

Research Article

Long-Term Persistence of Diastolic Dysfunction and Dyspnea in Patients who Underwent Aortic Valve Replacement for Aortic Valve Stenosis

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Variable	NYHA < II at follow-up (n=109)	NYHA ≥ II at follow-up (n=82)	P value
Demographics			
Age (years)	77.00 [69.00, 82.00]	80.00 [76.00, 85.00]	0,003
Sex (male) n (%)	68 (62.4%)	38 (46.3 %)	0,027
Body Mass Index (kg/m ²)	26.49 ± 4.04	26.67 ± 4.17	0,770
Hypertension	67 (64.4 %)	48 (65.8 %)	0,855
Diabetes Mellitus	15 (14.4 %)	10 (13.9 %)	0,920
Coronary artery disease	22 (21.2 %)	11 (16.2 %)	0,418
Baseline symptoms			
Angina	16 (14.7 %)	9 (11.0 %)	0,39

NYHA class	-	-	0,004
I	18 (16.5 %)	1 (1.2 %)	
II	67 (62.0 %)	53 (65.4 %)	
III	21 (19.4 %)	24 (29.6 %)	
IV	2 (1.9 %)	3 (3.7 %)	
Syncope	7 (6.4 %)	5 (6.21 %)	0,27
Laboratory			
Haemoglobin (g/dl)	13.28 ± 1.47	13.04 ± 1.46	0,179
Serum Creatinine (µmol/l)	80 [69, 97]	89 [65, 107]	0.355
MDRD Clearance (ml/min)	74.7 ± 20.2	70.6 ± 24.2	0.244
NT pro-BNP (pg/ml)	646 [304, 1343]	1031 [487, 2134]	0,023
Electrocardiogram			
Rhythm			0.046
Sinus	95 (89.6 %)	61 (77.2 %)	
Atrial Fibrillation	8 (7.5 %)	15 (19.0 %)	
Ventricular pacing	3 (2.8 %)	3 (3.8 %)	
Medication			
Beta-blockers	49 (45.0 %)	36 (43.9 %)	0.885
ACEi / ARB	49 (45 %)	40 (48.8 %)	0,887
Diuretics	28 (25.7 %)	30 (37.5 %)	0.082

Values are expressed as mean ± SD, median [IQR] or frequency [n (%)]; ACEi= angiotensin-converting enzyme inhibitor; ARB= angiotensin receptor blocker; BMI= Body mass index; LVH= Left ventricular hypertrophy; NYHA= New York Heart Association; NT-pro-BNP= serum amino terminal pro B-type natriuretic peptide

Table 1BIS: Baseline clinical characteristics according to follow-up dyspneic status.

Variable	Post-operative E/e' < 14 (n=91)	Post-operative E/e' ≥ 14 (n=87)	P value
Age (years)	77 [67, 80]	80 [73, 85]	0.002
Sex (male) n (%)	61 (67.0 %)	43 (49.4 %)	0.017
Systolic Blood Pressure (mmHg)	133.55 ± 20.31	140.32 ± 21.58	0.033
Surgical Aortic Valve Replacement n (%)	66 (72.5 %)	44 (50.6 %)	0.003
Left-sided clinical congestive heart failure	3 (3.3 %)	15 (17.9 %)	0.002
ACEi / ARB n (%)	43 (47.0 %)	38 (43.7 %)	0.632
Beta-blockers n(%)	41 (45.1 %)	39 (44.8 %)	0.976
Loop diuretics n (%)	19 (21.1 %)	31 (35.6 %)	0.032
NT pro-BNP (pg/ml)	471 [183, 1124]	1030 [487, 1810]	0.004
Rhythm at baseline	-	-	0.214
Sinus	78 (89.7%)	67 (79.8 %)	-
Atrial Fibrillation	7 (8.0%)	12 (14.3 %)	-
Ventricular Pacing	2 (2.3%)	5 (6.0 %)	-
LVEF (%)	64 [59, 68]	64 [58, 68]	0.762
Left atrial reservoir function (%)	23 [16, 28]	18 [13, 22]	0.001
Aortic Valve Area (cm ²)	0.69 ± 0.18	0.65 ± 0.16	0.110
Mitral regurgitation grade (/4)	0.0 [0.0, 1.0]	1.0 [0.0, 1.0]	0.001
Mitral E wave velocity (cm/s)	74 ± 18	108 ± 37	<0.001
Mitral A wave velocity (cm/s)	101 [89, 115]	115 [92, 138]	0.005
Mitral E/A ratio	0.70 [0.60, 0.90]	0.90 [0.70, 1.20]	<0.001
Tricuspid regurgitation velocity (m/s)	2.5 ± 0.4	2.8 ± 0.5	0.004
Left atrial volume index (ml/m ²)	39 [31, 47]	43 [36, 53]	0.012
E/e' ratio	12 [10, 14]	18 [14, 21]	<0.001
Diastolic dysfunction grade			<0.001
Grade 0 (no DD)	28 (40.0 %)	5 (6.9 %)	-
Grade 1	3 (4.2 %)	1 (1.4 %)	-
Grade 2	21 (30.0 %)	39 (53.4 %)	-
Grade 3	5 (7.1 %)	6 (8.2 %)	-

