Doppler Myocardial Imaging and Acute Myocardial Infarction

Date: 8/12/00, from 14:00 to 15:30

Location: Room 7A

Chairpersons:

P. Caso (Naples/IT)
J. Drozdz (Lodz/PL)

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Early improvement of myocardial systolic velocities assessed by Doppler tissue imaging after primary coronary angioplasty in acute myocardial infarction

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Purpose: to evaluate the ability of Doppler Tissue Imaging (DTI) to detect early contractile recovery after AMI, sequential changes in myocardial velocities were studied during the first 8 days after successful primary PTCA.

Methods: Myocardial Velocities (V) were measured in 12 patients (62±4 years, no previous MI) admitted < 8 hours after AMI onset, with single vessel CAD successfully treated by primary PTCA. Abnormalities of regional anteroseptal or posteroinferior contractility were present in all patients. Radial epicardial (Epi) and endocardial (Endo) systolic V and gradients (G) were calculated using Color M-mode DTI acquisitions (short axis view) performed in anteroseptal and posterior walls immediately before, then 1 and 8 days after PTCA. Contractile reserve during low dose dobutamine stress echocardiography performed at D8 was present in 6 pts (Via+) and absent in 6 pts (Via-).

Results: Significant improvement of systolic EndoV and G was observed at D8 in pts with viable myocardium, while there were no significant variations in pts with no viability (Results are presented as mean value±SD, V in cm/s, ° p<0.05 Via+ vs DO, *p<0.05 Via+ vs Via-).

Conclusion: Color M-mode DTI allowed quantitation of changes in myocardial velocities and gradients before and after primary PTCA in AMI. These changes seem related to the presence of myocardial viability.

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Assessment of myocardial function at infarct zone after angioplasty - a study with pulsed tissue Doppler echocardiography

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Angioplasty of an infarct related artery (IRA) performed several weeks or months after myocardial infarction (MI) can improve myocardial function. However, an improvement of regional wall function occurs only if the myocardium is viable. This study was designed to quantitatively assess changes of regional left ventricular function in patients after PTCA of IMA by means of pulsed tissue Doppler echocardiography (p-TDE). Materials: 20 patients (21 M, 8 F, mean age 52±6.7 yrs) who had had an MI two to six months earlier, were qualified for IRA angioplasty on the basis of a dobutamine stress echocardiography (DSE) test if it demonstrated a viable myocardium. Regional wall function was assessed by p-TDE one day before PTCA (exam 1), 1-2 days (exam 2) and 30 days (exam 3) after successful angioplasty. Myocardial velocities and time p-TDE intervals were calculated in both systole (systolic peak=S, pre-ejection period=PEP, contraction time=CT) and diastole (E and A wave peaks, E/A ratio, isovolumic relaxation time=IVRT, rapid filling phase=RFP, atrial filling phase=AFP). All parameters were derived from apical views in viable basal and mid – segments of posterior (16 pts), anterior (11 pts) and lateral (2 pts) walls.

Results: Regional TDE data in all the three examinations are shown in table. Conclusions: After successful angioplasty, TDE parameters demonstrate a rapid initial improvement, which is not followed by marked improvement over the period of the next month. Changes of time-derived p-TDE intervals seem to be the most sensitive markers of myocardial perfusion.

<table>
<thead>
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<th>TDE exam1</th>
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<td>166±27**</td>
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* p<0.05 **p< 0.01

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491 Do strain rate imaging derived parameters predict the long-term outcome of reperfusion therapy in acute myocardial infarction? – Preliminary results

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Background: Strain Rate Imaging (SR) is a new method to visualize regional myocardial deformation (Strain, S) and deformation rate (Strain Rate, SR). S and SR are calculated from myocardial tissue Doppler data on- or off-line and can be displayed as curve or color coded M-Mode. This study was designed to investigate the changes in regional myocardial function in patients (PT) undergoing reperfusion therapy (RT) due to an acute myocardial infarction (AMI).

Methods: In 23 PT submitted for AMI (mean age 61 years, 4 female, onset of symptoms < 6 hours), left ventricular walls were imaged from an apical window immediately before and 1 day, 2 weeks and 6 months after acute RT (PTCA or thrombolytic). We acquired tissue Doppler data with a System Five ultrasound machine (GE Vingmed, Norway) at a frame rate of 178 fps. Among other parameters, systolic (S) as well as peak systolic (peakS) velocities, IVRT, and early diastolic SR were measured off-line from our digitally stored data using a dedicated research software. Post systolic shortening (PSS), defined as onset of myocardial longitudinal shortening after aortic valve closure with preserved but delayed early diastolic lengthening, was visually assessed from curved M-Mode images. Regional wall motion was scored from digitally stored grey scale image loops. Data were compared to measurements from 22 normal volunteers (NV).

Results: Compared to other wall segments as well as NV, preliminary results from 10 PT with successful RT show a significant reduction of S and peakS SR at the area at risk during AMI. At day 1 after RT, peakS SR was unchanged in normal segments (2.6%, n.s.) and segments with later functional recovery (>7%, n.s.). Segments without later recovery had a decreased peakS SR on day 1 (31%, p<0.01). On admission, a typical PSS could be noted in 16 of 29 intact wall segments. On long term follow up, 14 of those 26 segments showed a functional recovery, but only 1 of 46 segments with absent PSS recovered (p<0.001, positive predictive value=53%, negative predictive value=89%).

Conclusion: SR reveals typical patterns and significant changes in regional myocardial function during AMI. The effect of a RT can be visualized and quantified. The absence of PSS before RT and a post-interventionally increased peakS SR at the area at risk during AMI may be an early predictor of functional recovery after AMI.

