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## BC368 - Biochemistry of the Cell II Case Study #7

### **Background:**

A 22-year-old college student is brought to the emergency department after collapsing at her summer job in a jewelry workshop. The coworker who brought her to the ER explains that the workshop routinely uses chemicals for metal plating and cleaning. Earlier that day, the patient had been cleaning metal parts when she began to complain of headache and dizziness. Within minutes, she became confused and lost consciousness.

On arrival, the patient is unresponsive, with a blood pressure of 90/55 mmHg, a pulse of 74 bpm, and a respiratory rate of 28 breaths/min. She is unresponsive to painful stimuli but shows spontaneous, nonpurposeful movements.

### **Lab Findings:**

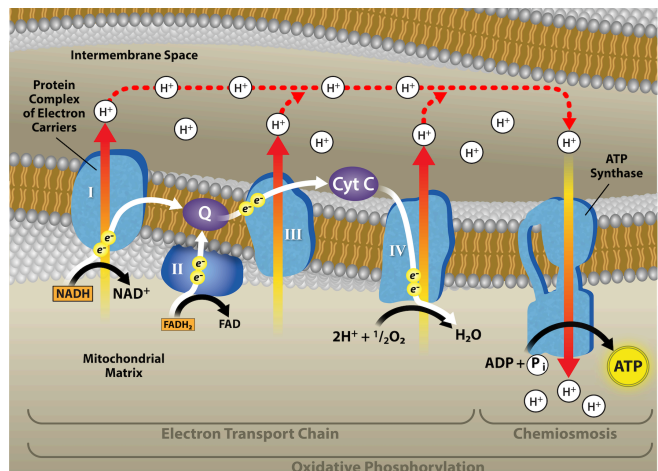
Activated charcoal is administered to absorb the unknown ingestion. Because of the patient's unresponsiveness, the possibility of a stroke is considered, and a CT scan of the head is obtained. No stroke is noted. Initial laboratory testing reveals severe metabolic acidosis with markedly elevated lactate. Oxygen saturation is normal, but the venous blood appears unusually bright red.

Test	Levels/Presentation	Flag
Blood Lactate	11 mmol/L	HIGH
Blood pH	7.08	LOW
Oxygen Saturation	99%	NORMAL
Venous Blood	<b>Bright red in color</b>	ABNORMAL

### **Biochemistry:**

ATP is primarily produced through oxidative phosphorylation in the mitochondria. The electron transport chain (ETC) transfers electrons to oxygen, pumping protons ( $H^+$ ) across the inner mitochondrial membrane to create a proton gradient (proton-motive force).

ATP synthase uses this gradient: as  $H^+$  flows back into the mitochondrial matrix, the enzyme rotates and synthesizes ATP from ADP and  $P_i$ .



**Question 1:** *What do the symptoms suggest about the patient's oxygen use?*

**Question 2.** *Which component of the electron transport chain is most likely not functioning properly in this patient, and what evidence supports your answer?*

**Treatment:**

To treat her hypoxia, you put the patient on 100% oxygen. She is put on an antidote treatment to help sequester and expel the ingestion, which consists of 300 mg of IV sodium nitrite and 12.5 mg IV sodium thiosulfate.

**Question 3.** *Given her symptoms and the biochemical pathways, why would these treatments help detoxify and excrete the unknown ingestion?*

**Follow-up:** *Why is sodium thiosulfate necessary if the patient has already been treated with nitrite?*

References:

Beasley, D. M. G., & Glass, W. I. (1998). Cyanide poisoning: Pathophysiology and treatment recommendations. *Occupational Medicine*, 48(7), 427–431. <https://doi.org/10.1093/occmed/48.7.427>

Chin, R. G., & Calderon, Y. (2000). Acute cyanide poisoning: A case report. *American Journal of Emergency Medicine*, 18(6), 714–717. [https://doi.org/10.1016/S0736-4679\(00\)00161-X](https://doi.org/10.1016/S0736-4679(00)00161-X)