Application of Feature Tracking with Cine Cardiac MR for Semiautomated Prediction of Normal Right Ventricular Systolic Function

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Background

Because of its complex shape, evaluation of RV function by echocardiography has been considered difficult. One of the proposed methods in echocardiography for RVEF determination was using Tricuspid Annular Plane Systolic Excursion (TAPSE). Cardiac Magnetic Resonance Imaging (CMR) has emerged as the gold standard for the evaluation of biventricular systolic function. Semi-automated algorithms for investigating left ventricular function exist but similar methodologies function poorly in the right ventricle (RV). Recently, feature tracking has been developed to semiautomatically track annullar movement on 4 chamber cine imaging.

The purpose of this study was to determine the feasibility of feature tracking using a semi-automated algorithm for assessing the tricuspid annular systolic plane excursion at cardiac MR (MR-TAPSE) compared to TAPSE at transthoracic echocardiography (echo-TAPSE) for the prediction of normal RV systolic function.

We hypothesize that a fast method to distinguish normal and abnormal RV function may be a relevant tool in the clinical practice."

Objective

- To determine the feasibility of semiautomated quantification of the CMR tricuspid annular plane systolic excursion (CMR-TAPSE) to predict normal RV systolic function;
- Compare it to echocardiography determined TAPSE (echo-TAPSE); and
- Correlate to quantitative assessment of RV systolic function at CMR."

Materials & Methods

This study was approved by the IRB.

- 64 subjects (43% female, avg 58.7±19 yrs) who were referred for CMR for any indication were retrospectively analysed.

- 4-chamber CMR images were acquired at 1.5T using a breath-held segmented ECG-gated cine steady state free precession sequence (TR/TE 2.8/1.2, 5 segments, in-plane res=1.5x2.1mm2, 6mm thick).

- CMR images were analyzed using prototype software evaluating deformation fields to semi-automatically identify and track the tricuspid base plane at the lateral tricuspid insertion.

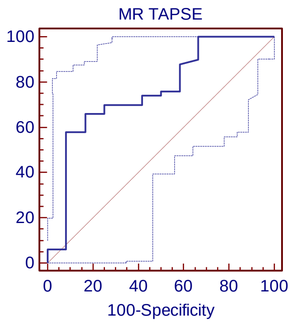
- The MR-TAPSE was correlated to CMR-determined RV ejection fraction (RVEF).

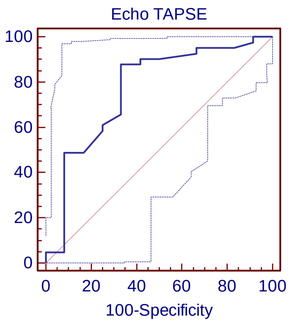
- Echo-TAPSE was obtained and correlated to the RVEF.

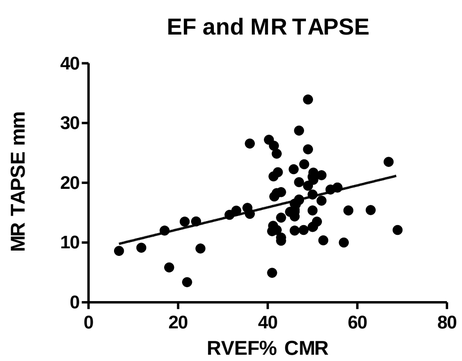
- Differences between MR- and echo-TAPSE were evaluated using a Bland-Altman analysis. RVEF was considered normal if > 40%. ROC analysis was performed to optimize the area under the curve (AUC) for MR-TAPSE prediction of a normal RVEF.

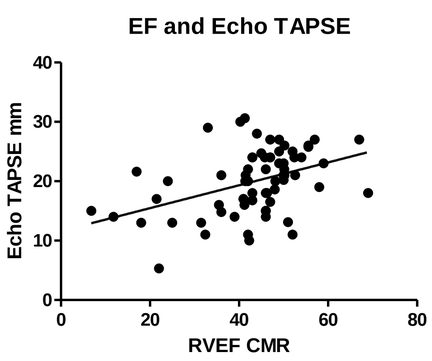
Results

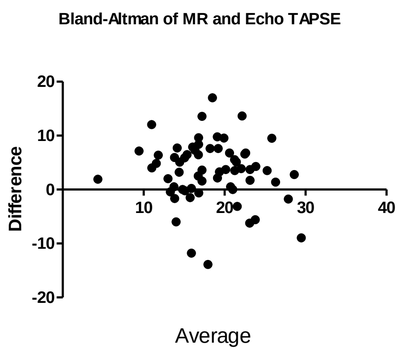
The median RVEF averaged 46% (range 7-69%). Correlation between MR-TAPSE and RVEF (r = 0.37, p = 0.002) was similar to that between echo-TAPSE and RVEF (r = 0.41, p = 0.0004). Bland-Altman analysis showed good agreement between MR- and echo-TAPSE with a bias of 3.3 ± 5.7 mm. ROC analysis demonstrated that a MR-TAPSE of ≥ 16 mm resulted in an AUC of 0.758 with a sensitivity of 58% and a specificity of 92% (p = 0.0002). The positive predictive value was 96.7% and negative predictive value of 34.4%.
For Echo-TAPSE of ≥ 16 mm resulted in an AUC of 0.765 with a sensitivity of 87.8% and specificity of 66.7% (p = 0.0001) with positive predictive value of 90% and negative predictive value of 61.5%.

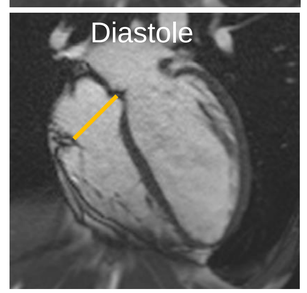












Conclusion

MR-TAPSE significantly correlates with RVEF and shows promise for the semi-automated prediction of normal RV systolic function with a high degree of specificity and positive predictive value.

CMR-TAPSE shows promise for efficient prediction of normal RV systolic function with similar performance to Echo-TAPSE and good correlation with CMR derived RVEF. Incorporating the semiautomated tool in the clinical arena may be a first step towards differentiating between normal and abnormal RVEF in a time efficient manner. Work is ongoing to validate our results in a larger cohort