Methemoglobinemia in an HIV patient

On presentation to our institution, he was tachycardic, tachypneic, hypoxic, and cyanotic (Figure 1). Chest radiography revealed multifocal bilateral airspace opacities. He was started on vancomycin and piperacillin-tazobactam for treatment of presumed pneumonia, and his dapsone was continued for prophylaxis against *Pneumocystis jirovecii* pneumonia.

During the next several hours, his hypoxia worsened, and his peripheral capillary oxygen saturation was 87% despite use of a Venturi mask at a 35% fraction of inspired oxygen. Arterial blood gas testing revealed an elevated partial pressure of oxygen (143 mm Hg) and chocolate-brown colored arterial blood. Due to the low peripheral capillary oxygen saturation, high partial pressure of oxygen, and abnormal color of his blood (Figure 2), serum methemoglobin testing was ordered and revealed a concentration of 22.9% (normal value < 1.5%).

Based on these test results, the patient’s dapsone was stopped and replaced with atovaquone. Intravenous infusion of methylene blue was started, with subsequent improvement of the hypoxia and cyanosis (Figure 1). His urine became green, but it returned to a normal color in a matter of hours. He was ultimately diagnosed with *P jirovecii* pneumonia and completed a course of atovaquone with total resolution of his symptoms.

### The mechanisms behind methemoglobinemia

Heme iron is normally in the ferrous state (Fe²⁺), which allows for hemoglobin to carry oxygen and release it to tissues. Exposure to an oxidative stress can lead to methemoglobinemia from an increase in abnormal hemoglobin that contains iron in a ferric state (Fe³⁺).
Methemoglobin reduces oxygen-carrying capacity in two ways: it is unable to carry oxygen, and its presence shifts the oxygen dissociation curve to the left, causing any remaining normal hemoglobin to be unable to release oxygen to the tissues.\textsuperscript{1,2}

Causes of acquired methemoglobinemia include topical anesthetics (eg, benzocaine, lidocaine) and antibiotics (eg, dapsone).\textsuperscript{2,3} Signs and symptoms include cyanosis, headache, fatigue, dyspnea, lethargy, respiratory distress, and dark-colored urine.\textsuperscript{1,2}

**MANAGEMENT**

Treatment consists of intravenous methylene blue, which reduces the hemoglobin from a ferric state to a ferrous state.\textsuperscript{1–4} Methylene blue is a water-soluble dye excreted primarily in the urine, and common side effects include dizziness, nausea, and green urine.\textsuperscript{5–7} The blue pigments from methylene blue combine with urobilin (a yellow pigment in the urine), producing a green color.\textsuperscript{1} This is not pathological and requires no treatment, as the urine returns to normal color after the body fully excretes the dye.\textsuperscript{5–7}

If intravenous methylene blue fails to produce a response, other treatments to consider include hemodialysis, blood transfusion, exchange transfusion, and hyperbaric oxygen therapy.\textsuperscript{2}

**REFERENCES**


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