Changes in peak myocardial power and its timing immediately after CABG.

Methods: We studied 20 patients (15 unstable anginas and 5 poor LVs with hibernating myocardium) with mean age 63±7 yr, and 14 were males. Transesophageal Echo and high fidelity LV pressures recordings was performed immediately before cardiopulmonary bypass and 9 hours after CABG operation. Transverse LV cavity dimension and wall thickness were derived from mid-cavity M-mode echocardiogram by pressure digitation. Cardiac index and LV stroke volume index was measured by Swan-Ganz pulmonary catheter. The magnitude and timing (with respect to ECG’s q wave) of regional peak Vcf, peak systolic wall stress and peak myocardial power were determined. LV mean ejection rate and mean global power were also measured.

Results: The mean graft was 3.2±0.7, and the aortic cross clamp time was 61±22 min. 9 hours after operation, heart rate and LV flow pressure did not change. However, LV ejection time was shortened (231±31vs 296±41,msec), while cardiac index (2.6±0.5 vs 1.9±0.5, l/min/m²), LV stroke volume index (28±7 vs 23±9, ml/m²), LV mean ejection rate (122±25 vs 79±23, ml/sec/m²), LV mean power output (1.33±0.38 vs 0.91±0.33, W/m²) and LV peak +dp/dt (112±253 vs 974±221, mmHg/sec) all increased significantly, all p<0.01. In regional contraction, there was also a significant increase in peak Vcf (1.9±0.6 vs 1.5±0.6, cm/sec), peak myocardial power (30±11 vs 22±10, mW/cm²) and a significant shortening of time from wave to these peaks (178±40 vs 214±54, msec; 167±33 vs 194±41, msec; both p<0.01). LV peak systolic wall stress did not change, but its peak was also occurred earlier (149±30 vs 189±46, msec; p<0.01).

Conclusion: Early after successful CABG, there is a clear pattern change in LV contraction. This is manifested in both the rate and the timing of peak contraction. Tracking both aspects during CABG operation may provide a more robust physiologic judgement in clinical setting.

Coronary flow in pre and post immediate by echo transesophageal with power Doppler in myocardial revascularization surgery.

Objective: to demonstrate the type and standard of coronary arterial flow evaluated by echo transesophageal (ETE) in intra-operation pre-revascularization and immediately after myocardial revascularization surgery (MR).

Serial work in literature has presented analysis of coronary flow by ETE mainly with wave to these peaks (178 ± 25 vs 79 ± 23, ml/sec/m²), LV mean ejection rate (122 ± 25 vs 79 ± 23, mmHg/sec), all increased significantly, all p<0.01). LV mean ejection rate and mean global power were also measured.

Results: The mean graft was 3.2 ± 0.7, and the aortic cross clamp time was 61 ± 22 min. 9 hours after operation, heart rate and LV flow pressure did not change. However, LV ejection time was shortened (231 ± 31 vs 296 ± 41, msec), while cardiac index (2.6 ± 0.5 vs 1.9 ± 0.5, l/min/m²), LV stroke volume index (28 ± 7 vs 23 ± 9, ml/m²), LV mean ejection rate (122 ± 25 vs 79 ± 23, ml/sec/m²), LV mean power output (1.33 ± 0.38 vs 0.91 ± 0.33, W/m²) and LV peak +dp/dt (112 ± 253 vs 974 ± 221, mmHg/sec) all increased significantly, all p<0.01. In regional contraction, there was also a significant increase in peak Vcf (1.9 ± 0.6 vs 1.5 ± 0.6, cm/sec), peak myocardial power (30 ± 11 vs 22 ± 10, mW/cm²) and a significant shortening of time from wave to these peaks (178 ± 40 vs 214 ± 54, msec; 167 ± 33 vs 194 ± 41, msec; both p<0.01). LV peak systolic wall stress did not change, but its peak was also occurred earlier (149 ± 30 vs 189 ± 46, msec; p<0.01).

Conclusion: Early after successful CABG, there is a clear pattern change in LV contraction. This is manifested in both the rate and the timing of peak contraction. Tracking both aspects during CABG operation may provide a more robust physiologic judgement in clinical setting.

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700 Coronary acute syndrome stratification: additional prognostic value of the dobutamine stress echocardiography to clinical variables.

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Stress echocardiography (SE) bring prognostic information in non selected patients with coronary acute syndrome (CAS).

The aim of this study is to know the additional prognostic value to clinical variables in patients (p) with CAS, selected for a dobutamine stress test echocardiography (DSE) because an uninterpretable EKG ad or a non conclusive exercise test.

Methods: 90 consecutive patients (56 m.age: 64±9.7years) with CAS in wich a DSE was indicated for prognostic stratification following 14 months (1-30).

Results: During follow-up were 20 p with events (2 death, 2 non fatal MI and 16 revascularization). In 53 p (36%) the result of DSE was positive for ischemia and in 57 (64%) was negative.

Conclusion: Patients with coronary acute syndrome and risk TIMI low to moderate dobutamine stress echocardiography bring additional prognostic information to clinical variables, identifying subgroups of low and high risk.

701 Stress-echocardiography: additional prognostic value to TIMI risk score in unstable angina or acute myocardial infarction without st elevation stratification.

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Stress echocardiography (SE) bring prognostic information in non selected patients (p) with coronary acute syndrome.

The Aim of this study is to know the prognostic value of SE in p with unstable angina/acute myocardial infarction without st elevation (UA/AMINST) selected for a SE, because an uninterpretable EKG and/or a non conclusive exercise test (ACC/AHA Task-Force indication class I-IIa) in relation to clinical variates.

Methods: 101 consecutive p (47 m, Age:63.9±8.4years) with UA/AMINST in wich a pharmalogic SE was indicated (53 dobutamine and 48 glypyridamole) for prognostic stratification following 14 months (1-30), incidence of death, myocardial infarction (MI) and angina like combinates events were registered.

Results: During follow-up were 24 p with events (one death, 1 non fatal MI and 22 recurrence of angina). In 27 p (27%) the result in the SE was positive for ischemia and in 74 (73%) was negative.From p with positive SE, 57% had events vs 18% of p with negative SE (p=0.001).From p with positive SE, 83% had coronary desease vs 17% with normal coronary arteries. Score TIMI was 2.68±1.2, and significativally higher (3.57±1.3 vs 2.47±1.4, p: 0.004) in p with complications. In Kaplan-Meier curves 80% of patients with a negative SE were free from events vs 25% of those p with a positive SE (p:0.002).

Conclusion: Patients in unstable angina or AMI without ST elevation and low TIMI risk score, stress echocardiography bring additional prognostic information to clinical variates, identifying hihg and low risk subgroups.
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Dipyridamole-echocardiography: additional prognostic value to score TIMI in short and long term coronary acute syndrome stratification.

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Aims: Stress echocardiography (SE) brings prognostic information in non selected patients (p) with coronary acute syndrome selected for this test, with class I-II indication ACC/AHA task-force and the additional prognostic value in relation to clinical variables stratified by score TIMI.

Methods: 60 consecutive p (28 m, age 65±11 years) with CAS in wich a DypSE was indicated for prognostic stratification, following 14 months (1-30) incidence of angina myocardial infarction (MI) and death like combinations events were registered.

Results: During follow-up were 15 p with events (12 recurrence of angina, one death and 2 non fatal MI). In 16 p (26%) the result of DypSE was positive for ischemia and in 44p (73.3%) negative. TIMI score was 0.8±1.2, it was significantly higher in group with events (3.8±0.9 vs 2.7±1.3, p<0.005). From the positive DypSE had events vs 12% of p with negative DypSE, (p=0.003) and 90% of p with negative DypSE has been free from events in Kaplan-Meier curves.

Conclusions: From p with positive DypSE, 90% have coronary disease vs 10% de pacientes with normal coronary arteries, P=0.001, Pearson correlation, r=0.8.

Ischemia in DypSE was significantly associated with incidence of events in univariate analysis:RR=5.7 (1.6-19.6) p=0.006, RR TIMI: 1.4 (0.6-3.18) p<0.4.

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Integrated evaluation of brain natriuretic peptide and cytokine induced by dobutamine stress echo: implications for evolution of ischaemic heart failure.

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Introduction: Interleukin 6 (IL6) mediates the ischemia-reperfusion myocardial infarction and is a marker of left ventricular dysfunction.

Aim of the study was to assess changes of these parameters during Dobutamine Stress Echocardiography (DSE) and the prognostic implications of their integrated evaluation for the prediction of the evolution of ischemic heart failure.

Methods: We studied 55 consecutive patients (pts) with stable coronary acute syndrome. BNP was produced by the ventricles due to increased wall stress and is a marker of left ventricular dysfunction.

A 16 segments model was used for DSE analysis. During follow up (FU) of 67±12 (range 22-78) months, 19 pts had cardiac death.

Results: Pts who died had greater BNP (RQR 3535±25 vs 1981±30, p<0.005) but similar IL6 (P) compared with pts having uneventful FU (N). Group CE compared with N had differences on EF (32±6 vs 21±6, p<0.001), IL6 (R) (4.2±4.3 vs 4±1.4, p=0.02) and a trend in BNP (R) (291±242 vs 198±130, p=0.08).

