Supplementary material

Table S1. Baseline demographic and clinical characteristics of the patients with severe low-gradient aortic stenosis with preserved left ventricular ejection fraction in transthoracic echocardiography (n = 102) and after reclassification to pseudo-severe (n = 16) and true-severe (n = 86) aortic stenosis groups using planimetry of aortic valve area in transoesophageal echocardiography

Demographic and clinical characteristics	Severe LG AS pEF in 2D-TTE (n = 102)	Pseudo-severe LG AS pEF in 2D-TOE (n = 16)	True-severe LG AS pEF in 2D-TOE (n = 86)	*P*-value
Age, mean (SD)	75.3 (9.2)	74.6 (9.3)	75.4 (9.2)	0.76
Sex, female, n (%)	65 (63.7)	11 (68.7)	54 (62.8)	0.65
Height, cm, mean (SD)	164 (9.0)	163 (8.0)	164 (9.0)	0.80
Weight, kg, mean (SD)	77.9 (16.4)	74.9 (16.6)	78.5 (16.4)	0.43
Body surface area, m², mean (SD)	1.87 (0.23)	1.83 (0.24)	1.88 (0.23)	0.45
Body mass index, kg/m², mean (SD)	29.0 (5.7)	28.0 (5.6)	29.2 (5.7)	0.45
EuroSCORE II, %, median (IQR)	2.66 (1.56-4.79)	1.80 (1.47-3.22)	2.98 (1.61-6.0)	0.08
NYHA class III and IV, n (%)	49 (48.0)	4 (25.0)	45 (52.3)	0.045
Hypertension, n (%)	76 (74.5)	12 (75.0)	64 (74.4)	1.00

Dyslipidaemia, n (%)	41 (40.2)	6 (37.5)	35 (40.7)	0.81
Diabetes mellitus, n (%)	28 (27.4)	4 (25.0)	24 (27.9)	1.00
Coronary artery disease, n (%)	65 (63.7)	7 (43.7)	58 (67.4)	0.07
Coronary artery bypass grafting, n (%)	15 (14.7)	1 (6.2)	14 (16.3)	0.46
COPD, n (%)	14 (13.7)	3 (18.7)	11 (12.8)	0.46
Asthma, n (%)	7 (6.9)	2 (12.5)	5 (5.8)	0.30
Permanent atrial fibrillation, n (%)	26 (25.5)	6 (37.5)	20 (23.3)	0.45
Permanent pacemaker, n (%)	13 (12.7)	0 (0)	13 (15.1)	0.21
Acute ischemic stroke, n (%)	8 (7.8)	1 (6.2)	7 (8.1)	1.00
Anaemia, n (%)	31 (30.7)	3 (18.7)	28 (32.9)	0.38
Chronic kidney disease, n (%)	47 (46.1)	8 (50.0)	39 (45.4)	0.73
Hemoglobin level, g/dl, mean (SD)	13.1 (1.48)	13.2 (1.5)	13.1 (1.5)	0.73
Creatinine level, mg/dl, median (IQR)	1.02 (0.82-1.23)	1.02 (0.89-1.19)	1.02 (0.81-1.24)	0.90
Cardiac troponin T, ng/l, median (IQR)	24.9 (11.3-49.4)	28.1 (13.2-41.6)	23.1 (11.3-49.4)	0.91
NT-proBNP, pg/ml, median (IQR)	631 (294-1345)	1595 (707-2482)	607 (280-1204)	0.11

Abbreviations: BMI, body mass index, COPD, chronic obstructive pulmonary disease; EurSCORE, European System for Cardiac Operative Risk Evaluation; IQR, interquartile range; NT-proBNP, N-terminal prohormone of brain natriuretic peptide; NYHA, New York Heart Association

Table S2. Baseline echocardiographic data of the patients with severe low-gradient aortic stenosis with preserved left ventricular ejection fraction in transthoracic echocardiography (n = 102) and after reclassification to pseudo-severe (n = 16) and true-severe (n = 86) aortic stenosis groups using planimetry of aortic valve area in transoesophageal echocardiography

Characteristic	Severe LG AS pEF in 2D-TTE (n = 102)	Pseudo-severe LG AS pEF in 2D-TOE (n = 16)	True-severe LG AS pEF in 2D-TOE (n = 86)	*P*-value
Data from transthoracic echocardiography				
Heart rate and rhythm				
Heart rate, bpm, mean (SD)	66.3 (10.0)	67.6 (8.8)	66.1 (10.3)	0.59
Permanent atrial fibrillation, n (%)	26 (25.5)	6 (37.5)	20 (23.3)	0.23
Chamber quantification – LV, RV, LA, RA				
LVDD, mm, mean (SD)	42.9 (5.8)	44.1 (7.5)	42.6 (5.5)	0.37
LVDDi, mm/m², mean (SD)	23.1 (3.3)	24.2 (4.3)	22.8 (3.1)	0.13
LVSD, mm, mean (SD)	28.1 (5.8)	28.8 (7.1)	27.9 (5.6)	0.59
LVSDi, mm/m², mean (SD)	15.1 (3.1)	15.7 (4.0)	14.9 (3.0)	0.41
LVEF Simpson's BP, %, mean (SD)	66.1 (7.7)	64.3 (9.5)	66.5 (7.4)	0.30
IVSd, mm, mean (SD)	13.2 (2.2)	12.8 (2.6)	13.2 (2.1)	0.49
LVPWD, mm, mean (SD)	11.7 (1.5)	11.7 (1.7)	11.7 (1.4)	0.97
RVIT, mm, mean (SD)	34.8 (5.2)	35.5 (4.7)	34.6 (5.3)	0.55
TAPSE, mm, mean (SD)	22.4 (4.2)	23.3 (4.1)	22.2 (6.0)	0.41
LA volume index, ml/m², mean (SD)	37.5 (12.9)	39.4 (17.8)	37.1 (11.9)	0.63

