

Northumbria Research Link

Citation: Vogiatzis, Ioannis and Bouros, Demosthenes (2021) Ergogenic Value of Oxygen Supplementation in Patients with Idiopathic Pulmonary Fibrosis with Isolated Exertional Oxygen Desaturation. *Respiration*. pp. 1-2. ISSN 0025-7931 (In Press)

Published by: Karger

URL: <https://doi.org/10.1159/000515397> <<https://doi.org/10.1159/000515397>>

This version was downloaded from Northumbria Research Link:
<http://nrl.northumbria.ac.uk/id/eprint/45927/>

Northumbria University has developed Northumbria Research Link (NRL) to enable users to access the University's research output. Copyright © and moral rights for items on NRL are retained by the individual author(s) and/or other copyright owners. Single copies of full items can be reproduced, displayed or performed, and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided the authors, title and full bibliographic details are given, as well as a hyperlink and/or URL to the original metadata page. The content must not be changed in any way. Full items must not be sold commercially in any format or medium without formal permission of the copyright holder. The full policy is available online: <http://nrl.northumbria.ac.uk/policies.html>

This document may differ from the final, published version of the research and has been made available online in accordance with publisher policies. To read and/or cite from the published version of the research, please visit the publisher's website (a subscription may be required.)



Northumbria
University
NEWCASTLE

Title: Ergogenic value of oxygen supplementation in patients with idiopathic pulmonary fibrosis with isolated exertional oxygen desaturation

Authors: Ioannis Vogiatzis¹ FERS, and Demosthenes Bouros² FERS, FAPSR, FCCP

Affiliations:

1. Professor Ioannis Vogiatzis, PhD, FERS. Northumbria University Newcastle, Department of Sport, Exercise and Rehabilitation, Newcastle upon Tyne, UK. ioannis.vogiatzis@northumbria.ac.uk
2. Professor Demosthenes Bouros, MD, PhD, FERS, FAPSR, FCCP. National and Kapodistrian University of Athens Medical Centre, 1st Department of Respiratory Medicine, Athens, Greece. dbouros@med.uoa.gr

The underlying physiological mechanisms regulating the effectiveness of oxygen supplementation during exercise in patients with idiopathic pulmonary fibrosis (IPF) with isolated exertional oxygen desaturation are largely unknown. The elegant study by Dipla and colleagues (1) examined the effects of oxygen supplementation during sub-maximal exercise (versus medical air) on cerebral and locomotor local muscle oxygen availability, and systemic hemodynamics.

In this prospective, randomised, cross-over, placebo-controlled study, 13 IPF patients without resting hypoxemia but a significant arterial oxygen desaturation during maximal cardiopulmonary exercise testing, underwent two steady-state exercise trials on the cycle ergometer (equivalent to 65% peak-work-load), breathing either oxygen-enriched air (FiO₂: 40%) or medical air (sham oxygen; FiO₂: 21%). Cerebral/skeletal muscle oxygenation was monitored (by near-infrared-spectroscopy) and beat-by-beat hemodynamics by photoplethysmography. The study concluded that correcting exercise-induced arterial oxygen desaturation with oxygen supplementation, enhanced exercise tolerance, prevented the decline in cerebral oxygen availability, and improved local muscle oxygen availability, whilst lessened dyspnea and leg discomfort, thus suggesting an efficacy of acute oxygen supplementation during exercise in IPF patients.

Discussion of why the oxygen compared to the medical air protocol significantly increased endurance time (15.2 ± 5.0 versus 10.0 ± 4.3 min, respectively) during exercise with same average exercise intensity in each protocol is of great interest to elucidate the physiological mechanisms enhancing exercise tolerance in IPF. The logic is as follows:

1. Suppose that there was one dominant limiting factor to endurance time to consider among the physiological (cardiac output, cerebral oxygen availability, peripheral local muscle oxygen availability) and perceptual (dyspnoea, leg discomfort) variables recorded.

