

Radionuclide image in chronic heart failure

Oral abstract session

11:00-12:30

9.1

Characterisation of cardiac phenotype in genetically defined hypertrophic cardiomyopathy.

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Background: Abnormalities in myocardial metabolism and mechanical performance are known to characterize hypertrophic cardiomyopathy (HCM). This study evaluated myocardial perfusion, oxidative and substrate metabolism in genetically homogenous HCM patients with different phenotypic expressions.

Methods: Eight patients with HCM caused by the Asp175Asn substitution in the alpha-tropomyosin gene underwent in fasting state myocardial blood flow, oxygen consumption (Kmono) and free fatty acid (FFA) uptake measurements using positron emission tomography and [¹⁵O]H₂O, [¹¹C]acetate and [¹⁸F]FTHA respectively. Echocardiographic measurements were used to assess myocardial function and work. Efficiency of forward work was calculated.

Results: As compared to normal values, patients with HCM were characterised with normal global perfusion but increased oxygen consumption and reduced efficiency. Myocardial FFA uptake was within the normal range. Global perfusion and Kmono as well as efficiency were inversely correlated with LV mass and were significantly lower in patients with LV mass > 180g (n = 4) than LV mass < 180 g (n = 4) (p < 0.05). Global myocardial FFA uptake was not associated with degree of hypertrophy.

Typical for HCM, hypertrophy was heterogeneous affecting more commonly septal wall. At individual level, regional FFA uptake and Kmono correlated nicely in patients with mild LV hypertrophy (R = 0.73-0.99, avg 0.85) whereas the correlation was mainly inverse in patients with more advanced hypertrophy (R = -0.88-0.68, avg -0.24).

Conclusions: Genetically defined homogenous HCM patients with Asp175Asn mutation in the alpha-tropomyosin gene are characterized with increased oxygen consumption and reduced efficiency of forward work but normal perfusion and FFA uptake. However, cardiac phenotypic expression is also associated with changes in perfusion, oxygen consumption and efficiency. The patients with advanced LV hypertrophy are characterised with uncoupling of regional oxidative metabolism and FFA utilization indicating switch in cardiac substrate metabolism not attributable to genetic factors.

Key words: hypertrophic cardiomyopathy, myocardial metabolism, efficiency

9.2

Impaired myocardial blood flow and flow reserve associated with increased coronary resistance in persistent idiopathic atrial fibrillation.

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Background: Many patients with atrial fibrillation (AF) present with signs and symptoms of myocardial ischemia despite exclusion of coronary artery disease. In this respect a regulatory disorder of the small vessels has been discussed. Aim of this study was to quantify myocardial perfusion and perfusion reserve in AF patients non-invasively by positron emission tomography and radioactive-labeled water (H₂15O-PET).

Methods and Results: Thirty patients (25 male, 5 female, age: 59±13 years) with persistent idiopathic AF were enrolled in this study. Using H₂15O-PET, myocardial perfusion was quantified at rest, during intravenous adenosine infusion provoking the maximal hyperaemic myocardial perfusion and during cold pressor testing (CPT) to obtain the maximal perfusion stimulated by the endothelial response. Values were compared to those in a group of 33 healthy volunteers (12 male, 21 female, age: 40±13 years).

Resting myocardial perfusion was reduced in AF patients as compared to the control subjects (0.89±0.22 vs. 1.02±0.25 mL/min/g; P<0.026). Hyperaemic perfusion reserve was significantly diminished in AF vs. controls (2.92±1.32 vs. 3.95±1.33 mL/min/g; P=0.024). Accordingly, endothelium-stimulated myocardial blood flow was reduced in AF patients after CPT as compared to controls (1.02±0.38 vs. 1.32±0.42 mL/min/g; P=0.005). Coronary vascular resistance, calculated from myocardial blood flow and mean arterial pressure, was significantly increased in AF patients when compared with controls at rest (110±33 vs. 90±23 mmHg*³mL⁻¹*g⁻¹*min⁻¹; P=0.007), under adenosine infusion (43±21 vs. 24±8 mmHg*³mL⁻¹*g⁻¹*min⁻¹; P<0.001) and following cold stress (113±41 vs. 76±21 mmHg*³mL⁻¹*g⁻¹*min⁻¹; P<0.001).