RA area, cm², mean (SD)	18.6 (5.3)	18.8 (6.1)	18.6 (5.1)	0.84
Chamber quantification – aortic root complex and ascending aorta diameters				
LVOT, mm, median (IQR)	21 (20-22)	21 (20-22)	21 (20-23)	0.49
Aortic annulus, mm, median (IQR)	22 (21-23)	22 (21-23)	22 (21-24)	0.38
Aortic bulb, mm, median (IQR)	32.5 (30-35)	31 (29-33)	33 (30-35)	0.10
STJ, mm, median (IQR)	27 (25-30)	27 (24.5-29)	28 (25-30)	0.19
STJ <30 mm, n (%)	70 (68.6)	14 (87.5)	56 (65.1)	0.076
Ascending aorta, mm, median (IQR)	36 (33.5-38.5)	37 (34.5-42)	35.5 (33-38)	0.20
RV and RA pressures				
RA pressure, mm Hg, mean (SD)	6.10 (4.3)	6.4 (4.3)	6.1 (4.3)	0.85
RVSP, mmHg, median (IQR)	37.8 (30.0-45.0)	40 (33-48)	37 (29.5-44.0)	0.21
AV and LVOT continuous and pulsed wave Doppler data				
Peak aortic velocity, m/s, mean (SD)	3.56 (0.41)	3.31 (0.50)	3.60 (0.38)	0.008
Mean AV gradient, mm Hg, mean (SD)	29.5 (6.5)	25.0 (6.7)	30.4 (6.1)	0.002
VTI AV, cm, mean (SD)	84.5 (13.9)	77.8 (14.5)	85.8 (13.5)	0.034
VTI LVOT, cm, mean (SD)	20.1 (4.7)	20.8 (3.8)	20 (4.9)	0.50
LV stroke volume and flow Doppler calculations				
SV, ml, mean (SD)	71.3 (16.2)	71.7 (14.3)	71.2 (16.6)	0.90
SVi, ml/m², mean (SD)	38.4 (9.3)	39.6 (8.6)	38.2 (9.5)	0.57
SVi <35 ml/m², n (%)	35 (34.3)	4 (25.0)	31 (36.1)	0.39
Calculated parameters of aortic stenosis severity				

AVA [by CE], cm², mean (SD)	0.84 (0.13)	0.92 (0.10)	0.82 (0.13)	0.006
AVAi, cm²/m², mean (SD)	0.45 (0.08)	0.51 (0.07)	0.44 (0.08)	0.004
DVI, mean (SD)	0.24 (0.05)	0.27 (0.06)	0.23 (0.05)	0.003
ELCo [for all patients], cm², mean (SD)	0.99 (0.17)	1.12 (0.17)	0.96 (0.16)	< 0.001
ELCo [for STJ < 30 mm], cm², mean (SD)	1.0 (0.19)	1.16 (0.11)	0.96 (0.18)	< 0.001
ELI [for STJ < 30 mm], cm²/m², mean (SD)	0.55 (0.12)	0.64 (0.11)	0.53 (0.11)	0.001
Data from 2D transoesophageal echocardiography				
AVA [by planimetry], cm², mean (SD)	0.91 (0.15)	1.15 (0.10)	0.87 (0.11)	< 0.001
Bicuspid AV, n (%)	26 (25.5)	3 (18.7)	23 (26.7)	0.75

Abbreviations: BP, biplane method; IVSd, interventricular septum in diastole, LA, left atrium/atrial; LVPWD, LV posterior wall end-diastolic diameter; LVSD, left ventricular end-systolic diameter; LVSDi, indexed LVSD; RA, right atrium/atrial; RV, right ventricle/ventricular; RVIT, RV inflow tract; RVSP, RV systolic pressure; TAPSE, tricuspid annular plane systolic excursion

Table S3. Baseline demographic and clinical characteristics of patients with AVA by planimetry in 2D-TEE ≤1.0 cm² and SVi <35 ml/m² (Group 1; n = 26), AVA by planimetry in 2D-TEE >1.0 cm² and SVi < 35 ml/m² (Group 2; n = 9), AVA by planimetry in 2D-TEE ≤1.0 cm² and SVi ≥35 ml/m² (Group 3; n = 31) and AVA by planimetry in 2D-TEE >1.0 cm² and SVi ≥35 ml/m² (Group 4; n = 35)

	SVi < 35 ml/m²		SVi ≥ 35 ml/m²		
Demographic and clinical characteristics	**AVAPlaniTOE** ≤1.0 cm² (n = 26)	**AVAPlaniTOE** >1.0 cm² (n = 9)	**AVAPlaniTO** ≤1.0 cm² (n = 31)	**AVAPlaniTOE** >1.0 cm² (n = 35)	*P*-value

