Validation of Feature Tracking Cardiac MRI for Myocardial Strain: The Dallas Heart Study

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BACKGROUND

- Left ventricular (LV) strain is a new marker of LV systolic function.
- Feature-tracking (FT) CMR is a recently established alternate technique of measuring strain.
- Objective: To evaluate the validity of Feature-Tracking (FT) CMR by examining the relationship between strain measured by FT CMR and cardiovascular risk factors.

METHODS

Study Participants

- Dallas Heart Study participants with tagged cardiac MRI examination at baseline.

Technique

- Tomtec Imaging software was used to measure both LV longitudinal (GLS) and LV circumferential (GCS) strain.

Data Analysis

- An interim analysis was conducted on 1,134 MRI studies.
- Linear regression modeling was used to determine associations between variables of interest and both GCS and GLS.

RESULTS

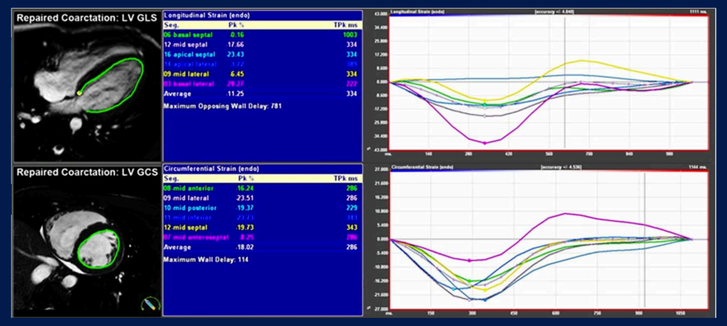

Fig 1: Circumferential Strain Assessment Using Feature Tracking Cardiac MRI imaging
(Image from: Cardiovascular Magnetic Resonance Myocardial Feature Tracking. Andreas Schuster, Kan N. Hor, Johannes T. Kowallick, Philipp Beerbaum and Shelby Kutty. Circulation: Cardiovascular Imaging. 2016;9:e004077)

