Echocardiography for Clinical Decision Making in Heart Failure

Date: 7/12/00, from 11:00 to 12:30
Location: Room 7A

Chairpersons:

K. Groundstroem (Tampere/Fl)
G. Karatasakis (Athens/GR)

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Comparison between three echo-Doppler methods for non-invasively estimating pulmonary capillary wedge pressure in patients with dilated cardiomyopathy at baseline and after loading manipulation

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Background: several Doppler echocardiographic methods have been proposed to estimate pulmonary capillary wedge pressure (PCP) in various cardiac conditions. These include equations comprising mitral and pulmonary venous flow (PVF) velocity variables and, more recently, formulas in which early diastolic mitral flow velocity (E) is normalised by indices of left ventricular relaxation such as propagation velocity of ventricular inflow as assessed by color-M-mode Doppler (Vp) and early diastolic velocity of mitral annulus (Ea) as assessed by tissue Doppler. These last methods should be theoretically "load independent".

Aim of the study: To direct compare the accuracy of three formulas for estimating PCP in patients with heart failure and low left ventricular ejection fraction (LVEF) at baseline and after sodium nitroprusside (NTP) infusion.

Methods: 40 sinus rhythm patients with HF (age 55±9 yrs, LVEF 27±5%, NYHA class 2.5±0.5, ischemic/nonischemic dilated cardiomyopathy: 22/18) underwent simultaneous right-heart catheterization and Doppler echocardiography. The following equations were used: 1) PCP=1.85*deceleration rate of E - 0.10 * systolic fraction of PV+10.9; 2)PCP=1.5+1.47*E/Ea; 3)PCP=5.27*E/Vp+4.6. In 19 the same equations were applied after 1.23±0.8 µg/kg/min of NTP i.v. infusion.

Results: the correlation between invasive and estimated PCP by equation 1, 2 and 3 were r=0.86, r=0.78 and r=0.75, respectively. The biases between invasive and estimated PCP were +0.8±4.5 mm Hg for equation 1 (n.s.), -3.8±5.9 mm Hg for equation 2 (p=0.00) and -2.4±5.8 mm Hg for equation 3 (p=0.01). After NTP infusion mean PCP changed from 25.6±5.9 mm Hg to 15.7±4.3 mm Hg (p=0.00). The correlation between invasive and estimated PCP by equation 1, 2 and 3 were r=0.85, 0.77 and 0.77 respectively. No significant correlation was found between changes in PCP and Vp and between changes in PCP and Ea,(r=0.40, p=0.10 (n.s.); r=0.10, p=0.69 (n.s.)).

Conclusions: In pts with HF the three echo-Doppler equations allow a fairly accurate estimation of PCP, the equation 1 without significant under or over estimation. Our study confirms that Vp and Ea are relatively load independent.

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Clinical significance of dynamic mitral regurgitation as assessed by continuous exercise Doppler echocardiography in heart failure patients

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In patients (pts) with heart failure, mitral regurgitation (MR) is an important marker of adverse outcome. These pts can develop worsening of dyspnea during dynamic exercise because of MR increase. We performed a symptom-limited semi-supine continuous exercise echocardiographic test (SEE) in 26 pts with LV dysfunction (<35% ejection fraction) and MR. Regurgitant volume by the PISA method (RV PISA) and pulmonary artery systolic pressure (PASP) were assessed at rest and peak-stress. Exercise duration was 8.7±2.8 minutes. Ejection fraction increased from 31±9 to 41±11% (p=0.0001). RV PISA from 21±12 (range: 5–55) to 38±23 (range: 8–85) ml (p=0.0001) and PASP from 27±9 to 54±21 mm Hg (p=0.0001). A correlation (r = 0.72) was observed between ΔPASP (Δ = peak rest) and ΔRV PISA. The 9 pts who stopped the test because of dyspnea exhibited the highest ΔRV PISA. During follow-up, all 9 required majoration of medical therapy, 8 had severe acute pulmonary edema requiring hospitalisation and 4 had mitral valve annuloplasty.

We conclude that 1) ΔPASP correlates with Δ RV PISA, 2) the PISA method during SEE can be used clinically to identify patients in whom dyspnea during exercise is related to high RV majoration.
Left ventricular systolic asynchrony: a link to malignant ventricular arrhythmias in dilated cardiomyopathy and left bundle branch block

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Limited data are available concerning potential ventricular pro-arrhythmic effect of left ventricular systolic asynchrony (LVSA) in patients (pts) with dilated cardiomyopathy (DCM) and left bundle branch block (LBBB).

The purpose of this study was 1) the identification and quantifi- cation of LVSA in pts with DCM and LBBB by pulsed Doppler Tissue Imaging (PDTi) and 2) the correlation of LVSA to QRS duration, left ventricular enddiastolic diameter (LVEDD), ejection fraction (EF) and incidence of ventricular arrhythmic events (sustained ventricular tachycardia / ventricular fibrillation)

METHODS: 59 consecutive pts with DCM and LBBB underwent a standard and PDTI echocardiographic examination; peak myocar- dial systolic velocity (PSV), the interval between Q wave in the electrocardiogram and the beginning of the typically systolic veloc- ity profile (recorded from 4 basal segments of the left ventricular wall from an apical approach, the basal left ventricular posterior wall from a parasternal short axis approach. 12 pts with LBBB and normal LVEDD/EF and 21 healthy volunteers served as control group.

