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WHAT'S YOUR DIAGNOSIS?

PEER REVIEWED

What Do These Overnight Pulse Oximetry Test Results Suggest?

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A 65-year-old man was referred to a pulmonology clinic for evaluation of dyspnea, tiredness, and fatigue for the past year. He denied any appetite changes and was not involved in any physical activity like he had been before the onset of symptoms. He reported having a 10 pack/day history of smoking for 25 years but had quit smoking 5 years ago. He also had a history of hypothyroidism for which he was on levothyroxine.

At presentation, his vital signs were as follows: blood pressure, 121/82 mm Hg; heart rate, 74 beats/min; height, 165 cm; weight, 93 kg; body mass index (BMI), 34.1 kg/m^2. Cardiac examination revealed normal S_1 and S_2 heart sounds and no murmur. Lung examination revealed decreased air entry at the bases.

Laboratory test results were within normal limits, including the following values: hemoglobin, 16 g/dL; mean corpuscular volume, 92 μm^3; platelet count, 200 × $10^3/\mu L$; hemoglobin A_{1c}, 6.1%; thyrotropin, 1.5 mIU/L; sodium, 143 mEq/L; potassium, 3.5 mEq/L; chloride, 102 mEq/L; and blood urea nitrogen, 18 mg/dL. His daytime arterial oxygen saturation (Sa_{O_2}) at rest was 95%. On walking, his Sa_{O_2}

dropped to 92%. It was decided to further evaluate his oxygen status during the nighttime with an overnight pulse oximetry test, the results of which are shown in **Figure 1**.

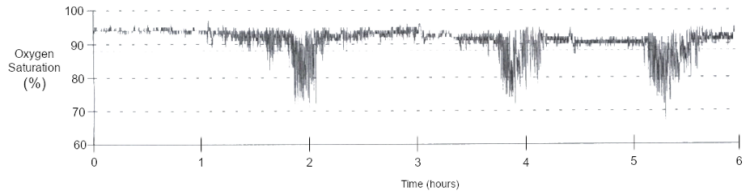

Figure 1. *The patient's results of an overnight pulse oximetry test.*

What diagnosis is suggested by the overnight pulse oximetry test report?

A. Interstitial lung disease

B. Obstructive sleep apnea

C. Chronic obstructive pulmonary disease

D. Bronchiectasis

Answer and discussion on next page.

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Answer: Obstructive Sleep Apnea

Pulse oximetry is an important tool to monitor patients' oxygenation routinely in primary care and in hospital settings.[1] This spectrophotometry technology determines the Sao_2 based on differing absorption spectra of oxyhemoglobin and deoxyhemoglobin. Sao_2 is the percentage of hemoglobin molecules that are saturated with oxygen compared with the total number of hemoglobin molecules available.

Spectrophotometry uses various wavelengths of light to evaluate the absorption of different substances. The technique transmits two wavelengths of light through tissue (660 nm and 940 nm), measuring changes in absorbance at each wavelength. Light absorption by tissue is cyclic due to cardiac cycling and the resultant pulsation of arterial blood. The pulse oximeter measures the change in light transmitted during diastole from that during pulsation and attributes the difference to absorbance by arterial blood. Oxyhemoglobin and deoxyhemoglobin each have a typical light absorption pattern. Because they have different extinction curves, it is possible to estimate the relative amounts of each present, utilizing knowledge of their light absorption characteristics at each of two wavelengths. Most oximeters have two light-emitting diodes (LEDs). A photoreceptor is present opposite the LEDs with patient tissue, generally a finger, held between.[1]

Over recent years, advancements in technology have allowed the possibility of continuous pulse oximetry recording, which gives a better idea of a patient's oxygenation and respiratory status. Generally, continuous oximetry is done while a patient sleeps overnight, hence it is called overnight pulse oximetry.

During a routine overnight pulse oximetry test, one can get an idea about the mean overnight Sao_2 and lowest Sao_2 during the entire night's recording. In healthy persons, the normal overnight mean Sao_2 is 96%.[2] A decreased value may point to an underlying cardiorespiratory problem.

In addition, the Sao_2 waveform patterns also provide a good view of the oxygenation status of the patient for the entire night's recording. In healthy persons on overnight pulse oximetry, Sao_2 is maintained above 90% throughout the night (**Figure 2**).

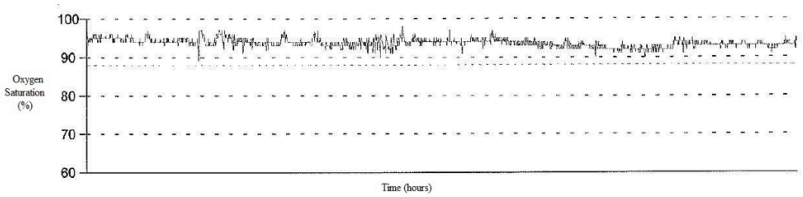

Figure 2. *A person with normal-range pulse oximetry test results. The Sao_2 is maintained above 90% throughout the night.*

Our patient's overnight pulse oximetry test results showed that at certain times during the recording, he showed evidence of desaturation, but during the rest of the night, his Sao_2 otherwise was above 90%. This is a typical pattern seen on overnight pulse oximetry tests and is reflective of the relationship between rapid eye movement sleep stage and occurrence of multiple clustered episodes of deep oxygen desaturation (also called a sawtooth pattern or "icicles from the rooftop" pattern, as is evident in **Figure 1**). This pattern on overnight pulse oximetry tests is generally seen in patients with obstructive sleep apnea (OSA).[3-5]

Patients with severe chronic obstructive pulmonary disease (COPD), interstitial lung disease (ILD), or bronchiectasis will not show such a pattern of clustered episodes of deep oxygen desaturation during the night. In such patients with very advanced pulmonary problems (COPD, ILD, or bronchiectasis) leading to continuous ventilation perfusion mismatch throughout the night, the overnight pulse oximetry findings may show low-average saturation.

OSA is a disorder characterized by intermittent narrowing (hypopnea) and/or total closure (apnea) of the upper airway during sleep. During these events, the intermittent lack of airflow leads to episodic oxyhemoglobin desaturations (intermittent hypoxemia). Untreated OSA is associated with long-term health consequences, including cardiovascular disease (eg, hypertension, stroke, myocardial infarction, atrial fibrillation), metabolic disorders (eg, diabetes), cognitive impairment, and depression.

The diagnostic approach to OSA includes a patient history (snoring, witnessed apneas, daytime somnolence) and clinical examination (obesity, large neck size). These patients may be screened using an overnight continuous pulse oximetry test, as in our patient's case.[6]

The gold standard test for diagnosing OSA is polysomnography.[7] During polysomnography one can calculate the apnea-hypopnea index (AHI).[5] AHI measures sleep apnea severity and is the sum of the number of apneas plus the number of hypopneas that occur, on average, each hour.

OSA is defined by an AHI of more than 5 events per hour. Our patient also had a BMI of 34.1 kg/m^2 and reported daytime tiredness and fatigue, which also suggested the presence of OSA.

Overnight pulse oximetry is a simple and relatively low-cost test that provides the primary care provider with rapidly available nocturnal oxygen data to assist in managing various cardiopulmonary disorders.[8] With advancement in home monitoring devices, this technology not only is cost-effective, but also allows timely screening of patients at risk for hypoxemia.

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