

Table 1 Inter-reader variability among 5 readers for measuring echo parameters in 25 patients

Parameter measured	% IRV (mean \pm SD)
MV E velocity	1.7 \pm 1.1
MV E deceleration time	4.5 \pm 2.7
MV A velocity	3.6 \pm 2.2
MV A duration	19.4 \pm 13.3
PV S velocity	3.0 \pm 1.7
PV D velocity	5.1 \pm 5.4
PV A velocity	12.3 \pm 7.1
PV A duration	20.8 \pm 12.8
Vp	11.7 \pm 6.7
MV TDI septal E'	4.4 \pm 3.0
MV TDI septal A'	5.3 \pm 3.0
MV TDI lateral E'	4.6 \pm 2.8
MV TDI lateral A'	10.9 \pm 6.1

The 4 parameters with the greatest IRV were PV A duration, MV A duration, PV A velocity and Vp (range 12-21%); in contrast, IRV for MV flow velocities and septal TDI ranged from 1.7-5.3%. PV flow and Vp took longer to measure (80 \pm 34s and 57 \pm 29s respectively) than did MV inflow (36 \pm 21s) and TDI (31 \pm 17s).

Conclusions: The excellent recording success rate, low inter-reader variability and lesser time required for MV flow velocities and TDI measurements suggest that these measures, rather than PVF and Vp, should be the first choice in the evaluation of diastolic function.

1149-156 Mitral Deceleration Time in Acute Myocardial Infarction: Relation to Myocardial Perfusion After Successful Primary Percutaneous Coronary Intervention

Giampaolo Cerisano, Angela Migliorini, Domenico Pucci, Piergiorgio Buonamici, Renato Valenti, Leonardo Bolognese, Guido Parodi, David Antonucci, Careggi Hospital, Florence, Italy

Background: In animal model of AMI the extent of microvascular obstruction in infarct segments is correlated to left ventricular stiffness. Doppler Mitral DT has been found to be inversely related to LV chamber. We evaluated the relation between Doppler Mitral Deceleration Time (DT) and myocardial perfusion, as assessed by myocardial contrast echocardiography (MCE), in patients with a first AMI after successful primary percutaneous coronary intervention (PCI).

Methods: The study population was based on 60 consecutive patients with a first AMI treated by successful primary PCI within 6 hours after the onset of symptoms. DT was evaluated within 24 h after PCI. MCE examinations were performed when patients were submitted to angiographic control at 48-72 hours and 1 month after primary PCI. **Results:** A "restrictive" mitral inflow pattern (DT \leq 130 msec) was present in 71% of pts with "no reflow" phenomenon at 48 h, and only in 17% of pts with adequate reperfusion (myocardial reflow), (p < .0001). Moreover, in 75% of pts with a DT \leq 130 msec and myocardial reflow at 48 hours, MCE evaluation at 1 month showed the appearance of a "no reflow" despite the persistence of a patent IRA. No patient with "no reflow" at 48 hours showed during follow-up an improvement in myocardial perfusion whatever the mitral Doppler pattern was. Significant correlation between DT and MCE index was observed at 48 hours (r = .48, P < .0001) and 1 month (r = .72; P < .000001) after primary PCI. By forward stepwise multiple analysis, DT emerged as independently related to MCE indices (p = .01 and p = .000001, respectively).

Conclusions: DT is a strong noninvasive marker of the effectiveness of myocardial perfusion after successful primary percutaneous coronary intervention for AMI, and a short DT (< 130 msec) is an indicator of "no reflow".

1149-157 Assessment of Fetal Diastolic Function by Tissue Doppler Imaging

John T. Wong, Louis Y. Chan, W. Y. Fok, T. N. Leung, C. M. Yu, T. K. Lau, Prince of Wales Hospital, The Chinese University of Hong Kong, Shatin, Hong Kong

Background: Myocardium relaxation velocity measured by tissue Doppler imaging (TDI) is an accurate reflection of diastolic function and an important prognostic indicator of many cardiac diseases in adults. Although there are ample data concerning the diastolic function and TDI in adults, information on this area in the developing fetuses is sparse.

Methods

Diastolic function of 178 singleton fetuses from 18 to 37 weeks of gestation was assessed by fetal echocardiogram. Myocardial relaxation velocities were studied by tissue Doppler at the left and right lateral ventricular wall.

