

# The Influence of Atrial Fibrillation on Tricuspid Annulus and Right Ventricular Geometry in Patients without Significant Tricuspid Regurgitation

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# Background

- **Secondary tricuspid regurgitation (TR)**
  - significant left-sided heart disease (commonly rheumatic in origin)
  - chronic pulmonary disease leading to cor pulmonale
  - another disease process causing tricuspid annular dilatation and the tethering of tricuspid leaflets associated with RV dilatation (eg, ASD)

*Sagie et al. J Am Coll Cardiol 24(2): 446-453.*

*Come et al. The American Journal of Cardiology 55(5): 599-601.*

*Mikami et al. The American Journal of Cardiology 53(1): 160-163.*

# Background

- Isolated TR
  - may be caused by organic TV disease, valve disease associated with systemic diseases, endocarditis, trauma or pacemaker leads.
  - occasionally idiopathic;
    - Annular dilatation secondary to aging, AF, RV remodeling is proposed as the likely mechanism of TR.

*Girard et al. J Heart Valve Dis 9(2): 283-287.*

*Mutlak et al. Journal of the American Society of Echocardiography 20(4): 405-408.*

*Seo et al. Circ J 72(10): 1645-1649.*

# Background

- **Atrial Fibrillation (AF)**
  - cause right and left atrial dilatation through loss of contractility and increased compliance.
  - AF is the striking risk factor associated with development of late significant TR after mitral or combined mitral/aortic valve surgery.
  - beneficial effect of a concomitant maze operation for prevention of late TR.

*Sanfilippo et al. Circulation 82(3): 792-797.*

*Matsuyama et al. Ann Thorac Surg 75(6): 1826-1828.*

*Kim et al. Circulation 112(9\_suppl): I-14-19.*

# Background

- **Atrial Fibrillation (AF)**
  - Isolated severe TR was frequently combined with AF.
  - On the other hand, the relationship between isolated TR and AF is not well established.
  - It is not clear whether AF is the cause or the result of TR because TR causes atrial enlargement and predisposes to AF.

*Girard et al. J Heart Valve Dis 9(2): 283-287.*

*Mutlak et al. Journal of the American Society of Echocardiography 20(4): 405-408.*

# Purpose

- To assess the relationship between chronicity of AF and tricuspid annulus dimension, RV geometry.

# Methods

- We retrospectively recruited consecutive patients with atrial fibrillation, who were referred for echocardiography.
- **Exclusion Criteria**
  - (1) echocardiographically apparent organic valvular heart disease with any degree of stenosis, or more than mild regurgitation
  - (2) acute RV dilatation including RV infarction, acute PTE
  - (3) suboptimal echocardiographic window
  - (4) patients with an implanted pacemaker
  - (5) patients who had received valve repair or replacement
  - (6) left ventricular ejection fraction less than 50%
  - (7) congenital heart disease with left to right shunt
  - (8) cor pulmonale
  - (9) significant pulmonary hypertension which was defined as pulmonary artery systolic pressure 50 mmHg or higher
  - (10) patient with untreated thyrotoxicosis.
- Finally, 83 patients participated in the study.

