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Early changes of left atrial reservoir function after cardioversion of paroxysmal atrial fibrillation predict relapse of arrhythmia.P. Barbier, R. Chiodelli, M. Alimento, E. Assanelli, G. Marenzi, M.D. Guazzi. *Centro Cardiologico Fondazione Monzino, IRCCS, Milan, Italy*

Atrial fibrillation (AF) causes systolic and diastolic left atrial (LA) dysfunction. Extent of LA systolic stunning after cardioversion of AF have been evaluated, but do not predict recurrence of AF.

Aim: to assess LA diastolic (reservoir) function after cardioversion of AF, as predictor of AF relapse 1 month after electrical cardioversion.

Methods: we studied 27 patients with paroxysmal AF > 1 month duration. Echocardiograms were performed 24 hours before (baseline) and 1 hour, 24 hours, 15 days and 30 days after cardioversion. We measured LA reservoir as the difference between LA maximum and minimum biplane volumes (ml), and LA systolic function (%) as: $[(LA \text{ end-diastolic, at ECG P wave, volume} - \text{minimum LA volume})/\text{end-diastolic volume}]$.

Results: after 1 month, sinus rhythm was maintained in 11 (group 1, 41%), and AF relapsed in 16 (group 2, 59%); 2 within 24 hours, 13 within 15 and 1 within 30 days) patients. Associated heart diseases, AF duration, and baseline left ventricular mass index and systolic function, LA biplane maximum (group 1: 90 ± 28 ml, group 2: 90 ± 19 , p=ns) volume, and estimated right ventricular systolic pressure were similar in the 2 groups. Baseline LA reservoir was similarly greatly reduced (when compared to value at 30 days post cardioversion of group 1) in both groups (group 1: 16 ± 6 vs 28 ± 7 ml, $p < .001$; group 2: 13 ± 6 vs 28 ± 7 ml, $p < .001$; group 1 vs 2, p=ns). In the 2 groups, mean LA volumes did not change during follow-up. In group 1, LA reservoir increased progressively during follow-up, with maximum increase rate at 24 hours (baseline = 16 ± 6 ml, 24 hours = 25 ± 9 , $p < .05$), whereas LA systolic function increased significantly only at 30 days (2 hours = $5 \pm 7\%$, 30 days = 15 ± 6 , $p = .02$). In group 2, LA reservoir and systolic functions changes during follow-up were not significant. At multivariate analysis, lack of reservoir increase in the first 24 hours after cardioversion was related to (and predicted) relapse of AF at 30 days ($p < .001$).

Conclusion: LA reservoir is impaired during AF, and reservoir stunning is associated with systolic stunning after cardioversion. However, LA reservoir recovers earlier than LA systolic function, and the extent of this recovery in the first hours after cardioversion predicts maintenance of sinus rhythm in the first month after cardioversion.

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Atrial deformation properties during atrial fibrillation and their prognostic value: a strain and strain rate imaging study.G. Di Salvo¹, P. Caso², R. Lo Piccolo³, A. Fusco¹, A.R. Martiniello³, A. D'Andrea³, N. Mininni², R. Calabrò³. ¹Second University of Naples, Department of Cardiology, Naples, Italy; ²Monaldi Hospital, Department of Cardiology, Naples, Italy; ³Second University of Naples, Paediatric Cardiology, Naples, Italy

Background: Atrial fibrillation (AF) is a common arrhythmia characterized by a lack of organized atrial mechanical activity.

Strain (S)(%) and Strain Rate (SR)(1/sec) imaging, derived by ultrasound offer a new quantitative approach to study regional myocardial deformation. S is the total amount of deformation while SR is the rate at which deformation takes place.

So far, few data are available about atrial deformation properties, their change during AF, and the value of the new deformation indices in predicting AF recurrence.

Study Aims: 1- to evaluate atrial deformation properties during AF, comparing those data with that of 30 healthy subjects; 2- to assess the prognostic value of S/SR imaging in defining the risk of AF recurrence.

Methods: we studied 40 consecutive patients (60% men; range 30-55 years) with lone AF and 30 healthy subjects.

All patients had duration of AF more than 1 month. The atrial peak systolic S and SR were measured during AF. All the studied patients underwent successful DC cardioversion 24 hours after S/SR imaging study. All patients were prospectively followed for a six months period (median 195 days; range 170-439 days). Hospitalization due to AF recurrence were regarded as endpoints. S/SR study was performed from the apical 4 and 2 chamber views, placing the sample volume in the middle segment of the left atrial walls.

