BENEFIT OF OXYGEN SATURATION MONITORING AT HOME WITH PULSE OXIMETERS FOR PATIENTS WITH LUNG OR HEART DISEASE

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Keywords: pulse oximetry, pulse oximeter, pulse oximeters, copd, chronic obstructive pulmonary disease, oxygen saturation, obstructive sleep apnea, hypoxemia

Introduction

The incidence of lung and heart disease is on the rise in the United States of America, and one of the major causes of death in the United States is chronic obstructive pulmonary disease (COPD), a deficient lung condition that is often attributed to smoking. COPD obstructs airflow to the lungs, interferes with the ability to breath, and prevents adequate oxygen from getting to the blood and cells of the body. It is the fourth leading cause of death, affecting more than 11 million Americans, according to the National Heart, Lung and Blood Institute (NHLBI) of the National Institutes of Health (NIH). Like blood pressure a patient's oxygen saturation level (SpO2) which measures the percentage of oxygen in arterial blood, fluctuates with different daily activities and is worse in patients with lung disease. In this article I discuss the progress in understanding of COPD as a contributor to nocturnal oxygen desaturation and the benefit of pulse oximeters for monitoring of oxygen saturation at home.

Oxygen Saturation Monitoring with Pulse Oximeter

In a study which assessed the influence of daily activities in COPD patients by comparing their oxygen saturation profile during day and night using pulse oximetry, it was found that COPD patients develop nocturnal oxygen desaturation as a result of alveolar hypoventilation, ventilation mismatch and obstructive sleep apneas (Soguel Schenkel, **et al**. 1996.)[1] This study like others before and after it has advanced the understanding of nocturnal oxygen desaturation.[2,3,4,5,6]

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[1] N Soguel Schenkel, L Burdet, B de Muralt, and J. W. Fitting**.** "Oxygen saturation during daily activities in chronic obstructive pulmonary disease." *European Resp. Journa*l, vol. 9, pp. 2584-2589, 1996.

[2] E. Weitzenblum, Ari Chaouat, et al. "The Scientific Basis for Long-Term Oxygen Therapy in Patients with Chronic Hypoxemia," in *Lung Biology in Health and Disease*," vol. 81. W. J. O'Donohue, Jr. Ed. New York, Marcel Dekker, Inc., 1995, pp. 25 – 45.

[3] R. S. Goldstein, et al. "Effect of supplemental nocturnal oxgygen on gas exchange in patients with severe obstructive lung disease." *New Engl J Med*, pp. 425-429, 1984.

[4] P. M. A. Calverley, et al. "The effect of oxygenation on sleep quality in chronic bronchitis and emphysema." *Am Rev Respir Dis*, vol 126, pp. 206 – 210, 1982.

[5] B. E. Levine, et al. "The role of long-term continuous oxygen administration in patients with chronic airway obstruction with hypoxemia." *Ann Intern Med*, vol. 66, pp. 639-650, 1967.

[6] A. S. Abraham, et al. "Reversal of pulmonary hypertension by prolonged oxygen administration to patients with chronic bronchitis." *Circ Res*, vol. 23, pp. 147-157, 1968.

In the United States of America, supplemental oxygen is frequently prescribed to patients that have a potential to benefit from supplemental oxygen as determined by arterial blood gas (ABG) analysis and pulmonary function testing. During the normal process of breathing, several factors influence the transport of oxygen from the lung's alveoli to the capillaries, such as cardiac output, ventilation perfusion mismatch, right to left shunting, and diffusion defect (particularly in COPD). More and more, pulse oximeters are being used for overnight studies as in the research by Schenkel, et al. (1996). In many countries, such as Belgium, Austria, Netherlands, UK and Portugal, to qualify for long term oxygen therapy (LTOT) an overnight pulse oximetry is mandatory.[7]

Arterial oxygen level is affected by adequacy of gas exchange in the lungs, and negatively affected by ventilation to perfusion (V/Q) mismatch due to resistance of the pulmonary capillary bed, caused by alveolar membrane impairment, and dead space which is increased in COPD subjects. This impairment of gas exchange in the lungs can also be expressed in terms of "wasted" pulmonary blood flow or venous admixture, which is a condition that is caused by right-to-left shunt. Furthermore, oxygen content in the blood is determined based on the oxygen carrying capacity of the blood, level of hemoglobin serum and the percentage of hemoglobin that is saturated with oxygen, cardiac output and amount of oxygen dissolved in the blood.

