LASER SPECKLE CONTRAST IMAGING OF ABDOMINAL ORGANS IN MOUSE MODEL

RESEARCH AND DEVELOPMENT CENTER BIOMEDICAL PHOTONICS

OREL STATE UNIVERSITY named after I.S. Turgenev

UNIVERSITY OF OULU

1 Research and Development Center of Biomedical Photonics, Orel State University, Orel, Russia

2 Faculty of Information Technology and Electrical Engineering, University of Oulu, Oulu, Finland

3 Orel Regional Clinical Hospital, Orel, Russia

Evgeniya Seryogina*   1
Viktor Dremin   1,2
Anton Sdobnov   2
Igor Kozlov   1
Mikhail Mezentsev   1
Andrian Mamoshin   1,3
Alexander Alyanov   1,3
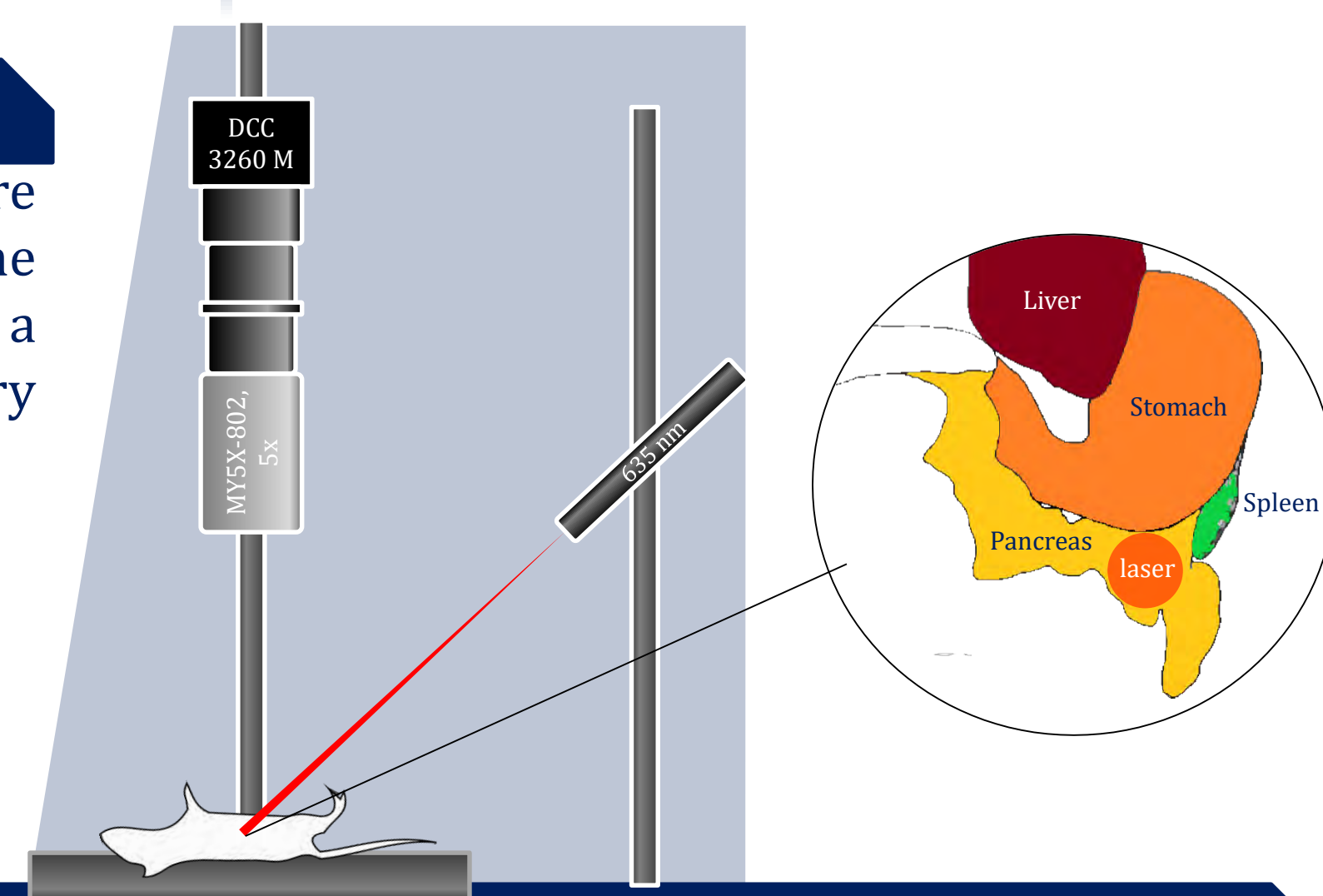Andrey Dunaev   1

Introduction

Acute destructive pancreatitis is one of the most dangerous cases in urgent abdominal surgery due to a constant increase in the incidence, probability of complications and high mortality. Up to date, the clinic has no clear criteria and methods for differential diagnosis of acute destructive pancreatitis and its postnecrotic complications with other abdominal pathologies. In particular, one of the problems that surgeons face is the need to obtain more diagnostic information during the operation. The study of new strategies for the acute pancreatitis treatment in humans is impossible without preliminary experimental studies on phantoms and model animals.