For prediction of CE, ROC analysis showed the following cut off points and respective sensitivity/specificity: EF<32% 0.63/0.90, Score (R)=27 0.58/0.87, BNP (R)=230 0.42/0.77, IL6 (P)=2.75 0.50/0.86.

In stepwise logistic regression analysis (SLRA) for prediction of CE including EF, score(R), IL6(P), BNP=230 parameters and DSE outcome, then only IL6 (P) > 2.75 had independent contribution (exp(b)=0.0754, p=0.045).

In SLRA for prediction of CE including DSE outcome, BNP=230 and IL6 >2.75, then DSE outcome was not selected in the model(exp(b)=3.5 and 0.11 for BNP and IL6(P) respectively, p<0.01).

Pts with a positive DSE could be further stratified for CE by IL6 (P) >2.75 (Kaplan-Meier log rank p=0.052)

Pts with a negative DSE and EF< 30% could also be further stratified for CE by IL6 (P) >2.75 (Kaplan-Meier log rank p=0.03).

Among pts interrogated for viability, those with presence of viability had a worse prognosis in the presence of a BNP baseline value > 230 (Kaplan-Meier log rank p=0.027).

Conclusions: Integrated evaluation of cytokines and BNP both contribute for the evaluation of evolving ischemic heart failure. IL-6 or BNP contribute to stratification incrementally to classical danger signs of DSE.

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Long-term prognostic value of pacing stress echocardiography compared with dipyridamole Ti201 tomography in patients with permanent pacemaker and known or suspected coronary artery disease.


Background: Myocardial ischemia is difficult to assess by noninvasive methods in patients with permanent pacemaker (PP). Recently, pacing stress echocardiography (PCE) using external programming of the PP has been used successfully for this purpose. However, the prognostic value of this method is unknown.

Methods: We compared the long-term prognosis of PCE and radionuclide tomography (SPECT) in 46 patients (mean age 75 yr) with PP and known or suspected coronary artery disease. All patients underwent PCE with increasing pacing rate up to 100% of age predicted maximal heart rate or upper limit of pacemaker rate. Forty-one pts underwent dipyridamole SPECT. Patients were followed for a median of 570 days (range, 60-870 days) after testing.

Results: The PSE was negative in 17 and positive in 29 patients. The SPECT was negative in 8 and positive in 33 patients. During follow up there were 15 cardiac deaths (death, myocardial infarction and need for revascularization). The actuarial two year event-free survival was 81±13% in patients with normal PSE and 24±18% when the PSE was abnormal (p=0.03). SPECT predicted two years event-free survival of 88±11% and 41±19% in patients with normal and abnormal SPECT, respectively (p=NS).

Conclusions: In patients with PP, PSE allows effective risk stratification in patients with known or suspected coronary artery disease. PSE predicted long-term occurrence of cardiac events better than SPECT in this population.

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Can we predict better functional recovery after coronary revascularization in mildly hypokinetic segments?

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Background: In mildly hypokinetic segments the contractile reserve (CR) during low-dose dobutamine stress echocardiography (DSE) may represent subendocardial scar with normal contraction of the outer layers of the myocardium or hibernating myocardium. Therefore, many mildly hypokinetic segments do not recover after revascularization. Whether the high-dose DSE may improve the prediction of functional outcome in mildly hypokinetic segments is not yet clarified.

Materials and methods: We compared the long-term prognosis of PCE and radionuclide tomography (PCE) using external programming of the PP has been used successfully for this purpose. However, the prognostic value of this method is unknown.

Methods: We compared the long-term prognosis of PCE and radionuclide tomography (SPECT) in 46 patients (mean age 75 yr) with PP and known or suspected coronary artery disease. All patients underwent PCE with increasing pacing rate up to 100% of age predicted maximal heart rate or upper limit of pacemaker rate. Forty-one pts underwent dipyridamole SPECT. Patients were followed for a median of 570 days (range, 60-870 days) after testing.

Results: The PSE was negative in 17 and positive in 29 patients. The SPECT was negative in 8 and positive in 33 patients. During follow up there were 15 cardiac deaths (death, myocardial infarction and need for revascularization). The actuarial two year event-free survival was 81±13% in patients with normal PSE and 24±18% when the PSE was abnormal (p=0.03). SPECT predicted two years event-free survival of 88±11% and 41±19% in patients with normal and abnormal SPECT, respectively (p=NS).

Conclusions: In patients with PP, PSE allows effective risk stratification in patients with known or suspected coronary artery disease. PSE predicted long-term occurrence of cardiac events better than SPECT in this population.
706 The assessment of myocardial perfusion improves the prognostic value of dipyridamole stress echocardiography.
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Myocardial perfusion can be visualized during contrast echocardiography but the prognostic usefulness of this approach is yet unsettled. We performed a prospective study of a group of patients (pts) studied with high-dose dipyridamole stress echocardiography (DSE) with contrast myocardial perfusion imaging (MPI).
Methods: 87 consecutive pts admitted for diagnosis of chest pain (24 females, 63 males, age 56±8, height 170cm, weight 79kg) underwent DSE with MPI at baseline and peak stress (triggered harmonic imaging 1:4, repeated boluses of Opison 0.3-0.5ml, visual assessment by consensus of 2 experienced observers) and coronary angiography. Patients were prospectively followed-up with respect to mortality, revascularization, infarction and unstable angina (UA) for a period of 518±155 days, range 90-940. The prognostic value of resting (r) and inducible(i) wall motion abnormalities (WMA) and perfusion defects (CPD) was compared.
Results: Events occurred in 48 pts (5 deaths, 2 infarctions, 14 UA and 41 revascularizations). Mortality was thus low and poorly predicted by WMA or CPD separately, but test with inducible WMA and CPD carried a hazard ratio HR=7.0 (p=0.037) and negative predictive value 97%. Event-free survival was predicted by absence of i-WMA (HR=0.48, p=0.0099) and even better by absence of i-CPD (HR=0.45, p=0.0093) and best-by absence of any inducible abnormality (HR=0.44, p=0.00311) negative and positive predictive value 71% and 67%.

Conclusions: Even using simple triggered harmonic imaging and visual assessment, MPI enhances the prognostic value of DSE in patients undergoing diagnostics for chest pain. Normal dual test optimally predicts low mortality in 17-months follow-up.

707 Prognostic value of dobutamine stress echocardiography in patients with previous coronary revascularization.
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Objectives: The aim of this study was to assess the prognostic value of dobutamine stress echocardiography (DSE) in patients with previous coronary revascularization.
Methods: A total of 332 consecutive patients with previous percutaneous or surgical coronary revascularization underwent DSE. Follow-up was successful in 331 (99.7%) patients. Thirty-eight patients who underwent early revascularization (arrest revascularization) had at least one cardiac event within 3 months after the test were excluded from analysis. Cox proportional-hazards regression models were used to identify independent predictors of the composite of cardiac events (cardiac death, nonfatal myocardial infarction and late revascularization).
Results: During a mean of 24±20 months, 37 (13%) patients died, and 89 (30%) had at least one cardiac event (21%) cardiac deaths, 11% non-fatal myocardial infarctions, and 68 (23%) late revascularizations. In multivariate analysis of clinical data, independent predictors of late cardiac events were hypertension (hazard ratio [HR]: 1.7, 95% confidence interval [CI]: 1.1-2.6), and congestive heart failure (HR: 2.1, 95% CI: 1.3-3.2). Reversible wall motion abnormalities (ischemia) on DSE were incrementally predictive of cardiac events (HR: 2.1, 95% CI: 1.3-3.2).

Conclusions: Myocardial ischemia during DSE is independently predictive of cardiac events in patients with previous myocardial revascularization, after controlling for clinical data.

708 QT dispersion correlates to myocardial viability assessed by dobutamine stress echocardiography in patients with ischemic cardiomyopathy.
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Objectives: QT dispersion is prolonged in numerous cardiac diseases, representing a general repolarization abnormality. Our aim was to evaluate the influence of viable myocardium on QT dispersion in patients with ischemic cardiomyopathy.
Methods: A total of 103 patients with chronic coronary artery disease and poor left ventricular ejection fraction (LVEF: 25±6%; range: 10 to 35%) were studied. Patients underwent 12-lead electrocardiography to assess QT and rate-corrected (QTc) dispersions, and 2-dimenionional echocardiography to identify segmental dysfunction. Dobutamine stress echocardiography (DSE) was then performed to detect residual viability. A patient was classified as viable in the presence of ≥ 4 dysfunctional viable segments.
Results: Resting echo demonstrated 1260 dysfunctional segments; of these, 476 (38%) were viable. Sixty-two (60%) patients had substantial viability (>4 viable segments on DSE). QT dispersion was lower in these patients, than in patients without viability (55±17 ms vs. 65±22 ms, Ms = 0.012). The number of viable segments significantly correlated to QT dispersion (r=0.33, P=0.0011) (see Figure). In contrast, there was no correlation between LVEF and QT dispersion (r=-0.001, P = NS). Results for QTc dispersion were comparable.

Conclusions: QT dispersion correlates significantly to the number of viable segments assessed by DSE. Patients with ischemic cardiomyopathy and a low QT dispersion probably have a substantial amount of viable tissue. Conversely, in patients with a high QT dispersion the likelihood of substantial viability is reduced.

