Comparison of semi-automatic border detection software with manual electronic calipers in 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 (EC). The aim was to compare the use of semi-automatic border detection software (AMS; Artery Measurement System) with EC in the analysis of arterial images obtained with transcutaneous 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 and EC were independently 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 for each measurement were assessed for both systems.

Results: No bias between AMS and EC was found. The intra and inter coefficients of variation (CV) for carotid LD (mean 5.60 mm) was lower with AMS compared with EC (0.4 vs. 1.9%, p=0.033 and 1.9 vs. 4.1%, p=0.037, respectively; N=20) while no difference in IMT or in test-retest comparisons were found. No consistently significant differences in intra, inter or test-retest CVs were observed for muscular artery LD, IMT, IMAT or AT overall. The intra CV for AT (15.6 vs. 24.8, p=0.011; mean 0.111 mm; N=41) and inter CV for IMT (14.3 vs. 21.2, p=0.001; mean 0.219 mm; N=58) obtained with AMS in higher quality muscular artery images was lower compared with EC.

Conclusion: Minor, although statistically significant, differences in the precision of AMS and EC-systems may be found in the analysis of arterial images obtained with VHRU. The improved precision of AMS for AT and IMT in higher quality images may be explained by a decrease in the technical variability imposed by the observer.