Variable	Post-operative E/e' < 14 (n=91)	Post-operative E/e' ≥ 14 (n=87)	P value
DD grade unknown	13 (18.6 %)	22 (30.1 %)	-

Values are expressed as mean ± SD, median [IQR] or frequency [n (%)]; ACEi= angiotensin-converting enzyme inhibitor; ARB= angiotensin receptor blocker; LVEF = left ventricular ejection fraction; NT-pro-BNP= serum amino terminal pro B-type natriuretic peptide; DD= diastolic dysfunction

Table 2 BIS: Baseline parameters according to post-operative E/e' ratio.

Variable	Pre-op E/e' ≤ 16 and SAVR (n=83)	Pre-op E/e' ≤ 16 and TAVR (n=42)	Pre-op E/e' > 16 & Pre-op E < 111 cm/s (n=23)	Pre-op E/e' > 16 & E Préop ≥ 111 (n=30)	P value
Baseline characteristics					
Age (years)	76 [65, 80]	82 [78, 87]	77 [71, 84]	81 [72, 84]	<0.001
Systolic Blood Pressure (mmHg)	133 [119, 148]	138 [119, 148]	137 [124, 148]	139 [130, 151]	0.599
Diastolic Blood Pressure (mmHg)	77 [70, 84]	75 [64, 80]	74 [66, 79]	70 [63, 78]	0.048
Permanent Atrial Fibrillation	3 (3.6 %)	9 (22.0 %)	2 (8.7 %)	5 (16.7 %)	0.007
Coronary artery Disease	9 (10.8%)	11 (34.4%)	5 (26.3%)	8 (29.6 %)	0.011
Surgical Aortic Valve Replacement n (%)	83 (100.0 %)	0 (0.0 %)	9 (39.1 %)	18 (60.0 %)	<0.001
Body Mass Index (kg/m ²)	26.3 [24.1, 29.2]	25.5 [23.0, 27.6]	29.0 [24.0, 30.7]	24.9 [23.1, 27.4]	0.029
Median NYHA class	2 [2, 2]	2 [2, 3]	2 [2,3]	2 [2, 2]	<0.001
Left-sided congestive heart failure n(%)	2 (2.4 %)	5 (12.2 %)	5 (21.7 %)	6 (20.7 %)	0.002
Loop diuretics n (%)	10 (2.2 %)	17 (40.5 %)	9 (39.1 %)	14 (46.7 %)	<0.001
MDRD Clearance (ml/min)	78 ± 22	69 ± 23	65 ± 22	68 ± 19	0.024
NT pro-BNP (pg/ml)	276 [135, 639]	1092 [647, 1658]	1394 [441, 2124]	1303 [503, 2145]	<0.001

