Persistent Low Oxygen Saturation on Polysomnogram

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A 61-year-old woman with past medical history of restless legs syndrome, and hypothyroidism presents for evaluation of snoring. Her medications include pramipexole 0.25 mg taken at 9 PM, clonazepam 0.5 mg daily, and desiccated thyroid 120 mg daily.

She goes to bed at 10 PM, wakes up at 6 AM unrefreshed, and takes two brief daytime naps. Review of systems is negative for headaches, visual changes, nasal congestion, sore throat, shortness of breath, wheezing, chest pain, palpitations, abdominal pain, numbness, or weakness.

Her Epworth Sleepiness Scale score is 12/24, and body mass index is 26 kg/m². Physical examination revealed enlarged inferior nasal turbinates bilaterally

and Mallampati IV. The remainder of the cardiopulmonary and neurological exam was normal.

Diagnostic polysomnogram (PSG) revealed a total sleep time (TST) of 440 minutes; sleep efficiency of 89%; sleep latency of 2 minutes; and wake after sleep onset of 51 minutes. TST apnea-hypopnea index was 1.7, average oxygen saturation was 96%, and the minimum oxygen saturation was 86%. A 2-h period during the recording shows decreased oxygen saturations to 86% to 92%. A typical epoch is shown in **Figure 1**.

QUESTION: What is the best explanation for the decrease in oxygen saturation seen in Figure 1, epochs 534-540?

Figure 1—5-minute polysomnogram sample from stage N2

ANSWER: Reduced plethysmography waveform amplitude provides evidence of artifact in the pulse oximetry.

DISCUSSION

Pulse oximeters calculate the oxyhemoglobin saturation (ratio of oxyhemoglobin to reduced hemoglobin in arterial blood) by spectrophotometry, the quantification of compounds by their light absorption characteristics. The peak absorption frequency of reduced hemoglobin is 660 nm, and the peak absorption frequency of oxyhemoglobin is 940 nm. The pulse oximeter emits red (600-750 nm) and infrared (850-1000 nm) light. A photoreceptor on the other side of the finger receives and isolates the pulsatile signal from which the oxygen saturation is calculated. The pulsatile wave signal also generates a “plethysmogram.”¹

In the sleep laboratory the plethysmogram wave is utilized to distinguish a non-artifactual oximetry signal from a signal distorted by motion. The shape and amplitude of the plethysmographic waveform provides a representation of changes in blood volume. A decrease in preload can result in plethysmographic waveform variation.² Vasoconstriction of the upper ex-

trinity from sudden exposure to cold has been shown to result in immediate decreases in plethysmography pulsatile amplitude.³ Reduction in plethysmographic pulse amplitude; width and area have been observed in proportion to progressive reduction in stroke volume with an immediate restoration of the pulse wave amplitude, width, and area with normalization of stroke volume.⁴

Pulse oximetry may also be falsely low due to many factors including: methemoglobin, dark nail polish, hypotension, peripheral vasoconstriction (e.g., hypothermia), or excessive limb movement. In our patient a reduction in plethysmographic pulse wave amplitude was seen when she moved from the supine position to the right lateral decubitus position. The pulse oximeter was on the patient's right index finger. Shift from supine to right lateral decubitus position may have resulted in right upper extremity arterial compression with reduction in plethysmograph waveform amplitude, and artifactual oxygen desaturation. Shift from right lateral decubitus position to supine resulted in improvement in the plethysmograph waveform amplitude and improvement in displayed oxygen saturation.

When a reduction of plethysmographic signal is seen in the supine position, adjusting pulse oximeter placement may also be necessary. In **Figure 2**, a 2-min sample taken from the PSG of another patient in the supine position shows low plethysmo-

Figure 2—Two-minute polysomnogram sample from another patient showing decreased plethysmography amplitude with falsely low oxygen saturation that improved with transfer of the oximeter to another finger

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graph amplitude with falsely low oxygen saturation.⁵ The sleep technologist moved the oximeter to another finger on the patient, which resulted in improved plethysmography amplitude and increased oxygen saturation values. In PSG systems that do not provide for plethysmography, a sudden unexpected drop in pulse oximetry without an accompanying respiratory event should prompt the technologist to check the patient's position for possible compromise of pulse oximetry accuracy.

CLINICAL PEARLS

1. Shape and amplitude of the pulse oximeter plethysmographic waveform provide a representation of blood volume in the monitored extremity.
2. Compression of an extremity (more likely in the lateral decubitus sleep position) may produce a decrease in pulse oximeter plethysmograph waveform amplitude and inaccurate oxygen saturation.
3. When the pulse oximetry does not fit the clinical picture, the technologist should change the probe, finger, or body posture if the extremity used in pulse oximetry measurement is compressed.
4. During PSG interpretation review of the video is important in assessing whether patient position has compromised pulse oximetry accuracy.

CITATION

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