

A PRACTICAL ESTIMATOR FOR INTERVENTRICULAR MECHANICAL ASYNCHRONY IN PULMONARY ARTERIAL HYPERTENSION

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Background

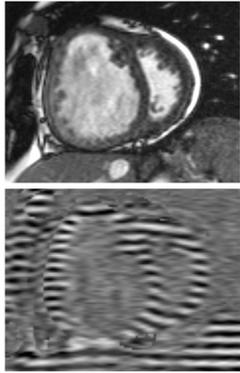
Interventricular Mechanical Asynchrony has proven to be of significant importance in patients with pulmonary arterial hypertension (PAH). It is a major determinant related to right ventricular (RV) overload, leftward septal bowing (LVSB), Left ventricular (LV) underfilling, and decrease in stroke volume and it is an important measure in the evaluation of disease severity and functional class. This left-to-right (L-R) mechanical asynchrony is due to prolonged RV circumferential shortening and leads to inefficiency in both RV systole and LV diastole.

MRI tagging and strain analyses allow a detailed assessment of L-R mechanical asynchrony. Although this assessment of asynchrony using MRI tagging is accurate, the use of tagged-MRI is still limited in clinical routine because of the complex and time-consuming post-processing and interpretation.

A recent study has demonstrated that the time of maximal LVSB (Tlvsb) coincides with the time to RV peak shortening and that the time to aortic valve closure (Taocl) is an estimator of the time to LV peak shortening (1). Thereby the time interval between Taocl and Tlvsb might be a semi-quantitative approach to assess L-R mechanical asynchrony. This is relevant, because the Taocl and Tlvsb can be measured more easily in clinical practice than MRI tagging and strain quantification.

Therefore the aim of this study is to determine the accuracy of this semi-quantitative assessment of L-R mechanical asynchrony in PAH patients compared to the MRI tagging approach.

Methods

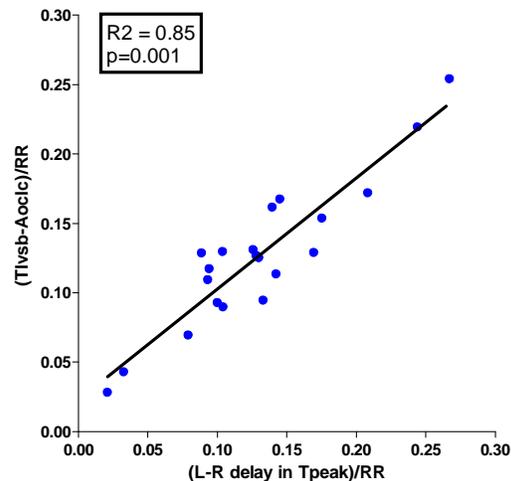
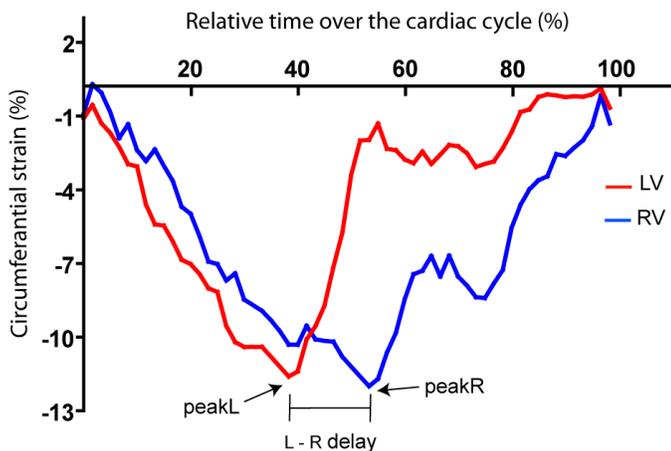


21 pulmonary arterial hypertension patients (mean pulmonary artery pressure 55 ± 13 mmHg) were included.

A 1.5 T Siemens 'Sonata' whole body MRI system, equipped with a 6-element phased-array coil, was used (Siemens Medical Solutions, Erlangen, Germany). MRI myocardial tagging with high temporal resolution (14 ms) was applied with Complementary Spatial Modulation of Magnetization (7 mm tag distance) and steady state free precession imaging. Parameters: three phase-encoding lines per beat, TR 4.7 ms, TE 2.3 ms, no view sharing, flipangle 20 deg, voxel size $1.2 \times 3.8 \times 6.0$ mm³. Image plane: the mid-ventricular short-axis plane. Circumferential strain curves of LV and RV free wall were calculated by the Harmonic Phase method. Onset and peak times of myocardial shortening were determined. Tlvsb and Taocl were measured by CMR cine imaging with 30 ms and 15 ms temporal resolution respectively.

Results

The example strain curves of 1 PAH patient, shown below, display the simultaneous onset of shortening, and the L-R delay in peak shortening.



With tagging, a large L-R delay (94 ± 41 ms, $p < 0.001$) in peak time of shortening was observed. A strong association ($r^2 = 0.85$, $p < 0.001$) was found between the delay between Taocl and Tlvsb, and the L-R delay in peak shortening (shown in the scatterplot above). RR is the cardiac cycle time.

Conclusion

The delay between Taocl and Tlvsb is an estimate for the L-R delay in peak shortening. As the Taocl and Tlvsb are easily measured with CMR or echo, this estimate of L-R delay has relevance for clinical practice.

Reference (1) J Am Coll Cardiology, vol 51, No 7, 2008.