The Aim of the Research

to develop a method of laser speckle contrast imaging (LSCI) application for visualization and revealing of pathological processes in various organs of the abdominal cavity by complex modeling of acute pancreatitis on the mice pancreas ischemia model.
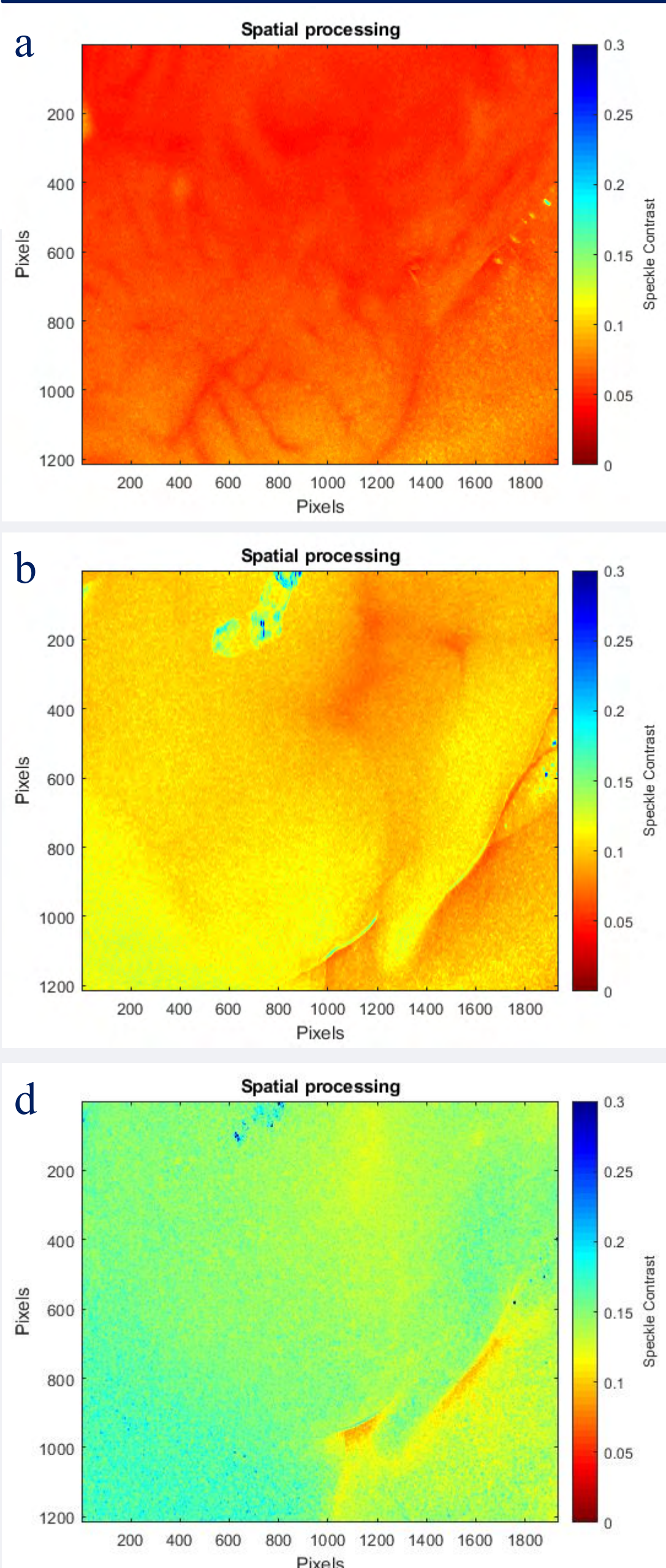
Materials and Methods

The develop of new strategies for the acute pancreatitis diagnosis and treatment in humans are followed by preliminary experimental studies on phantoms and model animals. Disturbance of the microcirculation is the main reason of death in acute pancreatitis. For the modeling of pathology, a complex approach was performed, including the occlusion formation in the pancreas of laboratory animals by ligature positioning.

For each mice (n=5, Balb/c line) a transverse laparotomy was performed. After appropriate manipulations, the pancreas was placed on the laboratory table. Registration of speckle contrast image of the tissue was made on a setup containing a laser source (wavelength - 635 nm), a video camera DCC 3260M and Mitutoyo Plan Apochromat Objective MY5X-802. Using the MATLAB software package with the standard algorithm for spatio-temporal processing of the speckle pattern the speckle images were obtained.