Results: During AF atrial deformation properties were significantly reduced in the studied patients when compared to normals (AF patients: $S = 17 \pm 16$; healthy subjects: $S = 80 \pm 20$, $p < 0.001$).

After 6 months follow-up period 4 patients (Group I) were hospitalized because of AF recurrence.

S/SR values, at the inclusion, of Group I were significantly reduced when compared to the other 36 patients (Group II) (S: Group I = $17\% \pm 22$ vs 22 ± 10 , $p < 0.05$; SR: Group I = 0.97 ± 0.39 vs 2.2 ± 0.4 , $p < 0.05$).

Conclusion: Atrial deformation properties are severely compromise during atrial fibrillation.

Patients with more severe reduction of atrial deformation properties seem to be at higher risk to develop an AF recurrence.

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Cardiac lipid accumulation associated with diastolic dysfunction in obese mice.E. Bollano¹, C. Christoffersen², M.L.S. Lindegaard², E.D. Bartels², J.P. Goetze², C.B. Andersen³, L.B. Nielsen². ¹Wallenberg Laboratory, Göteborg, Sweden; ²Rigshospitalet, University of Copenhagen, Department of Clinical Biochemistry, Copenhagen, Denmark; ³Rigshospitalet, University of Copenhagen, Department of Pathology, Copenhagen, Denmark

Obesity may confer cardiac dysfunction due to lipid accumulation in cardiomyocytes. To test this idea, we examined whether obese ob/ob mice display heart lipid accumulation and cardiac dysfunction. Ob/ob mouse hearts had increased expression of genes mediating extracellular generation, transport across the myocyte cell membrane, intracellular transport, mitochondrial uptake, and beta-oxidation of fatty acids compared with ob/+ mice. Accordingly, ob/ob mouse hearts contained more triglyceride (6.8 ± 0.4 versus 2.3 ± 0.4 $\mu\text{g}/\text{mg}$, $P < 0.0005$) than ob/+ mouse hearts. Histological examinations showed marked accumulation of neutral lipid droplets within cardiac myocytes but not increased deposition of collagen between myocytes in ob/ob compared with ob/+ mouse hearts. On echocardiography, the ratio of E to A trans-mitral flow velocities (an indicator of diastolic function) was 1.8 ± 0.1 in ob/ob mice and 2.5 ± 0.1 in ob/+ mice ($P = 0.0001$). In contrast, the indexes of systolic function and heart brain natriuretic peptide mRNA expression were only marginally affected and unaffected, respectively, in ob/ob compared to ob/+ mice. The results suggest that ob/ob mouse hearts have increased expression of cardiac gene products that stimulate myocyte fatty acid uptake and triglyceride storage and accumulate neutral lipids within the cardiac myocytes. The results also suggest that the cardiac lipid accumulation is paralleled by affected cardiac diastolic dysfunction in ob/ob mice.

LEFT-VENTRICULAR HYPERTROPHY

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Detection of myocardial hypertrophy in patients with unexplained negative T-waves on ECG.D. Pellerin, R.S. Sharma, P.M. Elliott, W.J. McKenna. *The Heart Hospital, London, United Kingdom*

The diagnosis of hypertrophic cardiomyopathy (HCM) is usually based on the echocardiographic demonstration of left ventricular hypertrophy (LVH). Despite the use of harmonic imaging, however, the detection of LVH at the LV apex can be problematic. In consequence apical hypertrophy can be misinterpreted as akinesia, apical thrombus or tumour. Left ventricular cavity opacification (LVO) using echocardiography contrast agents is commonly used for delineation of endocardial borders in all myocardial segments. Ten patients with negative T waves on ECG and low probability of coronary artery disease were studied by echocardiography with harmonic imaging before and during LVO. Two patients had family history of HCM. An endocardial border definition score was obtained in each segment as follows: 0 = not seen, 1 = adequate endocardial visualisation during at least one phase of the cardiac cycle, and 2 = excellent endocardial visualisation during entire cardiac cycle. End diastolic wall thickness was measured in the 16 myocardial segments. Four patients had poor visualisation of apical endocardium before LVO. Echocardiography with grey-scale and low velocity colour Doppler failed to demonstrate abnormalities in 6 patients and showed large apical akinesia in 4 patients. LVO identified 7 patients with apical cardiomyopathy showing a spade-like appearance of the left ventricular cavity caused by near obliteration of the apex by the hypertrophy. One patient had mid cavity obstruction with apical aneurysm. The 4 patients with apical akinesia before LVO had hyperdynamic apical motion during LVO. Thus, in 8 out of 10 patients, the diagnosis of cardiomyopathy would have been missed without the use of contrast agents. Echocardiography with harmonic imaging and LVO should be routinely used in patients with unexplained negative T waves on ECG and apparent apical akinesia.

