Oral presentations

001 WAVE INTENSITY ANALYSIS: INSIGHTS IN HAEMODYNAMIC ABNORMALITIES IN HEART FAILURE
S.L. Cunningham1, J. Mayet1, K.H. Parker2, R.A. Foa1, S.A. McG Thom1, A.D. Hughes3, 1St Mary’s Hospital, London; 2Physiological Flow Studies Unit, Imperial College, London, UK

Wave intensity analysis (WIA) is a recently described non-invasive technique that provides information on the working state of the heart, wave reflections, and arterio-ventricular interaction. It is a measure of the energy carried by a wave and is the product of instantaneous changes in pressure and flow velocity at any arterial site. We used WIA to investigate the possibility of altered wave reflection and to further understand the haemodynamic changes that occur in heart failure (HF). 29 patients with HF were compared to 29 age-matched subjects with normal systolic function (N). An additional 62 subjects with compensated HF were studied to examine possible relationships between ventricular function and wave dispersion. Brachial BP, carotid arterial pressure (P) and flow velocity (U) were measured by sphygmomanometry, tonometry and pulsed wave Doppler respectively. The intensities of forward and backward waves and carotid pulse wave velocity (c) were calculated. Data are means ± SD, P was calculated by Student’s t-test. P was lower in the HF group [129 ± 21 (N); 120 ± 24 mmHg (HF); p = 0.10]. c did not differ [13.6 ± 5.5 (N); 13.2 ± 6.3 ms-1 (HF)]. Peak U was significantly reduced in the heart failure group [0.70 ± 0.15 (N); 0.56 ± 0.17 ms-1 (HF); p = 0.006]. Ventricular wave power was dramatically reduced in HF [29.2 ± 19.8 (N); 15.4 ± 7.7 mWm-2 (HF); p = 0.00001], as was wave work [232 ± 80 (N); 124 ± 66 Jm-2 (HF); p = 0.00001]. Wave reflection from the head [13.3 ± 7.5 (N); 17.5 ± 11.7% (HF); p = 0.08] and the body [1.5 ± 1.7 (N); 5.4 ± 6.1% (HF); p = 0.001] were increased in the HF group. The magnitude of the systolic ventricular power wave correlated with SBP (r = 0.49, p = 0.001) and age (r = 0.29, p = 0.009). Heart failure is associated with a dramatic increase in wave reflection from the head, which is consistent with widespread vasoconstriction. This study did find that echo altered management of patients with suspected heart failure. It was also clear that local and NSF guidelines are not being met. Not all patients with heart failure receive echocardiography and not all patients with impaired systolic function are offered ACE inhibitor treatment.

002 AN AUDIT TO DETERMINE WHETHER ALL PATIENTS ADMITTED WITH HEART FAILURE RECEIVE ROUTINE ECHOCARDIOGRAPHY AND DOES IT ALTER THEIR MANAGEMENT
A. Waldock. Horton Hospital, John Radcliffe Hospitals NHS Trust, Oxford, UK

One hundred and eight admissions aged 49–92 with a diagnosis of heart failure were retrospectively evaluated. 57% of patients with suspected heart failure were not offered echo on admission however 8% of these patients had been scanned recently. In total 44 patients were referred for echo. Following echocardiography the clinical concept of disease altered in 28% of cases and a treatable cause for heart failure was found in 4.5%. Echo was useful in identifying a cause for heart failure of an unknown aetiology; it was also able to confirm a diagnosis of coronary heart disease. Echo significantly affected patient treatment with respect to ACE inhibitor prescribing (z² = 8.17, P < 0.005). Echo not only identified those patients with impaired systolic function who would benefit from treatment but also identified significant valve disease, a contraindication for ACE inhibitor treatment. This study identified a number of patients who were receiving sub optimal treatment for heart failure. Despite confirmed impaired systolic function on echo, 13.6% of patients were not prescribed an ACE inhibitor and 50% of patients with severely impaired left ventricular function were not taking Spironolactone. Referral of patients for echo was not consistent throughout the team of physicians. One physician in particular referred significantly more patients for echocardiography.
Improvement in LV relaxation and decrease in LA pressure after SRT may contribute to the clinical amelioration of the patients.

**DOBUTAMINE-INDUCED HAEMODYNAMIC CHANGES ASSESSED BY ECHO: IMPLICATIONS FOR INOTROPE DOSING**

G. McCann, A. Allen, J. McAdam, A. McCullough, J. Davies, D. Chin. Cardiorespiratory Directorate, University Hospitals of Leicester NHS Trust, Leicester, UK.

**Background:** Beta-adrenoceptor agonists are used in patients with severe heart failure. They increase contractility and heart rate and therefore forward cardiac output (CO). However, published data suggest that patient mortality is increased by these drugs. We hypothesize that higher drug doses reduce stroke volume (SV) by shortening diastolic filling times and decreasing end-diastolic volume, contributing to this outcome.