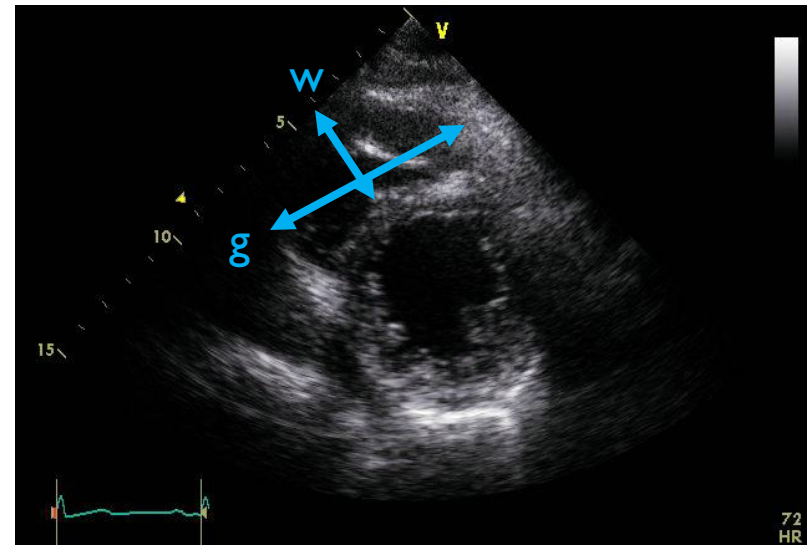
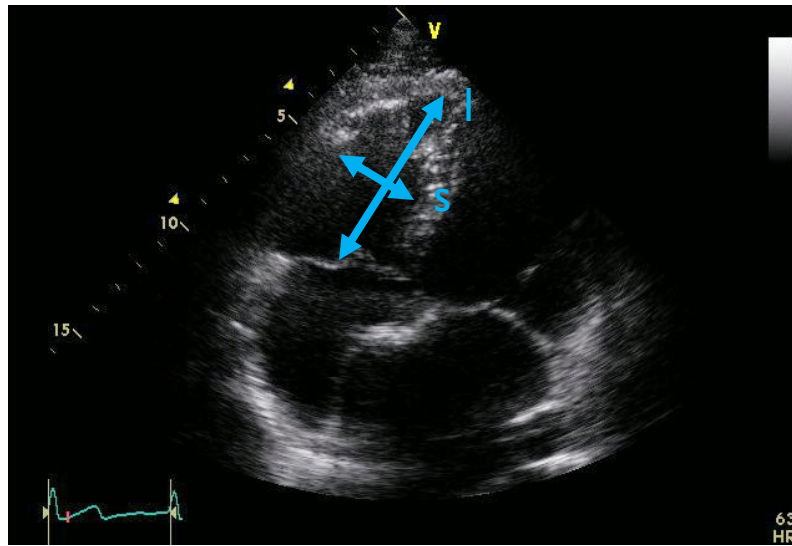
# Methods

- Definition of AF and Classification of Pts
  - **Paroxysmal AF (Group 1):** AF usually self-terminating within 48 h and, by definition, in  $\leq 7$  days
  - **Persistent AF (Group 2):** AF lasting  $> 7$  days and requiring pharmacological therapy or electrical cardioversion to terminate
  - **Permanent AF (Group 3):** long-standing AF which fails to terminate using cardioversion or is terminated but relapses with 24 h.



# Methods

- Echocardiographic examinations

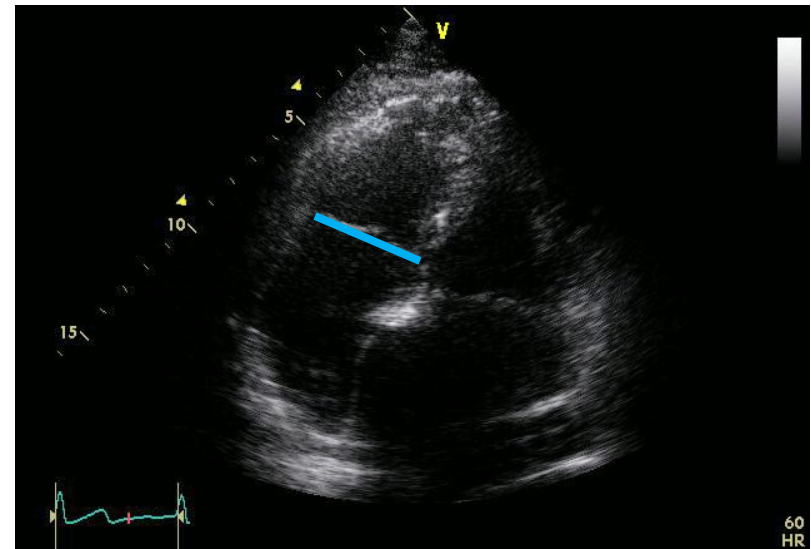
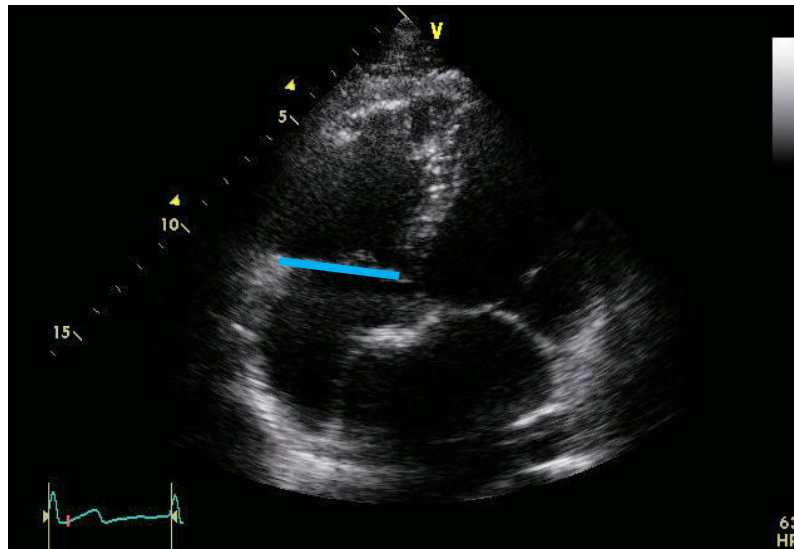