709 Pronostic value of exercise echocardiography in diabetic patients with known or suspected coronary artery disease.
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Coronary artery disease (CAD) is the leading cause of death in diabetic patients (pts). Currently there is a lack of data regarding to the value of exercise echocardiography (EE) for prognostic risk stratification in these pts.
Methods: 214 consecutive diabetic pts (mean age 64±8 years, 130 men) with known or suspected CAD who were referred for treadmill EE were included. Follow-up (F-U) data were obtained by reviewing clinical history and telephonic interview. During the 214 pts, F-U data was available in 207 (97%).
Results: Cardiac events during a F-U of 44±16 months occurred in 48 pts: unstable angina in 22, nonfatal myocardial infarction in 7 and cardiac death in 19. A total of 52 pts underwent revascularization, 40 because of the result of EE and 12 after a later event.
Ischemia was detected in 104 pts (50%) by EE (LV wall motion score index impairment at exercise) and in 69 pts (33%) by exercise ECG (p=0.001). Total cardiac event and cardiac death rate at F-U were lower in the 103 pts without ischemia on EE (49%) than in the 104 pts with ischemia (51%): total cardiac event: 15% vs 31%, p<0.01; cardiac death: 3% vs 10%, p<0.01. Previous myocardial infarction (OR: 1.83, 95% CI: 1.02-3.27, p=0.04) maximal workload (OR: 0.84, 95% CI: 0.75-0.94, p<0.01), insulin dependent diabetes (OR: 1.95, 95% CI: 1.09-3.48, p=0.02) and ischemia detected on EE (OR: 2.14, 95% CI: 1.16-3.94, p<0.01) were independent risk factors for predicting cardiac events by multivariate Cox’s analysis. Ischemia detected on EE (OR: 5.39, 95% CI: 1.56-18.59, p<0.01) and insulin dependent diabetics (OR: 3.34, 95% CI: 1.34-8.34, p=0.01) were independent risk factors for the prediction of cardiac death.
Conclusions: Ischemia detected by EE is an independent predictor of cardiac events and death in diabetic patients with known or suspected CAD.

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Comparison of peak and postexercise imaging during treadmill exercise echocardiography with the use of continuous harmonic imaging acquisition.

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Previous reports have demonstrated the superiority of peak (Pk) exercise echocardiography (EE) either with treadmill or bicycle in comparison with post-EE for the diagnosis of coronary artery disease (CAD). However most of these studies used fundamental imaging and viewing by view imaging acquisition. Technical advantages in stress echocardiography include harmonic imaging and continuous imaging capture.

Methods: To compare the feasibility and accuracy of peak- and post-EE using continuous harmonic imaging acquisition, we studied 240 consecutive patients (pts) referred for EE (age 60±13 years; 149 males). The only exclusion criteria was inability for exercise.

Results: Postexercise images were acquired within 60 seconds after exercise (30±9). Mean heart rate (bpm) was 141±22 at Pk vs. 128±33 at post-exercise imaging (p<0.001). The number of clearly visualized segments by view was similar at Pk- and post-EE except for the short-axis view (4-Ch apical: 5.9±0.4 vs. 5.9±0.3, p=NS; 2-ch apical: 5.9±0.4 vs. 5.9±0.3, p=NS; parasternal long-axis: 4.2±0.8 vs. 4.2±0.7, p=NS; parasternal short-axis: 4.9±1.6 vs. 5.1±1.4, p=0.01). Interpretable Pk and postexercise images (at least 2 views with ≥4 clearly visualized segments by view) were obtained for all the patients. LV wall motion score index and LVEF were worse at Pk than at post-exercise in patients with positive EE (1.5±0.3 vs. 1.4±0.3, p<0.001). For analysis of diagnostic capability we included 93 patients: 58 were included on the basis of having had an EE and a coronary angiography (CA) within 4 months of the EE. To avoid bias to CA a subgroup of 35 consecutive non-diabetic patients with pretest probability of CAD≤10% that had atypical chest pain or were asymptomatic were also included and considered as having no CAD. CAD (>49% diameter stenosis in at least 1 vessel) was confirmed in 46 patients, whereas 47 patients were considered to have no CAD. Positive EE was defined as ischemia or necrosis in at least 1 coronary artery territory. Sensitivity, specificity and accuracy for CAD were 91%, 81% and 86% with Pk-EE and 75%, 85% and 82% with post-EE, respectively (p=0.08 for sensitivity). Sensitivity for the prediction of multivessel CAD was 74% with Pk-EE and 63% with post-EE (p=NS).

Conclusion: Peak treadmill EE is as feasible as post-EE. Ischemia is more easily detected at peak than at postexercise. Therefore, in the clinical setting peak-EE should be performed for diagnostic purposes.

Prognostic value of noninvasive permanent pacemaker stress echocardiography.

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Background: Noninvasive stress echocardiography (PASE) is simple and efficient option for noninvasive diagnosis of coronary artery disease in the expanding population of patients with permanent pacemaker.

Aim: We investigated the prognostic value of PASE in patients with known or suspected coronary artery disease.

Methods: Seventy-six patients (men, age 67±11 years) with permanent pacemakers underwent PASE by external programming (10 bpm increment up to evidence of ischemia or target heart rate). All patients were prospectively evaluated during mean follow-up of 17±8 months.

Results: A positive result of stress echocardiography was detected in 30 (39%) patients. During follow-up, there were 3 cardiac deaths, 2 myocardial infarctions, 10 clinically-driven coronary revascularizations and 8 unstable anginas. The overall event-free survival was lower in patients with positive PASE (p<0.001). (Picture). In a multivariate analysis positive result of stress echocardiography was independently associated with increased risk (hazard ratio = 6.8, 95% confidence interval: 2.1 to 13.0; p<0.001).

Conclusions: Positive noninvasive PASE is a strong prognostic factor in patients with suspected or known coronary artery disease.
715 Late color M-Mode flow propagation as an index of left atrial function in pts with non-ischemic dilated cardiomyopathy. Effects of Dobutamine.
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Methods: Twenty eight pts with angiographically proven NIDC, NYHA functional class II-III and LVEF 30.57±6.21% were entered into the study. Dobutamine (10-40 mg/min) was infused in pts and left atrial transmural velocities (m.v.) changes in the presence of stress induced myocardial ischaemia (m.i.) in diabetic patients (pts) using pulsed wave Doppler myocardial imaging (PW-DMI).

Results: The WMSI(2.1±0.24 vs 1.54±0.36, P<0.001) was reduced. ANP (3.7±0.4 vs 3.3±2.3pmol/ml, P<0.02) and BNP (0.77±0.41 vs 0.71±0.39 pmol/ml, P=0.01) levels showed also a significant reduction at LDDE. A significant correlation was found between the resting Ep/Ap ratio with resting BNP levels (r=0.59, P<0.04) and between the Ap changes at Dobutamine was correlated with ANP changes (r=0.53, P<0.04).

Conclusions: The Ep/Aratio is related to BNP levels suggesting that it may be a useful index in assessing LV filling pressures in NIDC pts. The relationship of Ap changes to ANP changes at LDDE propose that Ap may depends to LA stretch and depolarization to accelerate. The maintained LA ejection velocities seem to be preserved only at the expense of raised atrial pressure as demonstrated by the voltage increase of P wave on the surface ECG.
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Application of a novel non tissue doppler based method for real-time quantitative assessment of myocardial function in normal subjects during exercise echocardiography.

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Objectives: To assess the feasibility of a novel software for real-time quantitative assessment of myocardial function in normal subjects during exercise echocardiography.

Methods: 12 patients underwent standard exercise echocardiography. Apical views at baseline and peak exercise were stored in a cineloop format for off-line analysis. The novel software is based on the estimation that a discrete set of tissue velocities per each of many small elements on ultrasound image show only mild shift during stress echocardiography and displayed in real time by the software. We also introduced a new parameter: Corrected time to the peak systolic strain was shorter at peak exercise than at rest; wall motion score in at least two contiguous segments was noted, during either stress echocardiography or levosimendan infusion. All patients also underwent resting echocardiography within 6 months after successful revascularization.

Results: Of the 448 segments studied, 212 (47%) was dyssynergic at rest. Dobutamine infusion resulted in augmented contraction in 96/212 (46%) abnormal segments while 88/90% of these showed functional improvement after revascularization. During LSE 110/220(52%) dyssynergic segments improved and 100/91% of these recovered function after revascularization. Analysis of results showed a significantly lower sensitivity of LSE compared with LSE (73% vs 94% respectively, p<0.001) but a similar specificity (89% vs 80%, respectively, p=ns) for the prediction of postrevascularization recovery of left ventricular dysynergies.

Conclusions: LSE can predict postrevascularization recovery of left ventricular dysynergies with higher accuracy than DSE.

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Dobutamine versus levosimendan stress echocardiography in the prediction of recovery of left ventricular dyssynergies after revascularization.

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Objectives: To compare the accuracy of levosimendan (L) and dobutamine stress echocardiography (DSE) for the prediction of recovery of left ventricular dysynergies after revascularization.

Methods: Twenty eight patients with left ventricular dysfunction due to previous myocardial infarction scheduled for revascularization (18 PTCA and 10 CABG) underwent low-dose DSE (5-10ug/kg/min) and LSE. Levosimendan was infused at least 1h after dobutamine infusion, at 2 doses of 12 and 24ug/kg, over a 5 min period each. Left ventricular wall motion score was assessed using a 16-segment model. Myocardial viability was detected if improvement of >1 grade of regional wall motion score in at least two contiguous segments was noted, during either stress echocardiography or levosimendan infusion. All patients also underwent resting echocardiography.

