Girl Pulled Alive from Ruins, 15 Days after Earthquake

by
Susan B. Chaplin
Department of Biology
University of St. Thomas, St. Paul MN

Part I – The Facts of the Case

I read the headlines, almost unbelieving. From all that disaster in Port-au-Prince, Haiti, in January 2010, a miracle occurred; someone was still alive, more than two weeks after the buildings collapsed around her. The paper reported that Darlene Etienne, a 17-year-old university student, was found in the rubble of a home near the university, very dehydrated, groaning weakly, but still conscious, with a very weak pulse and low blood pressure. Rescuers gave her oxygen and water and immediately evacuated her to a French military hospital ship for treatment.

"She was definitely within hours or perhaps minutes of death," said one rescuer. "It's exceptional that she managed to survive this long," said another. "In fact, it is rare for anyone to survive more than 72 hours without water, and no survivors have been documented in any earthquake after 14 days."

How did Darlene manage to survive? Was it due to her ability to conserve her body water, or did she somehow gain access to a meager supply of water while still buried?

Questions

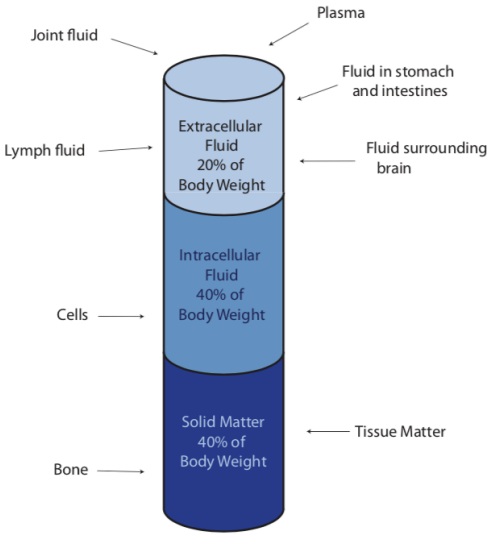
1. What are the physical signs and symptoms of progressive dehydration, such as Darlene might have experienced?
2. What do we know so far about Darlene's physiological responses to her prolonged ordeal?
   References

Refer to the following website for information about dehydration:
Signs and Symptoms of Dehydration http://www.symptomsofdehydration.com/
The site includes physiological characteristics associated with progressive states of dehydration.
https://www.youtube.com/watch?v=VACDx6QTJv4 the 60-40-20 rule

Part II – Calculating Darlene's Water Balance

The physiological consequences of Darlene's entrapment in the earthquake rubble were dehydration, starvation, and potentially heat exposure from daytime temperatures near 35°C (95°F) and high humidity. However, let's look first at just her ability to survive the dehydration of being buried for 15 days.

First, we should consider where water is "stored" in the body that could be tapped during Darlene's prolonged entrapment.



Questions

3. Based on the diagram to the right, list the major water compartments of the body, and explain how water moves between them. What is the 60-40-20 rule for body water?

4. Assuming that Darlene did NOT have access to water during her entrapment, how would her body begin to lose water? What are the specific avenues of water loss?

5. How might the body immediately begin to reduce those avenues of water loss in Question #4? What important physiological reflexes would minimize the rate of water loss from those specific avenues?

6. How would changes in blood flow to specific organs help Darlene resist dehydration? Consider how reduction of function in particular organ systems might help conserve water.

7. Calculation of Darlene's water loss—Enter answers in the spaces and table below as directed.

a.Let's assume that Darlene weighs about 55 kg (~120 lb). Based on the 60-40-20 rule, how much total body water (in liters) does Darlene have? Record your answer below.

b.Most humans can withstand only a 12% loss of total body water before they progress to clinical shock. The lethal body water loss for humans is 20% of total body water. Based on these estimates, how many liters of body water can Darlene afford to lose? Record your answer below.

c.Data from published studies on women show that water loss varies as a function of age, weight, and environment. Values range from 2.7 L/day for young female adults (Sawha et al., 2005) to 3.3 L/day in active (but not exercising), young female students (Westerterp et al., 2010). How many days without water could Darlene survive at this rate of dehydration, assuming a maximum of 12% body water loss? Record your answer in the table below.

d.Are these water loss values (in 7c) of any use in predicting how much water Darlene might have lost per day? Justify your answer.

e.The absolute bare minimum water loss possible for humans, with all compensating mechanisms in force, is about 1.2–1.4 L/day (approximately 6 cups of liquid). How many days could Darlene survive at this rate of water loss? Record your answer in the table below.

f.At the absolute minimal rate of water loss (7e) and maximal tolerance of dehydration (20% of total body water from 7b), how many days without water could Darlene survive? Record your answer in the table below.

g.Now, based on these calculations, could Darlene have survived 15 days without water? Explain the basis for your answer.

7a. Total body water in liters (55 kg human)_____

7b. 12% of total body water in liters_____

7b. 20% of total body water in liters _____

Condition	*Rate of water loss*	*Survival time in days*
7c. Average water loss for young adult females, 12% total body water loss	2.7 L/day	
7c. Average water loss during summer for European women (55 kg), 12% total body water loss	3.3 L/day	
7e. Absolute minimal water loss possible in humans, 12% total body water loss	1.2-1.4 L/day	
7f. Absolute minimal water loss possible in humans, 20% total body water loss	1.2-1.4 L/day	