Age, mean (SD)	75.9 (9.3)	74.9 (6.8)	76.8 (9.7)	73.6 (9.2)	0.53
Sex, female, n (%)	16 (61.5)	7 (77.8)	22 (71.0)	20 (55.6)	0.46
Height, cm, mean (SD)	165 (9)	161 (7)	162 (9)	165 (10)	0.33
Weight, kg, mean (SD)	79.9 (16.3)	85.9 (16.4)	72.4 (15.4)	79.2 (16.6)	0.103
Body surface area, m², mean (SD)	1.90 (0.21)	1.95 (0.19)	1.80 (0.25)	1.90 (0.25)	0.15
Body mass index, kg/m², mean (SD)	29.5 (6.3)	33.4 (7.1)	27.6 (5.3)	28.8 (4.7)	0.053
EuroSCORE II, %, median (IQR)	3.00 (1.61-7.63)	2.30 (1.87-3.66)	2.98 (1.74–6.47)	2.75 (1.42 -3.7)	0.52
NYHA class III and IV, n (%)	15 (57.7)	6 (66.7)	13 (41.9)	15 (41.7)	0.36
Hypertension, n (%)	17 (65.4)	9 (100)	24 (77.4)	26 (72.2)	0.22
Dyslipidaemia, n (%)	10 (38.5)	4 (44.4)	14 (45.2)	13 (36.1)	0.88
Diabetes mellitus, n (%)	9 (34.6)	4 (44.4)	5 (16.1)	10 (27.8)	0.27
Coronary artery disease, n (%)	19 (73.1)	5 (55.6)	18 (58.1)	23 (63.9)	0.65
Coronary artery bypass grafting, n (%)	5 (19.3)	2 (22.2)	4 (12.9)	4 (11.1)	0.74
COPD, n (%)	4 (15.4)	1 (11.1)	2 (6.4)	7 (19.4)	0.48
Asthma, n (%)	0 (0)	1 (11.1)	1 (3.2)	5 (13.9)	0.14
Permanent pacemaker, n (%)	7 (26.9)	1 (11.1)	3 (9.7)	2 (5.6)	0.086
Acute ischemic stroke, n (%)	3 (11.5)	0 (0)	3 (9.7)	2 (5.6)	0.65
Anaemia, n (%)	7 (26.9)	2 (22.2)	9 (30.0)	13 (36.1)	0.81
Chronic kidney disease, n (%)	15 (57.7)	4 (44.4)	14 (45.2)	14 (38.9)	0.54
Haemoglobin level, g/dl, mean (SD)	13.0 (1.7)	13.4 (1.5)	13.0 (1.4)	13.2 (1.4)	0.86
Creatinine level, mg/dl, median (IQR)	1.11 (0.90-1.40)	1.02 (0.88-1.27)	1.03 (0.82-1.18)	0.91 (0.76-1.19)	0.28

Cardiac troponin T level, ng/l, median (IQR)	36.5 (13.5-62.2)	25.8 (15.0-30,6)	14.5 (10.9-36.1)	17.0 (8.9-56.4)	0.56
NTproBNP level, pg/ml, median (IQR)	684 (607-1486)	2115 (342-2401)	529 (308 -634)	505 (180-975)	0.59

Abbreviations: see Table S1

Table S4. Baseline echocardiographic data of patients with AVA by planimetry in 2D-TEE ≤1.0 cm² and SVi <35 ml/m² (Group 1; n = 26), AVA by planimetry in 2D-TEE >1.0 cm² and SVi <35 ml/m² (Group 2; n = 9), AVA by planimetry in 2D-TEE ≤1.0 cm² and SVi ≥35 ml/m² (Group 3; n = 31) and AVA by planimetry in 2D-TEE >1.0 cm² and SVi ≥35 ml/m² (Group 4; n = 35)

	SVI < 35 ml/m²		SVI ≥ 35 ml/m²		*P*-value	
Characteristics	**AVA TEE ≤1.0 cm² n = 26**	**AVA TEE >1.0 cm² n = 9**	**AVA TEE ≤1.0 cm² n = 31**	**AVA TEE >1.0 cm² n = 35**		
	Group 1	**Group 2**	**Group 3**	**Group 4**		
Data from transthoracic echocardiography						
Heart rate						
Heart rate, bpm, mean (SD)	70.9 (9.1)	78.9 (10.1)	62.0 (6.2)	63.7 (9.8)	<0.001	G1 vs G2: 0.089 G1 vs G3: 0.001 G1 vs G4: 0.011 G2 vs G3: <0.001 G2 vs G4: <0.001 G3 vs G4: 0.836

Chamber quantification – LV, RV, LA, RA					
LVDD, mm, mean (SD)	43.6 (6.2)	44.0 (3.5)	42.0 (5.6)	42.7 (6.3)	0.71	
LVDDi, mm/m², mean (SD)	23.1 (3.5)	22.7 (2.2)	23.7 (3.8)	22.6 (2.9)	0.62	
LVSD, mm, mean (SD)	30.4 (5.2)	30.0 (4.6)	26.7 (5.3)	27.1 (6.4)	0.045	G1 vs G3: 0.077
LVSDi, mm/m², mean (SD)	16.1 (3.0)	15.5 (2.7)	15.0 (3.3)	14.3 (3.1)	0.15	
LVEF Simpson's BP, %, mean (SD)	62.4 (7.7)	63.7 (5.1)	67.4 (7.6)	68.4 (7.5)	0.011	G1 vs G3: 0.062 G1 vs G4: 0.013
IVSd, mm, mean (SD)	12.6 (1.9)	13.6 (2.8)	13.0 (2.2)	13.6 (2.1)	0.35	
LVPWD, mm, mean (SD)	11.4 (1.4)	12.2 (2.2)	11.3 (0.9)	12.0 (1.7)	0.16	
RVIT, mm, mean (SD)	35.0 (5.4)	37.5 (6.1)	33.8 (4.4)	34.9 (5.4)	0.35	
TAPSE, mm, mean (SD)	20.6 (3.7)	19.6 (5.5)	22.6 (3.4)	24.2 (3.9)	0.007	G1 vs G4: 0.021 G2 vs G4: 0.033
LA volume index, ml/m², mean (SD)	42.4 (12.5)	40.9 (15.7)	36.6 (15.0)	33.8 (9.1)	0.065	
RA area, cm², mean (SD)	20.2 (6.5)	21.6 (4.9)	17.6 (4.8)	17.5 (4.3)	0.046	G1 vs G4: 0.192 G2 vs G3: 0.175 G2 vs G4: 0.142
Chamber quantification – aortic root complex and ascending aorta diameters					
LVOT, mm, median (IQR)	20.5 (20.0-21.0)	21.0 (20.0-22.0)	21.0 (20.0-22.0)	22.0 (21.0-23.0)	0.020	G1 vs G4: 0.020 G3 vs G4: 0.099
Aortic annulus, mm, median (IQR)	22.0 (21.0-22.0)	22.0 (21.0-23.0)	22.0 (21.0-23.0)	23.0 (22.0-24.5)	0.032	G1 vs G4: 0.029 G3 vs G4: 0.150