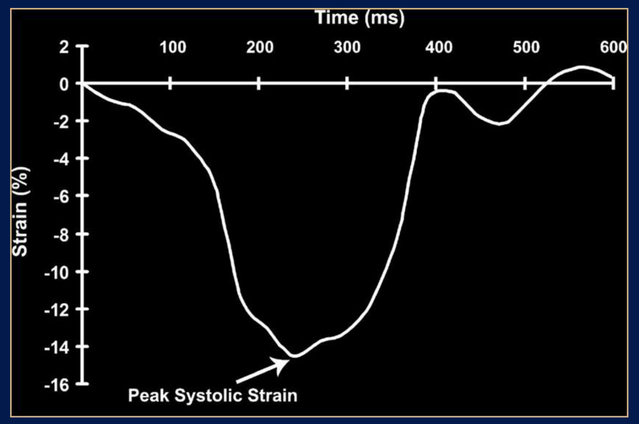

Fig 2. Global Circumferential Strain Curve

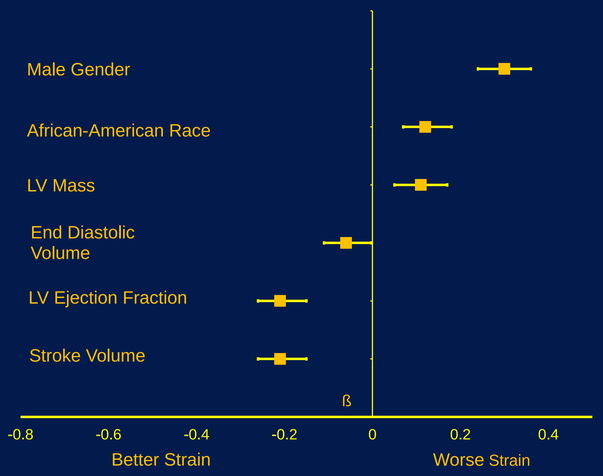

Fig 3: Adjusted association of variables with GLS strain

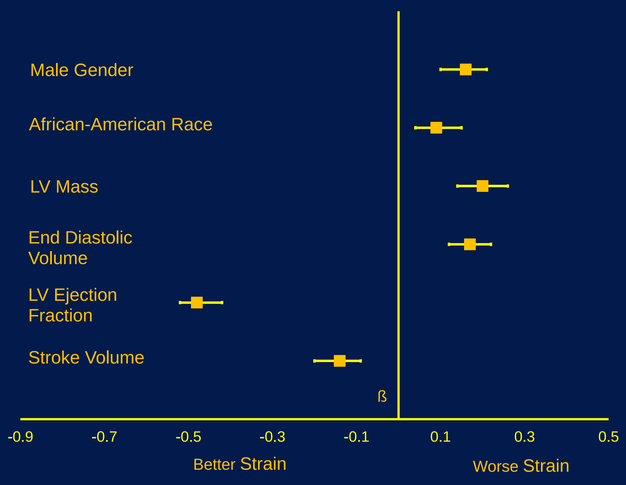

Fig 4: Adjusted association of variables with GCS strain

	Global Longitudinal Strain (GLS)			Global Circumferential Strain (GCS)		
	Tertile 1 (Better Strain)	Tertile 2	Tertile 3 (Worse Strain)	Tertile 1 (Better Strain)	Tertile 2	Tertile 3 (Worse Strain)
Age (years)	44	43	44	46	43	42
Male (%)	26.52	44.17	59.71	50.49	52.30	62.86
African American (%)	48.42	57.52	59.95	33.01	40.44	57.04
Systolic BP (mmHg)	123.67	125.83	125.67	127.17	124.67	124.67
BMI	29.26	29.07	28.74	29.44	29.09	28.65
Waist-Hip Ratio	0.88	0.90	0.92	0.89	0.90	0.92
Glucose	92	92	93	93.00	92.00	92.00
Brain Natriuretic Peptide	5.60	4.25	3.30	4.80	4.00	4.30
LV Mass	146.08	159.56	173.30	149.61	158.33	171.90
EDV	96.58	99.68	97.49	94.36	98.10	102.88
ESV	24.98	27.38	30.13	23.21	27.52	32.07
SV	71.62	71.38	67.02	71.03	70.78	68.41
LVEF	73.70	72.22	69.40	75.26	72.12	68.01
Aortic Compliance	23.73	23.97	21.95	21.81	23.58	24.10
LV Mass	76.23	80.91	86.58	77.28	79.36	85.89
LV Wall Thickness	10.96	11.58	12.33	11.27	11.38	12.14
Subcutaneous Fat	4.61	4.34	3.84	4.67	4.39	3.79
Visceral Fat	1.95	2.07	2.13	2.06	2.05	2.02

Table 1: Baseline Characteristics of study participants across strain adjusted tertiles used in GLS/GCS analysis

- Greater LV mass, male gender, and African-American race were associated with increased (worse) GCS and GLS values.
- Greater stroke volume and higher LV ejection fraction were both associated with decreased (better) GCS and GLS values.
- Greater end diastolic volume was associated with increased (worse) GCS values but decreased (better) GLS values.

CONCLUSIONS

- FT CMR is a reliable method of measuring both GCS and GLS.
- FT CMR derived associations echo previous findings obtained by other strain measurement techniques.
- Strain values notably reflect variations in LV structural variables.

REFERENCES

1. Cardiovascular Magnetic Resonance Myocardial Feature Tracking. Andreas Schuster, Kan N. Hor, Johannes T. Kowallick, Philipp Beerbaum and Shelby Kutty. Circulation: Cardiovascular Imaging. 2016;9:e004077
2. Race-ethnic differences in subclinical left ventricular systolic dysfunction by global longitudinal strain: A community-based cohort study. Russo, Cesare et al. American Heart Journal , Volume 169 , Issue 5 , 721 – 726
3. The relative impact of circumferential and longitudinal shortening on left ventricular ejection fraction and stroke volume. David H MacIver. Exp Clin Cardiol. 2012 Spring; 17(1): 5–11.
4. Females have greater left ventricular twist mechanics than males during acute reductions to preload.Alexandra Williams-Rob et al. American Journal of Physiology - Heart and Circulatory Physiology – 2016
5. Prognosis after acute coronary syndrome in relation with ventricular–arterial coupling and left ventricular strain. Milewska, Agata et al.International Journal of Cardiology , Volume 220 , 343 – 348
6. Uncontrolled blood pressure as an independent risk factor of early impaired left ventricular systolic function in treated hypertension. Chen, X.-J., et al. 2016 Echocardiography, 33: 1488–1494. doi: 10.1111/echo.13289