ABSTRACT

Acute complications of atherosclerosis are typically caused by arterial occlusion due to acute thrombosis forming over a ruptured vulnerable atherosclerotic plaque (VP). Early identification of such VP prior to their rupture could help prevent these events. At the same time, methods for assessing cardiovascular risk are focused on measures at the population level and are not sensitive and specific enough to assess the risk of individual patients. We therefore focused on the possibilities of in vivo detection of VP using biomarkers and invasive imaging methods. First, we focused on the detection of microRNAs (miRs), which have been investigated in recent years as promising biomarkers for a number of diseases, including atherosclerosis. We determined miR levels using quantitative polymerase chain reaction in peripheral venous blood samples from patients in very early phase of ST-elevation myocardial infarction (STEMI), which served as the closest clinical model of acute VP rupture. The results led to the identification of two miRs (miR-331 and miR-151-3p) that were deregulated in STEMI and could be biomarkers of VP. In the next part of the research, we dealt with the possibilities of invasive imaging of VP using intravascular ultrasound and near-infrared spectroscopy (IVUS and NIRS). We confirmed the safety and feasibility of NIRS data collection in carotid arteries and investigated their relationship to conventional risk factors of atherosclerosis. We analysed carotid artery plaque composition as a function of endothelial shear stress (ESS) distribution. Our hypothesis was based on the fact that destabilization and subsequent rupture of atherosclerotic plaques typically occurs in their proximal part, where accelerated blood flow causes high ESS. In an observational study, we examined patients undergoing elective carotid stenting at our hospital. The obtained NIRS data were analysed in relation to the maximum of carotid stenosis. The most lipids were observed immediately before the maximum of the stenosis, and the NIRS-detected lipid core occurred more often in the proximal part of the plaque, in agreement with our hypothesis.

Key words: atherosclerosis, vascular wall, prevention, vulnerable atherosclerotic plaque, biomarkers, microRNA, imaging methods, intravascular ultrasound, near-infrared spectroscopy