Echocardiographic phenotype in severe aortic valve stenosis with and without cardiac amyloidosis: the AMY-TAVI trial

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Background: Longitudinal Strain (LS) pattern in cardiac amyloidosis (CA) typically spares the apex of the heart, which is a sensitive and specific finding that can be used to distinguish CA from other causes of left ventricular (LV) hypertrophy. RELAPS >1 suggests with high specificity CA, and shows a bright red in the apical segments of the polar map.

Purpose: To identify differential echocardiographic characteristics of aortic stenosis (AS) with concomitant TTR-CA (AS-CA) compared to AS alone.

Methods: Patients with severe symptomatic AS undergoing TAVI were prospectively and consecutively included between Jan-19 and Dec-20. Pre-procedure, a complete echocardiogram was performed that included deformation parameters using Speckle-Tracking. Strain derived Indices accepted for CA screening were calculated: RELAPS: relative apical LS (average apical LS/average basal+mid LS); SAB: (apical-septal/basal-septal LS); EFSR: (LVEF/GLS). After TAVI, a 99Tc-DPD scintigraphy and a proteinogram were performed to screen for CA.

Results: 324 patients were included. The mean age was 81 yo, 52% women. 39 (12%) patients presented cardiac uptake on scintigraphy: 14 (4.3%) grade 1; 13 (4%) grade 2, and 11 (3.4%) grade 3. Strain analysis could be performed in 243 patients due to acoustic window and covid19 pandemic restrictions. Echocardiographic characteristics between AS alone and those with grade 1 (AS-DTD1) and grade 2/3 (AS-CA) are shown in Table 1.

Compared with AS alone, patients with AS-CA had significantly lower transvalvular gradients, although similar AVA, and low flow-low gradient (LF-LG) AS was more prevalent. AS-CA exhibited slightly worse cardiac remodeling (LV mass ind: 202 g/m^2 vs 176 g/m^2, p=0.032), and worse diastolic dysfunction, but without significant differences in thickness, diameters or volumes, with similar relative wall thickness (RWT: 0.53 vs. 0.51 mm, p=0.52). LVEF was similar, however myocardial contraction fraction (MCF= stroke volume/myocardial volume) and MAPSE were worse in AS-CA.

GLS, RELAPS, SAB and EFSR were not different, but RELAPS >1 pattern was more prevalent in AS-CA (74% vs 44%, p=0,006) (Figure 1). Mass/strain ratio (RMS) was similar. There were no differences in size and fractional emptying of left atrium, or atrial septum thickness.

Right ventricle (RV) size was similar, as well as conventional function parameters (TAPSE and S'). However, RV LS was worse in AS-CA. Pericardial effusion was more prevalent in AS-CA (25% vs 7.4%, p=0.013).

In the multivariate analysis, predictors of AS-CA were: age (OR: 1,2, p=0,02), BG (OR: 0,2, p=0,01), E/A (OR: 4,7, p=0,02), LV Mass index (OR: 1,02, p=0,04) and RELAPS >1 (OR: 0,12, p=0,01).

Conclusion: Dual pathology of AS-AC is common in older patients referred for TAVI. Although it is more prevalent in patients with AS-CA, RELAPS>1 pattern can be present in almost 50% of patients with severe AS alone, which reduces its value as screening tool for CA in this clinical setting respect to others.