Results

The mean Em of the left and right ventricular wall increases by more than 100% from mid-trimester (3.3 and 3.9 cm/s) to late third trimester (7.2 and 8.2 cm/s respectively). The mean Am of left and right ventricular wall also increases as gestation advances, but by a smaller magnitude (from 6.4 and 7.8 cm/s at mid-trimester to 8.0 and 11.0 cm/s at late third trimester). The Em/Am ratios of left and right ventricular wall progressively increased from 0.54 \pm 0.16 and 0.51 \pm 0.12 at mid-trimester to 0.92 \pm 0.25 and 0.76 \pm 0.20 at late third trimester respectively (r = 0.53, p < 0.001 and r = 0.59, p < 0.001 for left and right side respectively). The reference range of Em/Am ratio at different gestational age was constructed.

Conclusion

Ours results showed that in mid-trimester, ventricular filling during diastole is largely relied on atrial contraction. The role of active ventricular relaxation becomes increasingly important as gestation advances and Em/Am ratio was close to unity at term. The reference range allows further studied and comparison of diastolic function assessed by TDI in abnormal fetuses.

1149-158 Impact of Left Ventricular Diastolic Dysfunction on Left Atrial Remodeling and Function: A Volumetric Analysis

Swee Guan Teo, Hong Yang, Ping Chai, Tiong Cheng Yeo, National University Hospital, Singapore, Singapore

Background: Diastolic dysfunction may result in elevation of left ventricular and atrial pressures, resulting in left atrial (LA) remodeling. The change in LA volume and function in patients with diastolic dysfunction has not been adequately described. The aim of this study was to examine the effects of left ventricular diastolic dysfunction on LA remodeling and function.

Methods: We measured LA volume and function in 105 patients (25 normal controls, 80 patients with diastolic dysfunction). Maximal (Vol_{max}) and minimal LA volumes were measured using the ellipsoid method. LA Vol_{max} was then indexed to the body surface area. The passive filling, conduit and active emptying volumes were also estimated. The emptying volumes were corrected for body surface area and LA Vol_{max}. Traditional Doppler measures of diastolic function were also measured.

Results: Indexed LA Vol_{max} was strongly associated with diastolic function grade (Spearman p < 0.0001, r_s = 0.701). An indexed LA Vol_{max} > 19.7 ml/m² predicted diastolic dysfunction with 96% sensitivity and 96% specificity. Compared to normal controls, corrected passive filling and conduit volumes were lower, and corrected active emptying volume was higher in patients with grade 1 diastolic dysfunction (0.38 vs 0.51, p = 0.007; 1.69 vs 3.29, p < 0.0001; 0.59 vs 0.44 p = 0.001), resulting in a similar corrected total emptying volume (0.97 vs 0.96, p = ns). Patients with higher grades of diastolic dysfunction, however, had lower corrected passive filling, conduit, active and total emptying volumes.

Conclusion: LA remodeling occurs in patients with diastolic dysfunction and LA volume expressed the severity of the diastolic dysfunction. Initially, the atrium compensates for changes in LV diastolic properties by augmenting active atrial contraction. As the severity of the diastolic dysfunction increases, this compensatory mechanism fails as atrial mechanical dysfunction sets in, resulting in lower total atrial emptying volume.

1149-159 Left Atrial Systolic Force in Hypertensive Patients With Left Ventricular Hypertrophy: The LIFE Study

Marcello Chinalli, Giovanni de Simone, Julius M. Gardin, Eva Gerds, Kristian Wachtell, Kurt Boman, Markku S. Nieminen, Vasilios Papademetriou, Vittorio Palmieri, Richard B. Devereux, Weill Medical College of Cornell University, New York, NY

Inappropriate left ventricular (LV) mass (M) has been reported to be related to LV systolic dysfunction. We have recently reported that abnormal left atrial (LA) systolic force (SF) represents a useful measure of atrio-ventricular coupling, and of early diastolic dysfunction. The aim of this study was to analyze the relation of LASF to LV systolic and diastolic parameters in a population of hypertensive adults with adequate or inappropriate LV hypertrophy.

