Fourier Phase Analysis Can Be Used to Objectively Analyze Real-Time Myocardial Contrast Echocardiograms

Alexander E. Hansen, Grigorios Korosoglou, Stefan Hardt, David Wolf, Arthur Flilus, Helmut F. Kuecherer, University of Heidelberg, Heidelberg, Germany

Background: Real-time myocardial contrast echo (MCE) is increasingly used to assess myocardial perfusion. However, objective methods for evaluating MCE are not yet widely available. We sought to validate the ability of Fourier analysis applied to MCE to assess serial changes in microvascular perfusion during coronary occlusion and reperfusion.

Methods: Six pigs underwent 45 min of LAD occlusion followed by 120 min of reperfusion. Real-time MCE was performed during coronary occlusion and reperfusion. Signal intensities from replenishment curves were fitted to an exponential function to obtain plateau A and the rate of A rise. MCE images were mathematically transformed using a first-harmonic Fourier algorithm displaying the sequence of myocardial intensity changes as phase angles in parametric images. The phase difference (PD) of posterior versus anterior region was calculated as an index of myocardial opacification heterogeneity and compared to MCE index of myocardial blood flow Axb.

Results: After initial hyperemia, a progressive reduction in flow was observed during reperfusion. During LAD occlusion signal intensities were significantly reduced in anterior regions (A = 0.02±0.01) compared to baseline (1.3±0.34, p<0.01) and approached higher levels post recanalization (A = 1.8±0.6) but gradually decreased during 120 min of reperfusion (A = 0.5±0.3, p<0.01). Similarly, profiles of phase angles in LAD perfusion territories were consistently modified during reperfusion. The mean PD at baseline was 14±15°, decreased during coronary occlusion to -106±38°, increased to 29±19° post recanalization but decreased to -61±35° after 120 min of reperfusion. PD significantly correlated with A (r = 0.8, p<0.0001) and b (r = 0.73, p<0.0001).

Conclusions: The progressive reduction in postischemic myocardial perfusion was accurately detected by real-time MCE. Fourier phase imaging is an easy and objective method to quantify dynamics of myocardial opacification in a simple and objective format and is a promising approach for the clinical interpretation of contrast echocardiograms.

POSTER SESSION

1018 Computed Tomography: Coronary Angiography

Sunday, March 07, 2004, 9:00 a.m.-11:00 a.m.
Morial Convention Center, Hall G
Presentation Hour: 10:00 a.m.-11:00 a.m.

1018-142 Is Computed Tomography-Based Coronary Angiography Ready for Prime Time? A Meta-Analysis

Udo Hoffman, Hossein Jadvar, Edward J. Dunn, Bertrand Janne d'Othee, Harvard School of Public Health, Boston, MA

Background: Both electron beam computed tomography (EBCT) and multidetector CT (MDCT) have been shown feasible to detect significant coronary artery disease. However, these methods have not gained widespread acceptance among clinicians. We systematically reviewed the published data to estimate the diagnostic accuracy.

Methods: Studies were included if they (1) used contrast-enhanced CT as a diagnostic test, (2) reported absolute numbers, (3) used catheter based coronary angiography (CCA) as a reference standard. We analyzed patient population, study methodology and quality. Pooled estimates of sensitivity and specificity to detect significant coronary artery disease (CAD) using both the fixed and the random effects models were calculated. Analysis was performed separately for EBCT and four and sixteen slice MDCT with and without exclusion of assessible segments/vesseils. In a subanalysis, pooled NPV and PPV for the detection of any significant coronary artery disease was determined.

Results: 25 published studies (13 EBCT, 12 MDCT) with 1,439 patients were analyzed. The study population consisted mostly of Caucasian middle aged males at high risk for CAD referred for an invasive angiogram (79 % males, mean age : 59 ± 3.6 years, prevalence of CAD: 63 ± 20%). For assessible segments/veseils, pooled sensitivity for EBCT, 4-slice MDCT and 16-slice MDCT was 84%, 74% and 92%, respectively and pooled specificity was 87%, 82% and 93%, respectively. All vessels/segments included pooled sensitivity and specificity were 54% and 53% for EBCT, 64% and 64% for 4-slice MDCT and 83% and 85% for 16-slice MDCT. In a subgroup of 522 patients from 12 studies, PPV and NPV for the detection of any significant CAD per patient were 66% and 82%, respectively.

Conclusion: The diagnostic accuracy of EBCT and four slice MDCT coronary angiography is limited with moderate PPV and NPV for the detection of any significant CAD. In contrast, initial data indicate the potential of sixteen slice MDCT to serve as a confirmatory test in CAD prior to CCA. However, generalizability of available data is limited due to selection bias. Further studies of well defined patient cohorts with low to intermediate risk for CAD are warranted.

1018-143 Comparison of 16-Slice Submillimeter Multidetector Spiral Computed Tomography With Conventional Angiography for Diagnosis of Coronary Artery Disease

David E. Buxton, Julie M. Miller, Joo C. Lima, Edward P. Shapiro, Johns Hopkins Bayview Medical Center, Baltimore, MD, Johns Hopkins University School of Medicine, Baltimore, MD

CT is an evolving technology. The latest 16 slice multi-detector CT (MDCT) scanners with rotation times of 400 ms can image slices as thin as 0.5 mm with temporal resolution of less than 100 milliseconds. We compared CT coronary angiography (CTA) with conventional coronary angiography (cath) in 66 patients with severe coronary stenosis (stenosis of at least 50%). Both pre and post intervention CTA datasets of the 20 patients as well as the 80 normal volunteers were analyzed.

Results: All arteries were correctly identified by MDCT. The mean area of normal arteries was 27±3.5 mm² and the mean area of stenotic arteries was 8±2.5 mm². The sensitivity of MDCT for the detection of any significant coronary artery stenosis was 92% (95% CI: 83-99) and the specificity was 97% (95% CI: 93-100). The positive predictive value was 98% (95% CI: 93-100) and the negative predictive value was 98% (95% CI: 93-100). The area under the receiver operating characteristic curve for MDCT was 0.99 (95% CI: 0.97-1.0).

Conclusion: Current MDCT provides CTA that is diagnostic in most patients. This should allow both accurate diagnosis of CAD, and triage toward appropriate management strategies.

1018-144 Assessment of Coronary Atherosclerotic Plaque Composition by Multideector Computed Tomography: Comparison to Intravascular Ultrasound

Stephan Achenbach, Fabian Moselewski, Dieter Ropers, Karsten Pohle, Udo Hoffmann, Maros Ferencik, Suhyu Abbara, Ricardo Cory, Ray Chan, Ik-yung Jang, Tom Brady, Werner G. Daniel, Massachusetts General Hospital, Boston, MA, University of Erlangen, Erlangen, Germany

Background: We assessed the ability of MDCT to differentiate the composition of non-calcified coronary atherosclerotic plaque in comparison to intravascular ultrasound (IVUS).

Methods: The progressive reduction in postischemic myocardial perfusion was accurately detected by real-time MCE. Fourier phase imaging is an easy and objective method to quantify dynamics of myocardial opacification in a simple and objective format and is a promising approach for the clinical interpretation of contrast echocardiograms.