Vulnerable Atherosclerotic Plaque Imaging System

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Technology description

Technical Summary

Acute myocardial infarction and sudden cardiac death remain a major cause of mortality in the United States. Despite aggressive anti-atherosclerotic therapies, patients with coronary artery disease continue to experience significant 1-year rates of myocardial infarction (7%) and death (4%). Frequently these coronary events result from the rupture of thin-cap fibroatheromas that are bulky, non-flow limiting, and reside largely in the vessel wall. Currently, these lesions cannot be identified with angiography; however, data indicates that the local hemodynamic environment [e.g., low and oscillatory wall shear stress (WSS)] is likely a contributor to the progression and vulnerability of coronary segments. While current angiographic and imaging technologies can measure plaque severity, burden, and composition, these modalities cannot model the vessel hemodynamic environment and incorporate such data to track plaque progression and predict the likelihood of rupture.

This comprehensive, minimally invasive coronary imaging system can identify areas vulnerable to rapid progression and future plaque rupture by calculating the local WSS values. Once identified, such vulnerable segments could be treated with percutaneous plaque modifiers, sealing agents, vascular stents, as well as systemic medical therapies (e.g. statins, reductase inhibitors, ACE inhibitors, beta-blockers). Furthermore, the imaging system is capable of monitoring and quantifying the effect of such therapies, thus functioning as a surrogate marker for therapeutic effects of vulnerable plaque therapy.

Application area

A comprehensive, minimally invasive diagnostic imaging system that can predict regional atherosclerotic plaque progression and identify potentially dangerous, unstable (i.e., “vulnerable”) plaques earlier than currently modalities.

Advantages

System can identify previously undetectable atherosclerotic “hot-spots” in coronary arteries that are likely to cause future heart attacks or sudden cardiac death.

System can prospectively monitor plaque progression in at-risk patients.

Combines intravascular ultrasound information on plaque morphology and composition with mechanical data on plaque WSS and deformation to identify areas in the coronary vasculature that are

vulnerable for rapid lesion progression and, potentially, future rupture leading to myocardial infarctions or death.
Incorporates angiographic data to reconstruct in-vivo patient specific geometry, including major branch points.
Calculate and display WSS values (magnitude and direction) throughout the cardiac cycle. Identify maximum, minimum, time-averaged, oscillatory WSS values.
Measures blood velocity using a Doppler wire instead of angiographic frame count, producing more accurate velocity profile and WSS values.

Institution

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