Pulse oximeters are equipped with integrated probes, or come as an attachment, that produce two different wavelengths of light, usually 650nm and 805nm (where "nm" stands for nanometer) when powered on. The working principle is based on measuring the ratio of red and infrared light absorption transmitted through the finger, or in the case of disposable sensors through parts of the body like the toe or skin. Ear sensors accomplish the same thing, but these approaches to measurement are usually used in hospitals and clinics. The two different wavelengths of light are absorbed by the hemoglobin in different proportions, depending on whether the blood is saturated or de-saturated with oxygen. An embedded microprocessor then calculates the absorption for each wavelength of light and in order to determine the percentage of oxygen saturation or hemoglobin oxygenation. Lung and heart disease patients often want to know the quality of their blood flow as well as oxygen saturation levels and can monitor both with a pulse oximeter. These devices also measure pulse rate because blood flows in pulsing fashion, by calculating the number of pulses in a given interval of time, usually beats per minutes. This information along with arterial oxygen saturation is displayed on the pulse oximeter screen. Manufacturers usually specify a range of accuracy for their pulse oximeter. The majority can measure oxygen in the range 70 to 100 percent, representing the lower and upper limit within 2 to 3 percent accuracy. A normal oxygen saturation (SpO_2) level in a healthy patient is about 95 percent. This varies depending on a patient's health. For individuals with severe lung or heart disease, it is lower.

Patients can take a proactive step to monitor their oxygen saturation level by adding a pulse oximeter to their list of home health equipment, especially persons who experience abnormal oxygen saturation. For those on supplemental oxygen therapy, by measuring and recording their oxygen saturation at home, their physicians can determine the adequacy of their prescription based on oxygen saturation levels (SpO2) during different

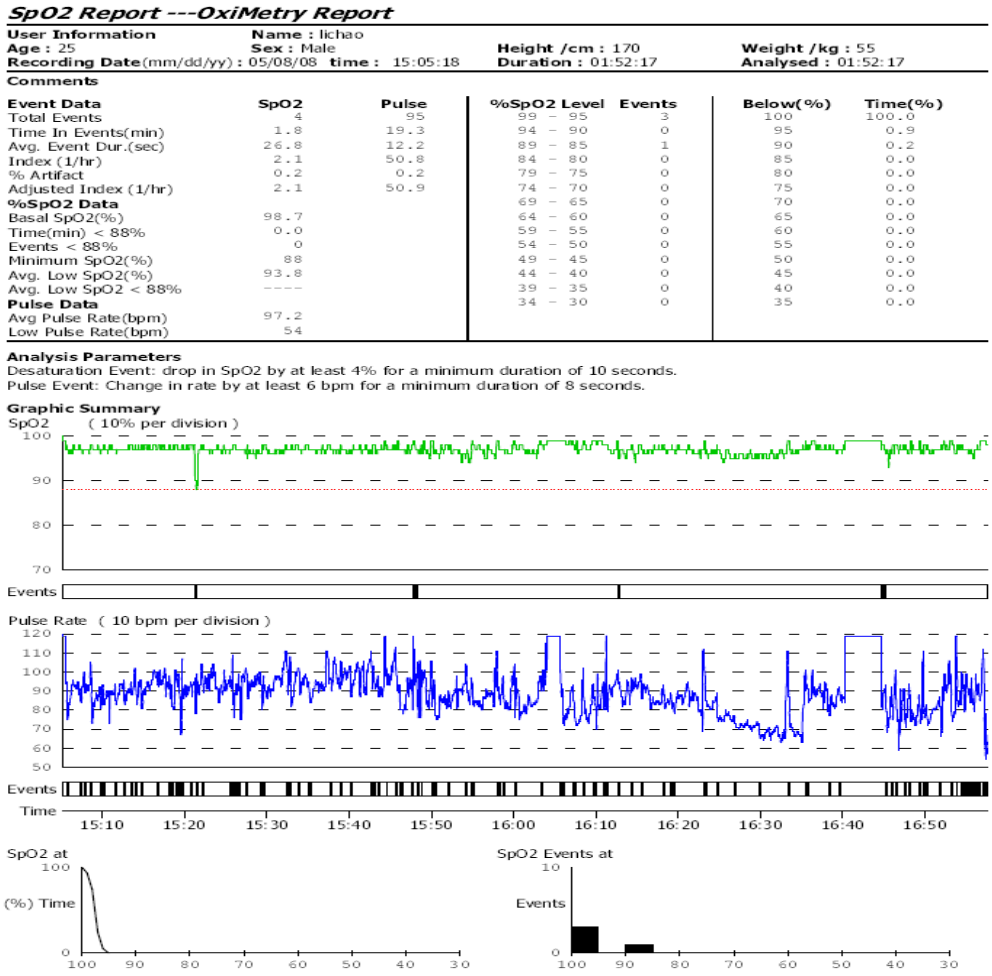
[7] J. Zielinski. "Long-term oxygen therapy in COPD patients with moderate hypoxaemia: does it add years to life? Eur. Respir J., vol. 12, pp. 756-758, 1998.

