Risk Factors, the New Calcium Score, Rheology and Atherosclerosis Progression

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The Vulnerable Plaque vs. Plaque Burden

CT Angiogram

Who Cares About the Past?

Is There a Role for Coronary Artery Calcium Scoring for Management of Asymptomatic Patients at Risk for Coronary Artery Disease?

Why Is Subclinical Disease Superior to Risk Factor Assessment?
- Integration of Risk Factors including Unknown Factors, Multiple SNPs
- Subclinical Disease Reflects the “Dosage” of Risk Factors over time
- Quantifying Subclinical Disease Reflects the High Risk Patient-the vulnerable plaque does not

What is the extent of atherosclerosis at the time of coronary events?

Coronary Atherosclerosis is a Diffuse, Not a Focal Disease

Roberts WC. Am J Cardiol 1988;62: 142-143

Diffuse CAD in Pts Ieth AMI and CABG

Roberts WC. Am J Cardiol 1988;62 (1); 144-147

Coronaries in Angina

Roberts WC. Circulation 1976: 54(3) 388.
Angiographically unrecognized left main coronary artery disease.


Prognostic Value of Presence and Extent of Non-obstructive and Obstructive CAD By CT Angiography


Atherosclerosis: what is it and why does it occur?

Michael J. Davies

The Quantitative Nature of the Relationship of the Extent of Coronary Artery Atherosclerosis and Coronary Heart Disease Risk


Weber BJ. JAMA. 2012;308(24):2577-2583
The Concept of Duration of Risk Factor Exposure

Conventional Approach-Ignores Duration of Risk Factor Exposure Past and Future


Limitations of the usual blood-pressure hypothesis and importance of variability, instability, and episodic hypertension

Lancet 2010; 375: 938–48

Total Cholesterol Distribution: CHD vs Non-CHD Population

Framingham Heart Study—26-Year Follow-up


Hypertrophy

What about the Cumulative Dosage of High Blood Pressure, Hypercholesterolemia and other Risk Factors?
Hyperlipidemia in Early Adulthood Increases Long-Term Risk of Coronary Heart Disease

“The emerging data suggest that CHD risk is likely best expressed as a function of cumulative exposure to all risk determinants over a lifetime”

Is There a Role for Coronary Artery Calcium Scoring for Management of Asymptomatic Patients at Risk for Coronary Artery Disease?

Does the Extent of Atherosclerosis or the Rate of Atherosclerosis Predict Future Coronary Events? Percentile vs. Score
Why Do Coronary Events Occur Almost Exclusively After Extensive Atherosclerosis is Present?

The Role of Rheology

Cunningham, C. Laboratory Investigation (2005) 85, 9–23
Carotid Flow

Effects of Disturbed Flow on Vascular Endothelium

Physiol Rev 91: 327–387, 2011;

Rheology and Thrombosis

A shear gradient–dependent platelet aggregation mechanism drives thrombus formation

Nesbitt WS, NATURE MEDICINE VOLUME 2009;15 (6) : 665
Disturbed Blood Flow Acutely Induces Activation and Apoptosis of the Human Vascular Endothelium

Thus, our findings raise the idea that disturbed blood flow induces EMPs which may further promote endothelial dysfunction at distal sites, resulting in a feed-forward vicious cycle of vascular injury.

Jenkins NT. Hypertension. 2013;61:615-621
The Future of Coronary Imaging

There is a lot more clinical information in CT and CTA Images

Natural History of Atherosclerotic Plaque

Natural History of the Post Rupture Lesion

Fibrous tissue

Calcium

Old

Young
How do we best quantify this atherosclerosis progression on a CT scan?

Steady Athero Progression-55 yo

Steady Athero Progression 70 yo

Steady Athero Progression 45 yo

Life Long Exposure (Homozygous 9P21)
Individual Plaque Score

Arrested Progression due to Rx
- # of Lesions in Range
- Individual Plaque Score
- AF 73 M CAC=274, from low score age 63→MS→DM2 x 10 yrs

Late Onset due to Weight Gain → Metabolic Syndrome or Young Patient
- # of Lesions in Range
- Individual Plaque Score

Is There a Role for Coronary Artery Calcium Scoring for Management of Asymptomatic Patients at Risk for Coronary Artery Disease?
Natural Hx of Atherosclerosis Progression

Atherosclerosis Progression Patterns

Noninvasive Assessment of Gender Differences in Coronary Plaque Composition with Multidetector Computed Tomographic Angiography

Noninvasive Assessment of Plaque Characteristics With CTA in Symptomatic Type 2 Diabetic Patients

Natural Hx of Atherosclerosis Progression

Thank You
Monitoring Atherosclerosis Progression