**Methods:** 92 (Gp A) and 69 (Gp B) patients with normal and ischaemic Dobutamine stress echocardiograms were assessed. Dobutamine was infused at 10 μg/kg/min increments and/or atropine to achieve ≥85% maximum predicted heart rate. Left ventricular wall motion score index (LV-WMSI) was calculated using the 16-segment gradient wall model. SV and CO were obtained from LV outflow tract and ECG data. Digitised data from an Enconcert (Philips) archive were analysed offline. Exclusions = atrial fibrillation, mitral regurgitation or obstructive LVOT gradients. Statistical significance = p < 0.05.

**Results:** There was no significant difference in heart rates. Dobutamine induces a biphasic change in SV, with SV falling at higher doses in both groups, but to greater extent in ischaemia.

**Conclusions:** Maximal forward SV occurs at lower inotrope doses in normal and abnormal hearts. Beyond this SV, any rise in CO becomes rate-dependent, with metabolic implications for the ischaemic heart.

---

**THE INFLUENCE OF MECHANICAL DISPERSION ON GLOBAL SYSTOLIC VELOCITY DURING BIVENTRICULAR PACING**

R.E. Lane, A.W.C. Chow, N.S. Peters, D.W. Davies, J. Mayet. St. Mary's Hospital and Imperial College School of Medicine, London, UK.

Tissue Doppler imaging (TDI) can provide a quantitative measure of both mechanical dysynchrony and systolic performance and enables assessment of the changes observed in patients with heart failure during biventricular pacing (BVP).

**Methods:** 17 patients age 72.6 ± 12.3 years, with severe heart failure (NYHA III-IV) and LBBB (QRS 166 ± 23 ms) underwent BVP. TDI from six segments across the LV at the level of the mitral valve annulus and from the RV free wall were recorded. Regional electromechanical delay was calculated as time from start of QRS to onset of systolic contraction. Intraventricular mechanical dispersion (LVD) was calculated as the time between latest and earliest sites of LV contraction. Interventricular mechanical dispersion (IVD) was calculated as the time delay between latest site of LV contraction and RV contraction. Global systolic velocity (Sg) as a measure of LV performance, was calculated as mean left ventricular (LV) systolic velocity. Measurements were made at baseline and during synchronous BVP.

**Results:** LVD and IVD were significantly reduced from baseline with BVP (78 ± 51.0 vs 42.3 ± 25.3, p = 0.011 and 116.8 ± 48.9 vs 56.6 ± 36.4, p = 0.001). During synchronous BVP, Sg was found to negatively correlate with both LVD and IVD (r = -0.54, p = 0.004 and r = -0.54, p = 0.005 respectively) see graphs.

**Conclusion:** During BVP, maximal reductions in both LVD and IVD are needed to derive optimal LV performance. These can be quantified using TDI, and may be used as a guide for optimising therapy.

---

**FEASIBILITY OF A NEW, COMPUTER BASED ASSESSMENT OF MYOCARDIAL PERFUSION WITH CONTRAST ECHOCARDIOGRAPHY**

N. Giatrakos1, J.X. Gao2, G.Z. Yang2, P. Nihoyannopoulos1. 1NHLI, ICSV, Hammersmith Hospital, Cardiology dept, London, 2NHLS, IC and Royal Society/Wolfson Medical Image Computing Laboratory, London, UK.

**Background:** Myocardial Contrast Echocardiography (MCE) is a promising technique of assessing myocardial perfusion in patients with Coronary Artery Disease (CAD). Currently, quantitative assessment is performed by manually selecting regions of interest (ROI). We have specially developed a new software, Echofit, that automatically analyses and colour codes the redistribution of contrast bubbles after high impulse destruction.

**Methods:** Twenty patients with suspected CAD that were referred to our department for stress echocardiogram were studied, 13 men and 7 women, mean age 64 ± 14. All patients underwent coronary angiography. A standard dipyridamole stress test (0.142 mg/kg/min for 4 min) was performed and continuous infusion of Sonazoid® (NC100100) was administered for MCE. We used the HDI 5000 (Philips Medical Systems) with Pulse Inversion and Real Time Perfusion Imaging (RTPI) with low mechanical index (MI) for imaging and high MI for destruction. The 3 standard apical views were digitally acquired and stored, at rest and peak stress. Twelve ROI were evaluated using dedicated standardised commercially available software (Calc, Philips Medical Systems), and the alpha and beta values were calculated. The results were compared with the coefficient patterns derived from Echofit which models the behaviour of the myocardial tissues in terms of the micro-bubble intensities over time as alpha(1-exp(-beta)t), where t is time. Marquardt-Levenberg optimisation method was used to minimise the overall residual error between the optimised and the original intensity curve, resulting in the measurement of alpha and beta. These alpha and beta coefficients at of all image pixels are displayed in a final colour-coded image: the alpha pattern, and the slope pattern with the slope being slope = alpha/beta.

**Results:** Areas of abnormal perfusion were characterised visually and by the slope and the alpha. Altogether, 180 ROI were studied with both techniques. Overall concordance between the two methods for all regions was 98% for normal versus abnormal myocardial perfusion. Using Echofit areas of subendocardial hypoperfusion were easier identified and studied further. In two patients subendocardial perfusion of the mid septum was noted using Echofit and angiography confirmed 70–80% RCA stenosis.

