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POSTER PRESENTATION **Open Access**

The clinical value of phase-contrast CMR mitral inflow diastolic parameters: comparison with echocardiography

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Purpose

To evaluate the ability of phase-contrast cardiovascular magnetic resonance (PC-CMR) blood flow diastolic parameters to characterize left ventricular (LV) diastolic dysfunction.

Introduction

Early detection of LV diastolic dysfunction is crucial for the management of patients with heart disease. PC-CMR is increasingly used for this evaluation. However, its usefulness in clinical routine is not established yet because of technical issues such as the lack of automated post-processing tools. We hypothesized that the analysis of velocity and flow-rate curves extracted from an accurate segmentation of the transmitral flow would provide sensitive diastolic parameters.

Methods

We studied 35 healthy controls (21 women; age: 38±16 years) and 12 consecutive patients (8 women; age: 81±5 years) with a severe aortic stenosis (valve area/body surface=0.47±0.17 cm^2/m^2, ejection fraction=66±16%, end-diastolic volume=94±18 ml, end-systolic volume=33±19 ml). All subjects had an echocardiography (GE Vivid 7) and a transmitral flow PC-CMR acquisition (GE 1.5 T) on the same day. For PC-CMR images analysis, we used our custom software for semi-automated segmentation of transmitral flow and automated extraction of diastolic parameters from velocity and flow rate curves. Flow rate curves provided: 1) peak filling rate (Ef_{MR}, ml/s) and peak atrial filling rate (Af_{MR}, ml/s) combined into Ef_{MR}/Af_{MR}, 2) peak filling rate to filling volume ratio (Ef_{MR}/FVf_{MR}, s^{-1}), and 3) the deceleration time (DTf_{MR}), while maximal velocity curves provided the early and late peak velocities E_{MR} and A_{MR}, combined into E_{MR}/A_{MR}. DT_{US} and E_{US}/A_{US} as well as the flow to tissue velocity ratio E_{US}/E'_{US} were estimated from Doppler echocardiography.

Results

A stronger correlation and a slope closer to 1 was found for the comparison between the echocardiographic E_{US}/A_{US} and the flow rate-related Ef_{MR}/Af_{MR} (r=0.80, $Ef_{MR}/Af_{MR}=0.89{\cdot}E_{US}/A_{US}+0.09$) than the velocity-related E_{MR}/A_{MR} (r=0.72, $E_{MR}/A_{MR}=0.55{\cdot}E_{US}/A_{US}+0.49$). Results of receiver operating characteristic (ROC) analysis summarized in table 1 indicated the good sensitivity and specificity of the PC-CMR parameters to separate controls from patients.

Table 1 Summary of echocardiographic and CMR diastolic parameters for controls and patients and their ability to characterize pathological subjects. AUC=area under the ROC curve

	Controls	Patients	Sensitivity	Specificity	AUC
EUS/AUS	1.39 ± 0.60	0.82 ± 0.33	94	67	0.86
EUS/E'US	5.34 ± 1.83	14.3 ± 8.10	83	100	0.96
DTUS(ms)	180 ± 56	271 ± 58	77	92	0.86
EMR/AMR	1.34 ± 56	271 ± 58	77	92	0.86
EfMR/AfMR	1.44 ± 0.58	0.49 ± 0.20	91	92	0.95
DTfMR(ms)	187 ± 36	258 ± 45	86	83	0.88
EfMR/FVFMR (s-1)	4.26 ± 0.94	2.37 ± 0.55	91	100	0.97

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Conclusions

Our automated method provided diastolic parameters in good agreement with Doppler echocardiography especially for our new Ef_{MR}/Af_{MR} ratio estimated from flow rate analysis. In addition, our preliminary findings indicated their high sensitivity and specificity to determine patients from controls. The addition of tissue velocities analysis, which is under investigation, to our tool would increase this efficiency.

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