

## When is the Urine “Cherry Red” in Carbon Monoxide Poisoning?

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### Introduction

For decades, physicians have been taught to look for “cherry red” coloration of the skin and mucous membranes in patients with carbon monoxide (CO) poisoning, but this is rarely seen [1,2]. In 1857, Hoppe in Germany first described the change in blood color when hemoglobin is loaded with CO [3]. Because carboxyhemoglobin (COHb) is a brighter shade of red than oxyhemoglobin and the color of capillary blood contributes to skin color, it would seem reasonable that a poisoned patient’s appearance might change with sufficient amounts of circulating COHb. However, a lethal level of COHb is required for a human’s skin and mucous membranes to appear “cherry red”. Even when reflectance spectrometry is used to measure skin color after death in individuals who have died of CO poisoning, less than one-half demonstrate “cherry red” skin [4]. Recently, however, “cherry red” urine has been described in a subgroup of individuals with acute CO poisoning [5].

### Case Report

The patient was a 22-year-old African American male transferred to our hospital from the nearby county trauma hospital for hyperbaric oxygen treatment of acute CO poisoning. He had been involved with a house fire in a city 30 miles distant at approximately 5:30 AM. When discovered by emergency medical services, he was initially unresponsive but demonstrated improvement in mental status following extraction from the environment and administration of 100% normobaric oxygen. He was taken to the closest emergency department where he was sedated, paralyzed and endotracheally intubated for airway control and protection.

Initial arterial blood gas analysis, performed approximately 10 minutes after extraction demonstrated pH 7.07, PCO<sub>2</sub> 53 mmHg, PO<sub>2</sub> 35 mmHg. He was placed on mechanical ventilation. Other notable laboratory values included COHb 29% and lactate 11.3 mmol/l. The patient was administered 75 ml hydroxycobalamin over 7 minutes for treatment of possible cyanide poisoning. Following sedation with propofol, fiberoptic bronchoscopy was performed to evaluate his lower respiratory tract and a moderate amount of carbonaceous secretions removed. The patient was transferred by helicopter to the regional trauma center, then by critical care ground transport to our hospital for hyperbaric oxygen therapy.

Upon arrival at our hyperbaric facility, examination was notable for an intubated middle-aged African American male on a stretcher being bagged by a paramedic. He aroused with stimulation and followed simple commands. Breath sounds were coarse and left flank demonstrated full thickness burn. The patient had a urinary drainage

maximum pressure and was transferred back to the referring hospital (Figures 1 and 2).



Figure 1: Urinary drainage system.



Figure 2: Transparent cherry red urine.

## Discussion

### Diagnosis

**Cherry red urine in a patient with CO poisoning:** Carbon monoxide exposure does not cause a change in urine color, as it does in blood,

because of the absence of hemoglobin in urine to turn brighter red when loaded with CO. However, patients with CO poisoning may have their urine turn red for another reason. Those poisoned from house fires are at risk for simultaneous cyanide poisoning with the combustion of wool, silk, polyurethane, and plastics, among other possible household contents. In the house fire CO-poisoned patient, cyanide poisoning is diagnosed clinically when presenting with severe metabolic acidosis. Severe metabolic acidosis correlates with a high short-term mortality rate in CO-poisoned patients and, if the CO source was a house fire, is likely due to concomitant cyanide poisoning [6]. That study demonstrated short-term mortality of 30-50% in CO-poisoned patients with initial  $pH_a$  not exceeding 7.20, regardless of COHb levels. If arterial blood gas analysis demonstrates severe metabolic acidosis with pH less than 7.20 or a plasma lactate level equal to or greater than 10 mmol/L [7] and the source of CO was a house fire, empiric treatment for cyanide poisoning has been recommended since confirmatory tests for cyanide are not readily available [6].

A specific cyanide antidote is hydroxocobalamin, which has few significant side effects in individuals with smoke inhalation [7,8]. One side effect that is harmless and transient, lasting up to two weeks, is red discoloration of the urine and skin [9]. In an individual with dark skin pigmentation, the skin changes may not be apparent. When the CO-poisoned patient presenting with red urine comes from a community where pre-hospital personnel can administer hydroxocobalamin, or the patient is transferred from another hospital, asking the question about prior administration of the cyanide antidote will allow a search for a source of urinary bleeding to be avoided.

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