**Conclusion:** This new software offers an objective and easy offline assessment of regional myocardial perfusion in patients with CAD using MCE. Additionally, subendocardial hypoperfusion was easily detected.

---

**IN CLINICAL PRACTICE TRANSOSEPHAGEAL ECHOCARDIOGRAPHY USUALLY FAILS TO DETECT LARGE PERSISTENT FORAMEN OVALE**

P.T. Wilmshurst1, M.J. Pearson1, K.P. Walsh2, W.L. Morrison3. 1Royal Shrewsbury Hospital, 2Our Lady’s Hospital for Sick Children, Dublin, 3Cardiothoracic Centre, Liverpool, UK.

A large persistent foramen ovale (PFO) is a mechanism for paradoxical thromboembolism and decompression illness. Transoesophageal echocardiography (TOE) is the gold standard for detecting a PFO. We have
closed over 120 PFOs in divers who have had shunt-related decompression illness and many cases of paradoxical thromboembolism. In each case the PFO was demonstrated by transthoracic contrast echocardiography. This technique has also been proven to be effective and simpler form of cardiac resynchronisation therapy and improves LV performance comparable with BVP. MRVP may offer an alternative to BVP in providing cardiac resynchronisation.

Methods: Fourteen patients (mean age 63 ± 11 years, EF < 30%, 7 with ischaemic heart disease and all with chronic heart failure and left bundle branch block) underwent temporary MRVP prior to BVP. Quadripolar catheters were positioned in the high right atrium, mid RV inferior wall and on the anterior RV septum and synchronous MRVP commenced. Pulsed wave TDI was used to measure regional electromechanical delay, from which the dispersion of mechanical contraction within the LV (LVd) and between LV and RV (IVd) were calculated. Measurements were made at baseline, during synchronous BVP and MRVP.

Results: For all parameters there were no significant difference between BVP and MRVP except for QRS duration p<0.001.

Conclusion: MRVP significantly reduces mechanical dispersion and improves LV performance comparable with BVP. MRVP may offer an effective and simpler form of cardiac resynchronisation therapy and should be considered as an alternative for patients where BVP is not possible.

A new approach to cardiac resynchronisation: multisite right ventricular pacing

R.E. Lane, J. Mayet, N.S. Peters, D.W. Davies, A.W.C. Chow. St. Mary's Hospital and Imperial College School of Medicine, London, UK

Biventricular pacing (BVP) aims to improve systolic function and symptoms in severe heart failure. Left ventricular (LV) lead problems account for the majority of complications and failures of BVP. With the use of tissue Doppler imaging (TDI), we investigated the feasibility of an entirely right-sided pacing configuration: multisite RV pacing (MRVP), as a simpler and safer alternative to BVP in providing cardiac resynchronisation.

Methods: Fourteen patients (mean age 63 ± 11 years, EF < 30%, 7 with ischaemic heart disease and all with chronic heart failure and left bundle branch block) underwent temporary MRVP prior to BVP. Quadripolar catheters were positioned in the high right atrium, mid RV inferior wall and on the anterior RV septum and synchronous MRVP commenced. Pulsed wave TDI was used to measure regional electromechanical delay, from which the dispersion of mechanical contraction within the LV (LVd) and between LV and RV (IVd) were calculated. Measurements were made at baseline, during synchronous BVP and MRVP.

Results: For all parameters there were no significant difference between BVP and MRVP except for QRS duration p<0.001.

Conclusion: MRVP significantly reduces mechanical dispersion and improves LV performance comparable with BVP. MRVP may offer an effective and simpler form of cardiac resynchronisation therapy and should be considered as an alternative for patients where BVP is not possible.

Abstract 11

<table>
<thead>
<tr>
<th>QRS (ms)</th>
<th>EF (%)</th>
<th>IVd (ms)</th>
<th>LVd (ms)</th>
<th>LVd-LVd (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>165±26</td>
<td>19±7</td>
<td>78±5</td>
<td>64±28</td>
</tr>
<tr>
<td>BVP</td>
<td>161±27</td>
<td>24±10</td>
<td>46±36</td>
<td>30±10</td>
</tr>
<tr>
<td>P</td>
<td>0.167</td>
<td>0.014</td>
<td>0.016</td>
<td>0.005</td>
</tr>
<tr>
<td>MRVP</td>
<td>189±21</td>
<td>35±7</td>
<td>44±18</td>
<td>18±45</td>
</tr>
<tr>
<td>P</td>
<td>0.006</td>
<td>0.061</td>
<td>0.035</td>
<td>0.009</td>
</tr>
</tbody>
</table>

(p values compared to baseline).

Conclusion: MRVP significantly reduces mechanical dispersion and improves LV performance comparable with BVP. MRVP may offer an effective and simpler form of cardiac resynchronisation therapy and should be considered as an alternative for patients where BVP is not possible.