RESULT: The degree of LVSA showed no correlation with the LVEDD, EF and QRS duration in pts with DCM and LBBB. In the patient group with LVSA of more than 60 ms difference (20 pts) malignant ventricular arrhythmic events occurred in 9 pts during a follow up of 6 months. No symptomatic ventricular event (VT/VF) occurred in pts with LVSA of less than 60 ms difference (39 pts).

CONCLUSIONS: Severe LVSA of more than 60 ms seems to be associated with malignant ventricular arrhythmic events in pts with DCM and LBBB. In the future PDTI may be the best method to select pts with LVSA, who are candidates for implantation of a combined cardio-verter - defibrillator - biventricular pacing system with the aim of stabilizing rhythm and hemodynamics.

Pre-implantation tissue-velocity imaging predicts improvement in left ventricular performance following implantation of a biventricular pacemaker in patients with severe heart failure

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Background: Acute hemodynamic improvement has been reported during biventricular pacing (BVP) in patients with severe heart failure and the severity of the QRS complex has been used as a predictor of improved resynchroni- zation. Tissue-velocity imaging (TVI) has the potential of demonstrating both the degree and extent of left ventricular (LV) asynchrony and three dimen- sional echocardiography (3D ECHO) enables accurate quantification of oper- ational LV volumes and ejection fraction. TVI and 3D ECHO have not been compared in the same individuals.

Methods: TVI and 3D ECHO (GE-Ewing System Five) was performed during sinus rhythm, 1-3 days and 6 months following BVP implantation in 25 consecutive patients (22 males) with severe heart failure, NYHA classification III/IV (14/11). Ischemic heart disease was present in 16 patients and 9 patients had idiopathic dilated cardiomyopathy. A 16 segment model of the LV was used for the description of global and regional asynchrony.

Results: As compared to baseline, BVP significantly improved contraction synchrony at the basis of the LV. This caused a significant increase in global LV ejection fraction (EF%) as seen in the Table 1. By univariate analysis baseline QRS duration, the duration of the pre-ejection period and the extent of myocardium with post-systolic contraction (PS) predicted pacing efficacy. However, multivariate analysis revealed that the extent of myocardium with PS at the LV basis independently predicted BVP efficacy. In patients (N=11) with 1-2 segments displaying PS the acute improvement in LVEF was 10.4±7% as compared to 32.1±12% in patients (N=14) with > 2 segments (p<0.01). At present 13 patients have been examined after 6 months. Among 8 patients with > 2 segments displaying PS at baseline a further improvement in LVEF were noted in 7 as compared to 1/5 in patients with 1-2 segments (p=0.05).

Conclusion: TVI makes it feasible to evaluate the mechanism by which BVP induces LV improvement in patients admitted for heart failure treatment. In addi- tion, TVI seems to be a powerful tool for the selection of patients prone to benefit from BVP

EF (%) 23.2 (6) 28.3 (7) <0.01
Myocardium in synchrony (%) 53.6 (13) 66.2 (11) <0.01
Duration of synchrony in systole (%) 68.2 (10) 72.6 (9) <0.01
LV-systolic performance

Could dobutamine echocardiography be usefull in the selection of coronary patients with an ejection fraction <25% for bypass surgery or heart transplantation

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Previous studies have indicated that low-dose dobutamine echocardi- ography (DeE) allows for an accurate prediction of both contractile recovery and long term prognosis in patients with coronary artery disease and moderate left ventricular (LV) dysfunction (ejection fraction (EF) <35%). However, few data exist regarding the prognostic impact of this imaging modality in patients with severe LV dysfunction and an EF <25%. Accordingly, we prospectively studied 62 consecutive patients with 3-vessel coronary artery disease and an EF <25% (mean EF: 20±4%) who underwent DeE prior to bypass surgery. The primary end-point was total mortality and mean follow-up was 38 (range 16-66) months.

Survival data of coronary patients undergoing bypass surgery were compared to those of 44 patients with severe LV dysfunc- tion (mean EF: 19±4%) who underwent heart transplantation during the same period. During follow-up, 21 patients (34%) and 10 transplant recipients (23%) died. Five year survival was significantly greater in patients with viable myocardium by DeE (defined by ROC curve analysis) as a decrease in wall motion score by > 3.5 grades between rest and low-dobutamine (less than in patients with non viable myocar- dium (80% vs. 48%, p<0.001). In patients with viable myocardium, survival was similar to that in patients undergoing heart transplantation (80% vs. 77%, p=ns). Kaplan-Meier survival rates showed significant differences in survival between patients with and without viable myocardium (log rank p<0.01), but no differences between patients undergoing bypass surgery in the presence of viable myocar- dium and those undergoing heart transplantation. Our data thus indi- cate that among patients with severe LV dysfunction, bypass surgery provides survival benefits only when significant amount of viable myocardium is detected pre-operatively. In this case, bypass surgery can be considered as a safe and valuable alternative to heart transplantation.