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Role of echocardiography in the diagnosis of arrhythmogenic right ventricular cardiomyopathy: comparison with Magnetic Resonance Imaging.

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Background: The arrhythmogenic right ventricular cardiomyopathy (ARVC) is a hereditary heart disease of unclear etiopathogenesis, characterized by a gradual loss of myocytes which are replaced by fibro-fatty tissue and consequent right ventricular (RV) dilation and dysfunction. The clinical course is characterized by arrhythmias, sudden death and heart failure. Echocardiography (ECHO) may be useful to evaluate right ventricular size and function, which are important major and minor criteria for the diagnosis of ARVC, but since structural abnormalities are slight or moderate in most cases, they can be easily overlooked. Recently several studies have investigated the role of other diagnostic techniques such as computed tomography (CT) or magnetic resonance imaging (MRI) to obtain more specific evidence of the disease.

Aim of the study: To evaluate the role of ECHO in the diagnostic pathway of ARVC in a selected cohort of patients undergoing MRI.

Methods: We retrospectively analyzed 78250 MRI performed in MRI lab of L'Aquila University. One hundred and fifty three patients (pts) underwent MRI for suspected ARVC. In 108 (70.5%) was performed a color Doppler ECHO. As echocardiographic findings of ARVC we considered: dilation, kinetic alterations and systolic dysfunction of the RV. According to MRI data we considered as probable diagnosis the detection of at least two of the following criteria: dilation, dyskinesia, adipose substitution.

Results: MRI confirmed diagnosis in 18/46 (40%) pts who had a positive ECHO for ARVC, whereas it was positive in 6/62 pts (9%) (p<0.001) with a non significant echo. RV dilation was present in 25 (54%) pts with and in 8 (12%) without positive ECHO (p<0.0001); adipose substitution was present in 15 (32%) pts with and in 10 (16%) without positive ECHO (p=0.07); kinetic alterations were present in 16 pts (35%) with and in 7 (11%) without positive ECHO (p<0.001).

Conclusions: Echocardiography may be a useful screening method for ARVC, as it is confirmed by MRI. It can clearly distinguish slight forms of the disease from severe ones, and it can give useful informations for further diagnostic exams. In fact, only 9% of pts with a non significant ECHO had a later positive MRI, without significant clinical symptoms.

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The heart preserves contraction and contractility during maximal exercise even during moderate hypoxic conditions.

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Background: It is known that exercise capacity at high altitude is restricted. During exercise the cardiac metabolism is partly changed from aerobic towards anaerobic energy delivery at altitudes exceeding 2500-3000 m. Up to that altitude the cardiac performance is compensated by increased coronary flow. The objective of the present study was to see if cardiac contraction and contractility is unchanged at maximal exercise with inhaled oxygen tensions comparable with 4500 m altitude.

Methods: 8 healthy young individuals were studied with myocardial tissue Doppler technique for quantitative evaluation of myocardial velocities. Contractility was estimated from maximal iso-volumetric velocity and contraction from systolic max velocities. Mainly longitudinal function was studied, because the subendocardial fibres generate that and a reduction in oxygen delivery should therefore give the most pronounced result in that function. Cine loops were acquired for analysis at rest, after 6 min of sub maximal exercise and after 6 min of maximal symptom limited exercise during breath of normal air. After half an hour of rest the protocol was repeated during breath of air containing 12% of oxygen (comparable with 4500 m height). The loading was adjusted to similar heart rates (HR) and scaling of effort. The exercise was performed on a supine bicycle ergometer.

Result: During air breathing a maximal exercise of 208 W (range 170-230) was achieved. In the hypoxic situation identical HR and effort scaling was reached at a load of 155 W (range 120-170). The percutaneously measured oxygen saturation fell from 98% to 70%. The myocardial velocities were normal at rest and more than doubled during maximal exercise. In the hypoxic situation there were similar myocardial velocities both at rest and during exercise.

