

A Friend in Need Is a Friend Indeed:

A Case Study on Human Respiratory Physiology

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Questions were modified by Larissa Eiselein to fit BIO 131A course content

When Charles returned to his apartment at 5 pm in the evening, he turned on his old kerosene-fueled space heater. It had been a cold day in late spring and his third floor apartment was chilly. After spending an hour fixing dinner, he ate while watching the evening news on TV. He noticed that his vision became progressively blurred. When he got up to go to the kitchen, he felt lightheaded and unsteady. Entering the kitchen, he became very disoriented and passed out. The next thing he remembered was waking up in the intensive care unit of the hospital. Some friends who had stopped by about 7 pm had found Charles unconscious on the kitchen floor. They had called an ambulance, which had rushed Charles, still unconscious, to the hospital.

An arterial blood sample drawn when he first arrived at the hospital showed the following values:

<u>PN₂</u>	<u>PO₂</u>	<u>PCO₂</u>	<u>PCO</u>
573 mmHg	95 mmHg	40 mmHg	0.4 mmHg

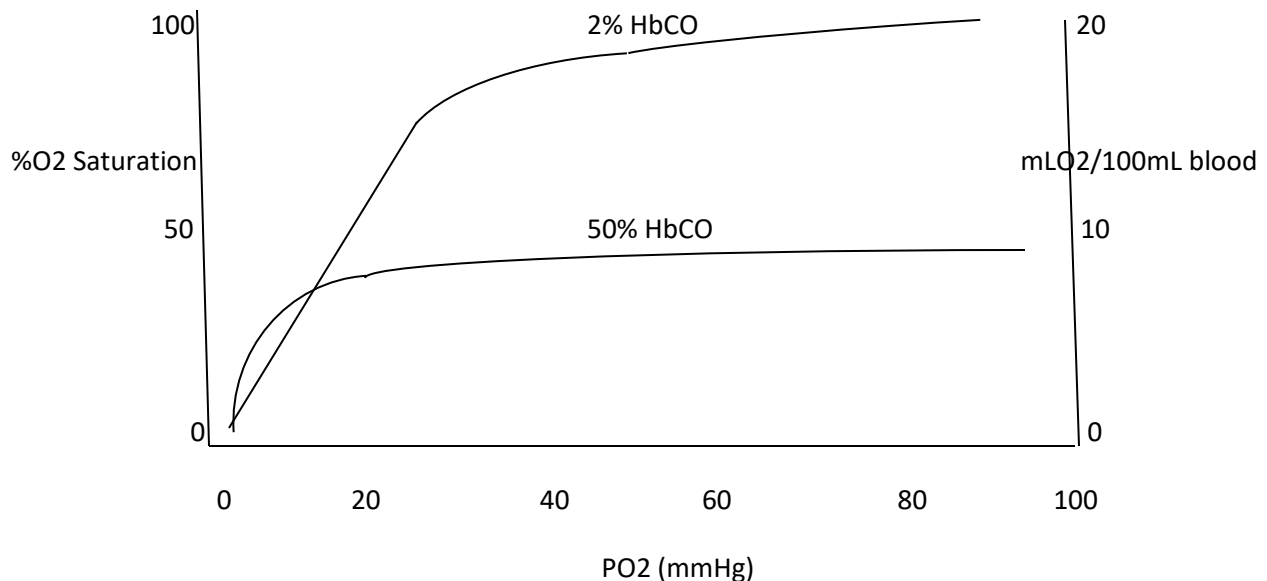
Questions

1. The blood gas measurements show abnormalities in the partial pressure(s) of what gas(es)?
2. Why is PO₂ normal? What does PO₂ measure.
3. Discuss all ways in which O₂ is carried in the blood.
4. What is hemoglobin?
5. What is myoglobin? Where is it found? Do you expect the affinity for oxygen to be higher for myoglobin or hemoglobin. Explain your answer.
6. Discuss all ways in which CO₂ is transported in the blood.
7. Define the following in your own words: Hypoxia, Hyperpnea, Hyperventilation, Apnea, Dyspnea

8. A measurement of Charles' blood reveals that the total O₂ content is low (50% of normal) and hemoglobin is 50% saturated with CO (50% HbCO).

The oxygen-hemoglobin saturation curve in Charles' blood (50% HbCO) and under normal conditions (2% HbCO) is shown below. CO₂ binding to hemoglobin is normal in both instances.

- What is the approximate % saturation of hemoglobin by O₂ in normal arterial blood?
- What is the maximum amount of O₂ (ml/100ml blood) that can be carried in Charles' arterial blood?
- CO enhances the Bohr effect. This means that CO will cause a more pronounced shift of the hemoglobin oxygen saturation curve to the: Right? Left?
- What are other factors that shift the curve in the same way?
- If the partial pressure of O₂ in the body tissues is 20 mm Hg, what is the best estimate of the amount of O₂ (ml/100ml of blood) that can be released from Charles' blood as it circulates in his systemic capillaries?



- In Charles' blood, the partial pressure of CO in the blood is far lower than the partial pressure of O₂, yet the percent saturation of hemoglobin by each gas is equal. This result indicates WHAT about the affinity of hemoglobin for CO compared to O₂?
- Would you expect Charles' disorder to be accompanied by chemoreceptor-mediated hyperventilation? Why or why not? Discuss the location and activation of chemoreceptors. Compare and contrast the peripheral and central chemoreceptor.
- Would you expect Charles' disorder to be accompanied by a rise in EPO (erythropoietin) levels? Why or why not? What is EPO and where does it come from?

12. Fundamentally, Charles' condition is a problem of:
- a . pulmonary ventilation
 - b . diffusion across the respiratory membrane between the alveolar air space and the alveolar capillaries
 - c . transport of gases between the alveolar capillaries and capillary beds in other tissues
 - d . exchange of dissolved gases between the blood and the interstitial fluid in peripheral tissues
 - e . absorption of oxygen and release of carbon dioxide by cells in the peripheral tissues
13. With regard to the physiology of external respiration, Charles' disorder is most analogous to:
- a . barbiturate-induced hypoventilation
 - b . altitude sickness
 - c . emphysema
 - d . acute hemorrhagic anemia
14. Which of the following is NOT an appropriate component of an aggressive treatment plan for Charles' disorder?
- a . administration of a breathing gas mixture with a high percentage of oxygen
 - b . alkalization of the blood (increase the pH)
 - c . partial blood replacement with normal, compatible whole blood
 - d . administration of a breathing gas mixture with elevated levels of carbon dioxide

For each of the above discuss why they would or would not be appropriate.

15. Why did Charles faint?
16. Why can a person die from carbon monoxide poisoning?