Results

Sequence of 20 frames was recorded for each stage. After the spatio-temporal algorithm processing, speckle-contrast images were obtained. As a result of ischemia, an increase in perfusion is noticeable after the ligature positioning. This is increase of the blood flow caused by blood vessel ligation. At 6 and 9 min after ischemia, there is a noticeable decrease of blood flow.

Speckle contrast images:
a) before ligation;
b) 1 min after ligation;
c) 6 min after ligation;
d) 9 min after ligation;
e) 12 min after ligation.

analyzed area 100x100

Average speckle contrast value evaluation in a camera field of view (100 x 100 pixels) during ligation process.
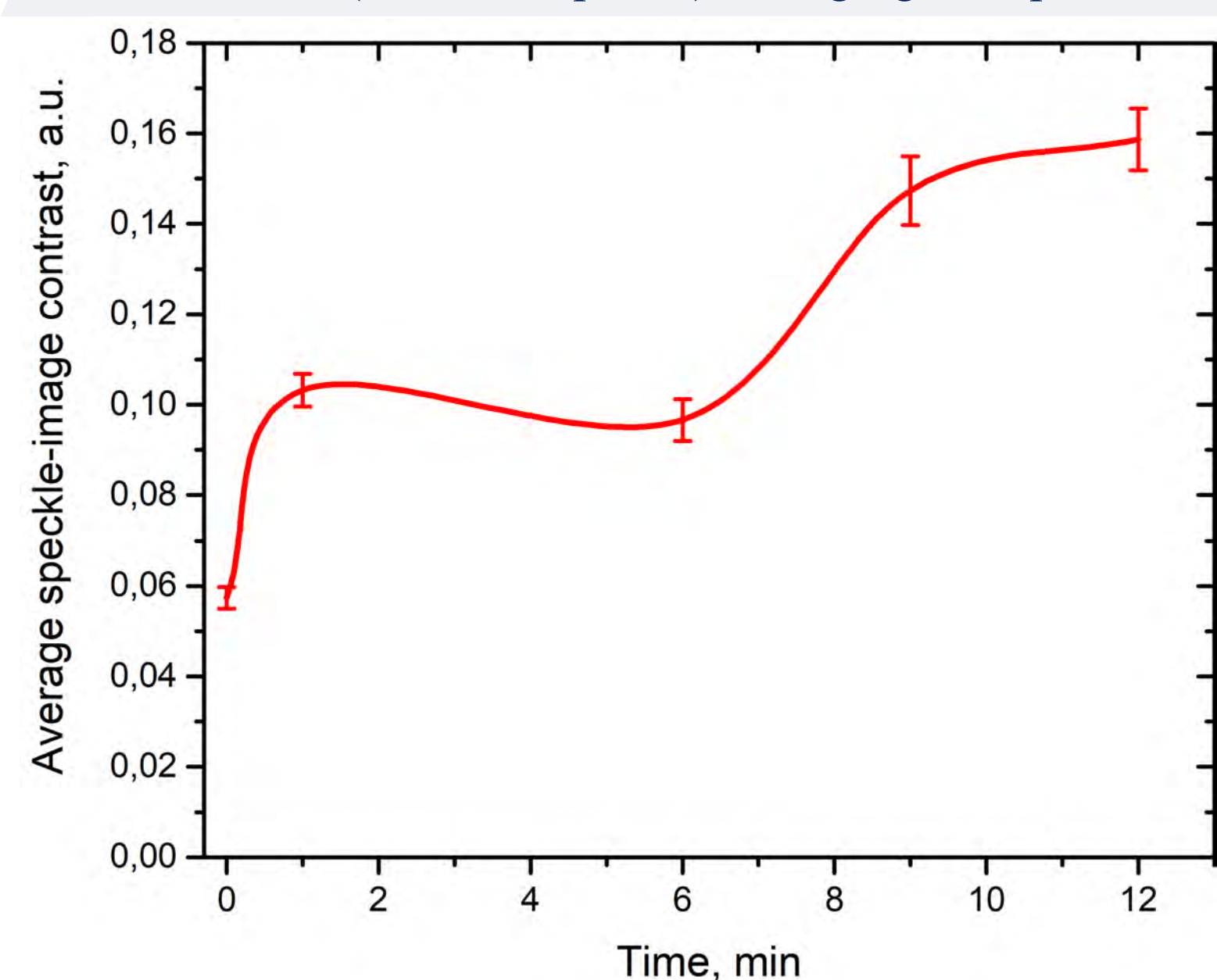
Standard deviation values presented for before, 1, 6, 9 and 12 min after ligation.

Conclusion

Microcirculatory changes registrated by LSCI allows us to present different degrees of pancreatic tissue necrosis development in ischemia modeling.

The experiment out showed difference in the contrast of the speckle fields in a healthy and pathological tissue.

Main results of this work will be applied for the development of a laparoscope with an integrated LSCI channel for tissue analysis during surgical operations.

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*Email: e.s.seryogina@gmail.com