Resolution of post-systolic strain as a non-invasive marker of successful revascularisation of viable myocardium in patients with ischaemic left ventricular dysfunction

R. I. Williams, N. Payne, A. Tweddel, J. D’Hooge, A. G. Fraser 1, University of Wales, Wales Heart Research Institute, Cardiff, United Kingdom; 2 Providence Health System, Portland, Oregon, United States of America; 3 University of Wales College of Medicine, Cardiff, United Kingdom; 4 University Hospital Gasthuisberg, Department of Cardiology, Leuven, Belgium

Background: LV function improves after early revascularisation in patients with extensive myocardial ischaemia, if there are many viable segments, and surgery also improves survival. Identifying patients who will benefit is difficult. In a prospective study, we assessed if pre-operative myocardial responses to dobutamine, assessed by tissue Doppler echocardiography (TDE), could predict improved regional function after coronary artery bypass surgery (CABG).

Methods: We studied 23 patients (21 men, aged 61-10 years) with multivessel coronary disease and poor LV function (ejection fraction EF<35% on Technecium 99 blood pool imaging). All had graded dobutamine stress echocardiography, with storage of digital loops (GE Vingmed) for off-line TDE analysis, and nitrate-enhanced rest-reconstruction Thallium 201 perfusion imaging. Perfusion scans were assessed and scored from polar plots scaled to 100% using a 16-segment model and a colour cut-off of 50%. Both investigations were repeated 6-8 months after elective CABG. Graft patency was confirmed by CT angiography.

Results: After CABG, mean segmental perfusion scores improved (from 6.7±2.7 pre-op to 9.8±2.7; p<0.02) and angular symptoms abated (Canadian Cardiac Society class, from 2.08±0.85 to 0.74±0.75; p<0.005). There was a smaller reduction in NYHA class (from 2.48±0.5 to 1.65±0.08; p<0.005), global EF was unchanged (32±17% pre-op v 34±13% post-op). Systolic strain rate in basal myocardial segments imaged from apical windows (thus assessing subendocardial longitudinal function) increased with dobutamine both before and after CABG, but there were no significant differences between pre-op and post-op studies. Peak myocardial systolic velocities increased similarly during both studies, and were not significantly greater after CABG. Normal systolic strain fell during dobutamine pre-op (from -8.4±0.9 to -6.1±0.7%, p<0.05) suggesting ischaemia, while after CABG it remained low at rest but did not deteriorate during dobutamine (-8.2±0.9 to -7.1±0.7%, ns). Post-systolic strain was observed during stress imaging before and after CABG (9.6±0.8 to -7.6±0.06%, p<0.05) but not afterwards (-0.1±0.01 to -0.1±0.01%, p<0.05 between pre- and post-op studies).

Conclusions: The elimination of post-systolic strain observed following successful revascularisation may be a sensitive non-invasive marker of improved myocardial perfusion and resolution of ischaemia. This study supports further investigation of post-systolic strain as a potential clinical marker of hibernating myocardium.

Functional diagnosis of coronary stenosis using tissue tracking provides best sensitivity and specificity for circumflex disease

S.K. Saha 1, C. Storaas 2, J. Nowak 3, S. Roumina 3, B. Lind 3, C. Maidler 4, A. Fraser 4, L.A. Brodin 1, on behalf of the MYDISE Investigators, 1 Huddinge Univ Hospital, Clinical Physiology Dept, D, Stockholm, Sweden; 2 Karolinska Institute, Medical Engineering, Stockholm, Sweden; 3 Huddinge University Hospital, Clinical Physiology Dept., Stockholm, Sweden; 4 University of Wales College of Medicine, Dept of Cardiology, Cardiff, United Kingdom

Background: Tissue Doppler (TVI) quantification of dobutamine stress echocardiography (DSE) for velocity-aided diagnosis of coronary artery disease (CAD) has yielded excellent diagnostic capacity in the European MYDISE & in the Australian study. In this study we have performed displacement imaging (tissue tracking, TT) of the MYDISE database in order to assess the diagnostic power of TT, an in-built component of the TVI software. Methods: The principle of TT is based on color-coding of the longitudinal atrioventricular motion (normally in decreasing order from base to apex of the left ventricle (LV) in systole. By dividing each LV wall from base to apex into 8 colour bands (2 mm each), it is possible not only to have a reasonable idea on the distribution of the motion data along a given LV wall, it also provides information on the strain (=deformation) in multiple segments. The stronger bands (pink, light & deep blue) represent the greater displacement in the basal segments while the weaker apical bands (yellow and red) represent the lesser power displacement in that region. By analysing the distribution pattern of color bands in 90 individuals with low probability of CAD, we used the ratio of the basal to apical bands expressed as a percentage of the involved myocardium (BA ratio) to study 120 patients with critical CAD. The diagnostic capacity of the procedure was assessed by receiver operating characteristic curves constructed by successive consideration of several BA cut points in all 4 myocardial walls (septal, anterior, lateral and inferior). Results: The TT derived BA ratio provided a significant discrimination of patients with CAD (p<0.05 for anterior wall, p<0.001 for all the others). The procedure appeared to be most sensitive for the detection of circumflex artery disease, the BA ratio of 0.8 in the inferior wall providing the best combination of sensitivity and specificity values (77±8% and 77±5%, respectively). Conclusion: Since velocity imaging alone can provide erroneous data because of "tethering" and "translational" effects, TT may provide an additional online option, literally in seconds, to quantify DSE in order to distinguish healthy from ischemic walls. Whether TT in combination with velocity or wall motion scoring can provide incremental information remains to be seen. The availability of newer soft wares along with image storage at higher frame rates would certainly improve the diagnostic capacity of TT, possibly by itself. Image quality of the anterior wall is still sub optimal as we reported previously.

