Quantification of Tricuspid Annular Excursion from Cine MRI and Validation by Doppler Echocardiography

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Background

• Tricuspid annular plane systolic excursion (TAPSE) reflects global right ventricular (RV) systolic function.

• We present a practical technique to track atrioventricular junction (AVJ) motion throughout the cardiac cycle from cine cardiovascular magnetic resonance (CMR) (Figure 1).

• Measures of maximal annular excursion and derived recoil velocities were correlated with ejection fraction (EF) and echocardiographic indices of systolic and diastolic function.

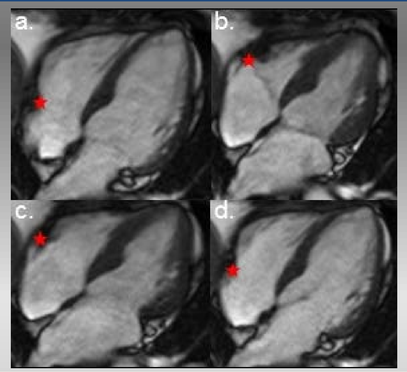

Figure 1. 4-chamber view with marked RV AVJ (red asterisk)

Methods

• Twenty-seven patients underwent CMR and transthoracic echocardiography (TTE) within 24 hours, between June 2010 and September 2013. Echocardiographic evaluation of RV indices of systolic and diastolic function (S', E' and A') were made in 18 patients. Right ventricular EF was determined by CMR.

• Using custom-written MATLAB software we tracked RV AVJ motion throughout the cardiac cycle, using 4-chamber cine MR images (Figure 1). The longitudinal AVJ displacement was plotted as a function of time, and maximum systolic displacement (MD) as well as early (maximum velocity early diastole = MVED) and late (maximum velocity late diastole = MVLD) diastolic velocities were determined (Figure 2).

•Three separate tissue Doppler echocardiography (TDE) measurements of lateral RV S', E and A' were averaged.

• Pearson's correlations were calculated between various measurements.

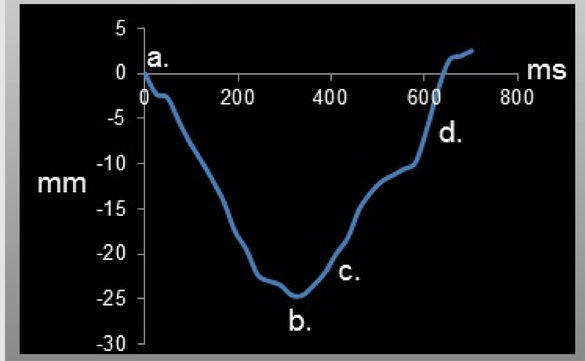

Figure 2. AVJ displacement-versus-time curve at end diastole (a), end systole (b), early (c) and late diastole (d)

Results

Mean Age (years)	**59 (36-82)**

Measures RV Function	Mean ± SD
EF (%) CMR	50 ± 9
MD (mm) CMR	22 ± 8
E' (cm/s) TTE	11 ± 4
MVED (cm/s) CMR	9 ± 4

CMR AVJ Motion Variable	Comparator	Pearson's r	p
MD	E' (Doppler)	0.748	<0.001
MD	A' (Doppler)	0.702	0.001
MD	S' (Doppler)	0.628	0.005
MD	MVLD (CMR AVJ)	0.755	<0.001
MD	MVED (CMR AVJ)	0.395	0.038
MD	RV EF (CMR)	0.377	0.048
MVLD	E' (Doppler)	0.701	0.001
MVLD	A' (Doppler)	0.787	<0.001
MVED	E' (Doppler)	0.570	0.014
MVED	MVLD (CMR AVJ)	0.402	0.034
MVED	RV EF (CMR)	0.386	0.042

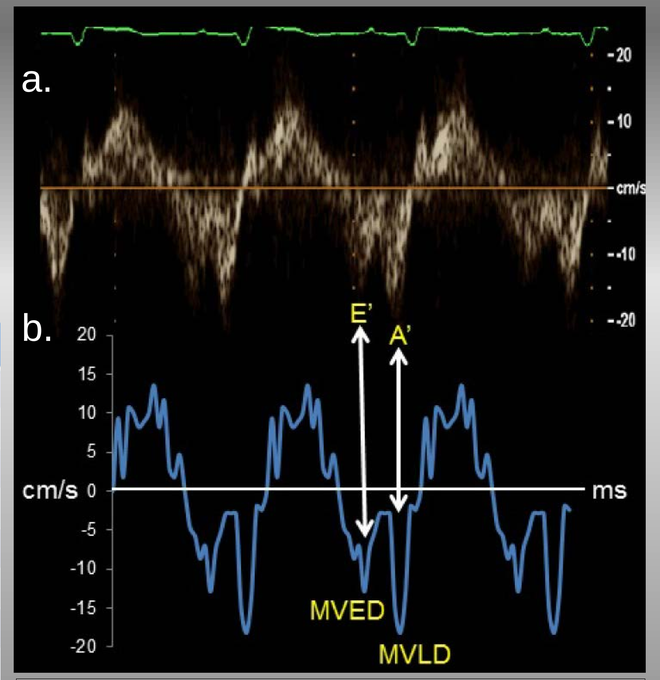

Figure 3. TDE (a) demonstrates S', E' and A' waves corresponding to tricuspid annular velocities during systole, early diastole and with atrial contraction, respectively for a representative patient. Corresponding CMR-derived AVJ velocity-versus-time curve (b). Bidirectional arrows demonstrate corresponding tricuspid annular velocities during various phases of the cardiac cycle.