Variable	Pre-op E/e' ≤ 16 and SAVR (n=83)	Pre-op E/e' ≤ 16 and TAVR (n=42)	Pre-op E/e > 16 & Pre-op E < 111 cm/s (n=23)	Pre-op E/e > 16 & E Préop ≥ 111 (n=30)	P value
LVEF (%)	63 [57, 67]	63 [60, 68]	62 [59, 68]	65 [61, 70]	0.366
Left atrial reservoir function (%)	23 [17, 28]	17 [12, 23]	16 [12, 20]	17 [13, 22]	<0.001
Mitral regurgitation grade /4	0 [0, 1]	1 [0, 1]	0.5 [0, 1]	1 [1, 1.5]	<0.001
Mitral annulus e' wave (cm/s)	6.3 ± 1.7	7.0 ± 1.9	4.7 ± 0.7	6.2 ± 1.3	<0.001
Mitral E wave velocity (cm/s)	73 [59, 84]	88 [74, 108]	93 [82, 97]	139 [123, 154]	<0.001
Mitral A wave velocity (cm/s)	101 [86, 114]	109 [101, 135]	116 [89, 133]	125 [90, 142]	0.021
Mitral E/A ratio	0.70 [0.60, 0.90]	0.70 [0.52, 0.90]	0.80 [0.70, 0.97]	1.10 [0.90, 1.50]	<0.001
Mitral E wave deceleration time (ms)	240 [177, 276]	195 [165, 245]	223 [158, 261]	186 [143, 217]	0.006
Tricuspid regurgitation velocity (m/s)	2.5 ± 0.4	2.7 ± 0.4	2.7 ± 0.7	2.9 ± 0.5	0.004
Left atrial volume index (ml/m ²)	37 [29, 43]	46 [39, 55]	45 [37, 55]	51 [38, 58]	<0.001
E/e' ratio	12.0 [10.0, 14.0]	12.3 [10.0, 15.0]	20.0 [19.0, 22.0]	22.5 [19.0, 26.7]	<0.001
Follow-up characteristics					
E/e' ratio	9.7 [8.3, 12.7]	13.4 [9.8, 17.5]	13.7 [11.3, 17.9]	19.1 [16.3, 22.8]	<0.001
Diastolic dysfunction n (%)	23 (37.1 %)	28 (71.8 %)	15 (93.8 %)	27 (96.4 %)	<0.001
NYHA class					0.026
Class I	51 (66.2 %)	16 (42.1 %)	15 (68.2 %)	16 (59.3 %)	
Class II	26 (33.8 %)	18 (47.4 %)	7 (31.8 %)	11 (40.7 %)	
Class III	0 (0.0 %)	4 (10.5 %)	0 (0.0 %)	0 (0.0 %)	
Hospitalisation for heart failure n (%)	0 (0.0 %)	1 (2.4 %)	0 (0.0 %)	2 (6.7 %)	0.069

Values are expressed as mean ± SD, median [IQR] or frequency [n (%)]

Table 3 BIS: Main baseline and follow-up variables according to the four groups defined by our model.

