A New Window for Imaging of Endothelial Function. In Vivo and in Vitro Study

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Background:
Preceding atherosclerosis is endothelial dysfunction. There is therefore an interest in the application of non-invasive clinical tools to assess endothelial function. Although there are commercially ultrasound machines available to measure flow-mediated vasodilatation (FMD) of the brachial artery, they operate at a maximum of 10-12 MHz and the resulting resolution is limited to 0.2-0.3 mm. Introducing a higher scanning frequency can help in improving the axial resolution, providing more accurate tracking of small changes in artery diameter.

Aim:
Our aim was to introduce a high frequency, 25MHz ultrasound scanner to examine radial arteries.

Methods and Results:

A dynamic ultrasound phantom (DUP) of a radial artery (RA) to imitate FMD was developed. DUP was prepared using a rubber material and was modeled into a homogeneous pipe: approximately 2 cm in length and 2mm in diameter. DUP was connected at the end to an adjustable external pump. DUP was immersed in water for ultrasound scanning with two different diameters (an extension of 5 and 10%). FMD of radial artery was examined in 14 healthy young male volunteers (25-35 years old). In vivo and in vitro examinations were performed using a high frequency Golay encoded ultrasound scanner (uScan developed at our institution). The device operates with a single element mechanically scanned transducer at the frequency 25 MHz. The examined RA was visualized in B-mode in a longitudinal plane with the probe at rest and after reactive hyperemia induced by forearm cuff occlusion. The measured initial internal RA diameter was in a range of 1.59-2.35 mm, the maximum diameter 2.01-2.60 mm was observed 2-3 min after tourniquet deflation.

Conclusions:
The introduction of a high frequency ultrasound scanner 25MHz to examine RA opened a new window for imaging of endothelial function. The received ultrasound images of DUP proved to imitate the human RA image.