by another observer from the end-systolic frame of color-encoded AQ. In addition, inter-observer variability for each method was evaluated. *Results:* Mean WMS was 1.4 ± 0.8 by 2DE alone, and 1.4 ± 0.7 by color-encoded AQ. Correlation between Color-encoded AQ (y) and 2DE WMS (x) was $y = 0.6x + 0.6$, $r = 0.71$, $p < 0.001$. Inter-observer concordances were: 83% for 2DE: $r = 80$; 88% for Color-encoded AQ: $r = 0.86$. Besides displaying the overall extent of motion, color-encoded AQ allowed easy appraisal of the temporal abnormalities in regional contraction. We conclude that color-encoded AQ offers for the first time an on-line method for semi-quantitative evaluation of spatial and temporal abnormalities in regional LV function with less inter-observer variability.

9:00

## 774-3 Influences of Acoustic Power, TGC and Location of Region of Interest on the Measurement of Integrated Back Scatter Signal Using Acoustic Densitometry In Vivo

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To test the hypothesis that differences in transducer frequency (FR), acoustic power (AP), time gain control (TGC), and the location of myocardial region of interest (ROI) examined would influence the measurement of cyclic variation of integrated backscatter (CV/IBS) of the heart, measurement of CV/IBS were performed *in vivo* in the left ventricular (LV) mid-papillary short axis view of 10 open chest swine. On-line measurement of IBS was obtained using the acoustic densitometry package on the Hewlett-Packard Sonos 1500, with FR between 2.0 and 5.0 MHz, varying AP between 0 and 40 dB, TGC between 0 and 60 dB and with ROI placed at the anterior (ANT), inferior (INF) and posterior (POST) walls of the LV.

CV/IBS (dB)

| AP | ANT | INF | POST | TGC | ANT | INF | POST |
|---|---|---|---|---|---|---|---|
| 5 | 2.0 ± 0.9 | 1.7 ± 1.3 | 1.8 ± 1.0 | 10 | 1.7 ± 1.3 | 0.6 ± 0.2 | 0.9 ± 0.2 |
| 15 | 4.3 ± 1.2 | 2.4 ± 1.5 | 4.2 ± 1.5 | 20 | 3.4 ± 0.8 | 1.3 ± 0.6 | 2.9 ± 1.2 |
| 20 | 5.7 ± 1.4 | 3.2 ± 2.1 | 6.9 ± 1.9** | 30 | 4.7 ± 1.2 | 2.6 ± 1.4 | 6.5 ± 1.0** |
| 30 | 4.5 ± 1.5 | 5.5 ± 2.5* | 7.2 ± 1.6* | 40 | 4.8 ± 1.4 | 5.5 ± 2.3* | 7.9 ± 1.6** |
| 35 | 3.2 ± 0.9 | 5.5 ± 2.1* | 7.4 ± 1.3* | 50 | 3.0 ± 1.3 | 4.2 ± 1.6* | 7.0 ± 2.0** |
| 40 | 4.1 ± 2.1 | 6.4 ± 2.7* | 6.8 ± 2.6 | 60 | 1.9 ± 1.6 | 3.3 ± 0.8 | 4.2 ± 1.9 |

*$p < 0.01$, **$p < 0.005$ vs. AP 15 dB or TGC 20 dB

For varying FR between 2.0 and 5.0 MHz, CV/IBS was consistently higher for FR greater than 2.0 MHz for all ROI at fixed AP and TGC (for 2.0 MHz CV did not differ because of saturation of IBS). For varying AP, CV/IBS was consistently higher between 20–35 dB in the POST ROI only. For varying TGC, CV/IBS also was consistently higher for 30–50 dB in the POST ROI only. AP less than 20 dB and TGC less than 30 dB produced minimal CV. AP greater than 35 dB and TGC greater than 50 dB caused image saturation. These data indicate that proper transducer selection and setting of AP and TGC, as well as an understanding of ROI, are necessary and critical for interpretation of the analysis of CV/IBC *in vivo*.

9:15

## 774-4 Echocardiographic Cardiac Rejection Surveillance Using Acoustic Densitometry of Two Dimensional Ultrasound Backscatter Imaging: Multiple Views and Regions of Interest

Takahiro Ota, Sheila K. Heinle, Wendy Evans, Michael Higgenbotham,
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On the hypothesis that cyclic variation of integrated backscatter (CV/IBS) could detect acute cardiac allograft rejection (REJ) independent of the echo view and location of the region of interest (ROI), CV/IBS was measured in 54 cardiac transplant patients. IBS images were made in the long axis (LAX) and short axis views at papillary muscle level (SAX) using a 2.5 MHz transducer. Acoustic densitometry with on-line analysis was performed in 83 biopsy cases analyzing 6 ROIs: septal (SEP), basal posterior (POST) and mid posterior wall (MID) in the LAX view and anterior (ANT), inferior (INF) and MID of the SAX views individually and in combination. Of 83 biopsies, 27 had mild REJ and 6 had moderate REJ. Significant differences in the magnitude of CV/IBS between non-REJ and both mild and moderate REJ were found at SEP and POST in the LAX view. Combining ROIs in the LAX and/or the SAX views showed more significant discrimination of REJ.