Aortic bulb, mm, median (IQR)	32.0 (30.0-35.0)	33.0 (29.0-35.0)	31.0 (29.0-33.0)	33.0 (30.0-35.0)	0.49	
STJ, mm, median (IQR)	27.5 (25.0-30.0)	30.0 (25.0-30.0)	27.0 (25.0-32.0)	27.5 (26.0-29.0)	0.95	
STJ <30 mm, n (%)	18 (69.2)	4 (44.4)	19 (61.3)	29 (80.6)	0.14	
Ascending aorta, mm, median (IQR)	35.0 (33.0-43.0)	38 (34.0-41.0)	35 (33.0-38.0)	36 (34.0-39.0)	0.78	
AV and LVOT continuous and pulsed wave Doppler data						
Peak aortic velocity, m/s, mean (SD)	3.40 (0.42)	3.03 (0.49)	3.74 (0.25)	3.65 (0.36)	<0.001	G1 vs G2: 0.053 G1 vs G3: 0.003 G1 vs G4: 0.036 G2 vs G3: <0.001 G2 vs G4: <0.001
Mean AV gradient, mmHg, mean (SD)	27.1 (6.3)	22.5 (7.8)	31.8 (4.4)	31.1 (6.1)	<0.001	G1 vs G2: 0.196 G1 vs G3: 0.015 G1 vs G4: 0.043 G2 vs G3: <0.001 G2 vs G4: <0.001
VTI AV, cm, mean (SD)	76.6 (10.9)	61.4 (9.7)	93.0 (8.9)	88.7 (10.7)	<0.001	G1 vs G2: 0.001 G1 vs G3: <0.001 G1 vs G4: <0.001

						G2 vs G3: <0.001
						G2 vs G4: <0.001
VTI LVOT, cm, mean (SD)	16.1 (3.4)	17.7 (3.2)	21.5 (4.4)	22.4 (4.2)	<0.001	G1 vs G2: 0.731 G1 vs G3: <0.001 G1 vs G4: <0.001 G2 vs G3: 0.060 G2 vs G4: 0.011 G3 vs G4: 0.806
LV stroke volume and flow Doppler calculations						
SV, ml, mean (SD)	53.1 (9.1)	59.6 (10.3)	74.3 (8.9)	84.8 (11.4)	<0.001	G1 vs G3:<0.001 G1 vs G4:<0.001 G2 vs G3: 0.001 G2 vs G4:<0.001 G3 vs G4:<0.001
SVi, ml/m², mean (SD)	30.0 (4.0)	30.5 (3.7)	41.7 (5.6)	45.1 (7.4)	<0.001	G1 vs G3:<0.001 G1 vs G4:<0.001 G2 vs G3: 0.001 G2 vs G4:<0.001 G3 vs G4: 0.082
SVi <35 ml/m² n (%)	26 (100)	9 (100)	0 (0)	0 (0)		
Calculated parameters of aortic stenosis severity						

AVA [by CE], cm², mean (SD)	0.70 (0.11)	0.97 (0.05)	0.79 (0.05)	0.95 (0.06)	<0.001	All P <0.001 but G2 vs G4: 0.887
AVAi, cm²/m², mean (SD)	0.37 (0.05)	0.50 (0.06)	0.45 (0.06)	0.51 (0.08)	<0.001	G1 vs G2, G3, G4 P <0.001 G3 vs G4: P <0.001 G2 vs G3: 0.106 G2 vs G4: 0.990
DVI, mean (SD)	0.21 (0.04)	0.29 (0.06)	0.23 (0.04)	0.25 (0.05)	<0.001	G1 vs G2: <0.001 G1 vs G4: 0.002 G2 vs G3: 0.003 G2 vs G4:0.110 G3 vs G4: 0.174
ELCo [for all patients], cm², mean (SD)	0.80 13.15)	1.17 (0.12)	0.91 (0.06)	1.14 (0.08)	<0.001	All P <0.001 but G2 vs G4: 0.687
ELCo [for STJ <30 mm], cm², mean (SD)	0.79 (0.14)	1.27 (0.12)	0.92 (0.06)	1.14 (0.08)	<0.001	G1 vs G2: <0.001 G1 vs G3: <0.001 G1 vs G4: 0.002 G2 vs G3: 0.003 G2 vs G4: 0.083

						G3 vs G4: <0.001
ELI [for STJ <30 mm], cm^2/m^2, mean (SD)	0.42 (0.06)	0.65 (0.08)	0.53 (0.06)	0.62 (0.10)	<0.001	G1 vs G2: <0.001 G1 vs G3: <0.001 G1 vs G4: 0.002 G2 vs G3: 0.058 G2 vs G4: 0.938 G3 vs G4: 0.002
Data from 2D transesophageal echocardiography						
AVA by planimetry, cm^2, mean (SD)	0.86 (0.13)	0.96 (0.12)	0.89 (0.14)	0.96 (0.17)	0.032	G1 vs G4: 0.040
Bicuspid AV, n (%)	7 (26.9)	3 (33.3)	7 (22.6)	9 (25.0)	0.93	

Abbreviations: see Table S2, except G for group

Table S5. Baseline demographic and clinical characteristics of patients with severe low-gradient aortic stenosis with preserved left ventricular ejection fraction in transthoracic echocardiography (n = 102) with normal-flow (indexed stroke volume ≥35 ml/m^2) (n = 67) and low-flow (n = 35)