RV sphericity index (RVSI) =  $l/s$

RV eccentricity index (RVEI) =  $g/w$

# Methods

- Echocardiographic examinations



End-diastolic tricuspid annulus (TA) dimension

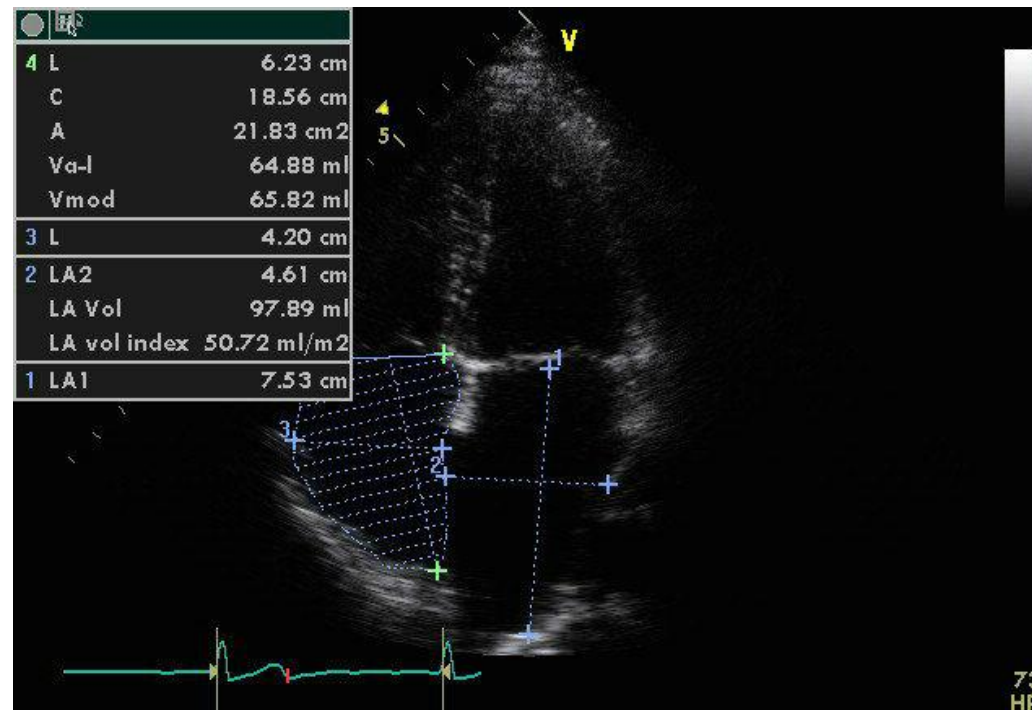
End-systolic tricuspid annulus (TA) dimension

