

Appendix 1 Supplementary methods

CMR protocol

All cardiac magnetic resonance (CMR) cine images were acquired using balanced steady-state free precession (bSSFP) sequences with electrocardiogram triggering and respiratory gating, including long-axis slices (two-, three-, and four-chamber), and a stack of short-axis slices from the mitral valve level to the apex. Typical parameters were as follows: slice thickness = 8 mm, section gap = 2 mm, echo time (TE) = 1.39 ms, repetition time (TR) = 3.2 ms, field of view (FOV) = 360 × 360 mm², matrix size = 189 × 154, flip angle = 46°, temporal resolution = 32 ms, and calculated phases = 25.

Native and post-contrast T1 mapping images were acquired using a modified look-locker inversion recovery (MOLLI) sequence in the same basal, mid, and apical short-axis planes with “5(3)3” and “4(1)3(1)2” schemes, respectively. The post-contrast T1 mapping images were acquired 15 minutes after the administration of the contrast agent. The acquisition parameters were as follows: slice thickness = 5 mm, TE = 1.2 ms; TR = 2.8 ms, inversion time = 197 ms, increase step = 80 ms, FOV = 360 × 324 mm², matrix size = 257 × 232, and flip angle = 35°.

The T2 mapping technique involved a T2 prepared pulse sequence to produce single-shot T2 prepared SSFP images (T2p-SSFP), with different T2 preparation times (0 ms, 30 ms, and 55 ms). The images were generated with three heart-beat recovery durations for each T2 preparation (with a total acquisition time of nine heartbeats). The T2 mapping parameters were as follows: slice thickness = 5 mm, TE = 1.35 ms; flip angle = 12°, FOV = 360 × 323 mm², and matrix size = 189 × 170.

Late gadolinium enhancement (LGE) imaging was acquired using a phase-sensitive inversion recovery (PSIR) sequence 10–15 min after the intravenous administration of a gadolinium-based contrast agent (0.2 mL/kg of Multihance, Shanghai, China). A TI-scout was performed to determine the optimal inversion time for nulling normal myocardium. The LGE scan parameters were as follows: slice thickness = 6.0 mm, TR = 3.2 ms, TE = 1.27 ms, FOV = 350 × 263 mm², matrix size = 192 × 173, flip angle = 10°, and nominal inversion time = 255 ms.

Table S1 CMR characteristics of the overall study cohort

Parameters	Pre-SM	Post-SM	P value
Left ventricular			
LVMWT, mm	17.8 (15.5, 20.5)	14.5 (12.3, 17.4)	< 0.001
LVEF, %	63.8 (58.6, 68.2)	59.1 (54.1, 63.6)	< 0.001
LVEDVI, mL/m ²	81.0 (71.7, 90.9)	80.3 (68.5, 87.9)	0.063
LVESVI, mL/m ²	29.9 (25.2, 34.0)	32.1 (26.9, 38.5)	< 0.001
SVI, mL/m ²	51.3±11.8	46.2±9.9	< 0.001
CI, mL/min/m ²	3.3±0.8	3.0±0.6	< 0.001
LVMI, g/m ²	94.3 (79.0, 111.2)	78.7 (63.3, 96.5)	< 0.001
LVRI, g/ mL/m ²	1.2 (1.0, 1.4)	1.0 (0.8, 1.2)	< 0.001
LVGFI, %	35.5±8.3	36.1±9.0	0.392
GRS, %	28.8±7.5	25.8±6.7	< 0.001
GCS, %	-17.3±3.3	-15.7±3.1	< 0.001
GLS, %	-13.2±3.8	-14.4±5.6	< 0.001
RDSR, 1/s	-1.4 (-1.2, -1.8)	-1.1 (-0.8, -1.4)	< 0.001
CDSR, 1/s	0.7 (0.6, 0.8)	0.7 (0.6, 0.8)	0.002
LDSR, 1/s	0.6 (0.4, 0.7)	0.6 (0.5, 0.8)	< 0.001
Native T1 value, ms	1305±40	1286±43	< 0.001
T2 value, ms	41 (40, 43)	40 (39, 42)	< 0.001
ECV, %	30 (27, 32)	31 (28, 34)	< 0.001
LGE, %	14.1(9.8, 18.4)	12.2 (8.1, 18.0)	< 0.001
LGE ≥ 15%, n (%)	135 (44)	101 (33)	< 0.001
Left atrial			
LAAPD, mm	42.0±6.9	37.8±6.0	< 0.001
LACI, %	28.9 (21.1, 39.0)	25.5 (19.2, 32.3)	< 0.001
LAVI _{max} , mL/m ²	49.2 (41.4, 59.0)	42.8 (38.0, 50.9)	< 0.001
LAVI _{bac} , mL/m ²	37.6 (29.7, 45.9)	32.4 (26.3, 40.1)	< 0.001
LAVI _{min} , mL/m ²	23.8 (17.1, 31.6)	19.8 (15.3, 26.3)	< 0.001
Total LAEF, %	51.6 (45.1, 59.2)	53.8 (48.3, 60.3)	< 0.001
εs, %	24.0 (19.8, 28.6)	28.4 (23.1, 34.2)	< 0.001
SRs, 1/s	1.2 (0.9, 1.5)	1.3 (1.0, 1.6)	< 0.001
Passive LAEF, %	23.7 (17.1, 31.6)	23.0 (18.3, 30.7)	0.568
εe, %	11.2 (7.9, 14.8)	13.2 (9.8, 16.7)	< 0.001
SRe, 1/s	-0.9 (-0.7, -1.3)	-1.2 (-0.8, -1.5)	< 0.001
Booster LAEF, %	34.7 (28.4, 43.4)	39.0 (30.8, 45.9)	0.002
εa, %	12.6 (9.6, 16.1)	15.0 (11.4, 19.0)	< 0.001
SRa, 1/s	-1.2 (-0.8, -1.6)	-1.5 (-1.1, -2.0)	< 0.001

