

Ultrasonic Imaging for Detection of Early Stage Atherosclerosis and Tissue Characterization of Atherosclerotic Plaques

Bio-Microscope for Characterization of Arteries



Rupture of lipid-rich arteriosclerotic lesion causes a blood clot to form, which leads to acute myocardial infarction and stroke. Effective use of phase of ultrasound transmitted from surface of the body makes it possible to visualize elastic property of arterial walls and to classify tissues inside the arterial walls (lipid and fibrous tissue) by measuring the minute change in thickness of the arterial wall caused during a cardiac cycle. This accomplishment results in invention of the biological microscope that electronically stains composition of arteriosclerosis lesion. It pioneers diagnosis of adult diseases by detecting the abnormality in elasticity of an arterial wall which defined as morphologically normal by conventional diagnosis. We also believe that those our accomplishments could contribute to appropriation of human healthcare.



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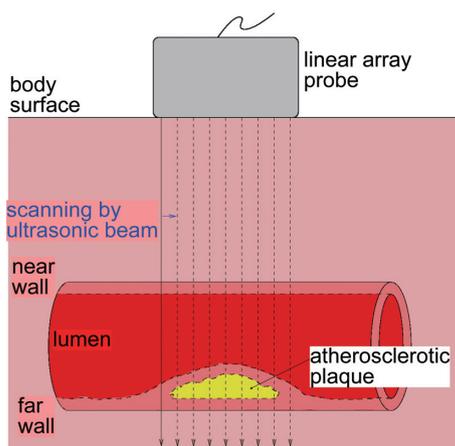


Fig. 1. Elasticity of arterial wall is evaluated by its minute change in thickness of arterial wall during a cardiac cycle measured with ultrasound and blood pressure measured in upper arm with a cuff.

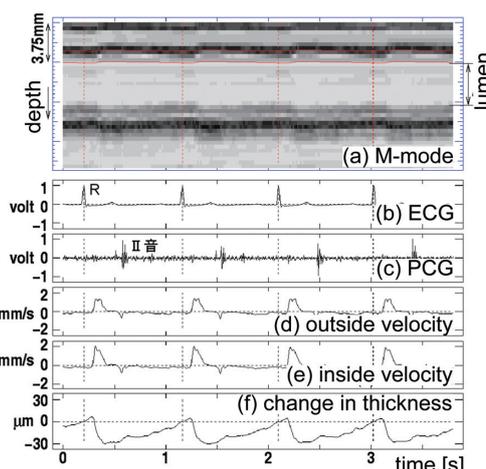


Fig. 2. Example of measurement of change in thickness of a carotid arterial wall. (a) Amplitude of echoes from near and far walls are shown in gray scale. Red lines show displacements of points of interest set at inside and outside of near wall. (b) Electrocardiogram (ECG). (c) Phonocardiogram (PCG). (d) Velocity at wall inside. (e) Velocity at wall outside. (f) Small change in thickness of near wall (< 30 μm).

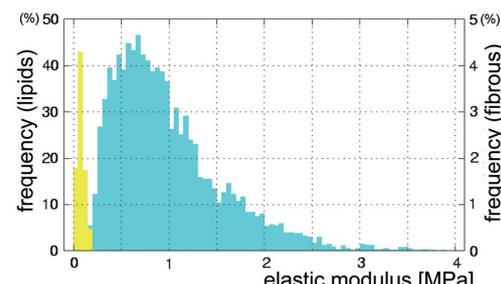


Fig. 3. Elasticity distributions of lipids (yellow) and fibrous tissue (cyan) obtained by elasticity measurements of 9 excised arteries.

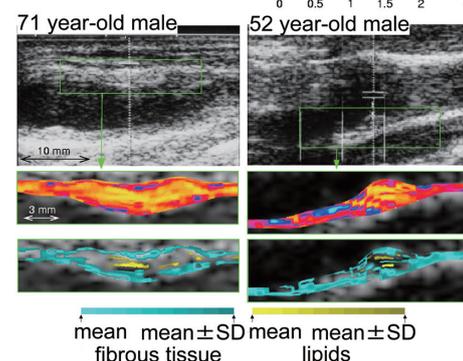


Fig. 4. Results for two patients with hyperlipidemia. **Top:** Conventional ultrasound images. **Middle:** Elasticity images. **Bottom:** Ultrasonic tissue characterization images.

reference: H. Kanai, H. Hasegawa, M. Ichiki, F. Tezuka, Y. Koiwa: *Circulation* **107**, 3018 (2003).