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Rozprawa doktorska

OBRAZOWANIE STANU CZYNNOŚCIOWEGO
UKŁADU SERCOWO-NACZYNIOWEGO *IN VIVO*
Z WYKORZYSTANIEM METOD OBRAZOWANIA
REZONANSEM MAGNETYCZNYM

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Abstract

The aim of the doctoral thesis was to apply magnetic resonance imaging (MRI) to investigate the impact of inflammation on the functions of the cardiovascular system. The acute liver failure (ALF) induced with concanavalin A (ConA) was chosen as the inflammation model. The thesis includes implementation of the animal model of ALF, selection of MRI methods, optimization of the imaging sequence parameters and selection of the image analysis techniques. The study used the following MRI techniques: magnetic labelling of arterial spins (ASL), dynamic contrast-enhanced MR imaging (DCE-MRI), contrast phase MRI (PC-MRI) and anatomical MR imaging.

MR experiments with the animal model of ALF were conducted to verify the inflammation effect on the cardiovascular system performance. Mice were imaged within two hours and 24 hrs after administration of ConA. Using ASL, we observed the decrease in the blood perfusion through the liver tissue during measurement 24 hrs after ALF induction. It was also noticed that kinetic of the contrast agent (CA) in ALF animals, measured with DCE-MRI, was corrupted due to the reduction of the CA transport rate through endothelium to hepatocytes as showed in the compartmental modelling. Anatomical images were analyzed considering textural and fractal features. Fractal dimension proved to be the most determining marker of tissue impairment. No significant changes were observed in the perfusion rate in the MR experiment performed within 2 hours after ConA administration but there was a difference in the blood flow through large vessels what might have been a consequence of the leucocytes activation and their inflow to the liver. MR results were confirmed with histopathological and biochemical evaluations.

The study showed that liver MR imaging can be indeed used for diagnosis of the murine model of acute inflammation. The developed MRI protocol allowed the quantitative and qualitative examination of the cardiovascular system disorders in the large and capillary blood vessels in relation to the structural changes of tissue. The first changes in the circulation were observed within two hours after the induction of inflammation. It was also possible to examine the major functional disorders of the cardiovascular system at the stage of advanced ALF when examined 24 hours after the induction of inflammation.

The development of a comprehensive and original research methodology may allow for its potential use in preclinical studies of the efficacy of hepatoprotective therapies in liver inflammation diseases. The obtained results implies that the functional state of the vascular system can be treated as a significant marker of the organism state in the course of the pathology.