Title:

Potential of hemodynamic waveform analysis to detect early-stage atherosclerotic lesions of the aorta

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[English Abstract]

Alterations in arterial properties detected by pulse wave velocity and pulse wave analyses in patients with hypercholesterolemia are controversial. Therefore, we used an animal model of atherosclerosis to test the potential of arterial mechanical properties indexed by aortic input impedance (Z_{in}) as markers for early detection of atheromatous lesions in the aorta. In 12-month-old anesthetized Kurosawa and Kusanagi-Hypercholesterolemic Rabbits (KHC; n=15), pressure and flow were measured at the ascending aorta during sinus rhythm and random pacing. We confirmed histologically in previous studies that early-stage atheromas developed in the aorta by this age. Age-matched Japanese White rabbits (JW; n=13) had no overt atheroma. High-resolution Z_{in} derived from random beating data was characterized by a lower ratio of the first local maximum to minimum $|Z_{in}|$ (1.36±0.26 vs. 2.08±0.33; $p<10^{-5}$) accompanied by more delayed phases over a range between 6 and 8 Hz (-0.35±0.21 vs. -0.05±0.15 radian; p=0.0002); and a lower characteristic impedance (2.30±0.67 vs. 2.92±0.59 mmHg s kg BW/ml; p=0.016) in KHC than in JW rabbits. We concluded that frequency-specific changes in Z_{in} are sensitive hemodynamic markers that can detect early-stage atheromatous lesions in the aorta. High-resolution Z_{in} analysis is essential and useful for detecting such frequency-dependent findings.