Methods: 557 hypertensive patients enrolled in the LIFE study, with echocardiographic LV hypertrophy and without history of atrial fibrillation, were analyzed. LVM was defined as inappropriate when higher than 128% of the value predicted for hemodynamic load (derived from age, sex and stroke work). The study population was divided on the basis of the presence of adequate (a) or inappropriate (i) LVM into two groups: aLVM (N=250; 66.4 \pm 7.1 years; 49.6% women) and iLVM (N=307; 65.8 \pm 6.7 years; 42.3% women). LASF was obtained from mitral orifice area and Doppler mitral peak A flow velocity.

Results: Individuals with aLVM or iLVM did not differ in age, gender distribution, plasma creatinine, or serum glucose. iLVM had higher mean BMI and heart rate and lower systolic and diastolic blood pressure (all p < 0.05). After controlling for clinical covariates, ejection fraction (62.5 \pm 4.5 vs 58.6 \pm 2.2%) and stress-corrected midwall shortening (100.9 \pm 14.1 vs 91.7 \pm 11.1%) were lower with iLVM as compared to aLVM (both p < 0.001). Among traditional parameters of diastolic function, isovolumic relaxation time, mitral E deceleration time, peak E velocity, atrial filling fraction and E/A ratio were statistically similar with iLVM and aLVM (all p = ns). Mitral peak A wave velocity was lower with iLVM (70.8 \pm 10.2 vs 65.8 \pm 12.3 cm/sec; p < 0.05). LA diameter was similar in the two groups (3.98 \pm 0.52 vs 4.03 \pm 0.57 cm, p = ns) while LASF was significantly lower in participants with iLVM (15.3 \pm 7.2 vs 18.1 \pm 8.3 Kdynes; p < 0.001).

Conclusions: Independently of covariates, hypertensive patients with inappropriate LVM have reduced LASF. The reduction of LA systolic performance is associated with LV systolic dysfunction but is independent of traditional measures of LV diastolic function.

1149-160 Early Changes of Left Atrial Reservoir Function After Cardioversion of Paroxysmal Atrial Fibrillation Predict Relapse of Arrhythmia

Paolo Barbieri, Roberta Chiodelli, Marina Alimento, Emilio Assanelli, Giancarlo Marenzi, Maurizio D. Guazzi, Centro Cardiologico Fondazione "Monzino", IRCCS, Milano, Italy

Background: Atrial fibrillation (AF) causes global left atrial (LA) dysfunction. Since AF recurrence after cardioversion is not predicted by LA systolic stunning, we tested the hypothesis that LA diastolic (reservoir) function, evaluated both during AF and after cardioversion, could predict relapse of AF 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 end-diastolic, at ECG P wave, volume - minimum LA volume) / end-diastolic volume].

Results: At 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 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, $p=ns$). 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 both reservoir and systole are stunned 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 at 1 month.

1149-161 Effects of Body Size, Stroke Volume, Age, and Gender on Left Atrial Dimension

Arthur E. Weyman, Jules Gardin, Ravin Davidoff, Tom Ryan, Neil Weissman, Massachusetts General Hospital, Boston, MA

Background: Previous studies with small samples have reported left atrial enlargement is strongly associated with obesity but weakly with age and not with gender. To further examine the determinants of LA size, the antero-posterior dimensions (LAD) from four, large, clinical studies of previous anorexigen users and matched controls were examined to identify the relationship of body size (height, weight, BSA, and BMI), age, gender and stroke volume to echocardiographic values.

Methods: LA dimension was measured from 2-D targeted M-mode recordings. Blood pressure, heart rate, anthropometrics and medical history were obtained; patients with co-morbid disease (CMD) conditions (cardiovascular) were identified and excluded from analysis. Ninety-five percent population ranges for LAD based on multiple regression models were constructed.

