A 70-Year-Old Man with Blue Skin

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CASE DESCRIPTION

A 70-year-old man with a history of hypertension, porcine aortic valve replacement, and chronic obstructive pulmonary disease began having dizziness and confusion. He had strange 1-word responses to his son, who took him to a hospital. A computed tomography scan was performed, showing a subarachnoid hemorrhage. There was no neurosurgeon at that hospital; therefore, the patient was transferred the next morning to our institution. The patient's son reported a remote history of falling and the patient hitting his head on a cabinet. The patient denied any headaches, nausea, vomiting, vision changes, or seizures, but he confirmed having a productive cough for the last 2 weeks for which he had been placed on levofloxacin. He smoked 1.5–2 packs of cigarettes a day. His physical examination showed no abnormal neurologic signs, and he was alert and oriented without acute distress. Laboratory tests revealed an increased white blood cell count, abnormal coagulation, and acute renal failure (Table 1). The patient received care and various medications (amiodarone, atorvastatin, azithromycin, benzocaine, citalopram, clonazepam, fluticasone, levalbuterol, metoprolol, and ropinirole) at admission to control his blood pressure, cough, throat pain, and subarachnoid hemorrhage.

Two days later (day 3), he developed fever (103.7 °F/39.8 °C) and atrial fibrillation, appeared very lethargic, and complained of mild shortness of breath, but he denied any chest pain, nausea, vomiting, or chills. His renal function had improved. His blood culture from the day of admission was positive for gram-positive cocci, and the physician was concerned for possible endocarditis. The patient was thus given vancomycin and cefepime, and he was scheduled for a transesophageal echocardiography (TEE) procedure the next morning (day 4).

The patient was treated with topical benzocaine spray before the TEE procedure. At the completion of TEE, the patient experienced respiratory failure, hypotension (87/48 mmHg), and decreased heart rate (57 beats/min), and he was noted to have a cyanotic appearance. The patient was awake and neurologically conversant, and he was able to follow commands. Arterial blood gas changes from day 3 to the morning of day 4 (2 draws that were 6 min apart) are shown in Table 2. Two heparin-containing syringe blood samples on day 4 had a dark-brown color, which was consistent with increased methemoglobin (Met-Hb) levels at 39.0% and 67.7% (reference interval, 0.0%–1.0%). The patient's pulse oximeter showed oxygen saturation at 77%. The patient's chest x-ray showed moderately enlarged heart size, atherosclerotic aorta, and minimal pulmonary vascular congestion, with no focal infiltrates or effusions.

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Table 1. Laboratory tests at admission.

Complete blood count (reference interval)		Coagulation (reference interval)		Basic metabolic panel (reference interval)	
White blood cells, $\times 10^9$/L (4.2–11.0)	15.2	Prothrombin time, s (9.4–11.4)	14.1	Na, mEq/L (135–150)	138
Red blood cells, $\times 10^{12}$/L (4.04–5.86)	4.54	Partial thromboplastin time, s (25.9–35.8)	30.1	K, mEq/L (3.5–5.0)	4.3
Hb, g/dL (13.0–17.3)	14.3	International normalized ratio (0.92–1.12)	1.31	Cl, mEq/L (100–109)	99
Hematocrit, % (34.0–45.0)	42.0			CO_2, mEq/L (24–32)	28
Mean corpuscular volume, fL (80–98)	92.5			Anion gap, mEq/L (7–15)	15
Mean corpuscular Hb, pg (27.0–34.0)	31.5			Blood urea nitrogen, mg/dL (7–18)	34
Mean corpuscular Hb concentration, g/dL (31.5–36.5)	34.0			Glucose, mg/dL (65–100)	117
Red cell distribution width–SD, fL (37.0–51.0)	48.6			Ca, mg/dL (8.6–10.7)	8.8
Platelets, $\times 10^9$/L (150–400)	109			Creatinine, mg/dL (0.8–1.5)	2.1
Mean platelet volume, fL (7.4–10.4)	11.6			Estimated glomerular filtration rate, $mL \cdot min^{-1} \cdot (1.73\ m^2)^{-1}$ (>90)	31

Table 2. Patient's arterial blood gas results on days 3 and 4.

Measurand (reference interval)	Day 3	Day 4, 11:07 AM	Day 4, 11:13 AM
pH (7.35–7.45)	7.48	7.36	7.38
Pco_2,[a] mmHg (35–45)	40.5	54.7	52
Po_2, mmHg (80–90)	56.9	82.1	274
O_2 saturation, % (95–100)	92	98.5	[b]
Base excess, mEq/L (−2 to 2)	6.02	3.8	[b]
Bicarbonate, mmol/L (21.0–28.0)	29.9	29.9	29.7
CO-Hb, % (0.0–1.4)	2.3	0.8	[b]
Met-Hb, % (0.0–1.0)	1.7	39.0	67.7
Hb, g/dL (14.0–18.0)	12.0	12.2	12.2

[a] Pco_2, carbon dioxide partial pressure.
[b] For the arterial blood gas sample on day 4 at 11:13 AM, O_2 saturation and base excess were not calculated as indicated by the instrument message; CO-Hb was not ordered for this sample.

Questions to Consider
• What clinical signs and laboratory results lead to a diagnosis of methemoglobinemia?
• What can cause methemoglobinemia, and what was the cause for this patient?
• What methods are available to measure Met-Hb?
• How should patients with methemoglobinemia be treated?

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Final Publication and Comments

The final published version with discussion and comments from the experts will appear in the April 2014 issue of *Clinical Chemistry*. To view the case and comments online, go to http://www.clinchem.org/content/vol60/issue4 and follow the link to the Clinical Case Study and Commentaries.

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