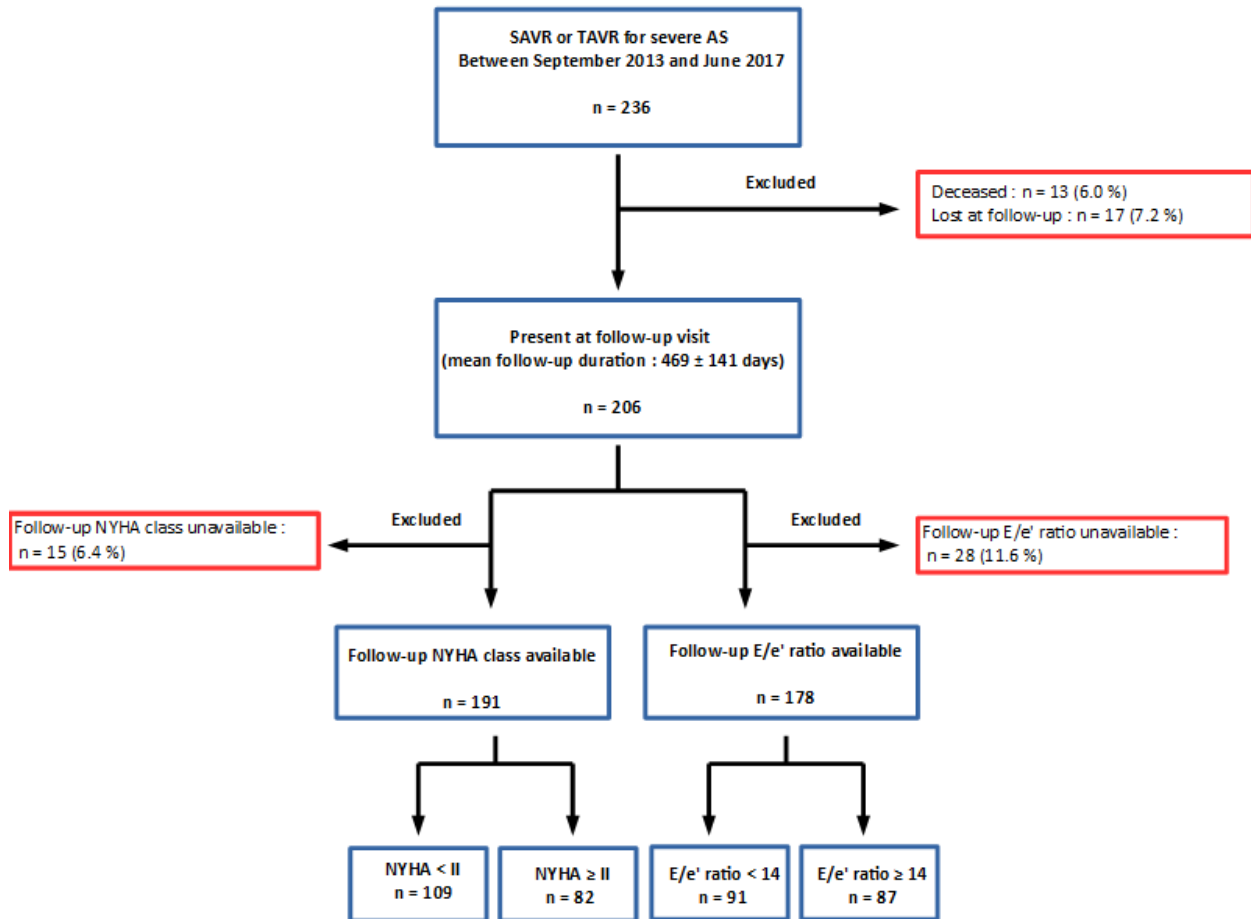


Figure 1 BIS: Flow chart.

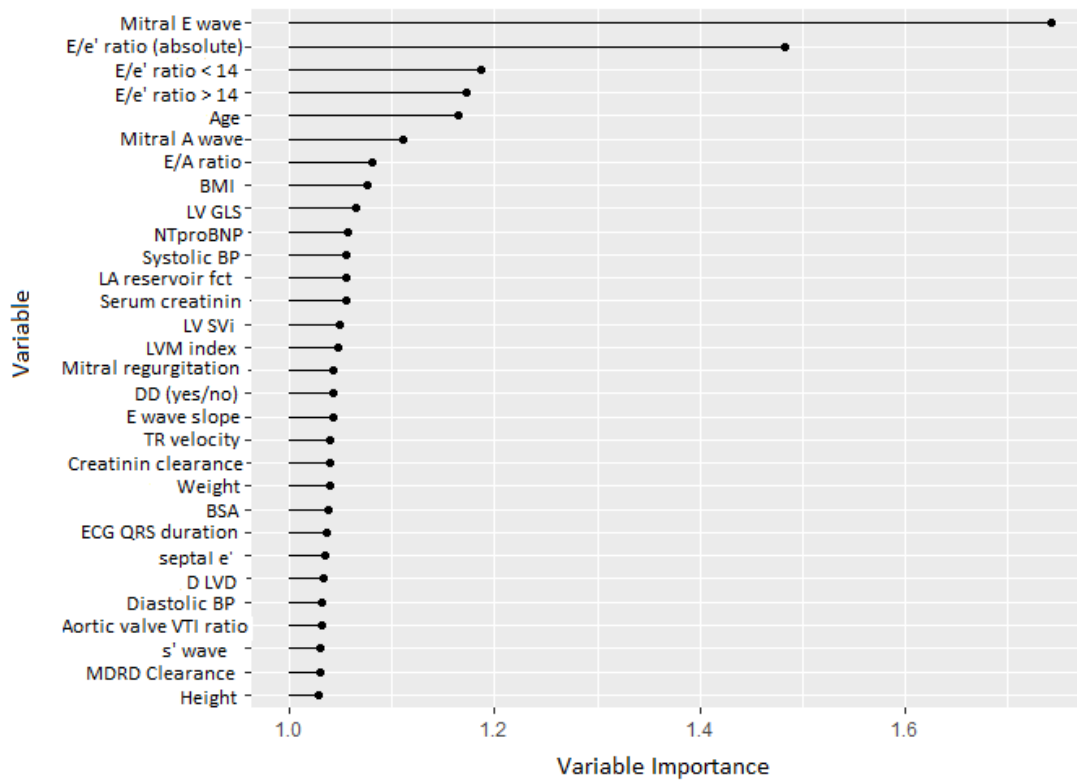


Figure 2 BIS: Post-operative NYHA class and improvement in NYHA class from baseline to follow-up.

