way, there is a necessity to conduct further research to determine the influence of each factor on obtained spectra. It will allow to interpret the results more properly and to develop new diagnostic criteria for the study and treatment of hepatopancreatoduodenal organs pathologies.

References:

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