2. At the time point marking the limit of tolerance in the air protocol (i.e.: isotime: when work completed was the same in air and oxygen protocols), one would expect that the value of the dominating limiting factor would be less altered (from resting values) in the oxygen protocol than in the air protocol. According to the results of the study, the candidate variables were: i) the lower dyspnoea, ii) the lower leg discomfort, iii) the lower locomotor local muscle de-oxygenation (i.e. greater locomotor local muscle oxygen availability) and iv) the lower cerebral de-oxygenation (i.e.: greater cerebral oxygen availability). Cardiac output does not fit this pattern because there were not any differences between the air and oxygen protocols, so circulatory limitation was not a limiting factor.

3. At the time point marking limit of tolerance in the oxygen protocol, one would expect the value of the dominating limiting factor to have reached the same alteration (from resting values) as at the limit of tolerance in the air protocol. Dyspnoea and cerebral de-oxygenation are not candidates because they were still lower at the limit of tolerance in the oxygen protocol compared to the limit of tolerance in the air protocol. The logic is that if dyspnoea or cerebral oxygen availability limited endurance time, then endurance should have been even longer in the oxygen protocol than it was because the perturbations had not yet reached the value seen in the air protocol.

4. The only variables examined that fit the pattern expected for a limiting factor was locomotor local muscle de-oxygenation (local muscle oxygen availability) and leg discomfort. In fact, at exercise termination perceived leg discomfort and locomotor

local muscle de-oxygenation were not significantly different between the air and oxygen protocols.

5. These data and the above analysis then suggest that the reason for reaching a limitation in each protocol was having reached the same degree of locomotor muscle de-oxygenation and leg discomfort, which took longer in the oxygen than in the air protocol. These findings, in turn, highlight the value of oxygen supplementation during exercise training as part of pulmonary rehabilitation in patients with IPF. Greater locomotor muscle oxygen availability would delay metabolic acidosis and attenuate locomotor muscle fatigue, thereby increasing the time that IPF patients can exercise during a session of pulmonary rehabilitation. This would, in turn, be expected to augment the benefits of pulmonary rehabilitation in improving functional capacity and autonomy in this population.

Of interest is that the duration of exercise with oxygen supplementation (on average 15 min) is still quite limited to optimise the physiological adaptations of exercise training in this population. Considering that oxygen supplementation is not always available in the hospital- and/or the community-based pulmonary rehabilitation setting, alternative modalities of exercise training, such as intermittent exercise, may be considered in patients with IPF with isolated exertional hypoxemia. Intermittent exercise training, as part of pulmonary rehabilitation, has been shown to be feasible and efficacious in IPF patients in improving exercise tolerance, functional capacity, pulmonary function, dyspnea and health-related quality of life, thereby suggesting that this training modality may be considered the standard care for IPF (2). A recently published review article introduces the principles and different modalities of exercise training, and also summarizes the effects of various types of exercise training in patients with Interstitial Lung Diseases including IPF (3).

References

1. Konstantina Dipla, Afroditi K. Boutou, Aikaterini Markopoulou, Georgia Pitsiou, Stavros Papadopoulos, Anastasia Chatzikosti, Ioannis Stanopoulos, Andreas Zafeiridis. Exertional desaturation in Idiopathic Pulmonary Fibrosis: the role of oxygen supplementation in modifying cerebral-skeletal muscle oxygenation and systemic hemodynamics. **Respiration-2020**-9 59.
2. Baruch Vainshelboim , Jose Oliveira, Liora Yehoshua, Israela Weiss, Benjamin Daniel Fox, Oren Fruchter, Mordechai Reuven Kramer. Exercise training-based pulmonary rehabilitation program is clinically beneficial for idiopathic pulmonary fibrosis. **Respiration; 2014**; 88(5):378-88.
3. Matthew Armstrong and Ioannis Vogiatzis. Personalized exercise training in chronic lung diseases. **Respirology; 2019** Sep;24(9):854-862.