Importance of variables is based on permutation error (added error rate if a given variable is removed from the predictors). The 30 most important variables are presented in descending order.

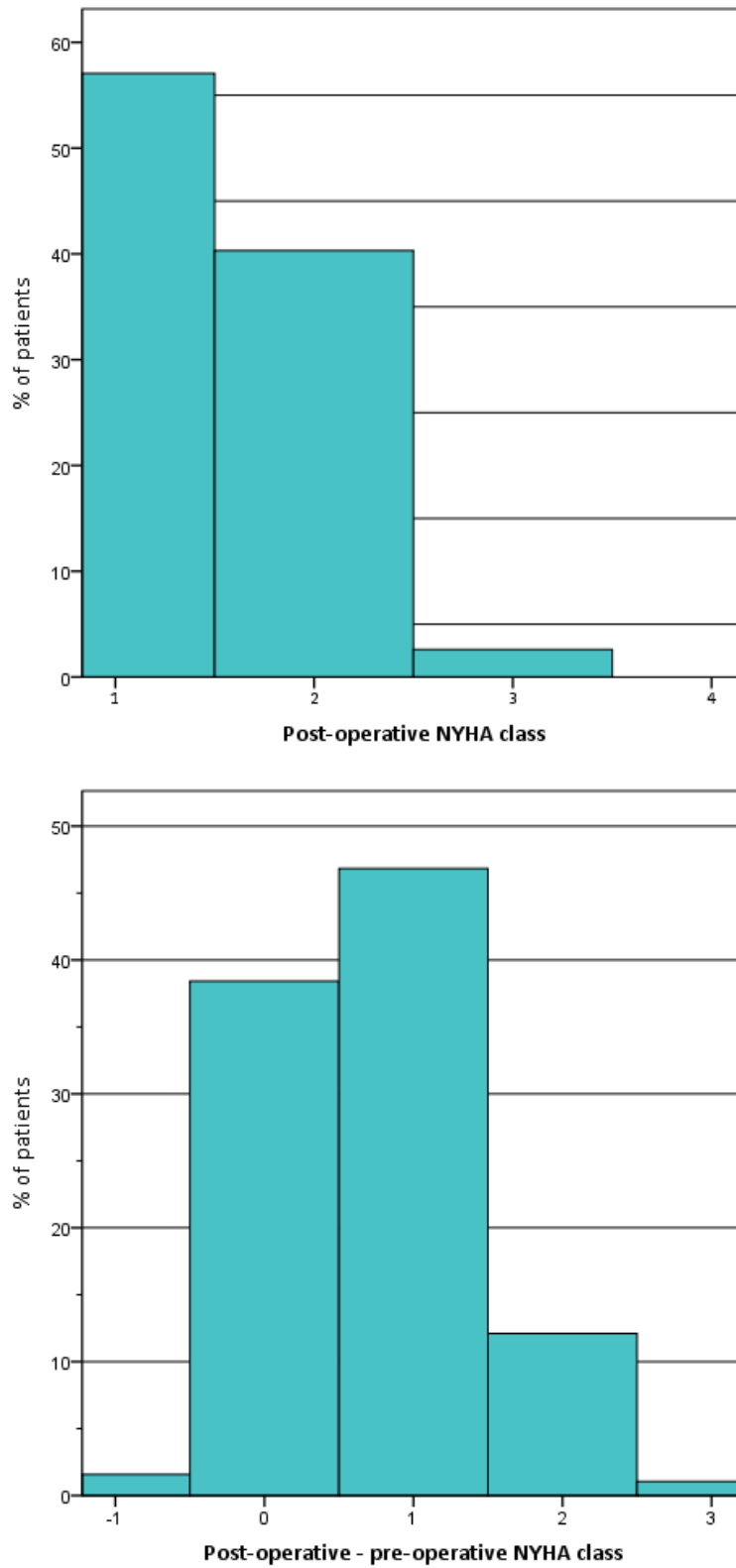


Figure3 BIS : Relative importance of variables used for prediction of a post-operative E/e' ratio ≥ 14 .



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