# **Pulmonary Vascular Function at Exercise in**

# Systemic Sclerosis: a Case-Control Study



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#### Background

- Pulmonary arterial hypertension (PAH) is a life-threatening condition occurring in 5 to 12% of patients with systemic sclerosis (SSc).
- Screening is mandatory in SSc patients to enable early detection of PAH, which improves the outcome.
- Exaggerated increase in pulmonary arterial pressure (PAP) at exercise has been reported in SSc patients based on arbitrary definitions.
- The clinical use of exercise echocardiography (ExEcho) has been limited by the difficulty to establish limits of normal, and lack of standardized protocol.



• Few studies investigated pulmonary circulation by relationship between mean PAP (PAPm) and cardiac output (CO) during exercise (P/Q relationship).

#### Purpose

To assess the exercise-induced changes in the pulmonary circulation by P/Q relationship in SSc patients compared with healthy controls.

# Methods

- We prospectively enrolled SSc patients with no significant lung or heart disease and healthy volunteers.
- Maximal ExEcho was performed to generate multipoint P/Q relationship.
- Results were compared after correction for age and gender.
- Data are expressed as mean ± SD or median (IQR) as appropriate.
- \* indicates non-parametric test was applied.

Table1. General characteristics of study population				
	SSc patients	Controls	р	
Ν	42	47		
Female, n (%)	39 (93%)	34 (72%)	0.01	
Age, y (mean ± SD)	53 ± 12	46 ± 11	0.004	
BMI (mean ± SD)	24 ± 4	24 ± 4	0.94	

## **Results**

- Main characteristics of the study population are shown in Table 1.
- At peak exercise, patients had lower PAP, lower CO, and higher TPR than controls (Table 3).
- They presented lower TAPSE and S velocity at exercise than controls.
- P/Q slope was higher in patients (Figure1), but the difference was not significant after correction for age (Table 3).

Table 2. Echocardiography at rest			
	SSc patients	Controls	р
LVD index, mm/m <sup>2</sup>	28 ± 3	27 ± 3	0.670
LVEF, %	62 ± 7	63 ± 6	0.569
LA volume index, ml/m2	25 (10)	18 (10)	0.013*
RV surface index, cm <sup>2</sup> /m <sup>2</sup>	9.6 ± 1.5	9.7 ± 1.5	0.74
RV FAC, %	55 ± 6	54 ± 5	0.5
PAPs, mmHg	27 ± 4	25 ± 4	0.09
CO, I/min	4,5 ± 1	$4,5 \pm 0,8$	0.977
TPR rest, WU	4.1 ± 0.9	$3.9 \pm 0.8$	0.274
TAPSE, mm	24 ± 4	25 ± 4	0.27
S wave velocity, cm/s	12 ± 2	13 ± 2	0.29
Table 3. Exercise Echocardiography			
	SSc patients	Controls	р
Peak Workload, Watts	50 (35)	130 (55)	<0.001*
Peak HR, % FMT	81 (21)	93 (19)	<0.001*
Peak PAPs, mmHg	46 ± 7	53 ± 9	0.001
Peak PAPm, mmHg	30 ± 4	34 ± 5	0.001
Peak CO, I/min	9.7 ± 1.9	13.6 ± 3.2	<0.001
Peak CI, I/min/m2	5.9 ± 1.2	7.7 ± 1.4	<0.001
Peak TPR, WU	$3.2 \pm 0.6$	2.6 ± 0.5	0.003
P/Q slope, mmHg/L/min	$2.35 \pm 0.59$	$1.93 \pm 0.56$	0.150
TAPSE max, mm	33 ± 4	36 ± 4	0.035
S wave velocity max, cm/s	19 ± 3	24 ± 3	<0.001



Figure 1. Multipoint relationship between mean PAP and CO during exercise in SScpatients (red points and lines) vs Controls (blue points and lines)

#### Discussion

- In the absence of patent cardiac or respiratory disease, SSc patients presented with lower exercise capacity than controls.
- Although patients had lower PAP at exercise, PAPm to CO ratio (TPR) and P/Q slope were higher in patients than controls.
- The steeper P/Q relationship in SSc patients may be related to their older age. In contrast, peak TPR was not affected by age.
- Left atrial (LA) dimension was in normal range but larger in SSc patients compared with controls, which may suggest latent left ventricular dysfunction.
- Cardiac output and right ventricular function at exercise were lower in patients, which might also suggest some degree of myocardial involvement.

### Conclusion

Our data suggest that patients with systemic sclerosis may have a different pulmonary vascular and myocardial adaptation to exercise compared with healthy individuals. This pattern may be observed in patients without overt cardiac or respiratory disease and should be taken into account when screening for pulmonary hypertension in this population.

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