

Supplemental Table 1: Characteristics of patients in VE/VCO₂ slope Group A, stratified by the y-intercept (high vs. low y-intercept)

GROUP A (VE/VCO ₂ slope ≥ 34)	A1 (high y-intercept ≥ 2.40)	A2 (low y-intercept < 2.40)	p-value	FDR-adjusted p-value†
	(N=396)	(N=371)		
Patient Characteristics				
Age, years	69 [62-76]	65 [58-73]	<0.001	<0.001
Male sex, n (%)	335 (85)	304 (82)	0.345	0.554
Height, cm	170 [165-175]	172 [167-178]	0.003	0.011
Weight, kg	72 [64-83]	77 [68-85]	<0.001	<0.001
Clinical Status & Etiology				
MECKI score, %	10.11 [4.57-16.96]	9.26 [4.33-21.28]	0.648	0.755
NYHA, n (%)			0.365	0.575
I	35 (9)	38 (10)		
II	191 (48)	187 (50)		
III	152 (38)	135 (36)		
IV	18 (5)	9 (2)		
ETIOLOGY, n (%)			0.468	0.654
Idiopathic	125 (32)	104 (28)		
Ischemic	206 (52)	192 (52)		
Valvular	20 (5)	13 (4)		

Other	34 (9)	40 (11)		
Systolic Blood Pressure, mmHg	110 [100-120]	110 [100-120]	0.262	0.446
Diastolic Blood Pressure, mmHg	70 [60-80]	70 [60-80]	0.920	0.954
Echocardiography				
LVEF, %	30 [24-37]	30 [25-35]	0.868	0.911
End-Diastolic Volume, mL	176 [129-224]	184 [137-229]	0.220	0.399
End-Systolic Volume, mL	121 [86-167]	127 [91-168]	0.510	0.683
Systolic PAP, mmHg	38 [29-49]	36 [29-46]	0.123	0.259
Cardiopulmonary Exercise Testing				
Peak VO ₂ , mL/kg/min	12.2 [10.3-14.8]	13.1 [10.7-15.5]	0.019	0.055
Peak VO ₂ in % of precited	47 [38-58]	50 [42-61]	0.005	0.021
Peak VCO ₂ , mL/min	969 [783-1249]	1095 [854-1386]	<0.001	<0.001
Peak Heart Rate, beats/min	102 [88-117]	105 [87-123]	0.218	0.399
Peak Heart Rate in % of predicted	68 [58-77]	68 [57-79]	0.750	0.819
Peak Power Output, Watt	56 [42-75]	65 [49-89]	<0.001	<0.001
Peak Respiratory Quotient	1.10 [1.03-1.17]	1.11 [1.05-1.20]	0.009	0.032
Peak PetCO ₂ , mmHg	28 [25-30]	27 [24-30]	0.023	0.063
Peak Minute Ventilation, L/min	47 [38-58]	52 [42-64]	<0.001	<0.001
Peak Respiratory Rate, breaths/min	33 [28-38]	34 [28-39]	0.470	0.654

VE/VCO ₂ slope	37.8 [35.3-41.3]	41.2 [37.0-48.4]	<0.001	<0.001
Y – Intercept	4.00 [3.10-5.20]	0.30 [-1.70-1.60]	<0.001	<0.001
VO ₂ /work slope, mL/min/W	9.2 [8.2-10.5]	9.0 [7.8-10.0]	0.007	0.026
Pulmonary Function				
FEV ₁ , L	2.20 [1.81-2.79]]**	2.39 [1.90-2.91]*	0.125	0.259
FEV ₁ , % predicted	83 (21)**	83 (17)*	0.683	0.764
FVC, L	3.08 [2.48-3.75]**	3.19 [2.52-3.76]*	0.384	0.582
FVC, % predicted	87 (20)**	86 (16)*	0.840	0.893
Laboratory Values				
Serum Creatinine, mg/dL	1.21 [1.03-1.58]	1.23 [0.98-1.52]	0.301	0.502
BNP, pg/mL	597 [320-1048]	479 [235-891]*	0.034	0.086
NT-proBNP, pg/mL	1489 [723-3425]**	1385 [566-2986]**	0.584	0.700
Hemoglobin, g/dL	13.4 (1.9)	13.6 (1.9)	0.144	0.291
Electrocardiography / Device therapy				
Atrial Fibrillation, n (%)	129 (33)	114 (31)	0.704	0.777
ICD, n (%)	189 (48)	207(56)	0.035	0.087
CRT, n (%)	85 (21)	96 (26)	0.192	0.362
Pharmacological Therapy				

