THE IMPACT OF ARTERIAL HYPERTENSION ON RIGHT VENTRICULAR DEFORMATION

National Heart Hospital

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Department of Noninvasive Cardiovascular Imaging and Functional Diagnostic

Aim:

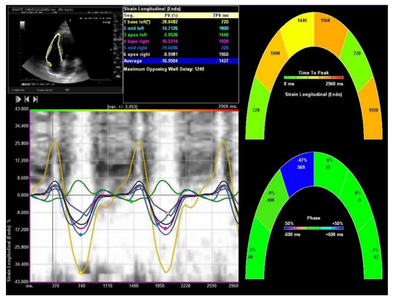
The aim of our study is to determine the effect of arterial hypertension and hypertensive cardiac remodelling on right ventricular (RV) function, using vector velocity echocardiography to determine strain and strain rate.

Methods:

We compared echocardiographic measures in 75 patients with arterial hypertension and left ventricular hypertrophy (LVH group) with 20 healthy control subjects. Of note, none of the hypertensive patients had symptomatic heart failure. Apical four-chamber images were acquired (frame rate 74 ± 6 frames/s) and analyzed offline in order to extract the strain (rate) curves. From these, the maximal systolic strain (PSS) and peak strain rate (PSR) on right and left ventricle were derived, using vector velocity imaging (VVI) software. Tricuspid annular plane systolic excursion (TAPSE) and as well as mid-apical and basal peak ejection strain (S) and strain rate (SR) of the RV free wall were measured.

Results:

Body surface area, blood pressure, and heart rate were comparable between the LVH and control groups. Relative to controls, the LVH group had greater average wall thickness (13,49 ± 1,67 mm vs. 9,2 ± 0,55 mm, p < 0,01), LV mass (264,30 ± 657 vs. 173 ± 11,3 g, p < 0,01) and left venticle diameter (51,05 ± 5,13 cm vs. 46,03 ± 2,01 cm, p = 0,64). The E/A ratio on mitral inflow tract was lower in the LVH group (0,75 ± 0,41 vs. 1,87 ± 0,48; P < 0,001). Global strain measures for the LV were not significantly different between groups (PSSLV -16,4 ± 3,14 vs. -19,69 ± 1,82, p= 0,56) whereas RV strain was diminished in the LVH group (PSS RV -10,03 ± 4,5 vs. -15,5 ± 2,3, p< 0,01). Similarly, greater differences were seen for strain rate in the RV (PSR 0,45 vs.1,75 1/s, p < 0,01 for LVH vs. control). For regional RV function, PSS was lower in the LVH group than the control group in the mid (-11,24 ± 3,2% vs. -17,23 ± 2,23%, p = <0,01) and apical (-7,87 ± 2,34% vs. -12,3 ± 2,56%; p < 0,05). RV free wall, whilst basal PSS was similar (-12,31 ± 3,87% vs. -14,03 ± 3,78%, p =0,65). TAPSE (LVH, 21 ± 2,9 mm vs. Control, 23 ± 2,2 mm, P = 0,34) did not differ between groups and other conventional RV measures were also similar in both groups.



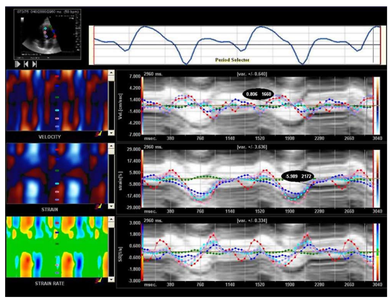


Figure 1. Echocardiography- vector velocity imaging (VVI) on LV and RV

Table 1. Demographic and echocardiographic characteristics in the both groups

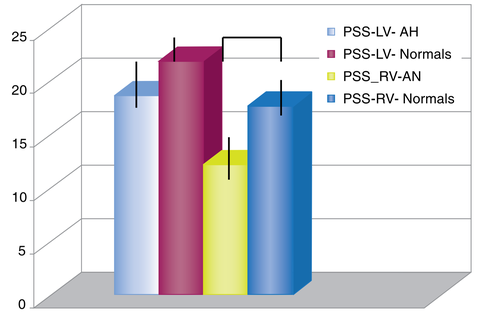
	AH – groups	Normals
Ages	68,90 ± 13,00	31,00 ± 5,00
Height (cm)	173,14 ± 9,45	174,00 ± 4,00
Weight (kg)	82,74 ± 13,80*	67,00 ± 11,00
BSA(m2)	1,99 ± 0,21	1,80 ± 0,11
HR (bpm)	67,50 ± 12,40	78,80 ± 3,40
SBP (mmHg)	156,80 ± 13,70*	115,00 ± 12,00
DBP (mmHg)	87,00 ± 12,00*	67,00 ± 9,00
LVEF (%)	62,00 ± 6,30	66,00 ± 10,10
LVEDD (mm)	48,70 ± 8,70	45,00 ± 4,40
LVEDD/BSA (mm/m²)	24,47 ± 4,70	25,00 ± 3,70
LVEDV (ml	109,60 ± 31,10*	81,11 ± 25,00
LVEDV/BSA (ml/m²)	54,77 ± 14,80*	45,06 ± 12,30
LVESV (ml)	48,71 ± 13,60*	38,37 ± 13,00
LVESV/BSA (ml/m²)	24,48 ± 6,70	21,31 ± 6,80
LVSV (ml)	60,56 ± 10,00	61,46 ± 16,00
LVSV/BSA (ml/m²)	30,43 ± 5,50	34,14 ± 8,20
LV mass (g)	264,30 ± 65,70*	173,00 ± 11,30
LV mass index(g/m²)	132,30 ± 30,90*	92,02 ± 5,60
E/A	0,75 ± 0,41*	1,87 ± 0,48
TAPSE (mm)	21,00 ± 2,90	23,00 ± 2,20