Abstract 9

<table>
<thead>
<tr>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Sx</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EOA cm²</td>
<td>&gt;1</td>
<td>0.75-1</td>
<td>&lt;0.75</td>
<td>&lt;0.75</td>
</tr>
<tr>
<td>N</td>
<td>14</td>
<td>15</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Vmax m/s</td>
<td>3.1</td>
<td>3.9</td>
<td>4.2</td>
<td>4.9</td>
</tr>
<tr>
<td>AI (%)</td>
<td>90</td>
<td>94</td>
<td>112</td>
<td>116</td>
</tr>
<tr>
<td>CSP(mmHg)</td>
<td>117</td>
<td>130</td>
<td>140</td>
<td>122</td>
</tr>
<tr>
<td>CDPP(mmmHg)</td>
<td>74</td>
<td>79</td>
<td>87</td>
<td>76</td>
</tr>
<tr>
<td>SEVR (%)</td>
<td>157</td>
<td>149</td>
<td>141</td>
<td>111</td>
</tr>
<tr>
<td>PWV (m/s)</td>
<td>9.3</td>
<td>10.4</td>
<td>12.3</td>
<td>9.5</td>
</tr>
<tr>
<td>RI (%)</td>
<td>77</td>
<td>66</td>
<td>76</td>
<td>54</td>
</tr>
</tbody>
</table>

Conclusions: Peripheral arterial physiology is related to the grade of aortic stenosis and the presence of symptoms.

A new protocol for low power contrast imaging in dobutamine stress echocardiography: preliminary clinical results

H. Thibault, J. Timperley, H. Becher. John Radcliffe Hospital, Oxford, UK

Real-time low power imaging has been introduced for myocardial contrast echocardiography. This technique has also been proven to be useful for improved endocardial border definition. It is unknown whether this technique is feasible and useful in Dobutamine stress echocardiography (DSE).

Objective: To test the feasibility of a new protocol for assessment of LV function using power modulation during DSE.

Methods: 89 consecutive patients referred for DSE underwent the established protocol for DSE using tissue harmonic imaging. After acquisition of the peak stress loops, contrast echocardiography was performed using power modulation. In 45 patients 0.3 ml bolus of Optison were given, in 44 patients a continuous infusion of SonoVue (0.8 ml/min) was started and 3 apical views were acquired. A second contrast study was performed in recovery when images at peak stress did not show normal findings. Endocardial border definition was evaluated by 3 step visual score.

Results: Contrast injections were performed at an average heart rate of 128 bpm. All contrast studies were diagnostic. A total of 1600 seconds were analysed. Endocardial border definition increased in 72% of the segments in comparison to the native images—particularly delineation of the apical segments and basal lateral and anterior segments improved.

Conclusion: power modulation is feasible in Dobutamine Contrast Echocardiography and results in significant improvement of the LV border delineation at peak stress.

Abstract 11

<table>
<thead>
<tr>
<th>QRS (ms)</th>
<th>EF (%)</th>
<th>IVd (ms)</th>
<th>LVd (ms)</th>
<th>LVd-LVd (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>165±26</td>
<td>19±7</td>
<td>78±5</td>
<td>64±28</td>
</tr>
<tr>
<td>BVP</td>
<td>161±27</td>
<td>24±10</td>
<td>46±36</td>
<td>30±10</td>
</tr>
<tr>
<td>P</td>
<td>0.167</td>
<td>0.014</td>
<td>0.016</td>
<td>0.005</td>
</tr>
<tr>
<td>MRVP</td>
<td>189±21</td>
<td>35±7</td>
<td>44±18</td>
<td>18±45</td>
</tr>
<tr>
<td>P</td>
<td>0.006</td>
<td>0.061</td>
<td>0.035</td>
<td>0.009</td>
</tr>
</tbody>
</table>

(p values compared to baseline).

Conclusion: MRVP significantly reduces mechanical dispersion and improves LV performance comparable with BVP. MRVP may offer an effective and simpler form of cardiac resynchronisation therapy and should be considered as an alternative for patients where BVP is not possible.

An audit of an echocardiogram service in a district general hospital

M. Townsend, D. MacIver, T. MacConnell. Musgrove Park Hospital, Taunton, UK

We carried out a retrospective, case-note based audit of all in-patient requests for echocardiography during the month of July 2002. The objective of our audit was to improve the quality of referrals for echocardiography and decrease the number of echocardiograms repeated unnecessarily thus improving the efficiency of the service, decreasing the out-patient waiting time.

The total number of requests was 83 with a mean patient age of 72yrs (excluding paediatrics). 25% of requests were for patients over the age of 80.

After submission of the request form the 24% patients had their request repeated unnecessarily thus improving the quality of referrals for echocardiography and decrease the number of echocardiograms repeated unnecessarily thus improving the efficiency of the service, decreasing the out-patient waiting time.

The total number of requests was 83 with a mean patient age of 72yrs (excluding paediatrics). 25% of requests were for patients over the age of 80.