Demographic and clinical characteristics	NF LG AS pEF (SVi≥35 ml/m^2) (n = 67)	LF LG AS pEF (SVi <35ml/m^2) (n = 35)	*P*-value
Age, mean (SD)	75.1 (9.5)	75.6 (8.6)	0.78
Sex, female, n (%)	23 (65.7)	42 (62.7)	0.76
Height, cm, mean (SD)	164 (10)	164 (8)	0.98

Weight, kg, mean (SD)	76.1 (16.3)	81.4 (16.3)	0.12
Body surface area, m², mean (SD)	1.85 (0.24)	1.92 (0.21)	0.19
Body mass index, kg/m², mean (SD)	28.2 (5.0)	30.5 (6.6)	0.080
EuroSCORE II, %, median (IQR)	2.93 (1.48-4.38)	2.53 (1.61-7.63)	0.35
NYHA class III and IV, n (%)	28 (41.8)	21 (60.0)	0.080
Hypertension, n (%)	50 (74.6)	26 (74.3)	0.97
Dyslipidaemia, n (%)	27 (40.3)	14 (40.0)	0.98
Diabetes mellitus, n (%)	15 (22.4)	13 (37.1)	0.11
Coronary artery disease, n (%)	41 (61.2)	24 (68.6)	0.46
CABG, n (%)	8 (11.9)	7 (20.0)	0.28
COPD, n (%)	9 (13.4)	5 (14.3)	1.00
Asthma, n (%)	6 (9.0)	1 (2.9)	0.42
Permanent atrial fibrillation, n (%)	8 (11.9)	18 (51.4)	< 0.001
Permanent pacemaker, n (%)	5 (7.5)	8 (22.9)	0.056
Acute ischemic stroke, n (%)	5 (7.5)	3 (8.6)	0.84
Anaemia, n (%)	22 (33.3)	9 (25.7)	0.43
Chronic kidney disease, n (%)	28 (41.8)	19 (54.3)	0.23
Haemoglobin level, g/dl, mean (SD)	13.1 (1.4)	13.1 (1.7)	0.95
Creatinine level, mg/dl, median (IQR)	0.98 (0.80-1.19)	1.10 (0.88-1.40)	0.080
Cardiac troponin T level, ng/l, median (IQR)	16.4 (10.7-43.6)	26.1 (13.5-62.2)	0.20
NTproBNP level, pg/ml, median (IQR)	529 (264-788)	835 (342-2115)	0.21

Abbreviations: see Table S1

Table S6. Baseline echocardiographic data and aortic valve calcium score of patients with severe low-gradient aortic stenosis with preserved left ventricular ejection fraction in transthoracic echocardiography (n = 102) with normal-flow (indexed stroke volume ≥35 ml/m^2) (n = 67) and low-flow (n = 35)

Characteristics	NF LG AS pEF (SVi≥35 ml/m^2) (n = 67)	LF LG AS pEF (SVi <35ml/m^2) (n = 35)	*P*-value
Data from transthoracic echocardiography			
Heart rate and rhythm			
Heart rate, bpm, mean (SD)	62.9 (8.3)	73.0 (9.9)	< 0.001
Permanent AFib, n (%)	8 (11.9)	18 (51.4)	< 0.001
Chamber quantification – LV, RV, LA, RA			
LVDD, mm, mean (SD)	42.4 (6.0)	43.7 (5.6)	0.29
LVDDi, mm/m², mean (SD)	23.1 (3.4)	23.0 (3.2)	0.87
LVSD, mm, mean (SD)	26.9 (5.9)	30.3 (5.0)	0.005
LVSDi, mm/m², mean (SD)	14.6 (3.2)	15.9 (2.9)	0.04
LVEF Simpson's BP, %, mean (SD)	67.9 (7.5)	62.7 (7.1)	0.001
IVSd, mm, mean (SD)	13.3 (2.1)	12.9 (2.2)	0.31
LVPWD, mm, mean (SD)	11.7 (1.4)	11.6 (1.65)	0.82

RVIT, mm, mean (SD)	34.4 (5.0)	35.6 (5.6)	0.27
TAPSE, mm, mean (SD)	23.5 (3.7)	20.3 (4.2)	0.002
LA volume index, ml/m², mean (SD)	35.1 (12.2)	42.0 (13.2)	0.012
RA area, cm², mean (SD)	17.5 (4.5)	20.5 (6.1)	0.013
Chamber quantification – aortic root complex and ascending aorta diameters			
LVOT, mm, median (IQR)	21 (20-23)	21 (20-22)	0.032
Aortic annulus, mm, median (IQR)	23 (21-24)	22 (21-23)	0.038
Aortic bulb, mm, median (IQR)	33 (30-35)	32 (30-35)	0.70
STJ, mm, median (IQR)	27 (26-30)	28 (25-30)	0.73
STJ < 30, mm, n (%)	48 (71.6)	22 (62.9)	0.36
Ascending aorta, mm, median (IQR)	36 (34.0-38.0)	36.5 (33.0-41.5)	0.62
RV and RA pressures			
RA pressure, mm Hg, mean (SD)	5.6 (3.7)	6.9 (5.1)	0.27
RVSP, mmHg, median (IQR)	37.8 (29.0-43.0)	37.5 (31.5-46.5)	0.42
AV and LVOT continuous and pulsed wave Doppler data			
Peak aortic velocity, m/s, mean (SD)	3.69 (0.32)	3.30 (0.46)	< 0.001
Mean AV gradient, mm Hg, mean (SD)	31.4 (5.3)	25.9 (6.9)	< 0.001
VTI AV, cm, mean (SD)	90.7 (10.1)	72.7 (12.4)	< 0.001
VTI LVOT, cm, mean (SD)	22.0 (4.3)	16.5 (3.3)	< 0.001
LV stroke volume and flow Doppler calculations			
SV, ml, mean (SD)	79.9 (11.5)	54.7 (9.7)	< 0.001

