Precision of semi-automatic border detection software for the quantification of arterial layer thickness with very-high resolution ultrasound

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Background: Non-invasive very-high resolution vascular ultrasound (VHRU, 25-55 MHz) has recently been developed but images are currently analyzed with manual electronic calipers. The aim was to evaluate the use of semi-automatic border detection software (AMS; Artery Measurement System) in the analysis of arterial layer thickness in images obtained with VHRU.

Methods: 100 images from central elastic (common carotid) and peripheral muscular (brachial, radial, femoral, tibial) arteries were obtained on two separate days from 10 healthy subjects of different sizes and ages including both adults and children. AMS was used to measure lumen dimension (LD) and intima-media thickness (IMT) for all arteries and intima-media-adventitia thickness (IMAT) for muscular arteries. Adventitia thickness (AT) was calculated as the difference between IMT and IMAT. The intra-, inter-, and test-retest variability were assessed for the different measurements.

Results: Intra, inter, and test-retest coefficients of variation (CV) were 0.4, 1.9, and 7.2% for carotid LD (mean 5.601 mm; N=20) and 9.2, 13.6, and 14.8% for carotid IMT (mean 0.373 mm). Intra, inter, and test-retest CVs were between 2.3-4.1, 2.6-7.4, 7.9-13.5% for different muscular artery LD (mean 1.965-7.751 mm; N=80), between 7.2-12.3, 5.8-13.5, 12.9-18.0% for muscular artery IMT (mean 0.143-0.325 mm), between 3.8-10.0, 7.8-12.9, 14.7-16.7% for muscular artery IMAT (0.225-0.564 mm), and between 9.4-28.8, 13.4-31.0, 23.4-32.5% for muscular artery AT (0.079-0.239 mm), respectively.

Conclusion: The quantification of arterial LD and wall layer thickness from images obtained with transcutaneous VHRU is reliable using semi-automatic border detection software.