492 How does collateral flow modify segmental myocardial systolic function during PTCA in patients with ischaemic heart disease? A Doppler myocardial imaging study

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Background: Prior clinical studies documented the protective role of collateral circulation on LV global and regional performance during acute myocardial infarction (MI). The effect of a RT can be visualized and quantified. The absence of PSS before RT and a post-interventionally increased peakS SR at the area at risk during AMI may be an early predictor of functional recovery after AMI.

Methods: In 23 PT submitted for AMI (mean age 61 years, 4 female, onset of symptoms < 6 hours), left ventricular walls were imaged from an apical window immediately before and 1 day, 2 weeks and 6 months after acute RT (PTCA or thrombolytic). We acquired tissue Doppler data with a System Five ultrasound machine (GE Vingmed, Norway) at a frame rate of 178 fps. Among other parameters, systolic (S) as well as peak systolic (peakS) velocities, IVRT, and early diastolic SR were measured off-line from our digitally stored data using a dedicated research software. Post systolic shortening (PSS), defined as onset of myocardial longitudinal shortening after aortic valve closure with preserved but delayed early diastolic lengthening, was visually assessed from curved M-Mode images. Regional wall motion was scored from digitally stored grey scale image loops. Data were compared to measurements from 22 normal volunteers (NV).

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493 Lower systolic velocity assessed by colour-tissue Doppler echocardiography as independent predictor of cardiac events after myocardial infarction – 2 years follow-up

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Tissue Doppler Echocardiography (TDE) allows the quantification of left ventricular (LV) function. However, little is known about prognostic value of TDE parameters in patients (pts) after myocardial infarction (MI).

Aim: to determine whether TDE measurements can predict cardiac events (CE) after MI.

Material and Results: The study group included 71 pts after anterior MI (50 male, mean age 54+/-14 years, mean ejection fraction (EF) 44+/-12%). Following parameters were measured within two weeks after MI in 3 standard apical views in 402 basal segments of LV – peak velocities (cm/s): systolic (S), early (E) and late (A) diastolic and cardiac cycle intervals (ms): pre-ejection period (PEP), rapid ejection (RE), isovolumic relaxation time (IVRT) and rapid filling (RF). During 2 years follow-up CE occurred in 45 pts (cardiac death-2, MI-3, unstable angina-13, CABG or PTCA-27). We found several differences in TDE parameters between pts with and without CE during the follow-up (respectively, p<0.05, #p=NS, velocities: S: 3.5+/-1.7 vs 4.1+/-1.6, E: 3.2+/-2.1 vs 4.1+/-2.2, A: 4.5+/-2.2 vs 4.3+/-2.1, time intervals: PEP 13+/-19 vs 13+/-17, RE 23+/-16 vs 24+/-21, IVRT 10+/-16 vs 12+/-17, RF 12+/-4 vs 12+/-5#: In multivariate analysis, systolic velocity and EF were independent predictors of CE during 2-yrs follow-up (p<0.05).

Conclusions: TDE can provide clinical useful prognostic information in patients after MI. Characteristic features in patients with CE during 2 yrs follow-up are lower systolic and diastolic velocity, prolonged pre-ejection period and shorter IVRT. Systolic velocity assessed by TDE and EF are independent predictors of cardiac events.

494 Pulsed wave Doppler myocardial imaging (PW DMI) in detecting viable myocardium during dobutamine echocardiography

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The aim of the study was a quantitative assessment of regional systolic and diastolic myocardial velocities (mv) changes during dobutamine echocardiography (DE) in dysynergic but viable myocardial (VM) segments using pulsed wave Doppler myocardial imaging (PW DMI).

Methods: We studied 34 pts, 13±3 days after acute myocardial infarction. In all pts multi-stage (low-dose: 5-10 mcg/kg/min; high-dose: up to 40 mcg/kg/min) DE was performed. Apical views were used to assess mv (Acuson-Sequoia) at baseline, low and high DE. A 11 – segments left ventricular (LV) model was utilized. In each adequately visualized segment we calculated peak mv of systolic (S), early (E) and late (A) diastolic waves and their ratio E/A. Viability was defined as an improvement of wall motion during low-dose DE (LDDE) after an improvement at LDDE identified viable but jeopardized myocardium. Results: At baseline echocardiography 122 (32%) LV segments were dysynergic. At LDDE 51 (41.5%) VM segments in 16 (47%) pts were detected, while 71 segments were non viable. E and S mv and ratio E/A measured at baseline were significantly higher in viable compared to non viable segments. After LDDE in VM segments E/A and S increased significantly (E from 6.7+1.7 to 7.8±2.1 cm/s, P<0.01; E from 0.6±0.2 to 0.9±0.18, P=0.05; S from 6.5±1.9 to 7.9±2.3 cm/s, P=0.005). During HDDE in 52 (43.1%) out of 51 VM segments worsening in wall motion was detected. In those segments after HDDE, E, A and S were significantly less compared to the values at LDDE (E: 6.1±1.6 vs 7.3±1.8 cm/s, P<0.05; E/A: 0.8±0.13 vs 0.9±0.14, P<0.025; S: 5.9±2.1 vs 7.7±1.8 cm/s, P<0.01). Myocardial velocities measured at baseline and after HDDE in those 22 segments did not differ significantly.

Conclusion: Quantification of mv changes during DE allows identification of VM and detection of viable but jeopardized myocardium in pts with recent myocardial infarction. In VM segments values of E and S mv and ratio E/A significantly increased at LDDE, and significantly decreased at HDDE in viable but jeopardized segments.