Fractional shortening of TA dimension =

$$\frac{(\text{End-diastolic TA dimension}) - (\text{End-systolic TA dimension})}{\text{End-diastolic TA dimension}}$$

# Methods

- Echocardiographic examinations



**RA volume:** area-length formula

**LA volume:** prolate ellipsoid method



# Results

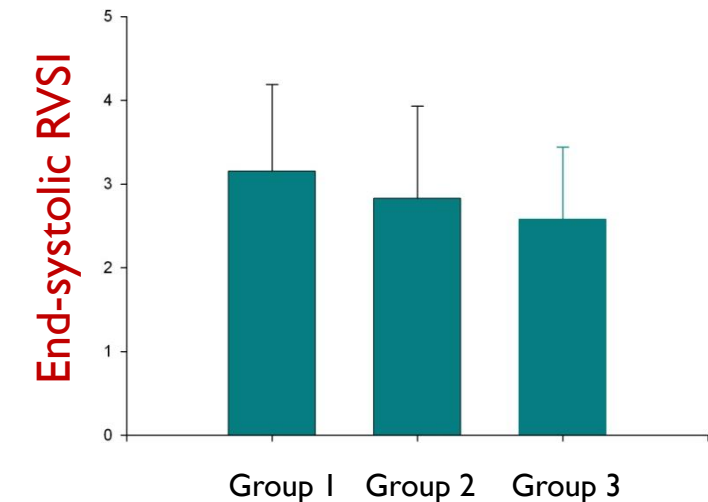
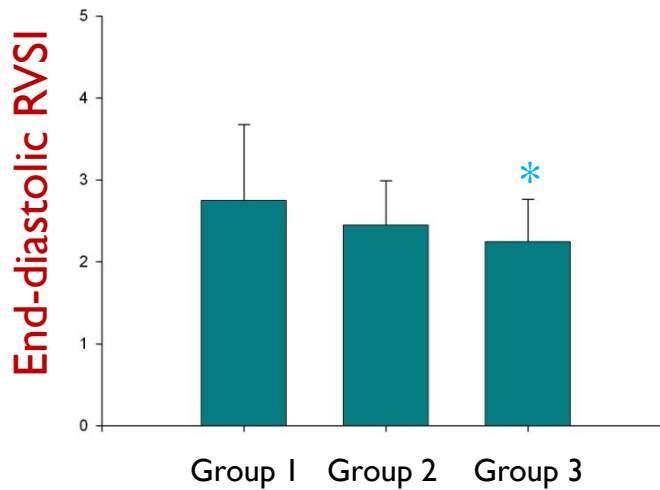
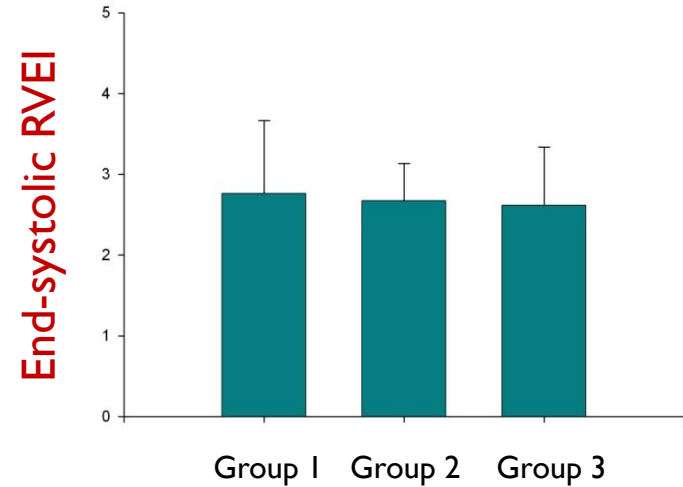
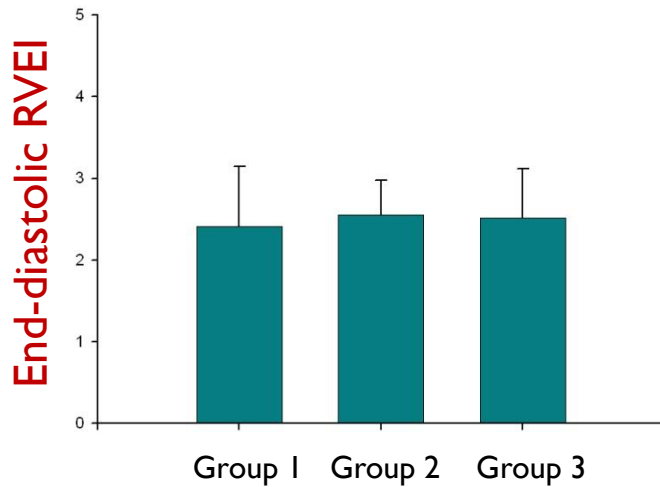
# Clinical characteristics