Results: Of the 448 segments studied, 212 (47%) was dyssynergic at rest. Dobutamine infusion resulted in augmented contraction in 96/212 (46%) abnormal segments while 88/90% of these showed functional improvement after revascularization. During LSE 110/220(52%) dyssynergic segments improved and 100/91% of these recovered function after revascularization. Analysis of results showed a significantly lower sensitivity of LSE compared with LSE (73% vs 94% respectively, p<0.001) but a similar specificity (89% vs 80%, respectively, p=ns) for the prediction of postrevascularization recovery of left ventricular dysynergies.

Conclusions: LSE can predict postrevascularization recovery of left ventricular dysynergies with higher accuracy than DSE.
722 Noninvasive assessment of left ventricular contractility by pacemaker stress echocardiography.
T. Bombardini1, A. Varga2, R. Pap2, N. Nativishvili1, F. Solomine2, F. Coltorti3, M. Agrusta2, G. Motolla1, E. Picallo1, C. Neri, Institute of Clinical Physiology, Pisa, Italy; 2University of Szeged, II Dept of Int Med and Card Center, Szeged, Hungary; 3Montevergine Clinic, Div. of Invasive Cardiology, Mercogliano (AV), Italy; 4CNR, Institute of Clinical Physiology, Pisa, Italy

Background: Estimation of contractility of left ventricle is an important, and as yet elusive, goal with noninvasive techniques. Positive inotropic interventions are mirrored by smaller end-systolic volumes and higher end-systolic pressures. An increased heart rate progressively increases the force of ventricular contraction (Bowditch treppe or staircase phenomenon).

Aim: To assess the feasibility of a non-invasive estimation of force-frequency relation (FFR) during pacing stress in the echo lab in patients with permanent pacemaker.

Methods: Transthoracic stress pacing echocardiography was performed in 22 patients with a permanent pacemaker (17 men; age 68±12 years). Seven patients had mitral valve disease, nine patients underwent stress during “normalized”; 9 had angiographically assessed coronary artery disease (3 with and 6 without induced ischemia with stress echo); 6 patients had dilated cardiomyopathy. To build the FFR, the force was determined at different steps as the ratio of the systolic pressure (SP, cuff sphygmomanometer) versus end-systolic volume index (ESV, biplane Simpson rule/body surface area). Heart rate was determined from ECG.

Results: The absolute value of the FFR slope was highest in controls and lowest in DC patients (figure). A flat-downsloping FFR was found in 9/7 normals and in 11/15 patients (p<0.1).

Conclusions: Non-invasive PASE is a simple and efficient option to assess left ventricular contractility in patients with permanent PM.

723 Echocardiographic detection of coronary artery disease during dobutamine infusion in patients with moderate aortic stenosis and normal left ventricular function.
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Background: Resting ECG in patients (pts) with aortic stenosis (AS) often reveals ST segment abnormalities due to hypotrophy and/or dilatation of the left ventricle (LV), making the diagnosis of coronary artery disease (CAD) on the basis of exercise ECG uncertain. However usefulness of dobutamine echocardiography (DE) in patients with AS has not been determined.

Aim: To assess the usefulness of DE for detection of CAD in patients with normal LV function with moderately increased transvalvular gradient through the stenotic aortic valve.

Materials: 123 pts (mean age 59 yrs, 8:18, 59.9% male) with AS and maximal aortic gradient in the range 25-65mmHg, without contraindication to DE, with normal LV systolic function. LV 52% were hypertensive.

Methods: All pts underwent standard DE (doses 5-40mcg/kg/min) in the framework of multicenter study involving 10 centers from Poland and Hungary. Classical DE termination criteria were used. Reaching maximal aortic gradient of 100mmHg during DE was also a reason for test termination. Diagnostic value of DE was assessed in relation to the significant coronary stenosis (>50%).

Results: Peak dobutamine dose was 32±11mcg/kg/min. Peak heart rate was 115±26bpm, systolic arterial pressure – 141±24 and diastolic pressure – 80±14mmHg. Transaortic mean and peak gradient increased from 31±13 and 48±15mmHg at rest up to 49±20 and 83±29mmHg (<0.001) during peak dobutamine dose, respectively. Aortic valve area did not change significantly during DE. DE was positive for ischemia in 17.9% of pts, negative – 45.5%, nondiagnostic – 36%.

Sensitivity of DE was 64%, specificity – 87%, positive predictive value – 72.7%, negative predictive value 87%.The reason for test termination was submaximal heart rate reached in 54±43(%), maximal dobutamine and atropine dose reached in 10.8(%), new wall motion abnormalities in 23(18,7%), side effects in 36(29,2%) and patients wish in 1(0,8%). No dangerous complications such as infarction, ventricular fibrillation or death were observed.

Conclusions: DE in pts with moderate AS is a valuable non-invasive method for studying LV contractility and coronary circulation. Pts can safely undergo DE. Although side effects occur more often than in pts diagnosed for CAD, they are mild and resolve without medical treatment. In pts with AS relatively high percentage of nondiagnostic DE tests was found.

724 Influence of beta-blockade on results of low-dose dipyridamole echocardiography tests for myocardial viability.
A. Djordjevic-Dikic, M. Ostojic, B. Beleslin, I. Nedeljkovic, J. Stepanovic, V. Giga, S. Stojkovic, M. Nedeljkovic, Z. Petrasinovic, A. Arandjevlic, Institute for Cardiovascular Disease, Cardiology, Belgrade, Yugoslavia

Introduction: In everyday clinical practice patients with chronic ischemic cardiomyopathies are usually under beta-blockade protection. It is always a safety issue whether beta blockers be withdrawn when diagnostic tests for ischemia and viability are performed.

Objective: The aim of this study was to examine the influence of beta–blockade on diagnostic potential of low-dose dipyridamole echocardiography test for viability.

Methods: Forty patients with resting dyssynergy, due to previous myocardial infarction, underwent low-dose dipyridamole (0.28mg/kg in 4 minutes interval) echocardiography test. Blockers were present in 19 pts. Criterion for viability was improvement in systolic thickening of dyssinergic segments of ≥1 grade. Coronary angiography performed in all pts revealed multivessel coronary artery disease in 29 patients and one vessel disease in 11, (diameter stenosis ≥50% of at least one major coronary artery). Mean EF was 50±5.44. Total number of dysfunctional segments at resting echocardiography was 315.

Results: During low-dose dipyridamole test WMSI significantly decreased in group of pts on beta-blocker therapy (1.76±0.36, p<0.05 vs. WMSI at rest) as well as in pts off beta-blockers (1.78±0.43, p<0.05 vs. WMSI at rest). Low dose dipyridamole identified 97 segments as viable in dysfunctional regions.

Conclusion: According to our results diagnostic potential of low-dose dipyridamole echocardiography test is not influenced by beta-blocker therapy and this could be recommendation for its use in everyday clinical practice when it is not possible to rule out therapy for safety reasons.

725 Tissue Doppler imaging with dipyridamole provocation predicts significant coronary artery disease.
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Introduction: Diastolic dysfunction precedes systolic dysfunction in myocardial ischemia and therefore may be a more sensitive parameter in stress echocardiography. We assessed the hypothesis that diastolic myocardial velocity measured by tissue Doppler imaging (TDI) can be used for evaluation of CAD.

Methods: Forty-five patients (mean age, 64.2±11.9 years; 31 men and 14 women) underwent TDI before and just after dipyridamole infusion (0.56 mg/kg in 4 minutes interval) at six sites (septal and lateral, anterior and inferior, anteroseptal and posterior left ventricular wall) adjacent to the mitral annulus, the early diastolic myocardial velocities (Em) were measured by TDI echocardiography in the apical 4-chamber, 2-chamber, and long-axis views, respectively. In each segment, the delta Em was calculated as the Em immediately after dipyridamole infusion minus the Em prior to dipyridamole infusion. The minimum delta Em in the six segments was assessed as the marker of ischemia. Each patient also underwent quantitative coronary angiography, and 22 patients were found to have significant coronary artery disease (CAD) defined as stenoses >50%, and the remaining 23 patients did not.

Results: The average delta Em of the six segments was lower in patients with CAD than in those who did not (mean ± SD, 1.34 ± 1.71 cm/s vs. 3.57 ± 2.62 cm/s, P<0.005). The minimum delta Em in the six segments was lower in patients with CAD than in those without CAD (mean ± SD, -1.43 ± 2.09 cm/s vs. 1.24 ± 2.48 cm/s, P<0.0005). The Em decreased in at least one of the six segments after dipyridamole infusion in 19 of the 22 patients (86%) with CAD. In contrast, Em increased in all six segments after dipyridamole infusion in 16 of the 23 patients (70%) without CAD. Therefore, a decrease in Em in at least one segment after dipyridamole infusion predicted CAD with a sensitivity of 86%, a specificity of 70%, a positive predictive value of 73%, a negative predictive value of 84%, and a diagnostic accuracy of 78%. No major side effects or complications occurred in any patients during the examination.

Conclusion: Dipyridamole stress TDI predicts significant CAD noninvasively.
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Mental stress and myocardial ischemia: hemodynamic and echocardiographic parameters.
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Introduction: Indirect evidences have suggested a link between mental stress and coronary artery disease (CAD). Recent research in CAD patients has confirmed the observation that mental stress is a potent trigger of myocardial ischemia.

