Oxygen in Pulmonary Rehabilitation

Mieczyslaw Pokorski
Opole Medical School, Opole, Poland

Oxygen belongs to therapeutic pharmacological tools. It is a life-safer in a host of clinical conditions, notably in emergency treatment when it is supplemented on the acute basis, and in chronic hypoxic lung pathologies when it is often used in home-based self-treatment. Emergency supplementation of oxygen is often shunned due to the possibility of dampening of lung ventilation mediated by carotid body inhibition. That rekindles an old and still unclear issue of whether oxygen is actually inhibitory or stimulatory for ventilation. To this end, I would like to present some of our results on the application of high oxygen concentration to breathing in healthy humans. The ventilatory inhibition appeared short-lived during 1-2 min after the commencement of oxygen bleed into the airway pipe, mediated by carotid body inhibition, and was followed by a gradual increase in ventilation over the baseline level, likely of central origin. Thus, a passing oxygen-related ventilatory inhibition in healthy persons does not seem of clinical significance.

The story may be different in chronic conditions, like COPD, in which breathing is diminished to start with. Then, oxygen, supplemented even on a short-term basis, might further decrease ventilation. Studies on oxygen use in hypoxic pathologies are rather scanty and not fully verified. Nonetheless, inhibition of antecedently diminished ventilation by oxygen does not seem of appreciable clinical relevance either. What is more, there does not seem to be a relation between the potential depressant effect of oxygen and desaturations or basal ventilation.

Protracted home-based delivery of oxygen in chronic lung pathologies, a case in point being COPD, raises yet different issues. Oxygen is an absolute requirement in ventilatory insufficiency, clinically defined as PaO2 <60 mmHg and PaCO2 >45 mmHg, is supplemented in high concentrations over long periods of time on daily basis. The basic capability for daily physical activity hinges on oxygen delivery in such patients, which make them kind of addicted to the use of oxygen concentrators. Home oxygen therapy, alongside breathing exercise (diaphragmatic breathing, mid-riff exercise, etc), proper diet and life style, and psychosocial support, has become part of a comprehensive pulmonary rehabilitation program for the aged that originated in Japan (Comprehensive Pulmonary Rehabilitation: Manual for Team Approach. Edited by K. Kida. Medical Review Co. Tokyo, Japan, 1995). The program is now advocated in patients suffering from neurodegenerative brain conditions, including Parkinson and Alzheimer’s diseases. Breathing exercises combined with home oxygen therapy help maintain physical activity, tissue oxygenation, cognitive agility, and general quality of life.

Oxygen should be used judiciously in clinical practice. Age-changes in the respiratory system involve both the chest wall and the lungs. Structural changes in lung parenchyma consist of a decline in the number of alveoli and alveolar lung surface area, which is conducive to outgrowth of connective tissue and limitation of gas exchange. Pulmonary surfactant and alveolar epithelial cell dysfunction in the senescent, but otherwise healthy lungs, adds up to the propensity for respiratory hypoxic pathologies in the aging lungs. Stiffness of skeletal elements supporting the chest wall and declining respiratory muscle strength acts in concert with lung changes in limiting or mismatching gas exchange. Nonetheless, it is not recommended to use oxygen in the physiological aging, even though there might be a substantial reduction in PaO2 content. At the electron microscopic level, in a series of animal studies, we found distinct pathological effects on lung parenchyma of a 40-min breathing of pure oxygen; the effects, notably, concerned the alveolar epithelial lining and surfactant. Such changes, on the background of antecedent chronic hypoxia of old age, may double down the risk of a lung detriment. Pulmonary rehabilitation rather than oxygen supplementation, holds an obviously greater potential to improve tissue oxygenation and exercise capacity in the aged.