β-Blocker, n (%)	354 (89)	340 (92)	0.322	0.527
RAAS – Inhibitor, n (%)	312 (79)	315 (85)	0.038	0.115
Diuretics, n (%)	344 (87)	297 (80)	0.014	0.044
Statin use, n (%)	201 (51)	200 (54)	0.247	0.437
Mineralocorticoid Receptor Antagonist, n (%)	272 (69)	262 (71)	0.572	0.694
Digitalis, n (%)	48 (12)	37 (10)	0.408	0.598
Amiodarone, n (%)	178 (45)	122 (33)	0.001	0.007

Supplemental Table 1: Comparison of patient characteristics between A1 (high y-intercept) and A2 (low y-intercept) subgroups. Continuous variables are presented as median [IQR], and categorical variables as counts (percentages). Group comparisons were performed using the Mann–Whitney U test for continuous variables and Fisher’s exact test for categorical variables. To correct for multiple testing, Benjamini–Hochberg false discovery rate adjustment was used. The Benjamini–Hochberg procedure was applied to adjust for multiple testing. Abbreviations: ACE = angiotensin-converting enzyme; AF = atrial fibrillation; BNP = B-type natriuretic peptide; bpm = beats per minute; CRT = cardiac resynchronization therapy; FDR = false discovery rate; FEV₁ = forced expiratory volume in 1 second; FVC = forced vital capacity; ICD = implantable cardioverter defibrillator; LAH = left anterior hemiblock; LBBB = left bundle branch block; LVEF = left ventricular ejection fraction; NT-proBNP = N-terminal pro-BNP; NYHA = New York Heart Association; PAP = pulmonary artery pressure; PetCO₂ = partial pressure of end-tidal CO₂; RBBB = right bundle branch block; VCO₂ = carbon dioxide production; VE = minute ventilation; VO₂ = oxygen uptake.

*>30% missing **>50% missing †FDR-adjusted p-value based on the Benjamin–Hochberg procedure.

Supplemental Table 2: Characteristics of patients in VE/VCO₂ slope Group C, stratified by the y-intercept (high vs. low y-intercept)

GROUP C (VE/VCO ₂ slope < 28)	C1 (high y-intercept ≥ 5.00)	C2 (low y-intercept <5.00)	p-value	FDR-adjusted p-value†
	(N=335)	(N=332)		
Patient Characteristics				
Age, years	59 [50-68]	58 [47-66]	0.010	0.074
Male sex, n (%)	291 (87)	263 (79)	0.014	0.085
Height, cm	174 [168-179]	172 [166-178]	0.049	0.187
Weight, kg	80 [70-90]	79 [69-89]	0.197	0.418
Clinical Status & Etiology				
MECKI score, %	1.32 [0.67-2.67]	1.30 [0.61-3.12]	0.996	1.00
NYHA, n (%)			0.133	0.345
I	111 (33)	94 (28)		
II	165 (49)	182 (55)		
III	53 (16)	55 (17)		
IV	6 (2)	1 (0)		
ETIOLOGY, n (%)			0.656	0.845
Idiopathic	169 (50)	168 (51)		
Ischemic	110 (33)	108 (33)		
Valvular	10 (3)	8 (2)		
Other	29 (9)	39 (12)		

