Cardiac magnetic resonance assessment of heart failure with preserved ejection fraction: abridged secondary publication

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KEY MESSAGES

1. Left atrial (LA) reservoir strain was the best cardiac magnetic resonance (CMR) strain parameter for diagnosing heart failure with preserved ejection fraction (HFpEF) in clinically suspected patients, with the area under the curve (AUC) of 0.804.

2. Two other CMR parameters with high diagnostic accuracy were LA area indexed and LA volume indexed, with AUCs of 0.815 and 0.776, respectively.

3. Tagging, CMR-feature tracking in the left ventricle, and CMR-feature tracking in the right ventricle parameters may be less useful than expected in the diagnosis of HFpEF.

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Introduction

Heart failure with preserved ejection fraction (HFpEF) is a persistent diagnostic challenge.[1] Cardiac magnetic resonance (CMR) atrial measurements, feature tracking (FT), and tagging are proposed parameters for diagnosis of HFpEF; they may complement echocardiography, particularly when echocardiography findings are inconclusive.[2] To our knowledge, there are no data supporting the use of atrial measurements, CMR-FT, or tagging. We conducted a prospective case-control study to assess the diagnostic accuracy of CMR atrial volume/area, CMR-FT, and tagging in the diagnosis of HFpEF among clinically suspected patients.

Methods

Patients with suspected HFpEF were prospectively recruited from four centres. Diagnoses of HFpEF were made on the basis of echocardiography, CMR, and N-terminal pro-B-type natriuretic peptide (NT-proBNP) measurements within 24 hours. Patients without a diagnosis of HFpEF were confirmed by catheter pressure measurements or stress echocardiography. Areas under the curve (AUCs) were determined by comparing patients with and without HFpEF.

Results

In total, 142 patients were initially recruited. There were 53 patients with HFpEF (median [interquartile range] age, 78 (74-82) years) and 38 patients without HFpEF (median [interquartile range] age, 70 (64-76) years) after application of exclusion criteria as well as stress echocardiography and invasive catheter pressure measurements. Parameters of CMR left atrial (LA) reservoir strain (ResS), LA area indexed (LAAi), and LA volume indexed (LAVi) had the highest diagnostic accuracy (AUCs: 0.804, 0.815, and 0.776, respectively) [Table]. Parameters of LA ResS, LAAi, and LAVi had significantly better diagnostic accuracy than the CMR-FT left ventricle (LV)/right ventricle (RV) parameters and tagging (p<0.01). The CMR-FT LV and RV strain parameters showed poor diagnostic accuracy, with circumferential strain having the highest AUC (0.603) to distinguish patients with HFpEF from patients without HFpEF (Fig). Tagging circumferential strain and radial strain also showed poor diagnostic accuracy (AUCs=0.644 and 0.541, respectively).

Conclusion

Among patients with clinically suspected HFpEF, CMR LA ResS, LAAi, and LAVi had the highest diagnostic accuracy to distinguish patients with HFpEF from patients without HFpEF, whereas the CMR-FT LV/RV parameters and tagging had low diagnostic accuracy.

TABLE. Accuracies of cardiac magnetic resonance and echocardiography parameters to distinguish patients with heart failure with preserved ejection fraction (HFpEF) [n=53] from patients without HFpEF (n=38)