Echocardiographic Parameters	AS alone (n= 286)	AS-GG1 (n= 14)	AS-GG2/3 (n= 24)	p
Morphological parameters				
IVSd, mm	14,4 ± 2,7	14,6 ± 2,1	15,6 ± 2,4	0,098
PWd, mm	12,7 ± 2,0	13,4 ± 2,3	13,5 ± 2,2	0,082
LV mass, gr	300,4 ± 83	309,5 ± 71	340 ± 90	0,080
LV mass index, gr/m2	175,7 ± 46,9	174,7 ± 41,5	202,1 ± 54,3	**0,032**
LVEDV, ml	102,3 ± 41,8	106,9 ± 25,9	100,5 ± 33,2	0,897
LVESV, ml	47,2 ± 35,6	52,1 ± 27,4	50 ± 26,9	0,833
MWT, mm	14,4 ± 2,8	14,7 ± 2,1	15,6 ± 2,3	0,119
RWT, mm	0,51 ± 0,13	0,53 ± 0,12	0,53 ± 0,13	0,521
LA vol index, ml/m2	59,5 ± 23,9	55,6 ± 20,4	60,1 ± 19,6	0,827
LA fracc vol, %	33,9 ± 16,9	28,1 ± 16,1	29,3 ± 15,2	0,257
Atrial septum, mm	6,5 ± 2,5	5,9 ± 1,9	6,5 ± 2,5	0,714
Pericardial effusion	21 (7,4%)	1 (7,1%)	6 (25%)	**0,013**
PASP, mmHg	42,3 ± 15,8	41,3 ± 15,1	44,6 ± 16,5	0,785
Systolic and diastólic function				
LVEF, %	57,8 ± 14,5	55,1 ± 15,8	53,3 ± 14,9	0,286
MAPSE, mm	11,3 ± 3	10,3 ± 2,1	9,7 ± 3	**0,035**
Mitral S´	6,1 ± 1,9	6,2 ± 1,8	5,5 ± 1,3	0,301
MCF	0,20 ± 0,1	0,19 ± 0,1	0,16 ± 0,05	**0,041**
LFLG, n (%)	22 (7,7%)	2 (14,3%)	6 (25%)	**0,015**
E wave	100,6 ± 36,5	119,9 ± 45	104,1 ± 23,4	0,142
A wave	103,7 ±35	107,3 ± 43	75,8 ± 30,2	**0,007**
E/A ratio	1,00 ± 0,56	1,5 ± 1,2	1,7 ± 1,2	**0,000**
E/E´ ratio	19,4 ± 8,4	21,7 ± 10,3	18,3 ± 5,9	0,471
EDT, ms	265,72± 120,3	225,1 ± 81,1	196,8 ± 76	**0,021**
LV Deformation parameters				
GLS, %	-15,0 ± 4,6	-13,7 ±4,5	-12,9 ± 3,7	0,069
Basal LS, %	-8,96 ± 4,3	-8,6 ± 5,3	-6,8 ± 3,8	0,073
Mid LS, %	-13,6 ± 4,7	-12,5 ± 4	-11,3 ± 4,1	0,073
Apical LS, %	-20,9 ± 7,5	-17,9 ± 5,9	-17,8 ± 6,1	0,070
RELAPS	1,01 ± 0,6	1,38 ±2,2	1,01 ± 0,4	0,220
SAB	2,98 ± 3,7	3,5 ± 1,9	4,2 ± 5,3	0,312
EFSR	3,98 ± 0,8	4,08 ± 1,1	4,23 ± 1,4	0,436
MSR	23,9 ± 16,1	24,9 ± 10,6	29,2 ± 14	0,304
RELAPS > 1	91 (44%)	3 (23,1%)	17 (73,9%)	**0,006**
Aortic valve disease parameters				
AVA, cm^2	0,65 ± 0,16	0,69 ± 0,17	0,68 ± 0,17	0,553
Vmax, m/s	4,5 ± 0,6	4,4 ± 0,6	4,0 ± 0,7	**0,000**
Grad max , mmHg	85,1 ± 22,4	78,3 ± 20,2	67,3 ± 24,3	**0,001**
Grad med, mmHg	51,2 ± 14,4	46,9 ± 12,9	40,3 ± 14,5	**0,001**
AS LG, n %	53 (18,7%)	3 (23,1%)	12 (50%)	**0,001**
AET, ms	327,5 ± 40	313,1 ± 38,5	332,5 ± 33,3	0,362
RV morphological and functional parameters				
RVT	6,3 ± 2,2	7,2 ± 1,9	6,2 ± 1,8	0,360
RVEDD basal, mm	37,2 ± 6,6	40 ± 8,1	38,5 ± 7	0,243
RVEDD medio, mm	27,7 ± 5,2	30 ± 6,8	27,4 ± 6,6	0,286
TAPSE, mm	20,5 ± 4,5	19,2 ± 5,1	20,1 ± 5,5	0,598
Tricuspid S´	12,6 ± 3,7	11,5 ± 4,4	11,4 ± 2,6	0,228
RVFWLS	-26,1 ± 6,6	-23,9 ± 8,7	-21,9 ± 6,8	**0,016**

Table 1. Echocardiographic parameters

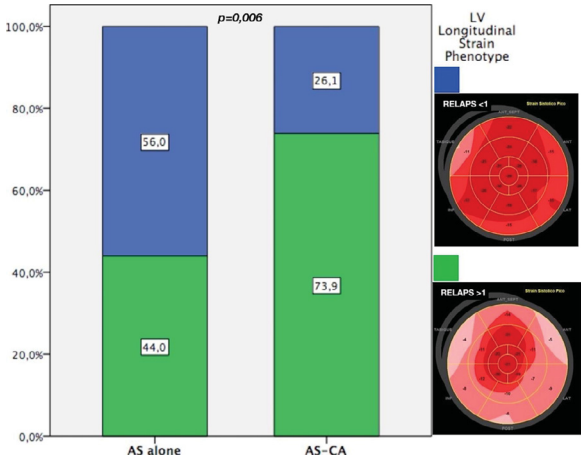

Figure 1. LV Longitudinal strain RELAPS phenotype