daily activities. This would enable proper disease management. It should not be left to occasional physician visits.

Like blood pressure monitor, a pulse oximeter is an important and affordable technology for any one with heart or lung disease, such as COPD, emphysema or asthma that needs to monitor their blood oxygen saturation regularly. They are very affordable and have become a routine monitoring tool for hospitals, private physician clinics, nurses, sports medicine, sleep laboratories and homecare patients. Progress continues to be made in biomedical engineering, and more sophisticated, yet user-friendly devices like the CMS50E wireless finger pulse oximeter have arrived in the market. The CMS50E can be used for regular spot checking or around the clock monitoring of SpO2 level in patients suspected of having irregular oxygen saturation due to heart or lung disease, or sleep apnea syndrome.

The CMS50E is a FDA cleared wireless finger pulse oximeter with true color display, for spot measurements of arterial oxygen saturation. It can record and transfer data to a computer for analysis, and is widely used in homecare, hospitals, physician clinics, sleep laboratories, community medical centers, sports medicine, and aviation. Data can be down loaded to a personal computer for analysis, with the CMS50E transmitter-receiver, which is an optional wireless communication device.

Around the Clock Measurement of SpO2 with CMS50E



It comes with a 1 year limited warranty.

The CMS50E, along with other types of pulse oximeters can be purchased at www.MedkioskInc.com. It is one of the most reliable websites for pulse oximeters.

Conclusion

In the present author's opinion, proper respiratory disease management should require routine monitoring and record of arterial oxygen saturation (SpO_2) during different daily activities. Just like hypertensive patients monitor their blood pressure with blood pressure measurement devices, severe COPD patients should monitor their SpO2 at home, in order to maintain clinically acceptable oxygen saturation as determined by their physician. By recording results of daily measurement, their physician can determine the adequacy of their supplemental oxygen and make proper therapeutic adjustments. Monitoring of SpO_2 in lung or heart disease patients should not be left to occasional physician visits. To start, patients can take a proactive step to monitor their oxygen saturation level by adding a pulse oximeter to their list of home health equipment. It should not be left to occasional physician visits. For the physician this would enable proper disease management, by providing not only information needed to assess the adequacy of oxygen prescriptions,

but also insight regarding how SpO_2 changes with disease progression at prescribed supplemental oxygen levels.