Comparison Between Two Novel Radionuclide Angiography Indexes And Tissue Doppler Imaging For The Evaluation Of Intra-Left Ventricular Asynchrony

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Background

Cardiac resynchronization therapy (CRT) by means of biventricular pacing has been proven effective in ameliorating symptoms and reducing mortality in patients (p) with symptomatic congestive heart failure (CHF) despite optimal medical therapy. Selection of patients who will benefit from pacing represents a crucial issue since echocardiographic indexes lack some sensitivity in specific clinical settings and are highly operator-dependent.

Fauchier et al and Dalle Mule et al demonstrated that radionuclide angiography may be highly accurate in predicting major cardiac events in patients with intraventricular dyssynchrony and may identify reverse remodeling after biventricular pacing.

On the other hand, Yu et al demonstrated that a 32 ms interval of the standard deviation of TDI contraction evaluation may totally segregate responders to CRT.

One of the caveats of any method for the evaluation of ventricular asynchrony is the lack of discrimination within the etiologic factors of asynchrony itself, particularly when this feature may be due to CAD in the presence of segmental contraction abnormalities. This may be crucial for the identification of responders to cardiac resynchronization therapy

Aim

To evaluate the reliability of two novel radionuclide angiography (RNA) phase analysis indexes of cardiac asynchrony, -

synchrony (S) and entropy (E)

when compared to tissue Doppler imaging (TDI) evaluation of dyssynchrony in patients with CHF.

This study has been conceived to evaluate at long-term follow up the value of S and E in identifying responders to CRT.

Methods

RNA

RNA planar studies were performed with a Siemens ecam dual-head amera, (best-septal LAO 99mTc-labelled red blood cells, 740 MBq i.v., 64x64 matrix size, 24 frames/cycle, 6000 KCounts). Phase images were generated on first Fourier harmonic fit of the time-activity curve of the cardiac cycle, drawing a region of interest on the end-diastolic frame for right ventricle (RV) and LV. Analysis of the phase histogram was performed with a commercial software calculating the LV and RV standard deviation (SD).

Synchrony and Entropy

Each pixel of a RNA is defined by it phase and amplitude, which together define its vector, whereas the amplitude gives the length of the vector.

The vector sum of all amplitudes based on the phase angle distribution divided by the scalar sum of the length of all vectors defines S.

$$S = \left|\sum_{i=1}^{N} v_i\right| / \sum_{i=1}^{N} |v_i|$$

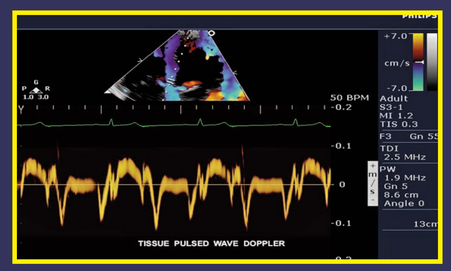
The degree of disorder in the LV based on the Shannon theory normalized by the number of phases in the LV region defines E.

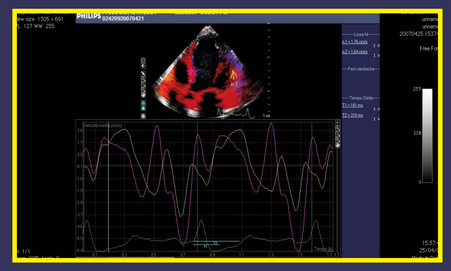
$$(E = -\sum_{i=1} P_i^M \log_2 (P_i) / -\log_2 (M$$

S and E were calculated with a home-made software, considering complete synchrony when S equals 1 and E equals 0, while dyssynchrony is marked by the opposite values.

TDI

TDI was performed with Philips Sonos 5500 and iE33 machines following the American Society of Echocardiography criteria, and asynchrony was evaluated following the method described by Yu et al on a LV 12-segment model.





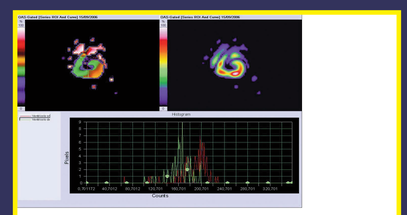
Pts	27
Age	72±4
M/F	17/10
CAD/IDC	13/14
QRS	136±31
NYHA	7/18/9

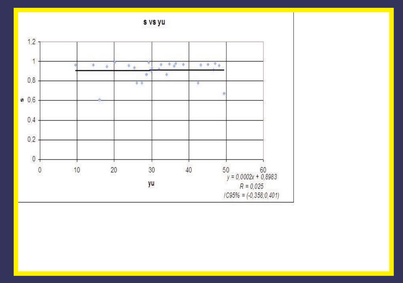
CRT

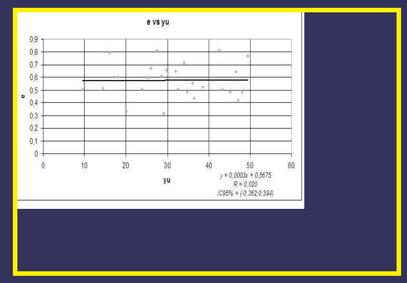
Results

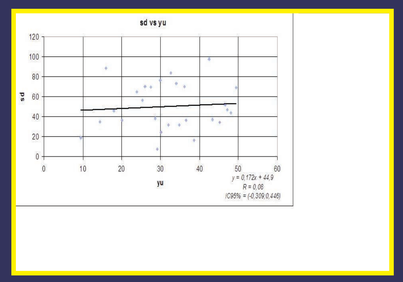
A significant correlation between RNA EF and ultrasound EF was noted. As expected, S significantly correlated with E and both correlated with SD, but S, E and SD did not correlate with any of the echocardiographic parameters or with QRS duration.

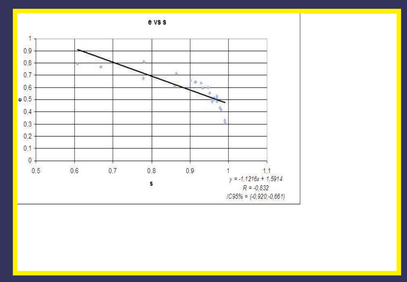
EF RNA	29±8
EF echo	28±6
S	0,89±0,1
E	0,59±014
Yu	32±10
SD	50±23











Conclusions

Our data did not demonstrate any specific correlation between baseline echocardiographic and nuclear data of intra-left ventricular asynchrony. S and E may furnish, together with TDI, a more complete evaluation of LV mechanical dyssynchrony and hopefully will represent a promising tool for the evaluation of candidates for CRT while overcoming the intrinsic limitations of ultrasound methods and of RNA SD.