** p < 0,05 – statistical significant between normal and hypertensive group*

Table 2. Regional PSS for RV in the both groups

	Peak Systolic Strain		
	Basal level	**Middle level**	**Apical level**
Normals	-14,03±3,78	-17,23±2,23	-12,30±2,56
AH group	-12,31±3,87	-11,24±3,20*	-7,87 ±2,34*

Graphics 1. Comparison of Peak Systolic Strain and Strain rate for LV, RV and between both groups – AH and normal patients



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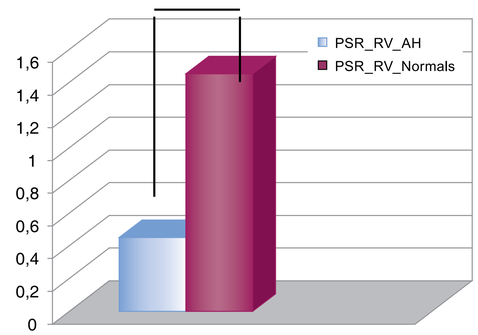

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Conclusion:

The present study demonstrates that measures of RV deformation are reduced in patients with LVH secondary to hypertension. Thus, this data suggests that LVH may cause early sub-clinical RV dysfunction even in the absence of overt diastolic heart failure.

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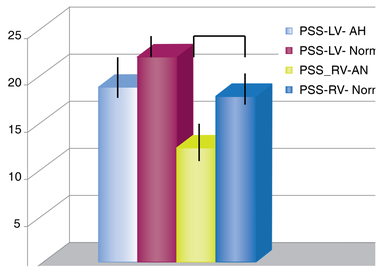
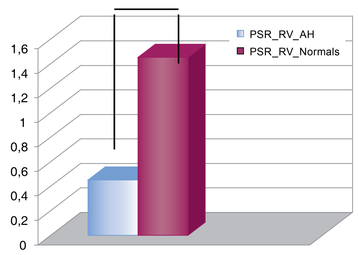
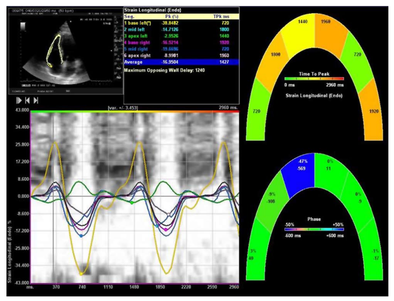
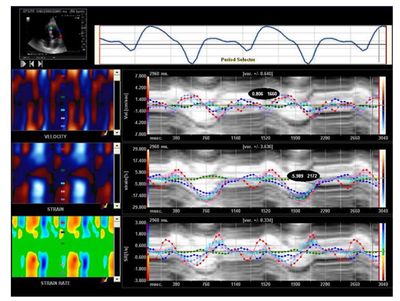


Graphics 2. Comparison on Peak Systolic Strain and Strain rate for LV, RV and between both groups – AH and normal patients







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AH – groups	68.90 ± 13.00	173.14 ±9.45	82.74 ±13.80*	1.99 ± 0.21	67.50 ± 12.40	156.80 ±13.70*	87.00 ±12.00*	62.00 ± 6.30	48.70 ± 8.70	24.47 ± 4.70	109.60 ±31.10*	54.77 ±14.80*	48.71 ±13.60*	24.48 ± 6.70	60.56 ± 10.00	30.43 ± 5.50	264.30 ±65.70*	132.30 ±30.90*	0.75 ± 0.41*	21.00 ± 2.90
Normals	31.00 ± 5.00	174.00 ±4.00	67.00 ±11.00	1.80 ± 0.11	78.80 ± 3.40	115.00 ±12.00	67.00 ± 9.00	66.00 ± 10.10	45.00 ± 4.40	25.00 ± 3.70	81.11 ±25.00	45.06 ±12.30	38.37 ±13.00	21.31 ± 6.80	61.46 ± 16.00	34.14 ± 8.20	173.00 ± 11.30	92.02 ± 5.60	1.87 ± 0.48	23.00 ± 2.20

p < 0,05 – statistical significant between normal and hypertensive group

Conclusion:

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