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Methemoglobinemia in an HIV patient

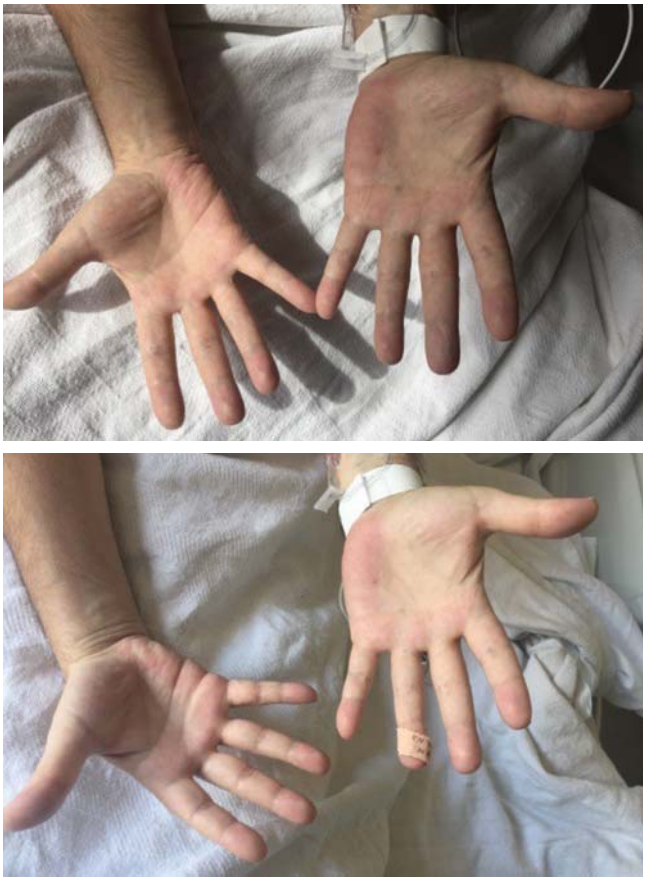

Figure 1. The patient's hands on presentation (top) and after treatment with intravenous methylene blue (bottom).

A 45-year-old man with known human immunodeficiency virus infection presented with a 5-day history of dyspnea. When his dyspnea had become symptomatic, he had restarted his home dapsone prophylaxis, but his dyspnea had progressively worsened, and his urine became dark.

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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 (Fe^{2+}), which allows for hemoglobin to carry oxygen and release it to tissues.[1] Exposure to an oxidative stress can lead to methemoglobinemia from an increase in abnormal hemoglobin that contains iron in a ferric state (Fe^{3+}).[1,2]

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.[1,2]

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

MANAGEMENT

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

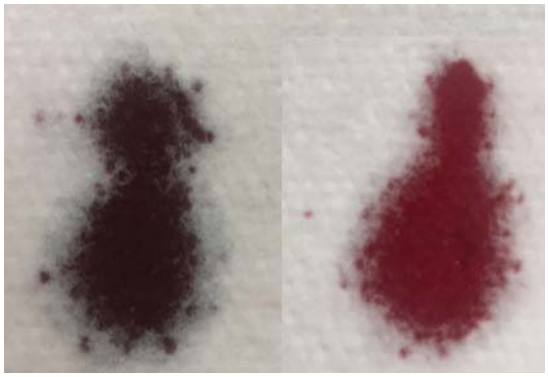

Figure 2. The patient's arterial blood on presentation (left) compared with a sample of normal arterial blood (right).

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

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Causes of acquired methemoglobinemia include antibiotics and topical anesthetics