	Group 1 (n=19)	Group 2 (n=27)	Group 3 (n=37)	P
Age (yr)	57 ± 15	67 ± 14	65 ± 11	0.047
Sex (male, %)	13 (68%)	13 (48%)	13 (35%)	0.065
Height (cm)	165 ± 9	163 ± 10	160 ± 8	0.196
Weight (kg)	62 ± 11	65 ± 19	60 ± 9	0.434
Body surface area (m <sup>2</sup> )	1.7 ± 0.2	1.7 ± 0.3	1.6 ± 0.0	0.415
Systolic blood pressure (mmHg)	128 ± 16	130 ± 18	125 ± 17	0.409
Diastolic blood pressure (mmHg)	75 ± 14	77 ± 14	74 ± 12	0.705
Heart rate (min <sup>-1</sup> )	78 ± 17	87 ± 20	76 ± 16	0.035
Coronary artery disease (n, %)	3 (16%)	1 (4%)	6 (16%)	0.279
Hypertension (n, %)	6 (32%)	16 (59%)	26 (70%)	0.021
Congestive heart failure (n, %)	0 (0)	2 (7%)	8 (22%)	0.053
Stroke (n, %)	3 (16%)	3 (11%)	13 (35%)	0.064
NYHA Class				0.757
I	16 (84%)	19 (70%)	23 (62%)	
II	1 (5%)	5 (19%)	8 (22%)	
III	1 (5%)	2 (7%)	3 (8%)	
IV	1 (5%)	1 (4%)	3 (8%)	

