2022 CAS Annual Meeting

Hyperbaric Medicine

(Abstracts and Case Report/Series)

Heavy Breathing: A Prospective Cohort Study of the Effect of Hyperbaric Oxygen Therapy on Pulmonary Function

Authors:

Brenna, Connor T. A.[1], Khan, Shawn[2]; Shiavo, Simone[3]; Wahaj, Mustafa[3]; Janisse, Ray[3]; Katznelson, Rita[1,3,4]

[1] *Department of Anesthesiology & Pain Medicine, University of Toronto, Toronto, Canada*
[2] *Faculty of Medicine, University of Toronto, Toronto, Canada*
[3] *Hyperbaric Medicine Unit, Toronto General Hospital, Toronto, Canada*
[4] *Department of Anesthesia, University Health Network, Toronto, Canada*

Introduction:

Hyperbaric oxygen therapy (HBOT) is an effective means of improving plasma and tissue oxygenation by way of exposure to supra-atmospheric partial pressures of oxygen, and is indicated in the treatment of an expanding list of medical conditions. Although the safety and efficacy of HBOT are well evidenced, it bears known risks of complications such as barotrauma and confinement anxiety or, in rare circumstances, pneumothoraces or arterial gas emboli.[1] In addition, it has been suggested that repeated exposure to pressurized, hyperoxic environments may lead to oxygen toxicity and impaired pulmonary function.[2,3] This remains controversial, however, and recent studies of HBOT with human subjects indicate that it may paradoxically improve some elements of pulmonary function.[4,5] The present study sought to evaluate serial changes in pulmonary function test performance among patients undergoing HBOT, to characterize the effect of this treatment on pulmonary function.

Methods:

This prospective cohort study recruited patients treated with HBOT, for any indication, at a single-institution academic centre between 2016 and 2021. All patients underwent HBOT using 100% oxygen at 2.0-2.4 ATA for 90 minutes, five times weekly, in one of three mono-place chambers. Pulmonary function testing was performed using a bedside spirometer and pneumotachometer, on the same day as the first HBOT treatment session and after approximately every 20 subsequent treatments. Patients' charts were reviewed retrospectively to collect demographic information, comorbidities and medications, specifications of HBOT protocolization, complications of treatment, and serial pulmonary function testing values including percentage of predicted forced expiratory volume in one second (FEV1%), forced vital capacity (FVC%), and mean forced expiratory flow from 25% to 75% of pulmonary volume (FEF25-75%). The primary outcome was change in serial measures of pulmonary function after 0, 20, 40, and 60 HBOT sessions. A secondary outcome was the incidence of acute pulmonary complications of HBOT within our large cohort. Data was subjected to descriptive statistics and mixed-model linear regression. This study received institutional ethics board approval, and the study protocol was registered in the US National Library of Medicine registry of clinical trials (ClinicalTrials.gov).

Results:

We enrolled 160 patients, of whom 86 underwent testing prior to HBOT and after 20, 40, and/or 60 sessions. These 86, included in the analysis, comprised 33 female and 53 male patients with an average age of 57.5±15.4 (24-87) and average BMI of 27.1±10.3 (15.7-83.7). Fourteen patients (16%) had pre-existing pulmonary disease, and the cohort included 47 lifelong non-smokers (55%), while the remaining 39 averaged 19.5±13.2 (1-50) "pack years" of smoking history. Patients underwent an average of 42.5 HBOT sessions (totalling 3666). At baseline (n=86), FEMunroV1% was 88.0 (83.3-92.7), FVC% was 92.7 (88.8-96.6), and FEF25-75% was 76.1 (68.8-

83.4). After 20 HBOT treatments (n=81), FEV1% was 85.9 (81.2-90.6), FVC% was 90.8 (86.8-94.7), and FEF25-75% was 75.9 (68.6-83.3). After 40 treatments (n=52), FEV1% was 87.4 (82.4-92.3), FVC% was 93.0 (88.8-97.2), and FEF25-75% was 75.5 (67.9-83.1). After 60 treatments (n=12), FEV1% was 84.6 (77.7-91.5), FVC% was 89.7 (83.9-95.5), and FEF25-75% was 74.0 (64.3-83.6).