Conclusion: AF reduces baseline myocardial perfusion as well as stimulated myocardial perfusion reserves and is associated with increased coronary resistance. Studies to elucidate the underlying cause are warranted to give further pathophysiological insights.

9.3

Effects of candesartan on cardiac sympathetic nerve activity in patients with congestive heart failure and preserved left ventricular ejection fraction.

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OBJECTIVES We sought to evaluate the effects of angiotensin receptor blocker (ARB) on cardiac sympathetic nerve activity in patients with congestive heart failure (CHF) with preserved left ventricular ejection fraction (LVEF).

BACKGROUND Approximately 50% of patients with CHF show preservation of the LVEF. It has been reported that ARB therapy improves cardiac sympathetic nerve activity in CHF patients and a reduced LVEF. However, the effect of ARB therapy on cardiac sympathetic nerve activity evaluated by 123I-meta-iodobenzylguanidine (MIBG) scintigraphy has not been determined in CHF patients with preserved LVEF.

METHODS We selected 50 patients with nonischemic CHF and an LVEF greater than 40% who were treated with standard therapy. Twenty-five patients were randomized to additionally receive candesartan, while the remaining 25 patients received placebo. The delayed heart/mediastinum count (H/M) ratio, delayed total defect score (TDS), and washout rate (WR) were determined by 123I-MIBG scintigraphy before and after 6 months of therapy. The left ventricular end-diastolic volume (LVEDV) and LVEF were determined by echocardiography, and the plasma brain natriuretic peptide (BNP) concentration was also measured.

RESULTS In patients receiving candesartan, TDS decreased from 28±8 to 23±8 (p<0.0005), the H/M ratio increased from 1.87±0.24 to 2.00±0.22 (p<0.005), and WR decreased from 37±11% to 32±8% (p<0.005). In addition, LVEDV decreased from 114±38 ml to 90±27 ml (p<0.05), and LVEF increased from 54±7% to 58±10% (p<0.05). In contrast, there were no significant changes of these parameters in the patients receiving placebo. There was a significant correlation between the changes of 123I-MIBG scintigraphic findings and the percent change of BNP from baseline to 6 months in patients receiving candesartan (TDS, r=0.587, p<0.005; H/M ratio, r=-0.509, p<0.01; and WR, r=0.602, p<0.005).

CONCLUSIONS Adding candesartan to standard therapy can improve cardiac sympathetic nerve activity and left ventricular performance in CHF patients with preserved LVEF.

9.4

Long-term prognosis in patients with chronic ischemic left ventricular dysfunction after viability testing with PET and revascularization.

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Background: Most outcome studies in patients with ischemic left ventricular dysfunction (LVD) and hibernating myocardium as assessed with PET are limited by short-term follow-up or small patient populations.

Aim: To assess the impact of myocardial viability testing with PET and revascularization (revasc) on long-term prognosis in a large study population with LVD.

Methods: The baseline characteristics and the follow up (f/u) of 246 consecutive patients (age 60±10 years) with ischemic LVD who underwent FDG and NH₃ PET scan for evaluation of hibernating myocardium (=NH₃/FDG mismatch) were assessed.

Results: see table 1

Conclusion: Our results demonstrate a strong association between myocardial viability on PET testing and improved survival after revascularization in patients with chronic ischemic LVD. Viable tissue seems to represent a risk factor, as lack of revascularization is associated with increased mortality. Absence of viability is associated with no significant difference in outcomes, irrespective of treatment strategy.

Table 1.

