CORRELATION BETWEEN SUBMAXIMAL EXERCISE TESTING AND RIGHT HEART CATHETERIZATION IN PATIENTS WITH SYSTEMIC SCLEROSIS (SSC)

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Abstract

Background:

The six-minute walk test (6MWT) has been used as a primary outcome measure in studies of pulmonary arterial hypertension (PAH). Correlations of 6MWT variables and right heart catheterization (RHC), a gold standard of PAH diagnosis, have not been examined in SSc patients.

Purpose:

To determine the correlations between the 6MWT and RHC variables in SSc patients.

Methods and Patients:

41 SSc patients with 1 test set of RHC, 6MWT and PFT within 12 weeks of the corresponding RHC were retrospectively identified. Data included clinical characteristics; RHC variables: right atrial pressure (RAP), mean pulmonary arterial pressure (mPAP), pulmonary capillary wedge pressure (PCWP), pulmonary vascular resistance (PVR), mixed venous O2 saturation (SvO2), cardiac output (CO); 6MWT variables: 6MW distance, SpAO2 (rest, nadir), Δ SpAO2 (SpAO2 rest-nadir), heart rate (HR rest, peak), HR change (Δ HR: HR peak-rest), Borg Dyspnea Index (BDI rest, peak), Borg Fatigue Index (BFI rest, peak); and PFT variables: FVC and DLCO (% predicted). Forehead probe pulse oximeter was used to measure SpAO2.

PAH was defined as mPAP >25 mmHg at rest and PCWP ≤ 15 mmHg. Interstitial lung disease (ILD) was defined as % FVC < 85. Pearson correlation coefficients were used to determine the correlations between 6MWT and RHC variables.

Results:

Mean (SD) age was 55.8 (10.1) yrs and mean disease duration 6.5 (4.9) yrs. 85.4% were female; 82.9% were classified as limited SSc, 58.5% SSc-PAH-ILD, 19.5% SSc-ILD, 17.1% SSc-PAH, 2.4% SSc-PH-LVdys, and 2.4% SSC-none. Mean (SD) values were: RAP 9.3 (6.3) mmHg; mPAP 40.2 (15.7) mmHg; PCWP 10.5 (4.0) mmHg; PVR 7.1 (4.4); SvO2 64.8 (8.2) %; CO 4.6 (1.3) L/min; 6MWD 312.6 (94.6) m; HR baseline 83.7 (15.3) beat/min; HR peak 118.4 (17.9); Δ HR 34.2 (14.8); SpAO2 baseline 98.0(1.5); SpAO2 nadir 91.8 (4.4); Δ SpAO2 6.2 (4.4); BDI rest 0.8 (1.2); BDI peak 4.2 (3.0); BFI rest 0.9 (1.3); BFI peak 3.5 (2.8); % FVC 67.9 (20.5), and % DLco 34.7 (15.8). 6 (14.6%) patients were on current use of beta blockers and 18 (43.9%) who used oxygen supplementation during the 6MWT.

Correlations between 6MWT and RHC variables are shown in **Table 3.**

Conclusions:

6MWD and heart rate change show statistically significant low to moderate correlation with the RHC variables. Correlations between RHC variables and HR peak, SpAO2 rest, BDI, and BFI peak, if significant, are low to moderate. HR rest, SpAO2 (nadir, Δ SpAO2), and BFI rest reveal no significant correlations with RHC variables. Further study is needed to validate HR response as an outcome measure of SSc-PAH.

Introduction

The 6-minute walk test (6MWT) is a standardized measure of submaximal exercise capacity which has been served as a primary outcome measure of idiopathic pulmonary hypertension. Although not fully validated, it has been used as an outcome measure in clinical trials of pulmonary arterial hypertension in SSc (PAH-SSc).

Correlations of 6MWT variables with right heart catheterization (RHC), a gold standard of pulmonary hypertension diagnosis, have not been examined in SSc patients.

Purpose:

To determine the correlations between the 6MWT and RHC variables in a sample of SSc patients.

Methods

Subjects:

- 41 SSc patients attending at University of Michigan between June 2005 and May 2008 with one test set of RHC, 6MWT and PFT within 12 weeks of the corresponding RHC were retrospectively identified.

