Is Coronary Thermodilution as Accurate as Doppler Velocity for Measuring Coronary Flow Reserve?

William F. Feigen, Leora B. Balsam, H. M. Omar Fareque, Anthony D. Cavallaro, Robert C. Robbins, Peter J. Fitzgerald, Alan C. Yeung, Paul G. Yock, Stanford University, Stanford, CA

Background: Coronary flow reserve (CFR) is a new technique for measuring coronary flow reserve (CFR) using a coronary pressure wire and based on the ability of the pressure transducer to also measure temperature changes. CFR thermo was defined as the mean transit time of room temperature saline injected down the LAD at rest divided by the mean transit time at maximal hyperemia.

Methods: In an open-chest pig model, CFR thermo in the left anterior descending (LAD) artery was measured and compared to flow reserve from a Doppler wire (CFR doppler), and an external flow probe placed around the LAD (CFR flow). In 6 pigs, CFR was measured by both techniques in the normal LAD and after occlusion of an epicardial LAD stenosis. In order to determine the added effect of microvascular disease, measurements of flow reserve were also performed after disruption of the coronary microcirculation using endothelin-1 microbeads. Intracoronary papaverine (20 mg) was used to induce hyperemia.

Results: In a total of 31 paired measurements, CFR thermo correlated strongly with the reference standard CFR flow (r=0.89, p<0.001). CFR doppler correlated less well with CFR flow (r=0.77, p<0.001). The correlation between CFR doppler and CFR thermo was the least strong (r=0.72, p<0.001).

Conclusion: Assessing CFR using a coronary thermodilution technique correlates better with absolute flow derived CFR than does CFR measured with a Doppler wire.

First Experience With Noninvasive Ultrasound Enhancement of Selective Cellular Delivery of Liquid Perfluorocarbon Nanoparticles to Angiogenic Sites

Kathryn C. Crowder, Michael S. Hughes, Jon N. Marsh, Michael J. Scott, Lori Chinen, Thomas D. Harris, Gregory M. Lanza, Samuel A. Wickline, Washington University School of Medicine, St. Louis, MO, Biolomed/Quidel, N. Billerica, MA

Background: Given that ultrasound (US) has been proposed as an adjunctive method to enhance delivery of drugs in conjunction with microbubble cavitation, we sought to delineate its use for noninvasive liquid drug delivery with the use of targeted liquid perfluorocarbon nanoparticles (PNs). We have previously demonstrated the potential for PNs to deliver agents and kill cells selectively upon binding to specific cellular epitopes, and to deliver agents and kill cells selectively upon binding to specific cellular epitopes.

Methods: PNs were complexed with ligands targeted to αv in culture. Control PNs were produced that carried no ligand to αv. A custom specimen holder permitted simultaneous visualization of cell interactions (Nikon Diaphot 300). Exposure to calibrated levels of US energy was imposed (MI=1.9, exposure time: 5 min, 2-3 MHz phased array transducer: Acuson 20A). Perfluorecarbon content (PFC) measured by gas chromatography was used as a tracer to confirm delivery of particles to cells.

Results: After PN binding to cells and application of US, a 2-fold increase in deposition was observed (0.87 +/− 0.34 vs 1.15 +/− 0.97 micrograms, with and without US respectively, p<0.005). For control PNs (nonbinding), US increased PFC deposition, but the overall level was significantly less. We observed that PN's were not destroyed by US and that acoustic radiation forces (primary and secondary) may have participated in the enhanced delivery.

Conclusion: Enhancement of cellular interaction with targeted PNs is feasible by noninvasive mechanisms. Accordingly, US enhanced delivery of tracers or agents to a wide variety of pathologic tissues may be useful for augmenting drug delivery after targeting, while limiting untoward effects on other tissues.

Acute Pulmonary Vein Reaction to Radiofrequency Catheter Ablation for Atrial Fibrillation: Assessment Using Intracardiac Ultrasound

Hideaki Kanzaki, John Gorcsan, III, L. Elf Sade, Donald A. Severyn, David Schwartzman, University of Pittsburgh, Pittsburgh, PA

Background: Radiofrequency (RF) catheter ablation of pulmonary vein (PV) ostia is a novel therapy for atrial fibrillation. However, PV stenosis after the procedure has been a recent concern. To assess the acute effects of RF ablation, features of PVs were analyzed using left atrial intracardiac echo (ICE).

Methods: Twenty-three patients (age 52 ± 8 years) were studied. A total of 125 PVs were assessed with Acruson (Mountain View, CA) and 60 PVs with IMRI (Boston Sci). ICE. After RF-ablation, peak Doppler velocity at PV ostium increased from 62 ± 17 to 71 ± 24 cm/s and gradient increased from 1.2 ± 0.7 to 2.4 ± 1.4 mmHg, (p < 0.01). Abalation also resulted in an acute decrease in PV cross-sectional area (CSA) from 3.1 ± 1.8 to 1.9 ± 1.1 mm² (p<0.001). In wall thickening from 0.7 ± 0.2 to 1.6 ± 0.7 mm and loss of the normal mobility throughout the cardiac cycle. %change decreased from 27 ± 14% to 20 ± 8% (Fig). (p<0.01). Unablated PVs remained unchanged.

Conclusion: RF ablation resulted in acute increases in PV flow velocity and wall thickening and decreases in CSA and mobility, although no significant pulmonary stenosis was observed. ICE provided useful information about PV status in RF catheter ablation.

Vulnerable Plaque Diagnosis by a Self-Contained Intravascular Magnetic Resonance Imaging Probe in Ex Vivo Human Insult Coronary Arteries

Jacob Schneiderman, Robert L. Wilensky, Assaf Weiss, Etzik Samuels, Lev Muhchn, Gil Alexandrowicz, Malca Chen-Zion, Mordechay T. Ilovich, Moshe Flugelman, Erez Golani, Renu Virmani, Armed Forces Institute of Pathology, Washington, DC

Background: To evaluate the efficacy of a novel intravascular MR probe in diagnosing vulnerable plaques (VPs) within ex vivo insult human coronary arteries.

Methods: A novel self-contained MRI probe has been developed, which requires no external MRI set-up for producing local high resolution images. The probe has been integrated into an intravascular catheter. Fourteen fresh postmortem hearts from patients suspected of coronary death underwent selective coronary angiography, yielding 7 hearts with coronary atherosclerosis. Eighteen intermediate proximal lesions (within 6 cm from origin), each presenting stenosis in the range of 30%-60%, were designated for MR assessment and comparative histological validation. MR acquisition with the MR catheter was performed at preselected coronary lesions, with the MR probe gently applied to the luminal surface. The experimental set-up was designed to mimic coronary catheterization, thereby, intra-coronary pulsatile saline perfusion was maintained during acquisition. MR measurements were performed at 4 different angles along the circumference at each site (45° degrees apart). Each segment obtained underwent MR evaluation was also examined histologically by a trained pathologist unaware of the MR data, and the MR diagnosis was subsequently matched against aortocoronary bypass surgery. Results: Fifteen out of 18 lesions were accurately diagnosed as VP (3), or nonVP (12). There were two false positive diagnoses of VP, and one missed ruptured lesion, where typical lipid necrotic material was replaced by laminating thrombus.

Conclusion: The self-contained intravascular MR probe has been demonstrated as an