After submission of the request form the 24% patients had their request repeated unnecessarily thus improving the quality of referrals for echocardiography and decrease the number of echocardiograms repeated unnecessarily thus improving the efficiency of the service, decreasing the out-patient waiting time.

The total number of requests was 83 with a mean patient age of 72yrs (excluding paediatrics). 25% of requests were for patients over the age of 80.
patients had already had an echocardiogram in the last 2 years and a quarter of these had no obvious reason for a repeat scan.

When we reviewed the notes in a sample of the patients in the audit we found that there was no recorded recognition of an echocardiogram having been performed in 42% of cases.

In conclusion, we suggest that improved filing of results, timely access to old notes and subsequent clinical review of these notes, would decrease the number of scans repeated unnecessarily. Improved record keeping can result, for example, introduction of a stamp in the notes would lead to increased awareness that the scan had been performed. Finally, we suggest that more detailed information on the request form, with a specific question posed would enable the sonographer a more focused approach and allow for improved time management.

### Moderated poster presentations

**013** THE EFFECT OF TIME TO THROMBOLYSIS ON THE LV FUNCTION POST ANTERIOR MI AND THE MOST ACCURATE AND REPROducible METHOD OF ASSESSMENT

T. A. Fox, P. Finn, N. J. Carline, K. F. Murt, J. Rees, A. Amadi. Aintree Cardiac Centre, Liverpool, UK

**Background:** Previous clinical trials have demonstrated that there is a reduction in mortality by thrombolytic therapy in acute MI in relation to a shorter time between onset of symptoms and treatment. This study analyses the link between time to thrombolysis and early recovery of LV function.

**Methods:** 35 patients with anterior MI but no previous cardiac history received thrombolysis. These patients had echocardiograms performed 5 days post MI. The LV function was assessed using a visual eyeballing method and the LV function graded as good or showing mild, mild-moderate, moderate, moderate-severe or severe LV dysfunction. An LV ejection fraction was then calculated 3 times per patient using the Modified Simpson’s package. Thrombolysis times were compared to LV function as assessed by each method.

**Results:** Mean call to needle times increased with a more severe degree of LV dysfunction. Mean times were, Severe-254 mins, Moderate-Severe-122 mins, moderate-78 mins, mild-moderate-62 mins, mild-45 mins and good-42 mins. There was poor correlation between Modified Simpson’s measurements and thrombolysis times.

**Conclusions:** LV systolic function was found to be better with a shorter time between symptoms and treatment. The patients with the poorer graded function had mostly had a lengthened call to needle time. The visual eyeballing method was found to be the most accurate and reproducible method of LV assessment, as the Modified Simpson’s showed poor correlation and variability.

**014** CHARACTERISATION OF A NEWLY DEVELOPED ULTRASONIC CONTRAST AGENT

C. M. Moran1, J. Ross2, I. Ansell2, C. Oliver2, M. Butler1, J. Williamson1, T. Anderson1, N. McDicken 1, K. A. A. Fox 3.

**Med. Physics, 2Dept. Clinical and Surgical Sciences, 3Dept of Cardiovascular Research University of Edinburgh, Edinburgh EH3 9YW, UK

**Background:** The size and composition of commercially available ultrasonic contrast microbubbles are such that when infused at routinely used diagnostic frequencies (2–7 MHz), the bubbles resonate in and strongly scatter ultrasound. Recently there has been increasing interest in imaging and manipulating these microbubbles at higher and strongly scatter ultrasound. Recently there has been increasing interest in imaging and manipulating these microbubbles at higher frequencies (25–40 MHz) and to use such an agent for targeting specific sites in arteries and to show sites of stenosis or thrombus and to use such an agent for targeting specific plaque sites in arteries and to show sites of stenosis or thrombus.

**Aim:** To produce an ultrasonic contrast microbubble capable of resonating at 30–40 MHz and to use such an agent for targeting specific cell lines found in the arterial wall.

**Method:** A lipoprotein-encapsulated nitrogen-filled microbubble was developed in-house. The agent was diluted to various concentrations using saline and blood-mimicking fluid (BMF). Using a ClearView Ultra system, an Atlantis SR intravascular probe was inserted into each solution and one frame of unprocessed ultrasonic data was acquired. The data was downloaded onto a PC. A region-of-interest (ROI) of 128 data points and 9 ultrasonic lines was chosen. Over these ROIs, mean backscatter power was calculated and referenced to data collected from a water-air interface. The ability of the agent to be targeted to specific cells was assessed microscopically by labelling the microbubbles with an antibody (ICD54) and then passing these microbubbles over endothelial cells grown on an agar interface.

**Results:** At concentrations of 25 mg/ml, mean backscatter power was approximately 9 dB less than a commercially available agent (Definity). This level of backscatter is adequate for arterial plaque studies. Under physiological flow conditions the microbubbles were observed (both optically and acoustically) to be attached to the endothelial cells.