Conclusions

• Atrioventricular junction analysis is a practical CMR technique that yields CMR measurements of RV diastolic and systolic function.

•Cardiac MR-derived TAPSE correlates with both diastolic and systolic function.

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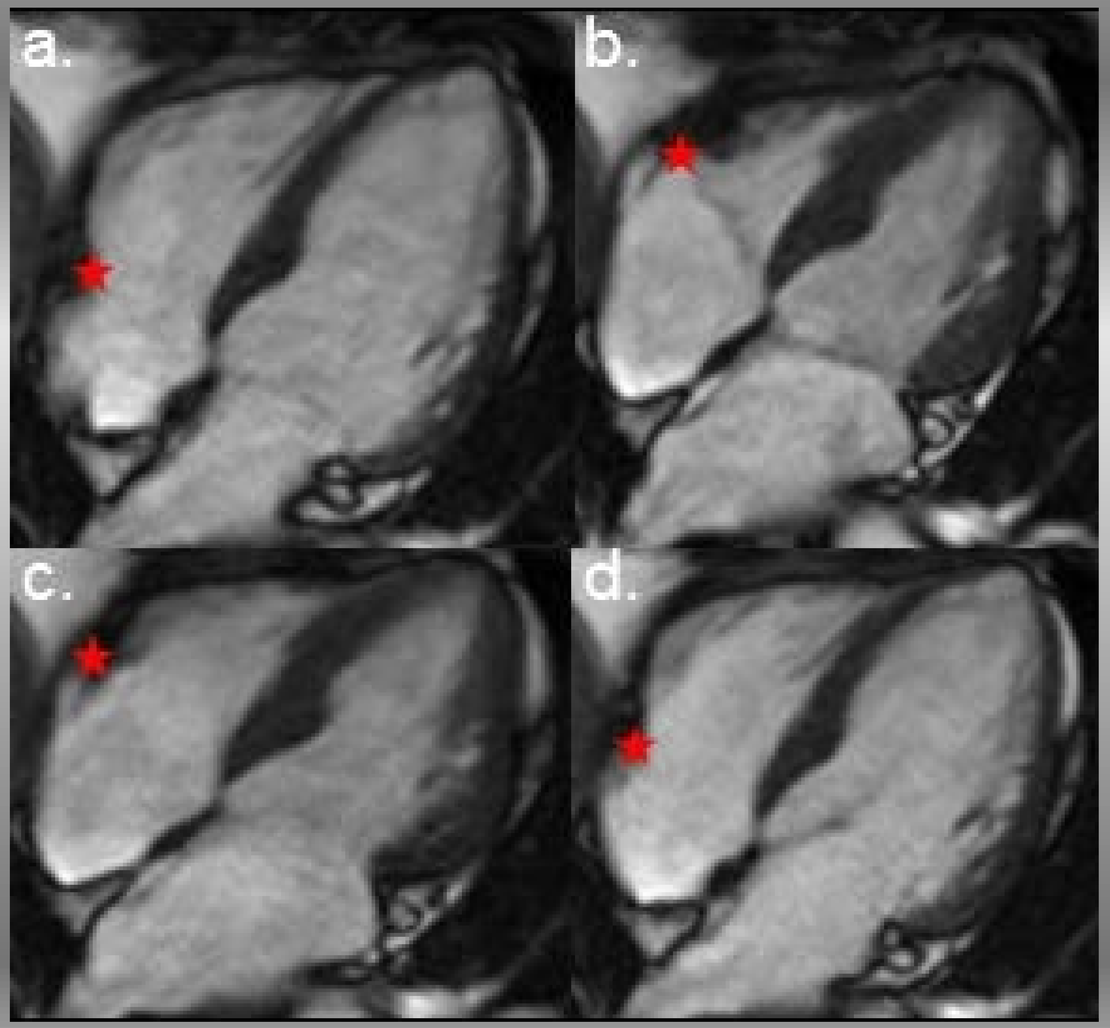