SVi, ml/m², mean (SD)	43.6 (6.8)	28.6 (4.0)	< 0.001
Calculated parameters of aortic stenosis severity			
AVA [by CE], cm², mean (SD)	0.87 (0.10)	0.77 (0.15)	< 0.001
AVAi, cm²/m², mean (SD)	0.48 (0.07)	0.40 (0.08)	< 0.001
DVI, mean (SD)	0.24 (0.05)	0.23 (0.06)	0.28
ELCo [for all patients], cm², mean (SD)	1.03 (0.13)	0.90 (0.21)	0.001
ELCo [for STJ < 30 mm], cm², mean (SD)	1.05 (0.13)	0.88 (0.23)	0.002
ELI [for STJ < 30 mm], cm²/m², mean (SD)	0.59 (0.10)	0.46 (0.11)	< 0.001
Data from 2D transesophageal echocardiography			
AVA [by planimetry], cm², mean (SD)	0.93 (0.16)	0.89 (0.14)	0.18
Bicuspid AV, n (%)	16 (23.9)	10 (28.6)	0.61

Abbreviations: see Table S2

Table S7. Baseline demographic and clinical characteristics of patients with severe low-gradient aortic stenosis with preserved left ventricular ejection fraction in transthoracic echocardiography (n = 102) with normal sinus rhythm (n = 76) and permanent atrial fibrillation (n = 26)

Demographic and clinical characteristics	Normal sinus rhythm (n = 76)	Atrial fibrillation (n = 26)	*P*-value
Age, mean (SD)	74.7 (9.9)	76.8 (6.6)	0.33
Sex, female, n (%)	48 (63.2)	17 (63.4)	0.84
Height, cm, mean (SD)	164 (9)	164 (11)	0.92
Weight, kg, mean (SD)	77.8 (16.8)	78.3 (15.5)	0.90
Body surface area, m², mean (SD)	1.87 (0.24)	1.88 (0.22)	0.88
Body mass index, kg/m², mean (SD)	28.9 (5.6)	29.2 (5.7)	0.83
EuroSCORE II, %, median (IQR)	2.58 (1.56-4.36)	3.29 (1.63-8.14)	0.24
NYHA class III and IV, n (%)	32 (25.0)	17 (65.4)	0.04
Hypertension, n (%)	56 (73.7)	20 (76.9)	0.74
Dyslipidaemia, n (%)	30 (39.5)	11 (42.3)	0.78
Diabetes mellitus, n (%)	19 (25.0)	9 (34.6)	0.34
Coronary artery disease, n (%)	46 (60.5)	19 (73.1)	0.25
Coronary artery bypass grafting, n (%)	9 (11.8)	6 (23.1)	0.20
COPD, n (%)	10 (13.2)	4 (15.4)	0.75
Asthma, n (%)	5 (6.6)	2 (7.7)	1.00
Permanent pacemaker, n (%)	9 (11.8)	4 (15.4)	0.74
Acute ischemic stroke, n (%)	2 (2.6)	6 (23.1)	0.003
Anaemia, n (%)	23 (30.7)	8 (30.8)	0.99
Chronic kidney disease, n (%)	34 (44.7)	13 (50.0)	0.64
Haemoglobin level, g/dl, mean (SD)	13.1 (1.5)	13.1 (1.4)	0.85
Creatinine level, mg/dl, median (IQR)	0.95 (0.80-1.20)	1.12 (0.88-1.40)	0.095
Cardiac troponin T level, ng/l, median (IQR)	15.9 (10.5-41.6)	28.3 (20.1-76.8)	0.027

NTproBNP level, pg/ml, median (IQR)	607 (264-788)	1816 (634-2563)	0.017

Abbreviations: see Table S1

Table S8. Baseline echocardiographic data of patients with severe low-gradient aortic stenosis with preserved left ventricular ejection fraction in transthoracic echocardiography (n = 102) with normal sinus rhythm (n = 76) and permanent atrial fibrillation (n = 26)

Characteristics	Normal sinus rhythm (n = 76)	Atrial fibrillation (n = 26)	*P*-value
Data from transthoracic echocardiography			
Heart rate			
Heart rate, bpm, mean (SD)	63.0 (7.6)	75.8 (10.3)	< 0.001
Chamber quantification – LV, RV, LA, RA			
LVDD, mm, mean (SD)	42.7 (6.1)	43.4 (5.0)	0.57
LVDDi, mm/m², mean (SD)	22.9 (2.8)	23.4 (4.4)	0.57
LVSD, mm, mean (SD)	27.5 (5.9)	29.6 (5.2)	0.13
LVSDi, mm/m², mean (SD)	14.7 (2.9)	16.0 (3.6)	0.089
LVEF Simpson's BP, %, mean (SD)	67.7 (7.2)	61.7 (7.6)	< 0.001
IVSd, mm, mean (SD)	13.0 (1.9)	13.7 (2.8)	0.20
LVPWD, mm, mean (SD)	11.7 (1.4)	11.7 (1.8)	0.83
RVIT, mm, mean (SD)	34.3 (5.2)	36.1 (5.0)	0.14
TAPSE, mm, mean (SD)	23.1 (3.9)	19.6 (3.9)	0.005
LA volume index, ml/m², mean (SD)	33.1 (9.4)	49.8 (13.7)	< 0.001
RA area, cm², mean (SD)	16.9 (4.3)	23.4 (4.9)	< 0.001
Chamber quantification – aortic root complex and ascending aorta diameters			
LVOT, mm, median (IQR)	21.0 (20.0-22.5)	20.5 (20.0-22.0)	0.31
Aortic annulus, mm, median (IQR)	22 (21-23.5)	22 (21.0-23.0)	0.36
Aortic bulb, mm, median (IQR)	32.5 (30-35)	32.5 (30-35)	0.92
STJ, mm, median (IQR)	27.5 (26-30)	27 (25-30)	0.73
STJ <30 mm, n (%)	52 (68.4)	18 (69.2)	0.94
Ascending aorta, mm, median (IQR)	35.5 (34-38)	37 (32-42)	0.58