| Parameter	Area under the curve (confidence interval)	Sensitivity, %	Specificity, %	Diagnostic accuracy, %	Cut-off
Feature tracking in left ventricle (LV)					
Radial strain, %	0.602 (0.475-0.713)	63.2	66.0	64.8	30.0
Radial early diastolic strain rate, 1/s	0.581 (0.455-0.695)	55.3	66.0	61.5	1.33
Circumferential strain, %	0.603 (0.477-0.714)	68.4	60.4	63.7	17.2
Circumferential early diastolic strain rate, 1/s	0.517 (0.401-0.645)	2.6	100	59.3	1.43
Longitudinal strain, %	0.522 (0.412-0.652)	0	100	58.2	5.5
Longitudinal early diastolic strain rate, 1/s	0.568 (0.446-0.692)	47.4	73.6	62.6	0.49
Feature tracking in right ventricle (RV)					
RV radial strain, %	0.530 (0.409-0.651)	100	0	58.2	8.8
RV longitudinal strain, %	0.501 (0.387-0.629)	98.1	2.6	58.2	8.4
Feature tracking in left atrium (LA)					
LA reservoir, %	0.804 (0.714-0.893)	81.1	68.4	75.8	25.9
LA booster, %	0.746 (0.649-0.847)	64.2	76.3	69.2	12.6
LA conduit, %	0.731 (0.619-0.831)	75.5	63.2	70.3	12.8
Atrial size					
LA volume indexed, ml/m^2	0.776 (0.681-0.871)	82.7	60.5	73.3	44.6
LA area indexed on 4-chamber, cm/m^2	0.815 (0.730-0.901)	66.0	86.8	74.7	15.3
RA area indexed on 4-chamber, cm/m^2	0.700 (0.595-0.812)	83.0	57.9	72.5	11.3
Tagging strain parameters					
Circumferential strain, %	0.644 (0.527-0.761)	75.5	55.3	65.9	15.9
Radial strain, %	0.541 (0.420-0.662)	69.8	42.1	58.2	24.6
Cardiac magnetic resonance LV myocardial mass					
LV myocardial mass indexed, g/m^2	0.523 (0.415 -0.656)	0	100	58.2	87.2
Echocardiography parameters					
Septal wall e', m/s	0.555 (0.426-0.663)	100	0	58.2	0.14
Lateral wall e', m/s	0.579 (0.470-0.706)	100	2.6	59.3	0.05
Mean E/e' ratio	0.584 (0.451-0.692)	84.9	28.9	61.5	9.3
Tricuspid regurgitation peak velocity, ms	0.768 (0.661-0.861)	79.2	60.5	71.4	2.3
LV mass indexed, g/m^2	0.621 (0.510-0.745)	96.2	21.0	64.8	74.6
LA volume indexed, ml/m^2	0.766 (0.666-0.860)	56.6	89.5	70.3	46.0
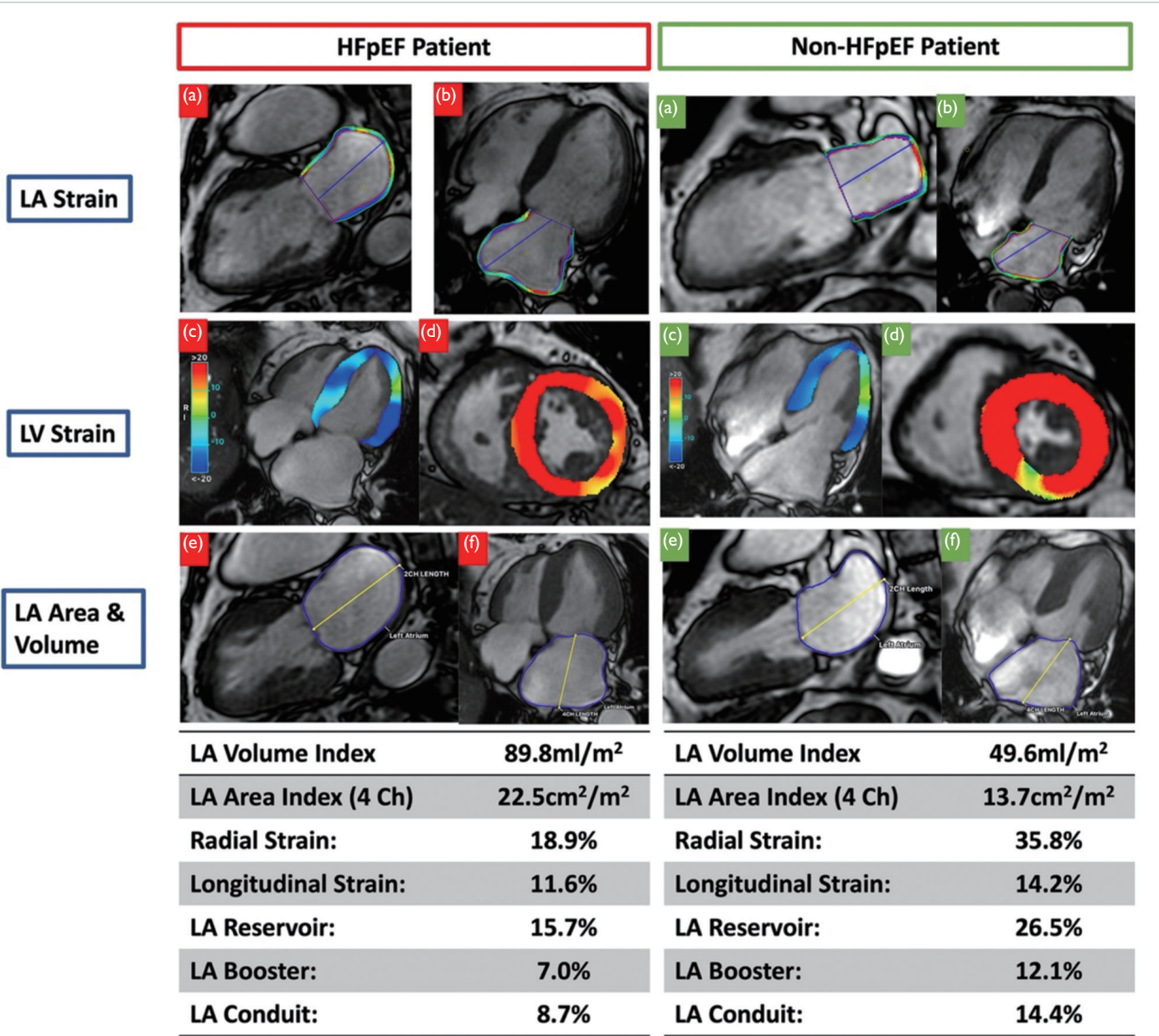
FIG. A patient with heart failure with preserved ejection fraction (HFpEF) has lower left atrial (LA) strain (reservoir, conduit, and booster) and larger LA volume/area, compared with a patient without HFpEF: (a and b) contours of the LA in 2- and 4-chamber cines for LA strain, (c and d) radial and longitudinal strain assessment in the short axis and 4-chamber cines using cardiac magnetic resonance feature tracking, and (e and f) contours of the LA and right atrial in 2- and 4-chamber cines in end-systole for volume/area.

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Disclosure

The results of this research have been previously published in:

1. Ng MY, Kwan CT, Yap PM, et al. Diagnostic accuracy of cardiovascular magnetic resonance strain analysis and atrial size to identify heart failure with preserved ejection fraction. Eur Heart J Open 2023;3:oead021.

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