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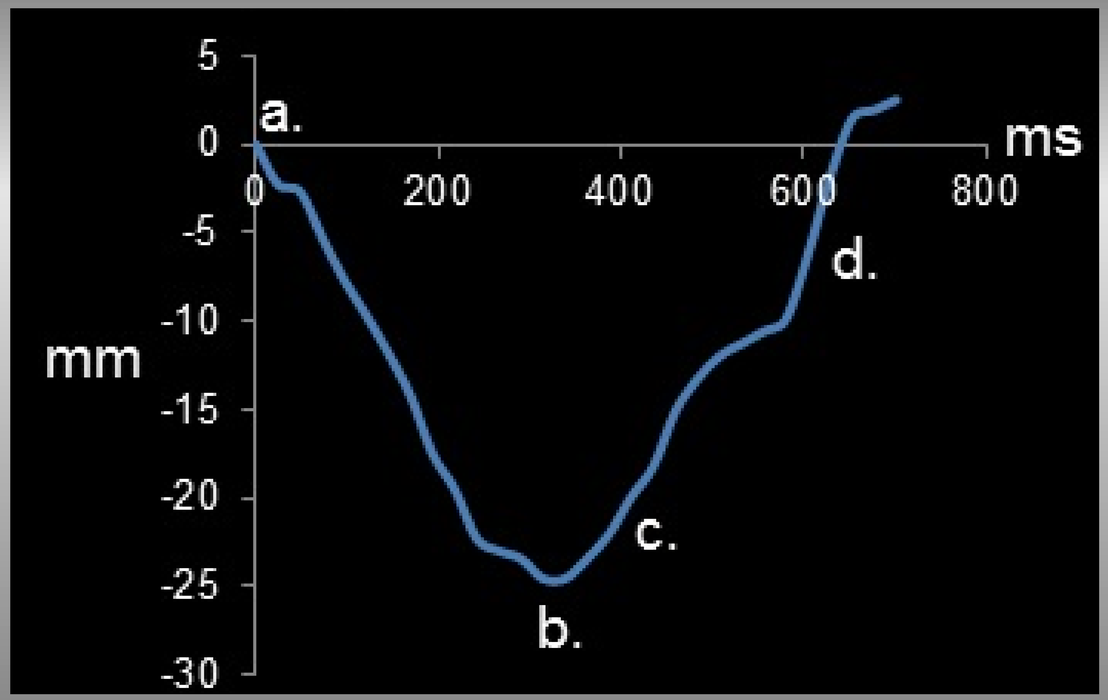

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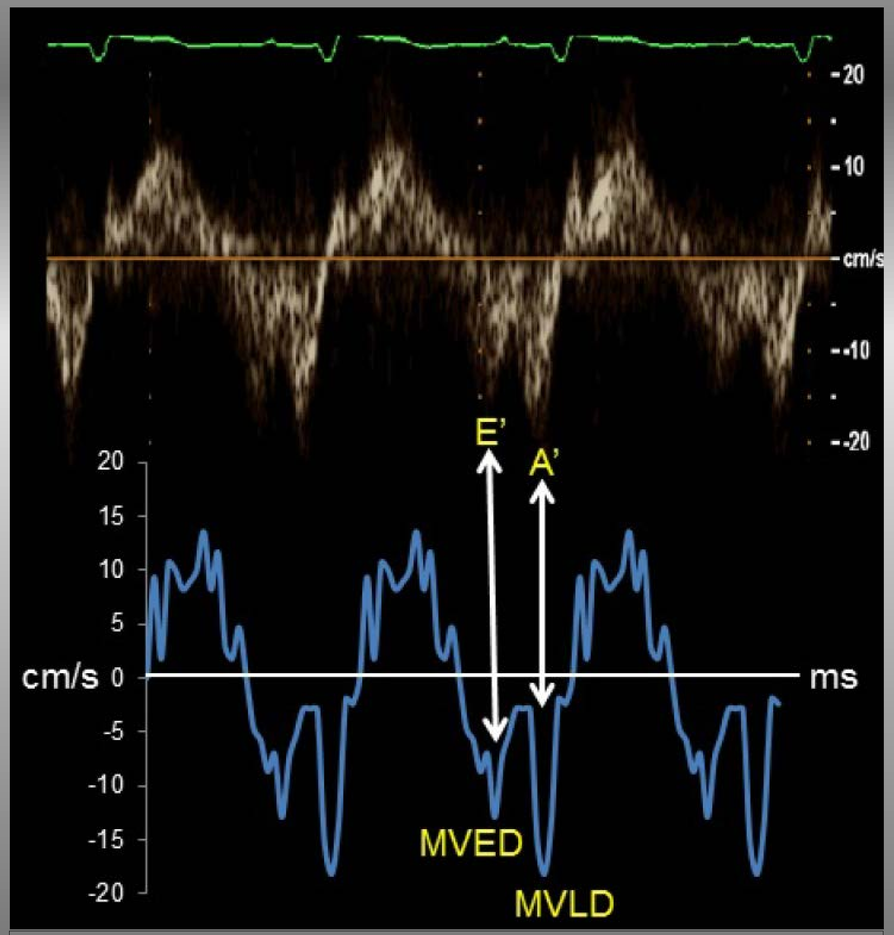

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