Computed high concentrations of low-density lipoprotein correlate with plaque locations in human coronary arteries

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Subendothelial accumulation of low-density lipoprotein (LDL) in arterial walls is an initiator of atherosclerotic plaque formation. We report here on the correlation between healthy state subendothelial LDL concentration distribution and sites of subsequent plaque formation in coronary arteries of patients with coronary artery disease (CAD). We acquired left (LCA) and right coronary artery (RCA) and atherosclerotic plaque geometries of 60 patients with CAD using dual-source computed tomography angiography. After virtually removing all plaques to obtain an approximation of the arteries' healthy state, we calculated LDL concentration in the artery walls as a function of local lumen-side shear stress. We found that maximum subendothelial LDL concentrations at plaque locations were, on average, 45% (RCA) and 187% (LCA) higher than the respective average subendothelial concentration. Our results demonstrate that locally elevated subendothelial LDL concentration correlates with subsequent plaque formation at the same location.

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