Objective: The aim of this study was to evaluate the feasibility of mental stress test and the relation between mental stress and occurrence of myocardial ischemia as evaluated by echocardiography.

Methods: All laboratory sessions began at noon, and the patients were studied off antangleial therapy. Study population included 38 patients with angiographically proven CAD (31 male, 7 female, mean age 48±10 years; multivessel CAD in all patients) and previous positive exercise stress test (development of chest pain and ST depression >1mv, 0.08 sec after J point). 12-leads ECG, blood pressure, and echocardiography for wall motion abnormalities were continuously monitored. Test protocol consisted of rest phase (30 min in a partially darkened room), mental task phase: mental arithmetic (5 min, subtract 7s' serially from a 4-digit number) and sim- plated public speech task (10-15 min, describing their personal faults and shortcomings). After mental stress test, in all patients submaximal Bruce treadmill protocol was performed.

Results: Mental stress test was successfully performed in all patients (feasibility 100%). During mental stress test, chest pain occurred in 5/38 pts (13%), ischemic ECG changes developed in 9/38 pts (24%, p< vs. angina) and new or worsening of wall motion abnormalities was observed in 22/38 (58%, p< vs. angina and ECG). Exercise stress echocardiography test after mental stress test was positive in 33/38 pts (100%; in 3 pts exercise stress test was not performed because of hypertensive reaction during mental stress test).

Conclusion: These results showed excellent feasibility of mental stress test and direct evidence that myocardial ischemia in significant number of pts with severe coronary artery disease is related to mental stress.

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Aim: The aim of this study was to evaluate the optimal surgical treatment of patients (pts) with severe post-myocardial infarction mitral regurgitation (MR), based upon transesophageal dobutamine stress echocardiography (TEE-DASE) results.

Material: The study group comprised 170 pts (105 men, 65 women; aged 64±11) with a history of MI following echo and coronary angiography (2-6 weeks post-MI). In this group small and mild MR was observed in 64 pts (38%), severe in 17 pts (10%). Detailed analysis was performed in 17 pts with severe MR. All this pts had multiple vessel coronary disease, significant contractility disturbances (EF<40%, WMSI ≥1.7) and were qualified to coronary artery bypass graft (CABG).

Method: All patients, prior to surgery underwent TEE examination for evaluation of mitral valve apparatus and TEE-DASE examinations for the evaluation of muscle function and MR. TEE-DASE was performed using Philips Sonos 5500 and 2500 of mitral valve apparatus and TEE-DASE examinations for the evaluation of muscle function and MR. TEE-DASE was performed using Philips Sonos 5500 and 2500.

Results: Influence of TEE-DASE on MR. In group 1 there were 6 pts with significant MR decrease(at least 2+). In group 2 we observed 11 pts without influence on MR or MR decreased without WMSI changes. Patients were qualified towards CABG if MR and WMSI deterioration during TEE-DASE (Group 1), while those without DASE influence on MR or decreased MR without WMSI changes (Group 2) underwent CABG and mitral plastic or valve replacement. Further patient analysis, according to administered treatment

Table 1. Degree of MR following treatment

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=17</td>
<td>After CABG</td>
<td>After CABG/mitral plastic</td>
</tr>
<tr>
<td>Small MR</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Mild MR</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Conclusions: 1. TEE-DASE enables to select patients with significant MR, in whom CABG improves mitral valve functioning.
2. TEE-DASE enables patient selection, in whom CABG should be performed with mitral plastic or valve replacement.

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Force-frequency relationship during dobutamine stress echo: noninvasive exercise-independent assessment of left ventricular contractility.
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Background: Force-Frequency relationship (FFR) is a methodologically robust approach to evaluate left ventricular contractility during exercise echo.

Aim: To assess the feasibility of a noninvasive estimation of FFR during dobutamine stress in the echo lab.

Methods: We enrolled 33 consecutive patients (27 males, age 66±12 years) referred for dobutamine stress echo (up to 40 mcg/kg/min). Ejection fraction was 41±15%. To build the FFR, the force was determined at different steps as the ratio of the systolic pressure (SP, cuff sphygmomanometer)/end-systolic volume index (ESV, biplane Simpson rule/body surface area). Heart rate was determined from ECG at different dobutamine steps.

Results: Dobutamine stress was uneventfully completed in all patients. The FFR could be obtained in all. The 15 pts with ischemic echo response (new or worsening dyssynergy) had a flat-downsloping FFR slope (1.5±2.5 x 10-2); the 18 patients with normal–response showed an upstoring FFR slope (3.2±1.9 x 10-2, p=0.05 between groups) (figure), in spite of comparable resting ejection fraction.

Conclusions: A noninvasive estimation of FFR is feasible during dobutamine stress in the echo lab. It unmask a substantially heterogeneous contractile response in patients with similar values of conventional indices of left ventricular function.

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Assessing the effect of low dose dobutamine on various diastolic function indexes.
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Objective: Despite the well known effect of low dose dobutamine (LDD) in patients with left ventricular dysfunction, its effect on various diastolic function parameters in patients with normal wall motion is not clear.

The aim of this study was to evaluate the effect of LDD infusion at a dosage of 5mcg/kg of body weight, which usually does not increase the heart rate, on various diastolic function parameters.

Methods: Thirty-one volunteer patients who had no regional wall motion abnormality were included in the study. There were 16 (51%) men and 15 (49%) women, ranging in age from 31 to 76 years (mean±SD 53 ± 12). Echocardiographic measurements were taken both at pre-dobutamine and during LDD. The second echocardiographic examination begun at least 5 minute after the infusion was started. Left ventricular ejection fraction (EF) was calculated with the modified Simpson’s method The peak E velocity, the E/A ratio, deceleration time (DT),isovolumetric relaxation time (IVRT), myocardial performance index (MPI), flow propagation velocity (FPV) were assessed as left ventricular diastolic function parameters. Early (Em) and late (Am) diastolic mitral annulus tissue Doppler velocities were also obtained in order to calculate the E/Em and Em/Am ratio.

Results: No significant changes were observed in heart rate, E velocity, E/A ratio, E/Em ratio, Em/Am ratio, systolic and diastolic blood pressure with LDD (5u/kg of body weight per minute). With LDD, DT (239±40 vs. 201±31, p<0.001), IVRT (109±12 vs 94±11, p<0.001), MPI (549±35 vs. 423±39, p<0.001) were found to be decreased, while there was an increase in FPV (45±8 vs 59±10, p<0.001) and EF (64±6 vs. 66±7, p<0.05).

Conclusion: Low dose dobutamine (5mcg/kg of body weight) improves left ventricular relaxation in patients with normal wall motion, while it has no effect on left ventricular filling pressure.
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Systolic mitral annular Doppler velocities immediately after dobutamine stress echocardiography predict left ventricular ischemia.

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Longitudinal systolic left ventricular contraction is complementary to radial performance, and can be assessed by tissue Doppler imaging (TDI).

Aim: Evaluation of the contribution of mitral annular systolic velocities using TDI after dobutamine stress echocardiography (DSE) in the assessment of coronary artery disease.

Methods: Fifty subjects with suspected coronary artery disease and chest pain were examined using DSE as well as TDI imaging of the mitral annulus at the septal, lateral, inferior, anterior, posterior regions and the proximal anteroseptal region from the apical views, before and immediately after DSE.

Results: 26 subjects had wall motion abnormalities (WMA) with wall motion score index (WMSI) of 1.16±0.02 at rest and 1.34±0.18 after DSE, while 24 were normal. In both groups systolic mitral annular velocity (Sa) at all 6 regions, increased after DSE by more than 40%, p<0.0002. The most prominent difference after DSE was in septal Sa, 19.2±3.8 in normals and 14.6±2.5 cm/sec in those with WMA, p<0.0003. A significant decrease in Sa occurred when WMSI exceeded 1.25. Septal Sa-17 cm/sec after DSE had a specificity and diagnostic accuracy for detecting WMA of 82%, 80%, and 88% respectively while these values for post-pro DSE Sa ratio<1.5 were 85%, 88% and 86% respectively.

Conclusions: 1) Systolic mitral annular velocities increase after DSE. 2) In patients with WMA the increase in these velocities are less than in normal subjects and can differentiate patients from normal subjects.

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Mechanisms of symptom development during dobutamine stress.

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Background: Mechanisms of symptom development at peak stress in patients with heart disease remain unclear.

Aims: To determine diastolic time reserve in normal subjects and in patients with CAD, and to ascertain the relationship between diastolic time reserve and changes in stroke volume during stress.

Methods: 69 subjects were studied during dobutamine stress; 33 were normal controls and 39 had CAD (normal LV cavity size at rest: EDD 6.0±0.5cm, ESD 3.3±0.5cm). Relative filling time, expressed as a percentage of total diastole, was calculated by dividing LV filling time (LVFT) by total diastolic time (measured as the interval between aortic valve closure and mitral valve closure). Stroke volume (SV) was measured using Doppler echocardiography at the level of the LV outflow tract. All measurements were made at rest and repeated at peak stress.