**015** DIFFERENTIATION OF ISCHAEMIC AND IDIOPATHIC DILATED CARDIOMYOPATHY: TISSUE DOPPLER CHARACTERISTICS IN PATIENTS WITH GLOBAL SYSTOLIC LEFT VENTRICULAR DYSFUNCTION

R. S. Sharma, P. M. Elliott, W. J. McKenna, C. Veyrat, D. Pellerin. The Heart Hospital, University College London, UK

Many studies have shown that conventional echocardiographic parameters are unable to distinguish between ischaemic and non-ischaemic aetiologies in patients with global severe left ventricular dysfunction when history of coronary artery disease lacks. A coronary angiogram is usually performed but an ischemic origin is rarely found. The aim of this study was to determine whether colour tissue Doppler imaging and strain could make this distinction. The study included 67 pts, (53 ± 10 yrs, 37 patients, with idiopathic dilated cardiomyopathy (DCM) (62 ± 10 yrs, 28 M, LVEF 30 ± 9%, LV EDD 6.1 ± 0.4 cm) and 16 patients with >3-vessel coronary artery disease (IHD) (67 ± 11 yrs, 13 M, LVEF 29 ± 10%, LV EDD 6.4 ± 0.3 cm). Colour tissue Doppler velocities and strain were measured in the 3 left ventricular papillary muscle segments.

**Results:** There was no significant difference in Doppler velocities measured in the 35 DCM patients and the 16 IHD patients. However, there was significant (p<0.05) difference in Doppler velocities measured in the most anterior and posterior segments, with DCM showing lower velocities. The strain was significantly higher in the 35 DCM patients than in the 16 IHD patients (p<0.01). The strain rate was significantly lower in the DCM patients (p<0.01).

**Conclusions:** Colour tissue Doppler imaging and strain measurements were able to distinguish between the 2 patient groups. Doppler imaging and strain are useful tools for assessing regional and global function. These results suggest that Doppler imaging and strain can be used to differentiate between ischaemic and non-ischaemic cardiomyopathy.

**016** ROLE OF TWO DIMENSIONAL AND DOPPLER CARDIACOGRAPHY IN PATIENTS WITH DUCHENNE CARDIOMYOPATHY

L. Desforges, A. Stefanidis, G. Koutroulis, M. Kinali, F. Muntoni, P. Nihoyannopoulos. Echo Lab, Dept of Paediatrics, Hammersmith Hospital, NHRI, ICSM, London, UK

**Patients:** 28 patients with Duchenne dystrophy (DMD) constitute a population of poor clinical state. DMD cardiomyopathy is one of the main reasons of morbidity and mortality in these pts. In this echocardiographic retrospective study several 2-D and Doppler variables were assessed in asymptomatic (a-DMD) or symptomatic heart failure DMD pts and in a control group of healthy children. We also focused on Doppler-index (DI), a new, reproducible variable capable to assess the myocardial performance in many clinical settings. We assessed the echocardiograms of 24 normal controls (aged 9 ± 3 yrs) and 38 DMD-patients ([a-DMD,n:35;8 ± 3 yrs] vs. [DMD,n:23;16 ± 3 yrs]). One investigator with no access to any clinical information calculated all the echo variables.

The DI was calculated using the sum of isovolumetric contraction plus relaxation time divided by ejection time (ET) ([ICT+IERT]/ET). The statistics were performed by using unpaired t-test and ANOVA method with Bonferroni’s correction. The ROC curve for the DI values was also estimated in an attempt to discriminate the best predicting value between controls and DMD pts.

**Results:** The LV fractional shortening (FS) of DMD pts in comparison with controls was significantly lower (28 ± 9% vs. 36 ± 6%, p<0.001). The peak E to A transmitral velocities ratio and the DI were significantly lower (28 ± 5 mm/s vs. 44 ± 11%, p<0.001). During early diastole, peak longitudinal velocity was significantly lower in a-DMD group compared to the control group (68 ± 24 cm/s vs. 44 ± 11 cm/s, p<0.001). During early diastole, peak myocardial performance index was significantly lower in a-DMD group compared to the control group (68 ± 24 cm/s vs. 44 ± 11 cm/s, p<0.001).

**Conclusions:** Colour tissue Doppler imaging and strain measurements were able to distinguish between the 2 patient groups. Doppler imaging and strain are useful tools for assessing regional and global function. These results suggest that Doppler imaging and strain can be used to differentiate between ischaemic and non-ischaemic cardiomyopathy.
controls were the E/A (1.7 ± 0.4 vs 2.2 ± 0.7; p < 0.01) and LV ET (256 ± 22 vs. 232 ± 15 msecs; p < 0.001). The DT between controls and a-DMD was similar (0.39 ± 0.06 vs 0.43 ± 0.09; p: NS). Finally, a DI value of 0.50 was the best cut-off value between normal subjects and DMD pts.

Conclusions: The FS, E/A ratio and DI are useful echocardiographic variables for the assessment of DMD pts. However, from all the measured variables only E/A and ET were different between controls and a-DMD pts.