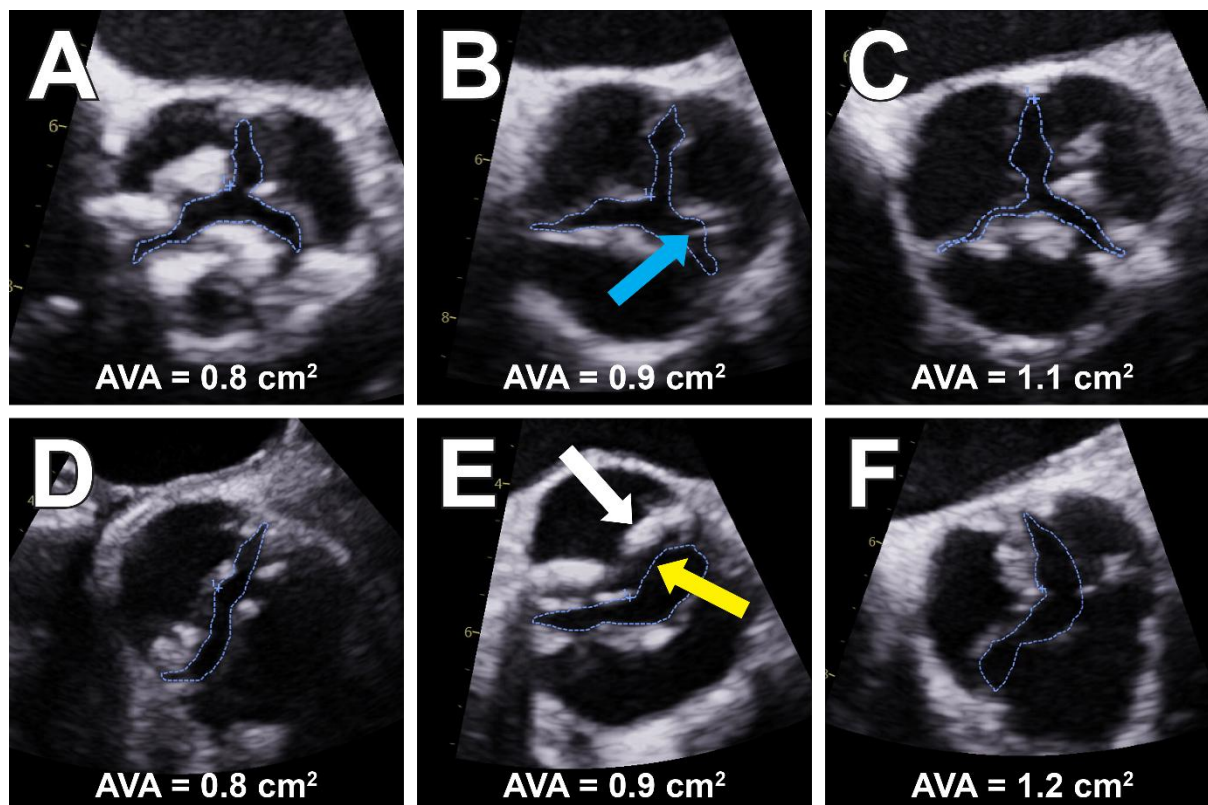| RV and RA pressures			
RA pressure, mm Hg, mean (SD)	6.1 (4.1)	6.1 (4.9)	0.96
RVSP, mmHg, median (IQR)	37 (29-43)	39 (31.5-57.0)	0.21
AV and LVOT continuous and pulsed wave Doppler data			
Peak aortic velocity, m/s, mean (SD)	3.64 (0.34)	3.31 (0.52)	< 0.001
Mean AV gradient, mmHg, mean (SD)	30.6 (5.4)	26.5 (8.2)	0.023
VTI AV, cm, mean (SD)	89.5 (10.7)	70.0 (12.0)	<0.001
VTI LVOT, cm, mean (SD)	21.2 (4.5)	16.8 (3.9)	< 0.001
LV stroke volume and flow Doppler calculations			
SV, ml, mean (SD)	76.0 (14.3)	57.6 (13.6)	< 0.001
SVi, ml/m², mean (SD)	41.0 (8.4)	30.9 (7.6)	< 0.001
SVi <35 ml/m² n (%)	17 (22.4)	18 (69.2)	< 0.001
Calculated parameters of aortic stenosis severity			
AVA [by CE], cm², mean (SD)	0.84 (0.12)	0.82 (0.16)	0.52
AVAi, cm²/m², mean (SD)	0.46 (0.07)	0.44 (0.09)	0.40
DVI, mean (SD)	0.24 (0.05)	0.24 (0.06)	0.64
ELCo [for all patients], cm², mean (SD)	0.99 (0.15)	0.97 (0.23)	0.75
ELCo [for STJ <30 mm], cm², mean (SD)	1.00 (0.16)	0.99 (0.25)	0.76
ELI [for STJ <30 mm], cm²/m², mean (SD)	0.56 (0.11)	0.53 (0.13)	0.35
Data from 2D transesophageal echocardiography			
AVA by planimetry, cm², mean (SD)	0.92 (0.15)	0.90 (0.16)	0.70
Bicuspid AV, n (%)	21 (27.6)	5 (19.2)	0.40

