Supplementary Table S1.

Correlation between Hemodynamic forces and clinical and echocardiographic variables.

	HDFs-ab		HDFs-ls		HDFs-angle	
	R	**p value**	**R**	**p value**	**R**	**p value**
Clinical variables						
Age (per year)	**-0.302**	**0.003**	**-0.290**	**0.004**	0.151	0.140
Weight (per kg)	-0.124	0.226	0.008	0.938	-0.144	0.159
Height (per cm)	0.108	0.293	0.175	0.087	-0.187	0.066
BSA (per m^2)	-0.055	0.591	0.066	0.522	-0.176	0.085
BMI (per kg/m^2)	-0.192	0.060	-0.103	0.318	-0.032	0.756
Serum creatinine (per mg/dl)	0.030	0.772	-0.035	0.735	0.070	0.502
Hemoglobin (per g/dl)	0.082	0.424	0.025	0.806	0.066	0.522
Heart rate (per bpm)	-0.026	0.798	0.083	0.420	-0.005	0.962
QRS duration (per ms)	**-0.201**	**0.049**	**-0.203**	**0.047**	0.037	0.717
Systolic BP (per mmHg)	0.065	0.527	0.095	0.357	0.026	0.803
Diastolic BP (per mmHg)	-0.144	0.160	-0.019	0.855	-0.037	0.721
Echocardiography						
Interventricular septum (per mm)	0.091	0.377	0.073	0.480	0.070	0.498
Inferior-lateral wall (per mm)	0.061	0.555	0.136	0.185	0.021	0.838
LV EDD (per mm)	**-0.358**	**<0.001**	-0.165	0.106	**-0.287**	**0.004**
RWT (per unit)	**0.223**	**0.028**	0.177	0.082	0.165	0.105
LV EDVi (per ml/m^2)	-0.188	0.065	-0.013	0.897	**-0.279**	**0.006**
LVMi (per g/m^2)	**-0.204**	**0.045**	-0.049	0.633	-0.145	0.156
Sphericity index (per unit)	**-0.283**	**0.006**	-0.062	0.555	**-0.383**	**<0.001**
LVEF (per %)	**0.629**	**<0.001**	0.149	0.146	**0.438**	**<0.001**
GLS (per %)	**-0.577**	**<0.001**	-0.063	0.543	**-0.460**	**<0.001**
GCS (per %)	**-0.609**	**<0.001**	-0.170	0.096	**-0.405**	**<0.001**
TAPSE (per mm)	-0.089	0.385	-0.064	0.534	0.032	0.755
RV FWS (per %)	-0.241	0.055	0.060	0.636	-0.205	0.105
LAVi (per ml/m^2)	-0.154	0.132	-0.004	0.970	**-0.232**	**0.022**
LA reservoir strain (per %)	**0.208**	**0.040**	-0.007	0.948	0.172	0.093
E wave (per m/s)	-0.117	0.255	0.026	0.798	-0.123	0.231
E/A ratio (per unit)	0.015	0.891	-0.061	0.571	0.057	0.598
E/e' ratio (per unit)*	-0.203	0.142	-0.235	0.087	0.120	0.387

BMI: body mass index; BP: blood pressure; BSA: body surface area; E wave: early filling wave at mitral inflow Doppler imaging; E/A ratio: ratio between E wave and atrial filling wave at mitral Doppler imaging; E/e' ratio: ratio between E wave and average septal and lateral early wave at tissue Doppler imaging (e'); GCS: global circumferential strain; GLS: global longitudinal strain; LA: left atrium; LAVi: LA volume indexed for BSA; LV EDVi: LV end-diastolic volume indexed for BSA; LVEF: LV ejection fraction; LVMi: left ventricular mass indexed for BSA; TAPSE: tricuspid annular plane systolic excursion; RV FWS: right ventricle free wall strain; RWT: relative wall thickness.

Supplementary Table S2.

