Title

CALCIUM ESTIMATION BY INTRAVASCULAR ULTRASOUND AND ULTRAFAST COMPUTED-TOMOGRAPHY

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Calcium Estimation by Intravascular Ultrasound and Ultrafast Computed Tomography

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Calcium in arterial lesions can be detected by both intravascular ultrasound (IVUS) and ultrafast computed tomography (UFCT). Validation of total calcium estimation has been demonstrated only for UFCT. To examine the utility of IVUS in estimating total calcium, 10 human arteries (9 coronaries and 1 iliac) were obtained at autopsy from 8 patients aged 41 to 83 years. Seven of the arteries were diseased, while 3 appeared normal. The arteries were pressure perfused with saline at 100 mmHg, and imaged using a 25 MHz IVUS catheter driven by a mechanical pull-back unit at 0.25 mm/sec to capture cross sectional images on videotape. Total calcium estimates were obtained using computer aided tracing of the calcified cross sectional areas (CSAs) at 0.5 mm intervals and application of Simpson's rule. Degrees of arc for the calcified CSA was also determined. Following fixation in 10% formalin, the arteries were placed in a phantom of the human chest and imaged with a UFCT scanner with a slice thickness of 3 mm. The UFCT images were analyzed by computer aided tracing of the calcified regions, followed by volume and mass estimation based on the outlined CSAs and densitometric data. The arteries were reduced to ash at 700° F, and the weight of the ashes was used to determine total calcium.

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Results: There was a close correlation between maximum calcium arc length by IVUS and UFCT (r = .81). However, the correlation between total calcium volume by IVUS and UFCT (r = .70) or between total calcium volume by IVUS and ash weight (r = .41) was dependent on the assumptions made when tracing the calcified CSAs in the IVUS images. In one artery which showed evidence of atheroma by IVUS there was no evidence of disease by UFCT, and in one artery which showed evidence of fibrous plaque by IVUS (no shadowing effect) there was significant evidence of calcium by UFCT.

Conclusion: Modifications in criteria used to identify calcium by IVUS are necessary before estimates of total calcium by IVUS will be reliable. IVUS shows greater sensitivity in detecting noncalcified lesions than UFCT.