Abbreviations: see Table S2

Figure S1. Transoesophageal two-dimensional echocardiography. Mid-oesophageal views (35°–70^0). Transverse short-axis plane of aortic valve. Zoom mode. Examples of aortic valve area (AVA) planimetry measurements (AVAPlaniTOE) in patients with severe (AVA by continuity equation ≤ 1.0 cm^2) low-gradient aortic stenosis with preserved ejection fraction (LG AS pEF) on transthoracic echocardiography. **A.** Planimetry of tricuspid aortic valve (TAV). AVAPlaniTOE = 0.8 cm^2. Confirmation of LG AS pEF severity. **B**. Planimetry of TAV. Blue arrow points to a commissure between right and left coronary cusp with reverberation artifact traced outside. AVAPlaniTOE = 0.9 cm^2. Confirmation of LG AS pEF severity. **C**. Planimetry of TAV. AVAPlaniTOE = 1.1 cm^2. An example of reclassification of LG AS pEF to pseudo-severe AS. **D**. Planimetry of bicuspid aortic valve (BAV) – RCC-LCC type. AVAPlaniTOE = 0.8 cm^2. Confirmation of LG AS pEF severity. **E**. Planimetry of BAV – RCC-LCC type. Yellow arrow points to a margin of noncoronary cusp adjacent to a large calcification (white arrow) mimicking the margin of the cusp. AVAPlaniTOE = 0.9 cm^2.Confirmation of LG AS pEF severity. **F**. Planimetry of BAV – RCC-LCC type. AVAPlaniTOE = 1.2 cm^2. An example of reclassification of LG AS pEF to pseudo-severe AS
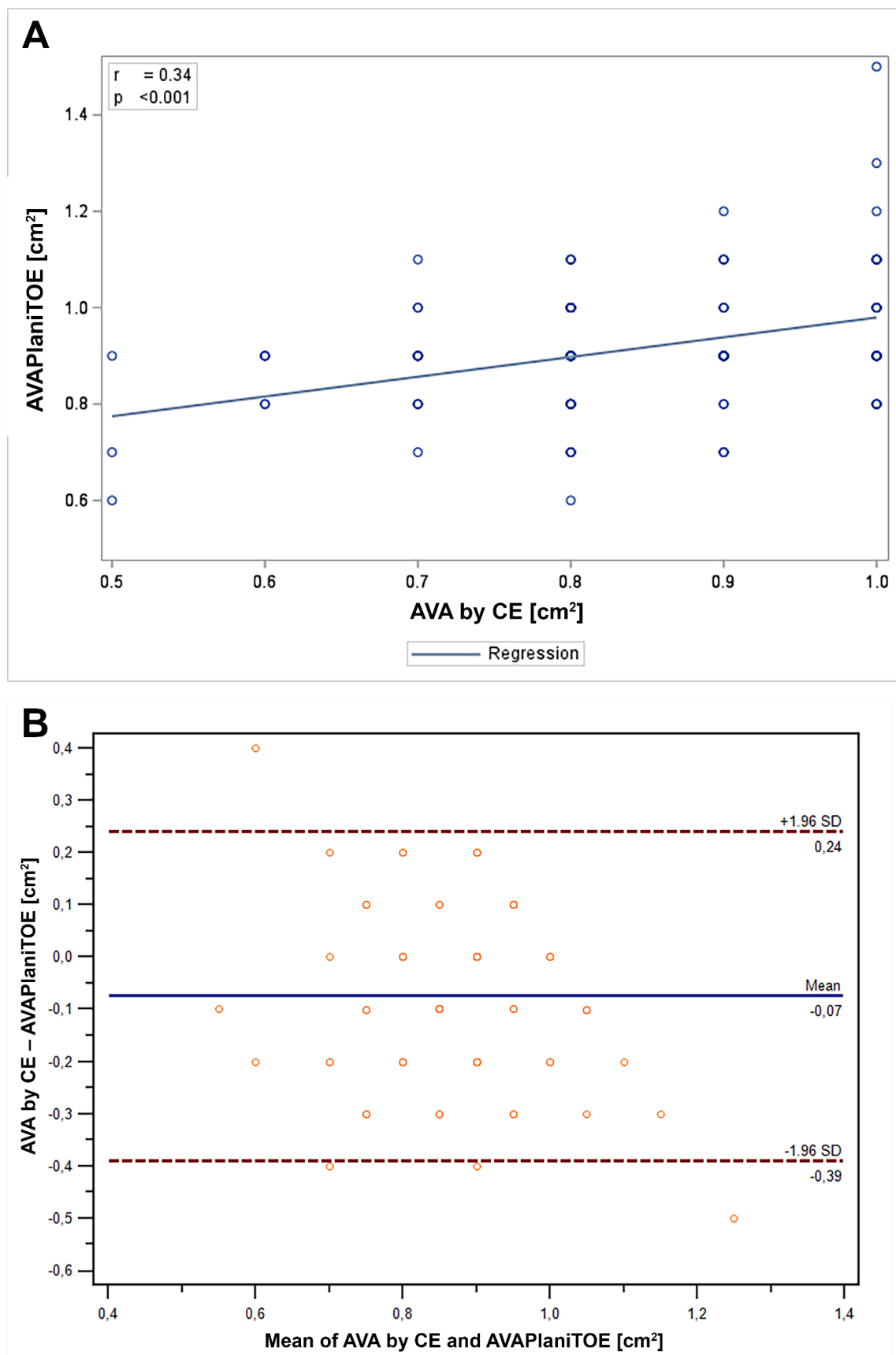
Figure S2. Linear correlation and Bland-Altman analysis of aortic valve area calculations by continuity equation (AVA by CE) in two-dimensional transthoracic echocardiography (2D-

TOE) and AVA measured directly by planimetry (AVAPlaniTOE) in 2D transoesophageal echocardiography (2D-TOE). **A.** Pearson correlations showed moderate but significant agreement between 2D-TTE (AVA by CE) calculations and 2D-TOE (AVAPlaniTOE) measurements. **B**. The Bland-Altman plot demonstrates that AVA is more often overestimated by 2D-TTE compared with TEE. 2D-TTE overestimated AVA by a mean of -0.07±(0.02) (SE) cm^2 compared with 2D-TEE