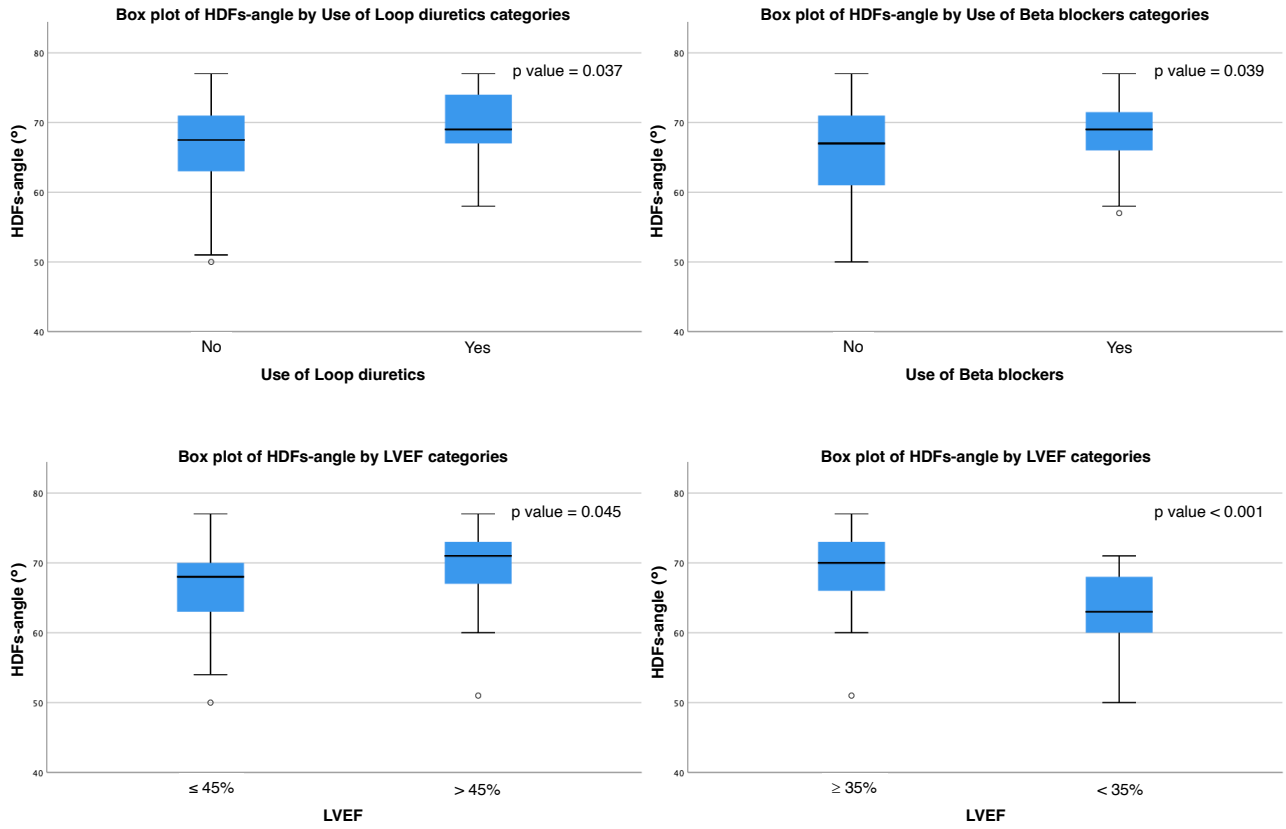
Mann-Whitney test for hemodynamic forces according to dichotomous variables.

	HDFs-ab	HDFs-ls	HDFs-angle
	p value	**p value**	**p value**
Clinical variables			
Male sex	0.558	0.177	0.100
Obesity	0.358	0.868	0.311
Hypertension	0.154	0.350	0.945
Dyslipidemia	0.491	0.413	0.628
Diabetes	0.297	0.561	0.307
COPD	0.765	0.650	0.505
CKD	0.463	0.796	0.854
Peripheral artery disease	0.750	0.098	0.677
Previous or active cancer	**0.003**	**0.003**	0.524
Previous heart failure hosp.	0.175	0.452	0.570
Charlson Comorbidity Index*	**0.050**	0.180	0.610
QRS ≥ 120 ms	0.114	0.230	0.781
Medications, use of			
Beta blockers	0.963	**0.009**	**0.039**
ACE-Inhibitors/ARBs	**0.047**	**0.004**	0.164
MRAs	0.227	**0.009**	0.144
Loop diuretics	0.332	**0.006**	**0.037**
Ivabradine	0.937	0.341	0.844
Echocardiography			
LVEF < 40%	**<0.001**	0.444	**<0.001**

*Kruskal-Wallis ANOVA for ordinal variable.

ACE: angiotensin-converting enzyme; ARBs: angiotensin II-receptor blockers; CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease; MRAs: mineralocorticoid receptor antagonists; LVEF: left ventricular ejection fraction.

Supplementary Figure S1. Box plots of hemodynamic forces angle by various categorical variables.



HDFs: hemodynamic forces; LVEF: left ventricular ejection fraction.

Supplementary Table S3.

Bivariate Cox regression for individual adjustment of HDFs-angle, including variables potentially associated with the endpoint (p≤0.200) on univariate analysis (variables not displayed in the main text).

	Hazard Ratio [95% CI]	p value
Clinical variables		
Male sex	0.46 [0.19-1.13]	0.091
HDFs-angle (per °)	1.16 [1.04-1.30]	0.011
Weight (per kg)	0.98 [0.94-1.02]	0.228
HDFs-angle (per °)	1.16 [1.04-1.29]	0.009
Height (per cm)	0.93 [0.89-0.98]	0.008
HDFs-angle (per °)	1.15 [1.02-1.29]	0.018
BSA (per m^2)	0.07 [0.01-0.85]	0.037
HDFs-angle (per °)	1.16 [1.04-1.30]	0.010
Hypertension	3.03 [1.08-8.47]	0.035
HDFs-angle (per °)	1.15 [1.04-1.27]	0.008
Dyslipidemia	2.08[0.83-5.21]	0.118
HDFs-angle (per °)	1.17 [1.05-1.32]	0.007
Diabetes	3.05 [1.23-7.55]	0.016
HDFs-angle (per °)	1.17 [1.05-1.31]	0.008
QRS ≥ 120	2.57 [0.92-7.22]	0.073
HDFs-angle (per °)	1.16 [1.04-1.29]	0.008
Medications		
Use of Beta blockers	1.73 [0.92-3.25]	0.087
HDFs-angle (per °)	1.14 [1.01-1.29]	0.038
Use of MRAs	1.41 [0.88-2.25]	0.102
HDFs-angle (per °)	1.17 [1.04-1.31]	0.009
Use of Loop diuretics	2.15 [0.86-5.34]	0.102
HDFs-angle (per °)	1.43 [1.03-1.28]	0.010
Echocardiography		
RWT (per unit)	1.05 [1.00-1.09]	0.033
HDFs-angle (per °)	1.16 [1.04-1.30]	0.010
RV FWS (per %)	0.95 [0.83-1.08]	0.418
HDFs-angle (per °)	1.17 [1.02-1.33]	0.010

Abbreviations as in Table S1 and S2.

Supplementary Figure S2. Receiver operating characteristics curve of MACE prediction by HDFs-angle >70°.