**017 ELECTRICAL OR MECHANICAL DISPERSION: PREDICTOR OF CARDIAC RESYNCHRONISATION THERAPY**

R.E. Lane, A.W.C. Chow, N.S. Peters, D.W. Davies, J. Mayet. St. Mary’s Hospital and Imperial College School of Medicine, London, UK

The ECG has been used to identify patients for cardiac resynchronisation therapy (CRT). However, 30% of selected patients fail to derive symptomatic benefit. Tissue Doppler imaging (TDI) can measure the dispersion of mechanical contraction between right and left ventricles (RV and LV) and within the LV, and may be a superior tool for predicting patient response.

Methods: 12 lead ECG, 2D echocardiography and TDI were performed at baseline and during synchronic CRT in 28 patients age 66 ± 12 years with chronic heart failure, ejection fraction (EF) <55% and left bundle branch block. TDI was used to measure regional electro-mechanical delay of the LV and RV. Intraventricular mechanical dispersion (LVD) was calculated as the time between earliest and latest sites of LV contraction. Interventricular mechanical dispersion (IVD) was calculated as the maximal delay between LV and RV contraction. Responders (R) or non-responders (NR) to CRT were classified on the basis of symptomatic and functional improvement.

Results: Baseline QRS was positively correlated with IVD (r = 0.5, p = 0.017) but not with LVD. Following CRT, mean QRS duration was unchanged, EF increased (19 ± 7 to 24 ± 10%; p < 0.01), IVd decreased (103 ± 62 to 61 ± 42 msecs; p < 0.001) and LVD decreased (76 ± 49 to 43 ± 30 msecs; p < 0.001). During CRT, IVd was reduced by 54% and 15% in R and NR respectively whilst LVD was reduced by 40% and 2% in R and NR respectively. A 20% reduction in both IVd and LVD had 91% sensitivity and 100% specificity in predicting clinical benefit following CRT.

Conclusions: The ECG duration does not predict clinical response with CRT. TDI can be used to assess dysynchrony and predict response to CRT. Optimal reductions in both IVd and LVD appear to be important for clinical improvement.

**018 CONTRAST AGENT INCREASES DOPPLER VELOCITIES AND IMPROVES REPRODUCIBILITY OF AORTIC VALVE AREA MEASUREMENTS IN PATIENTS WITH AORTIC STENOSIS**

L.A. Smith, S.J. Cowell, A.C. White, N.A. Boon, D.E. Newby, D.B. Northridge. 1Cardiovascular Research, University of Edinburgh, 2Cardiology, Western General Hospital, Edinburgh, UK

Purpose: Observer variability may limit assessment of aortic stenosis by Doppler echocardiography. The aim of this study was to assess whether echocardiographic contrast agent improves reproducibility of aortic valve area (AVA) measurements in patients with aortic stenosis.

Methods: 20 patients with aortic stenosis (67±10 years) underwent non-contrast and contrast Doppler echocardiography, on two occasions, three weeks apart.

| R baseline | 175 ± 23 | 140 ± 74 | 95 ± 64 |
| R CRT | 166 ± 23 | 67 ± 52 | 51 ± 36 |
| p | 0.3 | 0.003 | 0.003 |
| NR baseline | 156 ± 26 | 62 ± 43 | 34 ± 23 |
| NR CRT | 152 ± 10 | 53 ± 41 | 35 ± 29 |
| p | 0.6 | 0.2 | 1.0 |

Results: Intravascular and interobserver coefficients of reproducibility were 0.36 and 0.28 cm² respectively for left ventricular outflow tract (LVOT) diameter, and 0.38 and 0.24 cm² respectively for AVA.Whilst intravascular reproducibility was unaffected, the use of contrast improved interobserver reproducibility for LVOT diameter (mean of differences −0.02 cm vs 0.01 cm; p < 0.05) and AVA (mean of differences −0.02 cm vs −0.10 cm; p < 0.05), Pre- and post-valve velocities were increased with contrast compared to non-contrast imaging (pre: 1.07 ± 0.20 m/s vs 0.94 ± 0.19 m/s; p < 0.01; post: 3.76 ± 0.87 m/s vs 3.47 ± 0.78 m/s; p < 0.01). Mean AVA was unaltered.

Conclusions: Echocardiographic contrast significantly increases Doppler velocities and produces modest improvements in the reproducibility of LVOT diameter and AVA measurements. We suggest that, when assessing patients with aortic stenosis, contrast agents should be considered in the difficult-to-image patients with poor baseline LVOT images or Doppler studies, or when there appears to be marked variability in sequential echocardiographic studies.

**019 CONTINUITY EQUATION AREA IN BILEAFLET PROSTHETIC AORTIC VALVES: VALVE SIZE CANNOT BE SUBSTITUTED FOR LV OUTFLOW TRACT DIAMETER**

J. Chambers, L. Oo, A. Narracott, P. Lawford, C. Blauth. Valve Study Group, St Thomas Hospital and Sheffield University, UK

Background: The labelled valve size approximates the annulus in which it is implanted. A number of studies have suggested that it is more accurate than measuring LV outflow tract diameter for calculating the continuity equation area.

