

Computer Assessment of Carotid Intima-media Thickness

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Abstract

Accumulating evidence indicates that B-mode ultrasonography can be used for non-invasive quantitative measurement of intima-media thickness (IMT) as a primary indicator of atherosclerotic disease. However, current methods of IMT measurement rely on human visual judgement to manually identify echo coordinates. This limits the accuracy and precision of IMT measurements since manual methods are limited by human variability and resolution of displayed ultrasound images. In clinical trials, the precision of the end point measurement determines the smallest change that can be detected. This in turn influences the length of a trial and number of **subjects** required to detect change. We recently reported from 2 angiographic/ultrasound clinical trials that automated edge tracking (AET) of the lumen-intima and media-adventitia echoes of the common carotid arterial (CCA) wall detects early atherosclerosis change within 6 months of therapy in as few as 30 subjects. Both phantom and human replicate studies were carried out to determine the sensitivity and variability of IMT measurements with AET. AET measurement of acoustic interfaces (simulating the lumen-intima and media-adventitia echoes) separated by known distances in a step wedge phantom showed that the standard deviation (SD) over a range of gaps of 0.44 mm to 1.7 mm was 0.02 mm. Estimated error in measuring 2 different gap sizes, similar to the process of measuring IMT change over time was less than 0.05 mm over gap range of 0.3 mm to 1.7 mm. Average IMT measured in the distal CCA far wall in 24 subjects scanned twice within 60 days showed a mean absolute difference (MAD) of 0.03 mm with a SD of 0.04 mm. In another study, 12 subjects scanned every 4 months for 48 months (10 to 15 replicates per subject), MAD was 0.02 mm and SD 0.03 mm. Manual methods of IMT measurement have MAD of 0.08 to 0.13 and SD of 0.11. These data indicate that our method is not only precise over short time intervals (60 days) but also over long time intervals (48 months). In conclusion, our computerized AET method **represents a major advance for image analysis of B-mode ultrasound images of IMT reducing measurement variability 2 to 4 times compared with presently available manual methods.**