CV of IBS (dB)

| Individual ROI | LONG AXIS (LAX) | | | SHORT AXIS (LAX) | | |
|---|---|---|---|---|---|---|
| | SEP | POST | MID | ANT | INF | MID |
| non REJ | 6.0 ± 1.4 | 6.6 ± 1.8 | 5.2 ± 1.4 | 5.8 ± 1.9 | 4.6 ± 1.4 | 5.5 ± 1.4 |
| mild REJ | 4.5 ± 1.3** | 5.2 ± 1.6† | 4.5 ± 1.4 | 4.5 ± 1.3† | 3.8 ± 1.0 | 4.5 ± 1.3† |
| moderate REJ | 3.9 ± 1.4† | 4.3 ± 0.9† | 4.0 ± 1.3 | 4.5 ± 0.9 | 4.0 ± 0.8 | 4.6 ± 1.7 |

| Combined ROIs | LAX (SEP + POST) | LAX (SEP + POST + MID) | LAX–SEP + SAX–ANT | LAX–POST + SAX–MID |
|---|---|---|---|---|
| non REJ | 12.5 ± 2.7 | 17.7 ± 3.4 | 11.8 ± 2.6 | 12.1 ± 2.8 |
| mild REJ | 9.8 ± 2.6** | 14.2 ± 3.6** | 9.1 ± 2.2** | 9.7 ± 2.7** |
| moderate REJ | 8.2 ± 2.3** | 12.2 ± 3.4** | 8.5 ± 2.1† | 8.8 ± 1.8* |

*$p < 0.01$, †$p < 0.005$, **$p < 0.001$ vs. non-REJ

These data indicate that the magnitude of CV/IBS is highly dependent upon the view and ROI location. Therefore careful selection of views and ROIs is necessary for detection of REJ. The combination of CV/IBS from many ROIs may be more sensitive for diagnosis of REJ than the measurement from any individual site.

9:30

## 774-5 Effect of Cardiac Translation on Measurement of Left Ventricular Wall Velocities: Implications for Doppler Imaging of Myocardium

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Doppler imaging of the myocardium is a new application which has the potential to record myocardial velocities. These recorded velocities, however, include cardiac motion independent of ventricular contraction. A measured myocardial velocity, therefore, represents the net vector of contraction, translation, and rotation. To determine the effects of cardiac translation on myocardial velocities, 2-dimensional (2D) and M-mode echocardiographic recordings were obtained in 10 normal subjects. The average anteroseptal (AS) and posterior wall (PW) velocities were measured by 2D echo directed M-mode in the centerline of the parasternal short-axis view. Translation was measured from 2D echo cine-loop display as the displacement of the epicardial junction of the right ventricular free wall and interventricular septum during systole. The average translational velocity is reported as the component of the displacement vector parallel to the M-mode beam (+ = toward transducer). The AS and PW velocities (cm/sec) displayed in the table represent net measured velocities, which include the translational vector.

*Results:*

| | AS | PW | Translation |
|---|---|---|---|
| Mean ± SD | 3.2 ± 0.5 | 4.5 ± 1.1 | +1.3 ± 0.6 |
| Range | 2.4 to 4.0 | 3.4 to 6.9 | −1.4 to +2.4 |

In 8/10 subjects the velocity vector was positive. The mean percent error in the M-mode derived velocities due to translation was 41% for the AS wall and 31% for the PW.

*Conclusions:* 1) As measured by 2D echocardiography, the magnitude of the translational vector is significant when compared to the M-mode derived myocardial velocities. 2) The relative error demonstrated in the measured velocities may be further modified when applied in two dimensions, due to the angle of incidence of the Doppler beam. 3) New techniques for measuring myocardial velocities, such as Doppler imaging of the myocardium, should incorporate algorithms which correct for the translational vector.

9:45

## 774-6 Assessment of Systolic and Diastolic Myocardial Velocities in Dilated Cardiomyopathy Using Quantitative Doppler Tissue Imaging

Carolyn L. Donovan, David S. Bach, Ning Cao, William F. Armstrong. *University of Michigan, Ann Arbor, MI*

Doppler Tissue Imaging (DTI) may be used to quantify myocardial velocity (Vel) throughout the cardiac cycle. Patterns of myocardial Vel during systole (sys) and diastole (dias) may directly correlate with left ventricular (LV) performance. Quantitative DTI was performed in 11 patients with dilated cardiomyopathy (CM) with a mean ejection fraction of 19 ± 5% (range, 10–29) and in 21 normal (NL) subjects. Vel was measured in the inferoposterior myocardium continuously at 51 ± 8 msec intervals for a mean of 5 cardiac cycles and plotted as a function of time (Figure I).

A single Vel (mm/s) peak was identified during sys for both the CM and NL groups (gp) with a mean of 19 ± 7 (range, 8 to 31) and 38 ± 8 (range, 23 to 58), respectively ($p < 0.001$). Two distinct Vel peaks were identified in dias including an early (Ea) negative peak, corresponding to the early filling phase