# Echocardiographic characteristics

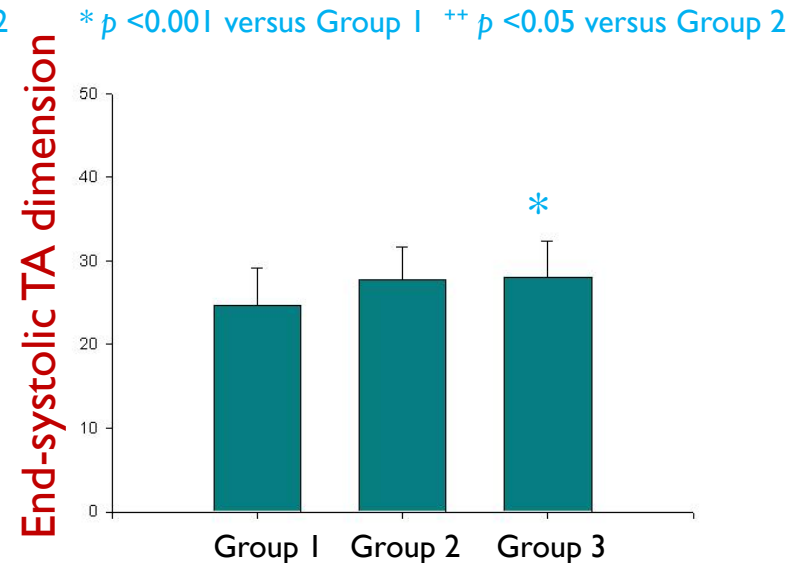
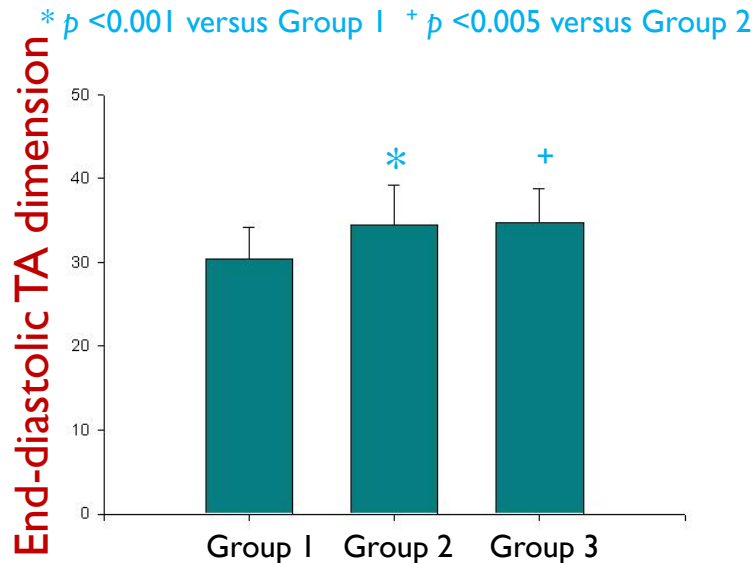
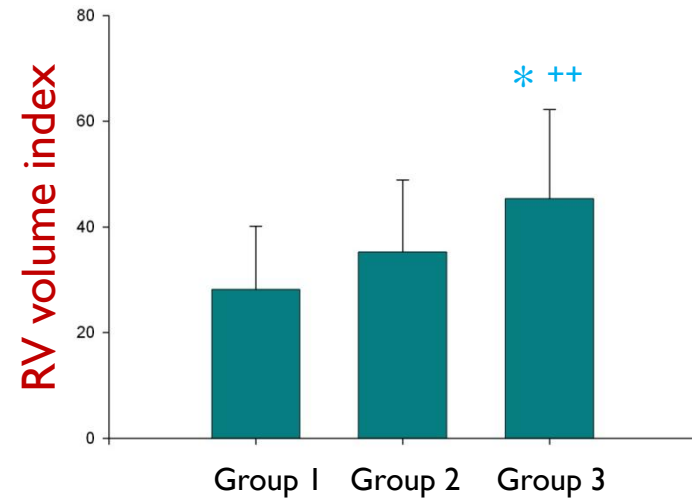
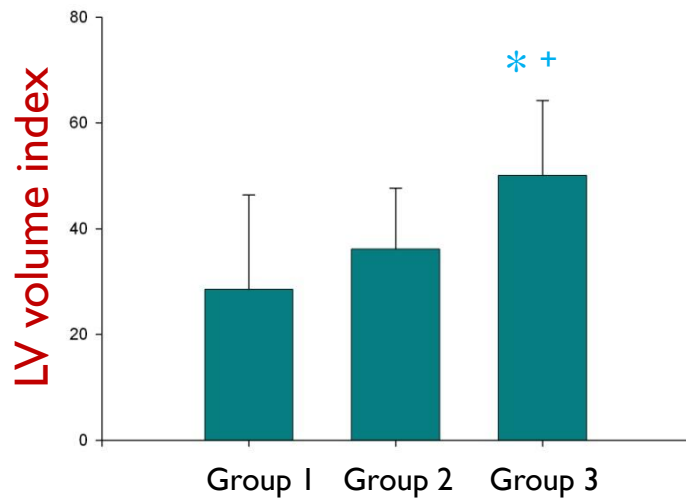
	Group 1 (n = 19)	Group 2 (n = 27)	Group 3 (n = 37)	P by ANOVA
End-diastolic LV dimension (mm)	46 ± 5	48 ± 6	49 ± 5	0.256
End-systolic LV dimension (mm)	30 ± 5	31 ± 5	32 ± 5	0.530
Ventricular septal wall thickness (mm)	10 ± 3	9 ± 2	10 ± 2	0.539
Posterior wall thickness (mm)	9 ± 1	9 ± 2	10 ± 2	0.007
Ejection fraction (%)	63 ± 4	61 ± 5	62 ± 5	0.310
LA volume index (mL/m <sup>2</sup> )	29 ± 18	36 ± 11	50 ± 14	<0.001
End-diastolic RVEI	2.4 ± 0.7	2.6 ± 0.4	2.5 ± 0.6	0.726
End-systolic RVEI	2.8 ± 0.9	2.7 ± 0.5	2.6 ± 0.7	0.764
End-diastolic RVSI	2.7 ± 0.9	2.4 ± 0.5	2.2 ± 0.5	0.028
End-systolic RVSI	3.2 ± 1.0	2.8 ± 1.1	2.6 ± 0.9	0.123
RA volume index (mL/m <sup>2</sup> )	28 ± 12	35 ± 14	45 ± 17	<0.001
Fractional area change of RV (%)	37 ± 11	33 ± 9	34 ± 10	0.354
End-diastolic TA dimension (mm)	30 ± 4	34 ± 5	35 ± 4	0.001
End-systolic TA dimension (mm)	25 ± 5	28 ± 4	28 ± 4	0.018
Fractional shortening of TA (%)	19 ± 10	19 ± 9	19 ± 7	0.986
RV systolic pressure (mmHg)	31 ± 5	30 ± 6	33 ± 9	0.449