Objectives: The aims of this study were to compare labelled size with an in vitro model of the LV outflow tract and to measure the orifice size in six designs of bileaflet mechanical heart valve.

Methods: The inflow aspect of each of 29 valves was photographed then digitised and the maximum internal diameter and orifice area calculated. The LV outflow tract model was constructed using a series of machined polypropylene blocks.

Results: The modelled LV outflow diameter ranged from 1.0 to 3.0 mm larger than labelled valve size for the intra-annular valves and from 3.5 mm smaller to 1.5 mm larger than labelled size for the supra-annular valves. Using labelled size gave an estimate of LV outflow area from 140 mm² smaller to 120 mm² larger than the actual area. The internal orifice diameter ranged from 1.6 mm to 4.6 mm less than the manufacturer’s labelled size. The geometric orifice area varied widely between 159 and 222 mm² for the six size 19 valves and between 316 and 405 mm² for the size 25 valves.

Conclusion: There are major differences between labelled size and actual size in bileaflet mechanical valves. Labelled size should not be used to compare haemodynamic function nor for the calculation of the orifice area using the continuity equation.

**020 ATORVASTATIN DOES NOT REDUCE LV MASS OR AFFECT DIASTOLIC FUNCTION AFTER ONE YEAR OF TREATMENT**


Methods: It has been postulated that the statins may have beneficial effects on LV mass in the hypertensive population. We randomised 406 hypertensive patients with normal levels of serum cholesterol (< 6.5 mmol/L) to take either 10 mg of Atorvastatin or placebo. All patients underwent echocardiography after one year of treatment.

Results: Data on LV mass was obtained from 406 patients, with a similar number providing data on transmitral Doppler flow (TMD) and Tissue Doppler Echocardiography (TDE) at the level of the mitral annulus on the lateral wall. Both groups were equivalent in terms of age, sex and BMI.

Conclusion: After one year of treatment Atorvastatin had no significant effect on LV mass or diastolic function. This large cohort of patients does not support preliminary data from small studies that statins have beneficial effects on cardiac structure.
ASSESSMENT OF THE DYNAMIC PERFORMANCE OF NATIVE AND PROSTHETIC AORTIC VALVES

J. Davies, A. Allen, J. McAdam, L. Hadjinikolaou, A. Sosnowski, M. Galinanes, D. Chin. Cardiorespiratory Directorate, University Hospitals of Leicester NHS Trust, Leicester, UK

Background: The assessment of aortic valve (AV) function by pressure gradients has limitations. Such gradients are dependent on flow across the effective AV orifice, which is affected by left ventricular stroke volume, heart rate and afterload. AV performance should therefore be characterised across a range of physiological flow rates. Measures such as the pressure-drop flow regression slope (PDFS) have been described. Due to nonlinear change, PDFS is not always obtainable; we hypothesized that measures of instantaneous AV resistance (mean pressure drop/flow, R) obtained during stress echocardiography could be used to define the performance of native and prosthetic aortic valves.

Methods: 23 patients with AV stenosis (Group A, continuity AV area at baseline <1 cm²), 29 with AV bioprostheses (B), 18 with AV mechanical prostheses (C) and 92 with no stenosis (D) underwent stress echocardiography. Mean pressure drop and flow was calculated from 2D and Doppler measurements at each stage of Dobutamine stress.

Results: Group A had higher R [p<0.05*, all groups compared to A] at baseline and low dose stress; maximal R occurred at baseline and decreased with stress. Prosthetic R increased with stress so that at peak, there was no statistical difference with Group A. Prosthetic R was higher than in group D, but no difference was seen between groups B and C.

Conclusions: AV stenosis causes a high R but such valves can still accommodate for increasing flow. Prostheses have lower R values but rigid orifices may reduce performance at higher flows.

Abstract 20

<table>
<thead>
<tr>
<th>LV Mass</th>
<th>N =</th>
<th>LV Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atorvastatin</td>
<td>217</td>
<td>239.655</td>
</tr>
<tr>
<td>Placebo</td>
<td>189</td>
<td>234.900*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transmural Doppler</th>
<th>Treatment</th>
<th>N =</th>
<th>E wave (cm/s)</th>
<th>A wave (cm/s)</th>
<th>E/A ratio</th>
<th>E wave decel. (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atorvastatin</td>
<td>218</td>
<td>60.934</td>
<td>71.810</td>
<td>0.849</td>
<td>0.193</td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>190</td>
<td>60.542</td>
<td>71.287*</td>
<td>0.849</td>
<td>0.193*</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lateral Wall velocities by TDE (cm/s)</th>
<th>Treatment</th>
<th>N =</th>
<th>S wave</th>
<th>E wave</th>
<th>A wave</th>
<th>E/A ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atorvastatin</td>
<td>207</td>
<td>9.470</td>
<td>9.311</td>
<td>12.168</td>
<td>0.801</td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>188</td>
<td>9.586</td>
<td>9.381</td>
<td>11.891</td>
<td>0.842*</td>
<td></td>
</tr>
</tbody>
</table>

*All differences are statistically non-significant.