Results: Subjects (N=4911) were predominantly white (88%), female (81%), obese (body mass index (BMI) range: $19-74$ kg/m², BSA range: $1.4-3.1$ m², age range: 18-80 years and 10% had CMD. LAD was similar in anorexigen treated patients (means across cohorts: 33.4 ± 4.0 to 38.7 ± 4.7 mm) and controls (33.4 ± 4.2 to 38.2 ± 4.7 mm) ($P=0.70$ to 0.10) and therefore both groups were analyzed together. BSA and BMI were the most significant predictors ($P < 0.001$) of LAD followed by stroke volume ($P < 0.001$). Across cohorts LAD correlated with BSA from $r=0.38$ to $r=0.45$. The LAD/BSA index also highly correlated with BSA and was significantly higher in males. Age was a significant predictor of LAD in three cohorts (2 mm increase per 30 years). LAD was 2.7 ± 0.3 to 3.5 ± 0.3 mm higher in men than women ($P < 0.001$). Multiple regression models were constructed with BSA, age, sex and stroke volume accounting for 15 - 30% of the total variance in LAD among the cohorts. The prevalence LAD > 40mm was found in 23.6 percent of subjects without CMD.

Conclusion: LAD significantly increases with height and weight and therefore, BSA. Population ranges for LAD dimensions have been identified and values should be corrected for BSA, age and gender during clinical evaluation. LAD/BSA has recently been reported as a good measure of LA size, independent of body size, however we did not find this.

1149-162 Sinus Rhythm Restoration After the Maze Operation and Relationship Between Pre- and Postoperative Left Atrial Volume

Hyeilim Oh, Jinho Choi, Sangcheol Lee, Jidong Sung, Hyeoncheol Gwon, Junesoo Kim, Eunseok Jeon, Dukkyung Kim, Sanghoon Lee, Pyowon Park, Kyungpyo Hong, Jeongyeu Park, Jungdon Seo, Sungkyunkwan University School of Medicine, Samsung Medical Center, Seoul, South Korea

Background: The maze operation is effective for the restoration of sinus rhythm in patients with atrial fibrillation (AF). The purpose of this study was to identify the predictors of sinus rhythm restoration and to investigate changes in left atrial volume and diameter after the maze operation.

Methods: The subjects for the study were 21 patients who underwent open-heart surgery in conjunction with the maze-III operation for chronic atrial fibrillation from October 2002 to April 2003. Electrocardiographic and transthoracic echocardiographic studies were prospectively made preoperatively and at 3 months postoperatively, respectively. Left atrial volume corrected for body surface area (LAV/BSA), and left atrial diameter (LAD) measured in M-mode were assessed.

Results: Sinus rhythm was restored and maintained in 17 of 21 patients (80.9%). Between the group with successful restoration of sinus rhythm (group A; n=17) and the group with unsuccessful restoration (group B; n=4), there was no difference in age, gender, and NYHA functional class. However, the duration of AF in group A was significantly shorter than in group B (3.2 ± 2.4 years versus 15.8 ± 7.0 years, $p=0.024$). Group A and group B did not show any difference in pre-operative left ventricular ejection fraction and left atrial diameter. However, pre-operative LAV/BSA in group A was significantly smaller than in group B (84 ± 23 mL/m² versus 135 ± 30 mL/m², $p=0.025$). In group A, LAV/BSA (84 ± 23 mL/m² versus 56 ± 15 mL/m², $p < 0.001$) and LAD (60 ± 9 mm versus 51 ± 8 mm, $p=0.001$) significantly decreased three months after operation. In group B, however, no difference was found in LAV/BSA (135 ± 30 mL/m² versus 116 ± 32 mL/m², $p=NS$) and LAD (68 ± 3 mm versus 66 ± 8 mm, $p=NS$). Post-operative LAV/BSA correlated to pre-operative LAV/BSA ($r=0.50$, $p=0.04$) and the duration of AF ($r=0.74$, $p=0.002$).

Conclusion: Pre-operative left atrial volume measured by echocardiography and the

duration of atrial fibrillation were predictors of successful sinus rhythm restoration after the maze operation. Significant reduction of left atrial volume after the maze operation was found in the patients with sinus rhythm restoration.

POSTER SESSION

1150 Echocardiography During Septal Defect Closure, Dysrhythmia Ablations: Intracardiac Echocardiography Is Nice and So Is Three-Dimensional Echo

Tuesday, March 09, 2004, Noon-2:00 p.m.

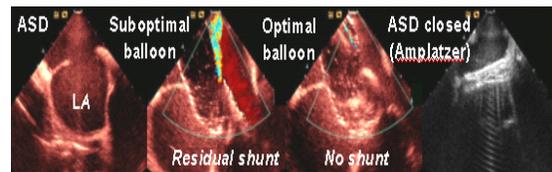
Morial Convention Center, Hall G

Presentation Hour: 1:00 p.m.-2:00 p.m.