Data:

1. Clinical characteristics
2. RHC variables
   - Right atrial pressure (RAP)
   - Mean pulmonary arterial pressure (mPAP)
   - Pulmonary capillary wedge pressure (PCWP)
   - Pulmonary vascular resistance (PVR)
   - Mixed venous O2 saturation (SvO2)
   - Cardiac output (CO)
3. 6MWT variables
   - % predicted FVC, DLco
4. Echocardiography
   - 6MW distance (6MWD)
   - SpAO2 (rest, nadir) *
   - Δ SpAO2 (SpAO2 rest - nadir) *

   * Forehead probe pulse oximeter was used to measure SpAO2.
   - Heart rate (HR rest, peak)
   - HR change (Δ HR: HR peak - rest)
   - Borg Dyspnea Index (BDI rest, peak)
   - Borg Fatigue Index (BFI rest, peak)
5. Pulmonary Function Test
   - FVC %, DLCO %

   • PAH was defined as mPAP >25 mmHg at rest and PCWP < 15 mmHg.

   • Interstitial lung disease (ILD) was defined as % FVC < 85.

Results

Table 1. Patient characteristics

Variable	Total population N=41
Age, yrs	55.8 ± 10.1
Disease duration, yrs	6.5 ± 4.9
Female, n (%)	35 (85.4)
Limited SSc, n (%)	34 (82.9)
SSc-PAH-ILD, n (%)	24 (58.5)
SSc-ILD, n (%)	8 (19.5)
SSc-PAH, n (%)	7 (17.1)
SSc-PH-LVdys, n (%)	1 (2.4)
SSC-none, n (%)	1 (2.4)
Current beta blocker user, n (%)	6 (14.6)
Oxygen supplementation, n (%)	18 (43.9)

Table 2. Right heart catheterization, 6MWT, and PFT variables

Variable	Total population N=41
Right heart catheterization	
RAP, mmHg	9.3 ± 6.3
mPAP, mmHg	40.2 ± 15.7
PCWP, mmHg	10.5 ± 4.0
PVR, Wood unit	7.1 ± 4.4
SvO2,%	64.8 ± 8.2
CO, L/min	4.6 ± 1.3
6MWT	
6MWD, m.	312.6 ± 94.6
HR rest, beat/min	83.7 ± 15.3
HR peak, beat/min	118.4 ± 17.9
Δ HR (peak - rest), beat/min	34.2 ± 14.8
SpAO2 rest, %	98.0 ±1.5
SpAO2 nadir, %	91.8 ± 4.4
Δ SpAO2 (rest - nadir), %	6.2 ± 4.4
BDI rest	0.8 ± 1.2
BDI peak	4.2 ± 3.0
BFI rest	0.9 ± 1.3
BFI peak	3.5 ± 2.8
Pulmonary Function Test	
% FVC	67.9 ± 20.5
% DLco	34.7 ± 15.8

Table 3. Correlations between RHC and 6MWT variables

Variable	6MWD	HR rest	HR peak	HR	SpAO2 rest	SpAO2 nadir	SpAO2	BDI rest	BDI peak	BFI rest	BFI peak
Total grp (N=41)											
RAP	-.47** 40	.15 40	-.24 38	-.44** 38	-.42** 40	.12 38	-.25 38	.37* 32	.27 34	.16 30	.40* 30
mPAP	-.48** 41	.06 41	-.30 39	-.42** 39	-.24 41	-.11 39	.03 39	.29 33	.37* 35	.03 31	.33 31
PVR	-.40* 37	.00 37	-.32 35	-.38* 35	-.27 37	-.08 35	-.00 35	.25 29	.21 31	-.00 27	.17 27
SvO2	.39* 35	.05 35	.37* 33	.39* 33	.16 35	-.14 33	.18 33	.01 28	.08 30	.24 26	-.01 26
CO	.36* 41	.13 41	.39* 39	.36* 39	.19 41	-.19 39	.25 39	-.27 33	-.11 35	-.01 31	-.19 31

Statistical method: Pearson correlation

* p < 0.05 , ** p < 0.01

Conclusions

- 6MWD and heart rate change show statistically significant low to moderate correlation with the RHC variables.
- Correlations between RHC variables and HR peak, SpAO2 rest, BDI, and BFI peak, if significant, are low to moderate.
- No significant correlations of RHC variables with HR rest, SpAO2 (nadir, Δ SpAO2), and BFI rest.
- Further study is needed to validate HR response as an outcome measure of SSc-PAH.