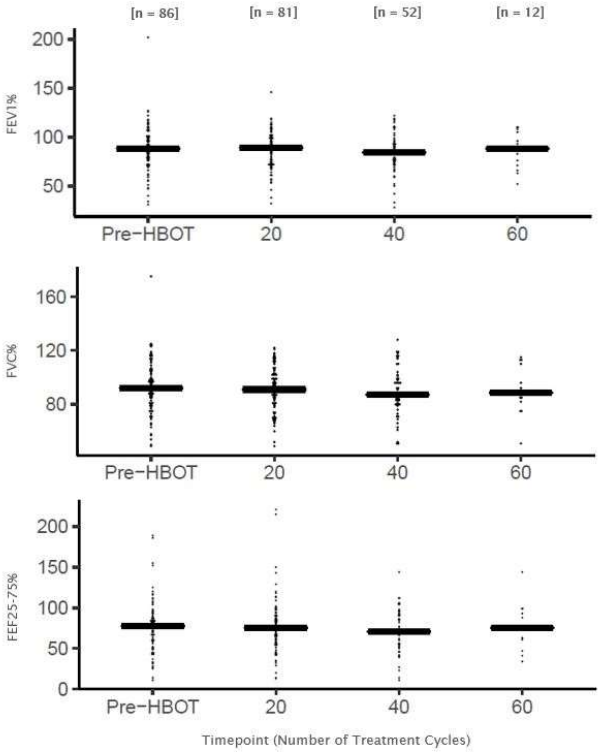
Discussion:

We found no significant changes in measures of FEV1%, FVC%, or FEF25-75% with serial HBOT. Our study's limitations include a lack of control group, as well as heterogeneity in the availability of pulmonary function data for enrolled patients. However, its strength is a relatively large cohort (representative of the breadth of patients treated at a large HBOT referral center), and its findings suggest that risks of oxygen toxicity as a sequela of HBOT are insubstantial in the context of modern treatment protocols. This study forwards the claim that even prolonged courses of HBOT are safe with respect to pulmonary function.

Reference:

1. Rivalland G, Mitchell SJ, van Schalkwyk JM. Pulmonary Barotrauma and Cerebral Arterial Gas Embolism During Hyperbaric Oxygen Therapy. *Aviation, Space, and Environmental Medicine*. 2010;81(9). doi:10.3357/ASEM.2783.2010
2. Thorsen E, Aanderud L, Aasen TB. Effects of a standard hyperbaric oxygen treatment protocol on pulmonary function. *European Respiratory Journal*. 1998;12(6):1442-1445. doi:10.1183/09031936.98.12061442
3. Pott F, Westergaard P, Mortensen J, Jansen EC. Hyperbaric oxygen treatment and pulmonary function. *Undersea and Hyperbaric Medicine*. 1999;26(4):225-228.
4. Hadanny A, Zubari T, Tamir-Adler L, et al. Hyperbaric oxygen therapy effects on pulmonary functions: A prospective cohort study. *BMC Pulmonary Medicine*. 2019;19(1):148. doi:10.1186/s12890-019-0893-8
5. Comert S, Sumen SG, Caglayan B. Effects of a standard hyperbaric oxygen treatment protocol on pulmonary functions and diaphragm. *European Respiratory Journal*. 2017;50:PA730. doi:10.1183/1393003.congress-2017.pa730

Figure 1:


[n = 86]
[n = 81]
[n = 52]
[n = 12]
FEV1%
200
150
100
50
Pre−HBOT
20
40
60
FVC%
160
120
80
FEF25-75%
0
Timepoint (Number of Treatment Cycles)