Continuous variables are presented as the mean ± standard deviation, or the median and interquartile range, and categorical variables are presented as the number and percentage. LVMWT, LV maximum wall thickness; LVEF, LV ejection fraction; LVEDVI, LV end-diastolic volume index; LVESVI, LV end-systolic volume index; SVI, stroke volume index; CI, cardiac index; LVMI, LV mass index; LVRI, left ventricular remodeling index; LVGFI, left ventricular global function index; GRS, global radial strain; GCS, global circumferential strain; GLS, global longitudinal strain; RDSR, radial diastolic strain rate; CDSR, circumferential diastolic strain rate; LDSR, longitudinal diastolic strain rate; ECV, extracellular volume; LGE, late gadolinium enhancement; LAAPD, LA anteroposterior diameter; LACI, left atrioventricular coupling index; LAVI, left atrial volume index; LAEF, left atrial phasic emptying fraction; εs, total strain; εe, passive strain; εa, active strain; SRs, peak positive strain rate; SRe, peak early negative strain rate; SRa, peak late negative strain rate.

Table S2 Univariable analysis between Mets and the rate of change in GLS and left atrial strain following TA-BSM in HOCM patients

Variables	Δ GLS%		Δ ϵ s%		Δ ϵ e%		Δ ϵ a%	
	r	P	r	P	r	P	r	P
Age, years	0.023	0.685	0.010	0.866	−0.063	0.271	0.031	0.666
Male, n (%)	0.146*	0.033*	0.044	0.441	0.051	0.373	0.067	0.313
TyG index	0.031	0.593	−0.037	0.525	−0.024	0.671	−0.019	0.774
Mets	0.253*	0.001*	0.216*	0.003*	0.095	0.246	0.118	0.137
BMI, kg/m ²	0.028	0.629	−0.027	0.633	−0.018	0.757	−0.028	0.665
SBP, mmHg	−0.050	0.388	0.203*	0.011*	0.024	0.670	0.048	0.479
DBP, mmHg	−0.031	0.587	−0.031	0.590	−0.034	0.560	0.029	0.646
TG, mmol/L	0.035	0.543	−0.055	0.343	−0.012	0.832	−0.043	0.610
HDL-c, mmol/L	0.137*	0.017*	0.040	0.48	0.043	0.451	0.050	0.452
FBG, mmol/L	0.106	0.162	0.020	0.723	0.142*	0.028*	0.083	0.201

*, statistical significance. Delta value (Δ) = preoperative value – postoperative value, rate of change ($\Delta\%$) = Δ /preoperative value $\times$ 100%. GLS, global longitudinal strain; ϵ s, total strain; ϵ e, passive strain; HOCM, hypertrophic obstructive cardiomyopathy; TA-BSM, transapical beating-heart septal myectomy; MetS, metabolic syndrome; TyG, triglyceride-glucose; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; TG, Triglycerides; HDL-c, high-density lipoprotein cholesterol; FBG, fasting blood glucose.

Table S3 Intra- and inter-observer reproducibility of CMR-derived myocardial strain and fibrosis parameters

Parameter	Intra-observer		Inter-observer	
	ICC	95% CI	ICC	95% CI
GRS, %	0.927	0.826–0.971	0.921	0.811–0.968
GCS, %	0.941	0.858–0.976	0.968	0.922–0.987
GLS, %	0.979	0.947–0.991	0.940	0.855–0.976
RDSR, 1/s	0.954	0.888–0.982	0.939	0.852–0.975
CDSR, 1/s	0.919	0.807–0.967	0.941	0.858–0.976
LDSR, 1/s	0.928	0.828–0.971	0.883	0.729–0.952
LGE, %	0.926	0.822–0.970	0.935	0.844–0.974
ECV, %	0.942	0.859–0.977	0.935	0.845–0.974
ϵ s, %	0.965	0.915–0.986	0.975	0.938–0.990
SRs, 1/s	0.960	0.901–0.984	0.938	0.850–0.975
ϵ e, %	0.957	0.894–0.983	0.954	0.887–0.981
SRe, 1/s	0.931	0.834–0.972	0.965	0.915–0.986
ϵ a, %	0.944	0.864–0.977	0.926	0.823–0.970
SRa, 1/s	0.959	0.899–0.984	0.969	0.922–0.987

ICC, intraclass correlation coefficient; CI, confidence interval; GRS, global radial strain; GCS, global circumferential strain; GLS, global longitudinal strain; RDSR, radial diastolic strain rate; CDSR, circumferential diastolic strain rate; LDSR, longitudinal diastolic strain rate; LGE, late gadolinium enhancement; ECV, extracellular volume; ϵ s, total strain; SRs, peak positive strain rate; ϵ e, passive strain; SRe, peak early negative strain rate; ϵ a, active strain; SRa, peak late negative strain rate.