Results: In normal controls, relative filling time increased with stress (from 85±3% to 92±2%, p<0.001), suggesting the presence of diastolic time reserve (7%), and SV also increased (from 69±17mls to 96±19mls, p<0.001). In patients with CAD, relative filling time was not different from controls at rest, but shortened with stress (from 83±5% to 74±5%, p<0.001), representing a loss in diastolic time reserve of 9%, and SV failed to increase (rest: 76±20mls, stress: 74±16mls, p=NS). Stress-induced changes in diastolic time reserve correlated with changes in SV in patients with CAD (r=0.60, p<0.001), but not in controls.

Conclusion: In patients with CAD, stress-induced ischaemic dysfunction is associated with loss of diastolic filling reserve that determines stroke volume. This loss of early diastolic reserve may itself affect diastolic coronary artery filling, and consequently perpetuate myocardial perfusion instability.

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Limitation of stroke volume during dobutamine stress by left ventricular filling time in patients with coronary artery disease.

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Background: Stress-induced left ventricular (LV) dysfunction in patients with coronary artery disease (CAD) may be associated with significant changes in LV filling pattern, particularly filling time.

Aims: To determine diastolic time reserve in normal subjects and in patients with CAD, and to ascertain the relationship between diastolic time reserve and changes in stroke volume during stress.

Methods: 69 subjects were studied during dobutamine stress; 33 were normal controls and 39 had CAD (normal LV cavity size at rest: EDD 6.0±0.5cm, ESD 3.3±0.5cm). Relative filling time, expressed as a percentage of total diastole, was calculated by dividing LV filling time (LVFT) by total diastolic time (measured as the interval between aortic valve closure and mitral valve closure). Stroke volume (SV) was measured using Doppler echocardiography at the level of the LV outflow tract. All measurements were made at rest and repeated at peak stress.

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Conclusion: In patients with CAD, stress-induced ischaemic dysfunction is associated with loss of diastolic filling reserve that determines stroke volume. This loss of early diastolic reserve may itself affect diastolic coronary artery filling, and consequently perpetuate myocardial perfusion instability.

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Left ventricular geometry is the major component of abnormal mid-ventricular gradients during negative dobutamine stress echocardiography.

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Background: Dobutamine stress echocardiography (DSE) is a useful method to detect myocardial ischemia by increasing oxygen demand. Mid-ventricular systolic gradient (MSG) - peak systolic velocity >2m/s) have been reported as a consequence of the isotropic effect of dobutamine mainly in pts with negative tests. However the influence of LV size and shape has not been studied yet. We therefore hypothesized that MSG is primarily dependent on LV geometry.

Methods: 118 pts with normal standard (high-dose) DSE were included in this study divided into 2 groups according to the presence of MSG. Group A (with): 19 pts, 13 female, 56±9.6 years and Group B (without): 99 pts, 60 female, 61.8±12.2 years. For both groups LV wall thickness (WT), diameters (D), volumes and ejection fraction were obtained. Geometry was defined as the diastolic WT/D ratio.

Results: MSG was observed in 19/118 pts (16%). There were no statistical differences for gender distribution (p=0.701) and age (p=0.059). Table shows the results for LV parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>WT - cm</th>
<th>D - cm</th>
<th>WT/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>0.99±0.15</td>
<td>4.66±0.39</td>
<td>0.22±0.04</td>
</tr>
<tr>
<td>Group B</td>
<td>0.88±0.14</td>
<td>5.04±0.81</td>
<td>0.18±0.04</td>
</tr>
<tr>
<td>p</td>
<td>0.002</td>
<td>0.048</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Conclusion: MSG is a common finding in pts with negative DSE and strongly correlated with higher WT/D ratio independently of LV hypertrophy.
734 "Ischemic cascade" during dipyridamole stress echocardiography in patients with stable coronary artery disease.


Background: Previous studies have shown that transmural myocardial ischemia caused by sudden epicardial coronary artery occlusion determines a typical sequence of events characterized, in order, by left ventricular wall motion abnormalities, ST segment ischemic modifications and, only at the end, angina.

In this study, we investigate if this typical "ischemic cascade" presents with the same modalities also during subendocardial ischemia induced by dipyridamole infusion.

Methods: A total of 41 patients (63±9 years; 12 women) with chronic stable angina and angiographically documented coronary artery disease (1-vessel: 14 [34%]; 2-vessel: 8 [19%]; 3-vessel: 19 [46%]) underwent dipyridamole stress echocardiography (total dose: 0.84 mg/kg iv). Cardiac images were acquired by a 2.5 MHz probe connected to a Toshiba set, Power Vision 8000.

Results: During test, 39 patients (95%) had left ventricular wall motion abnormalities, 31 patients (75%) had ST segment depression and 32 patients (78%) had angina. The first manifestation of ischemia was left ventricular wall motion abnormalities in 7 patients (17%), ST segment depression in 16 patients (39%) and angina in 9 patients (22%). When considering only the 21 patients who developed all three manifestations of ischemia during dipyridamole stress echocardiography, left ventricular wall motion abnormalities were the first manifestation of ischemia (alone or in association with ST segment depression or angina) in 5 patients (24%), ST segment depression was the first manifestation of ischemia (alone or in association with left ventricular wall motion abnormalities or ST segment depression) in 8 patients (38%).

Conclusion: Our data indicate that dipyridamole induced subendocardial ischemia results in a very variable sequence of events, which doesn’t seem to reproduce the typical "ischemic cascade" described after sudden coronary artery occlusion. The heterogeneity of the response among patients likely depends on a variable association of interindividual differences in the extension of ischemia, in the sensitivity of coronary algogenic receptors and in the adenosine-mediated effects of dipyridamole on cardiac perception of pain and on electrophysiological characteristics of myocardial cells.

735 Cultural evolution of digital description of coronary artery disease severity potential inducing myocardial ischemia during exercise stress echocardiography.


1University Institute for CVD, Cardiology, Belgrade, Yugoslavia; 2University Institute for CVD, Cardiology Dept., Belgrade, Yugoslavia

Objective: To determine, if other characteristics including not just severity and localization of coronary stenosis but also the amount of myocardium at jeopardy, would better correlate with the potential of provoking ischemia by exercise than classical numerical descriptions of diseased coronary vessels.

Background: Although simple and easy, coronary artery disease severity described by the number of diseased vessels, may underestimate the potential importance of coronary anatomy, as well as the importance of myocardium at risk to develop myocardial ischemia during exercise stress echocardiography test.

Methods: We evaluated 211 consecutive pts (171 male, 40 female; mean age 51±10 years; 103 with previous myocardial infarction, 108 with angina pectoris) by exercise stress echocardiography according to Bruce treadmill protocol and coronary arteriography (one-vessel CAD, 114 pts; multi-vessel CAD, 45 pts). Myocardial jeopardy score is calculated for each vessel as a sum of all significant lesions represented as a product of: (1) myocardial kinetic status (0 for akinetik, 0.5 for hypokinetik, and 1 for normokinetic myocardial segment subserved by the vessel with equal or more than 50% diameter stenosis), (2) diameter stenosis of significantly stenosed coronary vessel (scored from 3-5), and (3) weighing flow factor for particular localisation.

Results: Univariate logistic regression analysis showed significant correlation between number of diseased vessels, % diameter stenosis, weighting flow factor, myocardial jeopardy score, with the results exercise stress echocardiography (p<0.0001 for all). However, in multivariable analysis significant predictor of stress test results was only myocardial jeopardy score (p=0.0001). Cut-off value of myocardial jeopardy score best predictive for stress test outcome was 9.5.

Conclusion: Global myocardial jeopardy score was the only multivariate predictor of stress echocardiography test results containing the information of functional stenosis significance (severity and localization) and amount of myocardium at risk. Thus, this is the best digital description of coronary artery disease potential for provoking ischemia by exercise.

736 Automated classification of wall motion abnormalities by analysis of left ventricular endocardial contour motion patterns.


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Objective: fully automated border detection (ABD) and classification of wall motion abnormalities (WMA) is highly desired for objective analysis of stress echo.

Methods: We developed a fully automated ABD technique based on Active Appearance Models (AAM), which learns typical shape-motion patterns from a set of example image sequences. AAMM uses Principal Component Analysis to find eigenvariances of shape/motion, including typical normal and pathological endocardial contraction patterns, and expresses each shape as a linear combination of these. We hypothesized these AAM modal shape coefficients (MSCs) would allow WMA classification.

Experiments: Low-dose dobutamine (LDD) stress echo was performed on 129 patients split randomly into training (TRN, n=45) and test set (TST, n=44). Expert-verified endocardial contours (MAN) were available in 4-channel (4C) and 2-chamber sequences for baseline and LDD. AAMMs were generated from TRN and AAB was tested on TST sets. Resulting borders (AUTO) were compared to MAN borders, in average point distance (APD, mm) and LV endocardial area (LVA, cm²). MSCS for all sequences were extracted and statistically related to segmental and global Visual Wall Motion Scoring (VWMS).

Results: on 4C baseline TST, AAMM ABD succeeded (APD<8mm) in 97% of cases (APD Mean±SD: 3.3±1.2mm, LVA regression: AUTO<0.91*MAN+1.7cm², r2=0.87). Multivariate linear regression showed clear correlations between MSCS and global (R2=0.64) and segmental (average R2=0.60) VWMS. Discriminant analysis showed good prediction of both segmental (85±6% correctness) and global WMA (90% correctness).