Conclusion: In healthy individuals exercise at high altitude could be performed at least during 15-20 minutes without any decrease in myocardial contraction. This occurs despite there is a significant decrease in oxygen tension, which could not be compensated by increased flow or extraction. Myocardial metabolism must therefore be changed because aerobic energy delivery could only cover 80% of the energy need. With an unchanged contraction work this deficit must be covered from other sources.

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Tissue Doppler imaging identifies early improvement in left ventricular systolic and diastolic function after aortic valve replacement for aortic stenosis.

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Background: Whilst it is recognised that significant aortic stenosis (AS) is associated with impaired left ventricular (LV) systolic long axis function, its effect on diastolic long axis function and the response to aortic valve replacement (AVR) is less clear. This study aimed to examine the effects of AVR for AS on cardiac function as assessed by tissue Doppler imaging (TDI).

Methods: 20 patients (11 male, mean age 74 yrs) undergoing AVR for AS underwent echocardiographic examination prior to surgery and 6 months post operatively. This included measurement of longitudinal mitral annular velocities by TDI.

Results: (See table)

Table: Echocardiographic parameters

	Preop	6 months	p
LVMi (g/m ²)	178 (63)	139 (39)	<0.001
EF(%)	66 (11)	64 (10)	0.38
E/A	0.68 (0.23)	0.77 (0.27)	0.12
DCT (ms)	303 (91)	309 (74)	0.79
S' (cm/s)	5.4 (1.2)	6.8 (1.3)	0.002
E' (cm/s)	4.7 (1.7)	7.1 (2.0)	<0.001

Figures quoted mean(SD). LVMi - LV mass index, EF - LV ejection fraction by Simpson's method, E/A - ratio of early to late diastolic mitral inflow velocities, DCT - deceleration time early diastolic filling, S' - systolic mitral annular velocity, E' - early diastolic mitral annular velocity

AVR resulted in significant regression of left ventricular hypertrophy at 6 months. There was no significant change in LV ejection fraction or standard mitral inflow Doppler parameters. However, both systolic and early diastolic mitral annular velocities showed significant increases.

Conclusion: TDI shows significant improvements in both systolic and diastolic left ventricular long axis function within 6 months of AVR for AS. This improvement is not detected using conventional echocardiographic parameters.

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Assessment and monitoring recovery after aortic valve replacement using tissue Doppler echocardiography: a six-month follow-up study in elderly.

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Background: Tissue Doppler Echocardiography (TDE) is a reliable new modality that assists in the objective evaluation of regional right and left ventricular function. In this work we monitored left (LV) and right (RV) ventricular function as assessed by TDE, immediately before, and 15 days, 3 and 6 months after the aortic valve replacement (AVR) in patients with severe aortic stenosis (peak gradient 91 ± 21).

Methods: During 2002 we enrolled 43 consecutive patients (27 men, 65 ± 12 years old and 16 women, 69 ± 7 years old) who had undergone AVR. TDE images obtained from the apex, visualizing tricuspid and mitral free wall annulus. RV and LV systolic and diastolic velocities were compared immediately before, as well 15 days, 3 and 6 months after AVR, based on the Analysis of co-variance for repeated measurements. Mitral and tricuspid diastolic velocities (E, A) were also measured.

Results: Systolic (S) velocity in LV showed a significant increase after AVR (15d: 11±1 v 3m: 12±2 v 6m: 13±1, p for trend < 0.01), while RV S velocity showed no statistically significant changes (15d: 11±2 v 3m: 12±1 v 6m: 12±1, p for trend < 0.1). Both diastolic E velocities in RV and LV increased significantly from 15 days to 6 months after AVR (15d: 5±3 v 3m: 8±3 v 6m: 12±3, p for trend < 0.05 and 15d: 5±1 v 3m: 8±2 v 6m: 16±3, p for trend < 0.01). The ratio E/E(TDI) in LV showed a significant decrease after the AVR (15d: 10±2 v 3m: 9±2 v 6m: 7±2, p for trend < 0.001), while the ratio E/E(TDI) in RV decreased significantly between pre and post operation (pre: 6±2 v 15d: 0.97±1, p = 0.02), but remained constant thereafter AVR (3m: 0.86±1 v 6m: 0.92±1, p = 0.67).

Conclusion: Significant LV systolic improvement was observed after AVR, although no such improvement observed in RV systolic function. E diastolic velocity was also increased in both chambers. TDE can provide a simple non invasive quantitative method for monitoring RV and LV function.