

The reliable assessment of endothelial function, being considered as a key event in the development of atherosclerosis in humans, appears highly desirable. The endothelium is of essential importance for the maintenance of vascular tone. It participates in the regulation of blood flow in response to changes in tissue and organ perfusion requirements. When blood flow increases through a vessel, the vessel dilates. This phenomenon has been called flow-mediated dilatation (FMD), which after several minutes of hyperemia is mainly mediated by nitric oxide NO.

Brachial artery FMD has been intensively studied since early 2000. However the tools used to image brachial dilation after several minutes episodes of hyperemia are biased by rather low US resolution. The standard equipment used for brachial FMD studies employs liner array probes with center frequency not exceeding 7-10 MHz thus limiting spatial resolution to about 0.2-0.3 mm, often close to the real change in brachial artery diameter. That is probably the main source of discrepancies in results reported by different laboratories. We are proposing exploring FMD studies in radial artery, much smaller vessel comparing to brachial artery and thus experiencing larger percentage of dilation. We have developed a combined US imaging and pulsed Doppler system working at 20 MHz enabling 0.1 mm and 70 micrometers axial resolution in imaging and in Doppler velocity profile recordings, respectively.

The calculation of FMD is done as the percentage change of the maximum diameter of the artery caused by reactive hyperemia relative to the baseline resting diameter measured before the occlusion. After setting the imaging plane the multigate Doppler mode is turned on and Doppler spectra in 128 consecutive gates are recorded and flow velocity profiles are calculated. Based on the Doppler profiles the shear rate SR on the endothelium surface of radial artery is determined. The normalization of FMD of radial artery by shear rate (FMD/SR) will be done by dividing the FMD value by SR.

The study will be conducted in four groups: healthy volunteers and patients with two types of hypertension and with documented coronary artery disease. The statistical parameters combining the FMD and FMD/SR values with the clinical picture of the patients being examined will be determined. In particular, FMD and FMD/SR limit values will be set for healthy volunteers and patients with diseases mentioned above.

Our preliminary findings from the pilot study carried on the group of 10 healthy volunteers and 10 patients with documented coronary artery disease showed clear differentiation between both groups and are very encouraging for the success of the proposed project allowing for the classification of the hypertensive patients as well as support an early diagnosis of coronary heart diseases.

The long-term goal of the study is non-invasive ultrasonic prediction of atherosclerotic lesions and classification of hypertension.