# RVEI, RVSI between paroxysmal AF, persistent AF and Permanent AF



\*  $p < 0.001$  versus Group 1

# LAVI, RAVI and TA between Paroxysmal, Persistent and Permanent AF



\*  $p < 0.001$  versus Group 1 +  $p < 0.005$  versus Group 2

\*  $p < 0.001$  versus Group 1 ++  $p < 0.05$  versus Group 2

\*  $p < 0.01$  versus Group 1 +  $p < 0.005$  versus Group 1

\*  $p < 0.05$  versus Group 1



# Univariate and multivariate analysis

## End-systolic tricuspid annulus dimension

	r	Univariate p	Multivariate p	$\beta$	R <sup>2</sup>
End-diastolic RVSI	-0.563	<0.001	0.005	-0.258	0.587
End-systolic RVSI	-0.555	<0.001	-	-	
Fractional shortening of TA	-0.555	<0.001	<0.001	-0.427	
RA volume index	0.379	<0.001	<0.001	0.356	
End-diastolic LV dimension	0.306	0.005	0.003	0.222	
End-diastolic RVEI	0.201	0.068	0.004	0.212	
LA volume index	0.195	0.077	0.612	-	

# Univariate and multivariate analysis

## End-diastolic tricuspid annulus dimension

	r	Univariate p	Multivariate p	$\beta$	R <sup>2</sup>
RA volume index	0.505	<0.001	<0.001	0.456	0.390
End-diastolic RVSI	-0.357	0.001	0.027	-0.209	
End-diastolic LV dimension	0.306	0.005	0.016	0.223	
LA volume index	0.292	0.007	0.916	-	
End-diastolic RVEI	0.214	0.052	0.008	0.238	
Heart rate	-0.194	0.081	0.436	-	

# Univariate and multivariate analysis

## End-diastolic RV sphericity index

	<i>r</i>	Univariate <i>p</i>	Multivariate <i>p</i>	$\beta$	$R^2$
End-systolic TA dimension	-0.563	<0.001	0.005	-0.350	0.395
Fractional shortening of TA	0.464	<0.001	0.028	0.255	
End-diastolic TA dimension	-0.357	0.001	-	-	
LA volume index	-0.320	0.003	0.016	-0.240	
Systolic BP	0.289	0.008	0.182	-	
Diastolic BP	0.278	0.011	-	-	
RA volume index	-0.255	0.020	0.852	-	

# Summary

- Chronic AF without disease conditions causing secondary TR and without significant TR may cause TA dilatation which is associated with fractional shortening of TA dimension, RA volume index, end-diastolic RVSI & RVEI and LV dimension.
- Chronic AF may cause TA dilatation, RV remodeling and predispose to subsequent TR.



**THANK YOU FOR YOUR  
ATTENTION.**