117 Tissue velocity imaging and myocardial contrast echocardiography with power Doppler harmonic imaging during adenosine stress

A. Hagendorff 1, M. Pearson 1, A. Werner 1, N. Al-Saad 2, D. Pfeifer 1, H. Bechler 1, 1 University of Leipzig, Cardiology - Angiology, Leipzig, Germany; 2 University of Berlin - Campus Buch, Cardiology, Berlin, Germany; 3 University of Oxford, Cardiology, Oxford, United Kingdom

Tissue velocity imaging (TVI) is able to reduce the interobserver variability of regional wall motion in comparison to the analysis by eye. Myocardial contrast echocardiography (MCE) with power Doppler harmonic imaging (PDHI) using a repeti- tive bolus of 0.3ml Optison was shown to be able to detect regional hyperopposition in patients with acute coronary syndrome at rest. The aim of the present study was to evaluate prospectively the feasibility and efficacy of a combined contrast protocol with TVI and MCE using PDHI during adenosine stress (140 mg kg-1 min-1) echocardiography, 40 patients with unsppecfic stress induced chest pain were investigated at rest and during vasodilator stress. Coronary angiography was performed within one week after stress testing. Maximal shortening velocities below regional cut-off-values of regional systolic longitudinal shortening reported in the literature and regional post systolic longitudinal shortening of the mitral valve annulus were defined as pathologic. TVI dynamic was defined as significant alterations of TVI tracings detected in the early diastole. Per- fusion according to regional cut-off-values reported in the literature using a protocol for intravenous bolus administration of ultrasound contrast agents and according to the algorithm Distress > Direst was defined as pathologic. TVI and PDHI analysis at rest showed a high sensitivity and a low specificity to detect left ventricular territories supplied by a narrowed artery. The sensitivities for the detection of significant coronary artery disease calculated for the described dynamic TVI criteria were between 75 and 100% and the specificities between 67 and 95%. On the other hand MCE showed a high specificity but was not able to increase sensitivities and specificities to detect myocardial ischaemia.

Conclusions: The combination of TVI and MCE is possible using an intermit- tent bolus administration of microbubbles in clinical practice. However, the present study demonstrates that TVI is superior to MCE with PDHI using i.v. bolus adminis- tration of contrast to detect regional wall motion abnormalities due to myocardial hypoperfusion.

118 Importance of dobutamine Doppler tissue imaging on the evaluation of revascularization in patients with hyperperfused myocardium


To evaluate the efficiency of the new technique, colour Doppler tissue imaging (DDTI), before percutaneous coronary intervention (PCI), we studied 24 coronary artery patients using single photon emission computed tomography (SPECT) with Tc99m-MIBI and myocardial DTI during rest and pharmacologic stress.

Method: Dobutamine stress was used in 24 patients (mean age 56 ± 8 years; 5 women) with proven coronary artery disease (>70% diameter stenosis of at least one major coronary artery at angiogram). Myocardial tissue systolic and diastolic velocities from septal, lateral, anterior and inferior walls at rest and peak dobuta- mine stress were determined. SPECT images were performed after injection of MIBI at rest and peak dobutamine stress. Ischemic segments on the basis of SPECT findings were compared to nonischemic segments using DDTI.

Result: A total of 96 severely ischemic segments were visualised according to SPECT study. Mean ejection fraction was 5.7±1.5. Maximum mean septal, lateral, anterior and inferior DTI velocities were similar in ischemic and nonischemic segments (6.7 ± 1.1 cm/s, 6.8 ± 1.3 cm/s, respectively) at rest. Peak stress, maximum mean DTI systolic velocities were lower in the 37 ischemic seg- ments (10.7 ± 2.2 cm/s) than 59 nonischemic segments (13.9 ± 1.8 m/s, p < 0.001).

Conclusion: DTTI may be helpful as an adjunctive to SPECT to decide PCI when using dobutamine stress in the coronary artery disease. Addition to SPECT, more quantitative data by DTTI may provide better aggement for culprit lesion revascu- larization.