737 Positive pre-ejection velocity changes during dobutamine stress test in identifying hibernating myocardium and predicting functional recovery.

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Introduction: The value of pre-ejection velocity changes recorded by tissue Doppler imaging (TDI) during dobutamine stress echocardiography to predict functional recovery has not been studied.

Purpose: The aim of this study was to evaluate the accuracy of TDI velocity changes during low-dose dobutamine stress echocardiography to identify hibernating myocardium and to predict recovery of myocardial function after revascularization.

Methods: Dobutamine stress echocardiography using TDI was performed in 41 patients with coronary artery disease and left ventricular dysfunction. 2-5 days before revascularization. TDI ejection (E) and PE as well as early (EA) and late (DA) diastolic velocities were recorded during rest and dobutamine stress echocardiography. Rest echocardiography was repeated 3 months after revascularization.

Results: Left ventricular ejection fraction increased from 24±4.0 to 35±5.4% at follow-up (p<0.001). Of the 408 revascularized segments with severe dysfunction, 188 (45%) improved at follow-up. E, PE and EA velocities (cm/sec) changed significantly dobutamine stress echocardiography vs. rest (4.8±1.2 vs. 5.9±1.6, 4.9±1.13 vs. 6.5±1.95, 4.8±0.9 vs. 5.6±1.4, respectively, p<0.001), whereas Aa velocities (cm/sec) did not change (6.3±1.4 vs. 6.4±1.3). The user of receiver operating curves identified a stress-induced increase of 0.5 cm/sec in PE velocity as the optimal cut-off value for viability, which predicted recovery of myocardial function with a sensitivity of 80% and a specificity of 86%. Interestingly, a stress-induced increase of PE velocity by 0.6 cm/sec was identified as having superior sensitivity of 91% and a specificity of 90% in predicting functional recovery. A cut-off point of 0.44 cm/sec change in Ea velocity during Dobutamine stress echocardiography had a high also sensitivity (80%) and specificity (81%) to predict myocardial recovery function.

Conclusion: Pre-ejection velocity increase is the most accurate index, for the identification of hibernating myocardium during dobutamine stress echocardiography, concerning prediction of functional recovery. This is maybe due to lower tethering effect during pre-ejection period.
Assessment of myocardial viability in patients with myocardial infarction: comparison of low dose dipyridamole radionuclide ventriculography with dipyridamole echocardiography.


The purpose of the study was to compare diagnostic value of low dose dipyridamole radionuclide ventriculography (DIP-RNV) and low dose dipyridamole echocardiography (DIP-ECHO) for the prediction of functional recovery of viable myocardium in the medium term follow up.

Twenty patients (18 male; 51±10 years) with previous myocardial infarction and resting systolic dysfunction were studied before angioptiomy of infant related artery (IRA), by RNV and ECHO at rest, as well as during dipyridamole infusion (0.28 mcg/kg/min over 2 min). RNV as well as ECHO was repeated at rest, 12 weeks after successful angioptiomy. Five percent increase of regional ejection fraction (REF) by RNV was used as criterion for functional improvement of infarcted regions. By ECHO, viability was defined as improvement of wall thickening or contractile improvement of grade one or more, utilizing wall motion score index (WMSI).

Out of 180 examined (20x9) segments by RNV, 51 were dysynergic and they had abnormal REF (29±10%). Out of these 51 segments functional improvement was documented in 33 on low DIPY. Sensitivity for predicting functional recovery after 12 weeks follow up was 63%, and specificity was 77%. WMSI assessed by ECHO was 1.35±0.22, 1.16±0.20 and 1.13±0.14 for rest, low DIPY and rest follow up, respectively (p<0.05). Sensitivity of low DIPY-ECHO for predicting functional recovery was 80% and the specificity was 90% (p<0.05 vs low DIPY-RNV).

In conclusion, both techniques, RNV and ECHO are comparable diagnostic predictors of myocardial viability in medium term follow up.

The value of early ambulatory cardiac rehabilitation program after myocardial infarction on parameters of left ventricle in patients with left ventricular dysfunction.

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The aim of the study was to clarify whether the sequential performance of both methods in the same patients provides additional information, capable of changing our therapeutic decisions.

The aim of the study was to clarify whether the sequential performance of both methods in the same patients provides additional information, capable of changing our therapeutic decisions.

The patients hospitalized with first acute myocardial infarction were included in 8-weeks early rehabilitation program. Aerobic (60% VO2max) as well as isometric exercise program was performed in all patients. Before and after the training symptom-limited dynamic stress echo and spirometry were done. The rest and exercise ejection fraction (EF) and pVO2 analysis were calculated.

Patients: 86 patients (79male/7female) of the age 56±11 yrs were enrolled into study. The patients were divided in two subgroups in accord to the EEF group: EEF 115 pts with EF < 50% (40±6%) and group II of 71 pts with EF > 50% (60±4%).

Results: The aerobic exercise program increased significantly exercise tolerance (p<0.001) and pVO2 (p<0.001) in 2 subgroups. However, the rest and exercise EF after training was significantly increased only in subgroup I (p<0.05). The subgroup did not differ in training exercise tolerance as well as circulatory response to the aerobic exercise.

Conclusions: The early ambulatory rehabilitation program (including isometric exercise) is safe for patients with depressed LV function. The program has positively influenced the parameters of LV function as well as parameters of gas exchange analysis. The exercise-test was significantly increased only in subgroup I (p<0.05). The subgroup did not differ in training exercise tolerance as well as circulatory response to the aerobic exercise.

Sequential dobutamine stress echocardiography and TL-201 scintigraphy for detection of viable myocardial tissue in patients with a previous myocardial infarction.

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The purpose of the study was to compare diagnostic value of low dose dipyridamole radionuclide ventriculography (DIP-RNV) and low dose dipyridamole echocardiography (DIP-ECHO) for the prediction of functional recovery of viable myocardium in the medium term follow up.

Twenty consecutive pts (15 male, 5 female), mean age 65±9 years with a history of MI during the previous 13 months, underwent DSE for the detection of myocardial viability, followed by TI the day after. DSE was performed in two 3-min stages using low-dose dobutamine (5 and 10 µg/kg/min respectively), while TI SPECT study consisted of 3 stages (i.e. exercise, rest, redistribution phases and reinjection of 1MCi of TI-201). Left ventricle was divided in 16 segments for the evaluation of wall motion abnormalities and perfusion defects. These segments were identical and comparable to those used during TI quantitative analysis (bull’s eye), provided that apex itself belongs to apical segments. During DSE, myocardial segments were regarded to be viable if they were hypokinetic or akinetic but with improved contractility after dobutamine administration. During TI viable segments were those that demonstrated a reversible perfusion defect with or without TI re-injection (TI uptake<50% ROI).

Results: We studied a total of 320 myocardial segments (20 pts, 16 segments each); 144 segments (45%) demonstrated regional wall motion abnormalities (RWMA) on DSE; 36 of them (25% of the dysfunctional segments) were viable (V). On TI SPECT 150 out of 320 segments (47%) had a perfusion defect; 52 of these defects (35% of ds) were reversible and considered as V. When both methods were performed, 61 V segments were detected (36% of ds). Results were evaluated by the ANOVA test for repeated measurements. The percentage of viable segments detected by the combination of the two methods was found to be significantly higher than the percentage detected by DSE alone (p=0.025). On the contrary, no difference was found in the number of segments detected by the combination method versus TI alone.

Conclusion: The sequential performance of DSE and TI SPECT is feasible and seems to increase the likelihood for the detection of myocardial viability after MI, in cases of inadequate number of viable segment, capable of providing an indication for revascularization.

Apically directed postsystolic motion of the basal anteroseptal wall during stress-echo.

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Background: An apically directed postsystolic motion (PSM) is present in the basal anteroseptal wall and consists of two distinct waves PSM I and PSM II. Our goal was to study changes in peak velocity of PSM II in the basal anteroseptal wall during stress-echo.

Methods: 33 consecutive patients (mean age 60±10 years) referred for high-dose dobutamine stress-echo were included. 18 (55%) of the patients had proven coronary artery disease (CAD). A standard stress-echo protocol was used. Pulsedwave tissue Doppler imaging of the basal anteroseptal wall in the basal septum was performed at rest and during peak stress. Peak velocity of the apically directed PSM II was measured.

Results: Basal anteroseptal wall at rest was normokinetic in 31 patients, hypokinetic in 1 and akinetic in 1. In all studied patients no ischemia was detected during stress-echo in the basal anteroseptal wall. Heart rate was 72±13/min at rest, and 132±10/min during peak stress (86±10% of the calculated peak heart rate). The mean increase of the apically directed PSM II increased from 3.0±1.7 cm/s at rest to 7.9±2.6 cm/s during peak stress (p<0.001), mean increase of 4.9±2.0 cm/s. In the subgroup of patients with proven CAD the mean increase did not differ from that of the whole group. In 7 patients with a positive stress-echo (5 RCA, 1 LAD, 1 RCX territory) the mean increase was 5.3±1.8 cm/s (p=NS vs the whole group).

Conclusion: Peak velocity of the apically directed PSM II in the non-ischemic basal anteroseptal wall increases with approximately 160% during peak stress.

Routine assessment of left ventricular diastolic dysfunction in coronary artery disease by Doppler exercise stress testing.