1150-149 Intracardiac Echocardiography Aids Decision-Making During Percutaneous Device Closure of Patent Foramen Ovale and Atrial Septal Defects in Adults: Lessons From 223 Procedures in the Cardiac Interventional Laboratory

Luqin Cao, Zheng Liu, Amy Loyd, Heider Arjomand, Andrey Espinoza, Julie Wendell, Patrick Coon, Sheldon Goldberg, William Kussmaul, Daniel McCormick, Mani Vannan, Drexel University College of Medicine, Philadelphia, PA

Background: We have shown the value of ICE and fluoroscopy to guide percutaneous device closures (PDCs) of PFOs and ASDs, but have not shown whether ICE impacts decision-making during PDCs. **Methods:** 223 PDCs were done between May '01 and Sept. '03 with CardioSEAL® (n=106) and Amplatzer® (n=117) devices. 163 PFOs and 60 secundum ASDs were occluded with ICE (AcuNav™) guidance. **Results:** Detailed anatomy of the chambers, vessels, valves and the IAS (limbii, fossa and PFO and/or ASD) was imaged with 2-D, color and spectral Doppler in all patients. In 48 patients (21%), ICE data directly influenced: 1) *type and size of device* based on tunnel length, marked hypertrophy of the IAS limb or an aneurysmal septum (n=31), 2) *optimal balloon inflation sizing* using ICE color-Doppler obliteration of shunt in large ASDs (n=4), **Fig. below**, 3) *type and placement of multiple devices* in fenestrated IAS defects (n=3), 4) *complex PDCs* in the setting of *failed surgical patch repair* of large ASDs (n=2), 5) *assess the effect of IAS shunts on systemic desaturation* by ICE color-Doppler during balloon occlusion (n=4), 6) *decision to defer to surgery* when the ASD rim was dynamically altered during balloon inflation so that there was no discrete waist (n=4). **Conclusions:** Based on our large experience, ICE during PDCs is a valuable adjunct to fluoroscopy for successful procedural outcome. Furthermore, in about 20% of the cases it provides unique data not available by fluoroscopy which directly impacts decision-making in the interventional laboratory.



1150-150 Freehand and Rotational Transthoracic Three-Dimensional Echocardiography Improve the Quantification of Atrial Septal Defect Size Before Percutaneous Closure

Jaroslav D. Kasprzak, Michal Ciesielczyk, Pawel Dryzek, Piotr Lipiec, Andrzej Sypa, Michal Plewka, Jaroslav Drozd, Maria Krzeminska-Pakula, Medical University of Lodz, Lodz, Poland, Polish Mother's Health Centre, Lodz, Poland

We aimed to compare the feasibility and accuracy of freehand (FH) vs rotational (RO) transthoracic 3-dimensional echocardiography (3DE) for the planimetry of secundum atrial septal defect (ASD) before interventional closure with Amplatzer device.

Method: We studied 32 children and young adults (aged 3-32 years, mean 12 ± 7) prior to Amplatzer implantation using 3DE and TEE. 3D-RO was performed at 3° intervals (TomTec Echocan 3.0 - 18 pts) 3D-FH by sweep scan, 40-50 slices (EasyScan, 14 pts). Long and short diameter of defect were measured TEE and 3D and compared to stretched balloon and device waist diameter.

Results: FH provided superior data density and shorter study time ($28 / 16$ min, $p < 0.001$). ASD tissue rims could be measured in all cases. Mean stretched/Amplatzer diameter was $21 \pm 5 / 22 \pm 6$ mm and was severely underestimated by TEE and much less by 3DE: 13 ± 4 vs 18 ± 5 mm ($p < 0.001$), mean difference of 2.6 ± 3.8 mm by 3DE ($p < 0.001$) and 7.3 ± 3.6 mm by TEE. The results of 3DE had good correlation (better for FH than RO, $r=0.89$ and 0.80) and close agreement to stretch and device size diameter ($r=0.80$ and 0.83 resp.) with more underestimation of device size for FH than RO (difference 4.6 vs 1.1 mm).

Conclusions: Transthoracic 3DE is a robust technique, improving the quantification of ASD diameter and more reliable prediction of necessary Amplatzer size in young patients