	Hibernating	Hibernating	No Hibernating	No Hibernating
	Revasc	No Revasc	Revasc	No Revasc
n	49	38	52	107
age, years	58±11	58±10	59±9	60±9
gender, male	87%	82%	83%	88%
LVEF (%)	30±10	29±11	32±5	29±12
3-vessel disease	80%	37%	47%	46%
mean f/u, years	4.5±2.4	4.2±2.8	4.5±2.2	4.3±2.6
annual mortality	12.0%	19.3%	11.0%	9.5%
survivors, end of f/u	63.0%	27.9%	64.0%	53.0%

9.5

Biventricular pacing improves left ventricular synchrony irrespective of AV-delay in patients with congestive heart failure.

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Background: Biventricular pacing (bivPM) in patients with heart failure results in improved left ventricular performance through resynchronization of systolic myocardial contraction. A prolonged AV-delay improves diastolic left ventricular filling but is associated with increased probability of AV fusion beats that may interfere with resynchronization. The relative influence of these two potentially opposing effects is unknown so far.

Aim: To assess the influence of different AV-delays on left ventricular synchrony and left ventricular ejection fraction (EF) using multigated acquisition radionuclide ventriculography (MUGA).

Methods: In 12 patients with severe congestive heart failure EF and synchrony was assessed without (noPM) and during bivPM at different AV-delays (80ms, 100ms, 120ms, 140ms, 160ms) with MUGA. Synchrony was defined by the standard deviation in the phase-delay within the left ventricle (LV-SD). This was calculated by use of a phase-histogram and expressed as fraction of a 360° heart cycle. EF was compared to LV-SD at the different AV-delays using Pearson Correlation.

Results: see table 1.

Conclusion: bivPM for congestive heart failure improves left ventricular synchrony irrespective of the chosen AV-delay. Left ventricular synchrony is closely related to EF.

Table 1

A:						
AV-delay of bivPM (ms)	80	100	120	140	160	noPM
LV-SD (°)	66	68	67	69	67	76
p-values vs. noPM	0.006	.004	0.003	0.006	0.001	
B:						
correlation of LV-SD with EF	-0.85	-0.88	-0.82	-0.92	-0.82	-0.84
p-value for correlation	0.000	0.000	0.001	0.000	0.001	0.001

A: LV-SD was significantly reduced by bivPM at any AV-delay. B: LV-SD was inversely correlated to EF.

9.6

Selection of heart failure patients for cardiac resynchronisation therapy: Could there be a role for equilibrium radionuclide angiography with Fourier phase analysis?

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Background. Equilibrium radionuclide angiography (ERNA) with Fourier phase analysis could be used to identify heart failure patients likely to benefit from cardiac resynchronisation therapy (CRT). We compared phase indices in patients with left ventricular failure (LVF) with a "control group" of patients post orthotopic cardiac transplantation (OCT).

Methods. 138 patients with severe LVF due to coronary disease (CAD; n=19) or dilated cardiomyopathy (DCM; n=45), or who were clinically stable post OCT with (n=28) or without (n=46) LV dysfunction (ejection fraction (EF) >50%) underwent routine ERNA. A left anterior oblique projection was acquired with 32 frames per cycle.

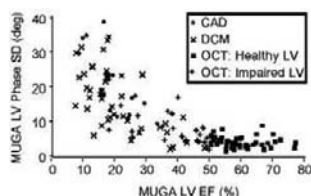
Results. LV phase standard deviation (SD) and interventricular phase difference (RV-LV) increased with increasing QRS duration and decreasing LV EF (Figure). Phase values were low with little variability in normal LV OCT patients, with progressively higher values for impaired LV OCT and LVF patients (Table). There was little overlap between normal LV and LVF groups for SD, but more for RV-LV.

Conclusion. SD and RV-LV increase with increasing QRS and decreasing LV EF, but the scatter implies that independent information is provided. Compared with RV-LV, SD may provide a clearer cut-off for selecting patients for CRT.

Table

	OCT healthy	OCT impaired	DCM	CAD	P
LV SD (deg)	4.3 (1.6)	7.4 (4.7)	17.3 (9.8)	20.3 (9.1)	<0.001
RV-LV (deg)	6.7 (6.7)	4.3 (9.4)	-2.6 (15.8)	-1.8 (12.0)	<0.001

Mean (SD) values of phase indices in different patient groups



Variation of LV phase SD with EF