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LASER SPECKLE CONTRAST IMAGING OF ABDOMINAL ORGANS IN RAT MODEL

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ABSTRACT

Acute destructive pancreatitis is one of the most important problems of emergency surgery of the abdominal cavity. This is due, above all, a steady increase in the incidence, an increase in the incidence of complications and high lethality.

To date, the clinic does not have clear criteria and methods for differential diagnosis of acute destructive pancreatitis and its postnecrotic complications. None of the current methods of diagnosis in itself, cannot be recognized as absolutely accurate for the early recognition of pancreatic necrosis and its complications. This work is aimed at developing the use of optical imaging techniques to identify pathological processes in the biotissues of the abdominal organs. Methods of optical visualization provide the necessary tools for accurate detection of regional changes in microcirculation in tissues and the study of various biochemical processes closely related to blood supply. One of the modern methods for recording and analyzing the blood flow and tissue perfusion is laser speckle contrast imaging (LSCI). If inhomogeneous object is illuminated by the coherent light, the randomly changing intensity pattern, produced by random interference in object, can appear. This pattern is widely known as speckle pattern. The temporal and spatial statistics of the speckle pattern give information about the motion of scattering particles.

The study of new strategies for the diagnosis and treatment of acute pancreatitis in humans is impossible without preliminary experimental studies on phantoms and model animals. Disturbance of microcirculation is the main cause of death during severe acute pancreatitis. There are many different techniques allowing to stimulate the development of diseases of the pancreas, such as the mechanical damage of tissues or complex combined effects. It will allow to reproduce the acute, chronic and recurrent forms of the disease.

Currently, the most popular models of acute pancreatitis are the occlusion of the duodenal loop, choline deficient diet supplemented with etionine, the ligation of the bile duct and the pancreatic duct, the injection of cerulein, the perfusion of the bile duct and pancreatic duct, the introduction

of alcohol, the perfusion of the bile duct and pancreatic duct with one-stage hyperstimulation of cerulein.

For the modeling of pathology, a comprehensive approach was proposed, including the creation of an occlusion on the pancreas of a laboratory rat by applying a ligature and the use of vasoconstrictors to regulate the degree of acute pancreatitis. The use of vasoconstrictors entails a change in microcirculation due to the narrowing of the blood vessels, which can lead to a transition from mild to severe pancreatitis. For each animal, a median laparotomy was performed. After necessary manipulation, the pancreas was placed on the manipulation table. Registration of speckle contrast image of the tissue was performed based on a tool consisting of a laser source, a diffuser and a video camera. To process the speckle image, we used the standard algorithm for spatial processing of the speckle pattern, implemented using the MATLAB software package.

The obtained results showed that registration of microcirculatory changes by LSCI allows us to present different degrees of development of pancreatic tissue necrosis in complex ischemia modeling. The experiments carried out showed differences in the characteristics of the speckle fields of healthy and necrotic tissue. This method of visualization will help during the operation to clarify the blood supply to the body and to adjust the methods of treatment.

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