Systolic Blood Pressure, mmHg	120 [110-130]	120 [110-130]	0.113	0.309
Diastolic Blood Pressure, mmHg	75 [70-80]	70 [70-80]	0.134	0.345
Echocardiography				
LVEF, %	35 (8)	37 (8)	0.038	0.169
End-Diastolic Volume, mL	170 [130-200]	165 [132-207]	0.729	0.849
End-Systolic Volume, mL	108 [80-140]	106 [80-137]	0.627	0.831
Systolic PAP, mmHg	29 [25-35]	30 [25-35]	0.828	0.916
Cardiopulmonary Exercise Testing				
Peak VO ₂ , mL/kg/min	17.8 [14.2-21.9]	17.8 [14.9-21.6]	0.706	0.849
Peak VO ₂ in % of precited	67 [55-80]	67 [57-76]	0.778	0.893
Peak VCO ₂ , mL/min	1602 [1242-2050]	1632 [1239-2040]	0.714	0.849
Peak Heart Rate, beats/min	122 [106-137]	125 [111-140]	0.052	0.187
Peak Heart Rate in % of predicted	75 [68-83]	76 [68-84]	0.399	0.657
Peak Power Output, Watt	103 [77-129]	106 [79-130]	0.354	0.607
Peak Respiratory Quotient	1.10 [1.05-1.17]	1.13 [1.07-1.19]	0.007	0.065
Peak PetCO ₂ , mmHg	37 [35-40]	38 [35-40]	0.521	0.744
Peak Minute Ventilation, L/min	53 [43-65]	52 [41-64]	0.181	0.413
Peak Respiratory Rate, breaths/min	30 [26-34]	28 [24-32]	0.005	0.065
VE/VCO ₂ slope	25.0 [23.0-26.3]	25.8 [24.1-27.0]	<0.001	<0.001

Y – Intercept	6.40 [5.50-7.40]	3.70 [2.90-4.30]	<0.001	<0.001
VO ₂ /work slope, mL/min/W	10.5 [9.4-11.5]	10.4 [9.4-11.4]	0.525	0.744
Pulmonary Function				
FEV ₁ , L	2.20 [1.72-2.83]**	2.42 [1.87-3.05]**	0.055	0.187
FEV ₁ , % predicted	79 (20)**	83 (21)**	0.105	0.296
FVC, L	2.99 [2.39-3.82]**	3.24 [2.54-3.92]**	0.256	0.507
FVC, % predicted	85 (18)**	87 (19)**	0.471	0.700
Laboratory Values				
Serum Creatinine, mg/dL	1.00 [0.86-1.20]	1.00 [0.88-1.16]	0.914	0.972
BNP, pg/mL	138 [55-274]*	105 [57-215]**	0.358	0.607
NT-proBNP, pg/mL	683 [172-1529]**	347 [113-924]**	0.102	0.296
Hemoglobin, g/dL	14.4 [13.4-15.4]	14.2 [13.0-15.0]	0.010	0.074
Electrocardiography / Device therapy				
Atrial Fibrillation, n (%)	42 (13)	35 (11)	0.451	0.691
ICD, n (%)	119 (36)	98 (30)	0.082	0.260
CRT, n (%)	39 (12)	29 (9)	0.247	0.501
Pharmacological Therapy				
β-Blocker, n (%)	295 (88)	308 (93)	0.052	0.187
RAAS – Inhibitor, n (%)	310 (93)	309 (93)	0.882	0.882

Diuretics, n (%)	216 (64)	206 (62)	0.554	0.762
Statin use, n (%)	140 (42)	143 (43)	0.807	0.914
Mineralocorticoid Receptor Antagonist, n (%)	185 (55)	181 (55)	0.870	0.936
Digitalis, n (%)	19 (6)	15 (5)	0.605	0.816
Amiodarone, n (%)	98 (29)	81 (24)	0.188	0.413

Supplemental Table 2: Comparison of patient characteristics between C1 (high y-intercept) and C2 (low y-intercept) subgroups. Continuous variables are presented as median [IQR], and categorical variables as counts (percentages). Group comparisons were performed using the Mann–Whitney U test for continuous variables and Fisher’s exact test for categorical variables. To correct for multiple testing, Benjamini–Hochberg false discovery rate adjustment was used. The Benjamini–Hochberg procedure was applied to adjust for multiple testing. Abbreviations: ACE = angiotensin-converting enzyme; AF = atrial fibrillation;; BNP = B-type natriuretic peptide; bpm = beats per minute; CRT = cardiac resynchronization therapy; FDR = false discovery rate; FEV₁ = forced expiratory volume in 1 second; FVC = forced vital capacity; ICD = implantable cardioverter defibrillator; LAH = left anterior hemiblock; LBBB = left bundle branch block; LVEF = left ventricular ejection fraction; NT-proBNP = N-terminal pro-BNP; NYHA = New York Heart Association; PAP = pulmonary artery pressure; PetCO₂ = partial pressure of end-tidal CO₂; RBBB = right bundle branch block; VCO₂ = carbon dioxide production; VE = minute ventilation; VO₂ = oxygen uptake.

*>30% missing **>50% missing †FDR-adjusted p-value based on the Benjamin–Hochberg procedure.