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To evaluate left ventricular (LV) diastolic function parameters before and after exercise-provoked myocardial ischemia, transtalal was studied in 48 patients with proven coronary artery disease (CAD) and Control group with 32 normal subjects using pulse Doppler echocardiography. The pick flow velocity of left ventricular rapid filling (E), that of atrial contraction (A) and the ratio of E to A(E/A), deceleration time of E and time of isovolumetric relaxation.

Of the 48 patients with CAD 41 (85%) patients developed ischaemia-ECG ST changes and wall motion abnormalities after pick Exercise. In this subgroup patients 11 develop restrictive Doppler pattern (E greater fourfold than A), 8 pseudonormalisation pattern and 22 worse EI/A ratio in sense delayed relaxation pattern. Those changes were statistical significant in relation to rest and pick exercise in normal subjects(< p<0.01). In patients without developing ischaemia Doppler indices changed with less extent but statistically significant versus normal (p<0.05) and patients with presence of myocardial ischemia. Mitral regurgitation may changed diastolic parameters.

These results suggest that in acute myocardial ischemia changes in Doppler diastolic indices reflect extent and severity of myocardial ischemia. Both systolic wall motion abnormalities in pick stress exercise test and Assessment of diastolic parameters contribute to non invasive determination of severity and extent of coronary artery disease.
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Strain rate best quantifies regional contractile reserve during dobutamine stress echocardiography in patients with ischaemic left ventricular dysfunction.

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Background: Detection of viability in myocardium that contracts poorly due to recurrent ischaemia is clinically important because hypokinetic or akinetic segments may recover function if treated promptly by revascularisation. Experiments suggest that non-invasive diagnosis may be possible using tissue Doppler echocardiography (TDE). Myocardial velocity responses to dobutamine can indicate ischaemia in patients with normal resting function, but changes in regional deformation indices may be more specific to diagnose viability since they are less influenced by motion of adjacent segments. We studied which TDE parameters can quantify functional reserve before and after coronary bypass surgery (CABG).

Methods: 23 patients (21 men) aged 61±10 years, who had multivessel coronary artery disease and poor left ventricular (LV) function (ejection fraction (EF) = 35% on Technetium 99 blood pool scan) underwent graded dobutamine stress echo- cardiography, and also nitrate-enhanced rest-redistribution Thallium 201 perfusion imaging, both before and 6 months after CABG. TDE parameters were analysed off-line in basal, mid-wall and apical segments, imaged from the apex (SPECLE, University of Leuven). Perfusion images were analysed and scored from polar plots scaled to 100%, using a 16-segment model with a cut-off of 50%.

Results: EF did not change after CABG (32±17 % pre-op vs 34±13 % post-op) but mean segmental perfusion scores improved (6.7±2.7 to 9.8±2.7; p<0.02). By TDE, peak systolic velocity in basal myocardial segments increased during dobutamine both before (from 2.7±0.2 to 6.1±0.6 cm/s; p<0.001) and after CABG (from 2.0±0.2 to 4.8±0.5 cm/s; p<0.001). Segmental functional reserve was also demonstrated by increases in maximal systolic strain rate at peak dobutamine dose, both before (from -0.7±0.1 to 1±0.1/s; p<0.001) and after CABG (from -0.7±0.1 to 1.1±0.1/s; p<0.001). In contrast, systolic strain in basal segments fell slightly from rest to peak dobutamine stress before CABG (from -8±4.0 to -6.1±0.7%; p<0.05) and after CABG it did not change (from -8±4.0 to -7±0.7%; ns).

Conclusion: In patients with ischaemic LV dysfunction, regional myocardial reserve cannot be demonstrated by measuring segmental strain at peak dobutamine stress, probably because strain is a load-dependent index. Changes can be observed in myocardial velocities but these are non-specific since they are influenced by tethering. Thus in patients with suspected viable myocardium, responses to dobutamine should be assessed using systolic strain rate as the most useful parameter of regional deformation.

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Stress echocardiographic left ventricular systolic response to adenosine differs from that of dobutamine and supine bicycle exercise: a tissue Doppler study on healthy volunteers.

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Background: Published data on dobutamine stress echocardiography (DSE) quantified by tissue Doppler (DV) have provided useful clinical data. However, quantification of stress-induced LV velocity changes by the Doppler (DV) technique is a valuable tool for non-invasive diagnosis. DV strain rate is a measure of myocardial velocity changes independent from detection of viable tissue with a worse cardiac prognosis. We studied 31 consecutive pts for viability (age 59±11, range 15-55). All underwent conventional DSE (16 segments model) and the DSE score of 4 viable segments (161±12 vs 142±19, 137±27, 105±33, 74±13, 79±9, 72±7, 307±78 SE±33, 175±0SE±53, 44, 191±90±24±6, and for (S%) were compared. *p=0.04, **p=0.005.

Conclusion: AVE evokes significantly weaker LV systolic response compared with the DSE & ESE. However, an increased velocity (-p<0.05 vs. rest) and strain (p<0.05) response at a much lower HR indicates that adenosine has some minor inotropic effects presumably secondary to hyperemia. Powerful chronotropic response to DSE & ESE is probably a prerequisite for strong velocity response albeit at the expense of strain.

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Coro transesophageal stress with dobutamine: better screening for coronary artery disease.

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Analysis of ischemia in Coronary Artery Disease (CAD) has been conducted in numerous ways, but few at the patient's bedside, others present difficulties in terms of physical capacity, age, or sex.

Aims and Methods: We performed our study of dobutamine stress with echo transesophageal echocardiography (ETED) and the help of Power Doppler (PD) on 200 individuals with suspected CAD, 115 men and 85 women, between the ages of 30 and 84, weighing between 40 and 168 kg and 140 to 188 cm tall. We achieved a 100% success rate in testing individuals, all being sedated with propofol without undergoing any problems. We used the protocol for dobutamine stress with 5, 10, 20 and 30 mcg/kg/min and up to 2 mg of atropine when necessary to acquire cardiac frequency of 85% of the maximum expected for the patient's age. We analyzed 16 segments of the left ventricle using criteria established by the American Society of Echocardiography. Using the PD technique, we evaluated the coronary flow in the trunk, anterior descending artery, circumflex artery and right coronary artery to determine the degree of estenosis of the reserve coronary flow and the rate of coronary vascular resistance.

Results: The method was 92% in terms of sensitivity and its specificity corresponded to 96%, the predictive negative value over 6 months was 98%. The predictive positive value of coronary artery disease of hemodynamic significance, according to the analysis of coronary flow, was 100% in relation to the angiographic study with lesions to more than 70% of anterior descending arteries, but the negative predictive value was 44% in relation to all coronary vessels. The response to endocardic viability in relation to the coronary reperfusion by hemodynamic and/or surgery was 100% in 6 months.

Conclusion: We concluded that echocardiography for Echo Transesophageal dobutamine stress with Power Doppler is the best test for determining whether or not it is an obstructive ischaemic coronary disease and the one with the best result of all methods of investigation and it is easy to perform, even at the bedside, and regardless of the patient's physical capacity, age and sex.

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Is there any role for baseline brain natriuretic peptide and its changes post dobutamine stress echo for myocardial viability interrogation?

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Introduction: Brain natriuretic peptide, a marker of heart failure, is produced mainly in the atria from atrial myocardial cells. Peak atrial natriuretic peptide (ANP) and peak brain natriuretic peptide (BNP) plasma levels during dobutamine stress echo (DSE) are useful predictors of myocardial viability. However, pts having viability in the LAD territory had a trend for increase in BNP levels at rest.

Methods: We studied 31 consecutive pts for viability (age 59±9, male/female 28/3, 16 with previous transmural myocardial infarction, ejection fraction 33±11%, range 15-55). All underwent conventional DSE (16 segments model) and the DSE score of 4 viable segments (161±12 vs 142±19, 137±27, 105±33, 74±13, 79±9, 72±7, 307±78 SE±33, 175±0SE±53, 44, 191±90±24±6, and for (S%) were compared. *p=0.04, **p=0.005.

Results: Data for AVE, DSE, and ESE were (For max HR: 84±15%, 142±19, 137±27, 105±33, 74±13, 79±9, 72±7, 307±78 SE±33, 175±0SE±53, 44, 191±90±24±6, and for (S%) were compared. *p=0.04, **p=0.005.

Conclusion: AVE evokes significantly weaker LV systolic response compared with the DSE & ESE. However, an increased velocity (-p<0.05 vs. rest) and strain (p<0.05) response at a much lower HR indicates that adenosine has some minor inotropic effects presumably secondary to hyperemia. Powerful chronotropic response to DSE & ESE is probably a prerequisite for strong velocity response albeit at the expense of strain.

Results: Twenty-four/31 pts had a positive DSE for viability. 6/24 pts had a biphasic response. Nine/24 pts had at least 4 viable segments. Viability was detected in LAD territory in 14/24 pts. Overall, pts presenting viability had similar changes of BNP compared with a negative DSE. However, pts having viability in the LAD territory had a trend for increase in BNP (Rec) compared with those having viability in other zones (absolute changes: 49±24 vs -24±63 respectively, p<0.06). Using ROC analysis, an increased BNP (Rec) compared with R, had sensitivity 0.71 and specificity 0.70 for prediction of LAD viability. Biphasic response did not influence BNP (Rec) levels.

Fig: Max systolic velocities in the 4 LV bases during AVE, DSE and ESE.