

CSM INTRODUCTORY PHYSIOLOGY

BONE DENSITY CASE

Darius was inside, playing at his computer after school. He could hear the sound of the city outside, but here in the dark, there was only his TV screen glowing with the battles of *Halo*. He knew his mom would want him to stop to have a decent dinner, but she was away, working the night shift at the local hospital. Every day his routine was the same. He would come home from his inner city middle school, get on the computer to play games late into the night, and then eat one of the TV dinners his mom had left for him in the freezer before going to bed.



His mom would call to make sure he had not stayed out after school. She was worried that he would be hurt playing in the streets. Just last week, one of the kids from his school had been hit by a stray bullet during a drive-by shooting, and drug dealers in the neighborhood were hitting on kids. His mom, a single mother, couldn't afford to move to a better neighborhood, and Darius knew she would be really mad if he got hurt while out in the neighborhood.

The next morning, Darius got up and saw his mother sleeping on the couch in the living room. He made himself a piece of toast, gave his mom a kiss, and headed for the door with his school bag. As he started down the stairs that led to the street he felt his foot slip on something on the stairs. He fell, landing on his butt. He immediately felt a radiating pain from both hips. He called for his mom, but she was already awake and coming to the stairs to see what had happened. Darius was in a lot of pain and his mom called for an ambulance.

At the hospital, Darius was given an X-ray. Darius had broken both hips (bilateral femoral neck fractures), the femurs had fractured at the neck. However, the surgeon who came to see Darius was also concerned about something else. It was strange to have such a small accident cause such a major injury. On the X-Ray the doctor had noticed that Darius's bone density seemed to be low. Questioning about Darius's history revealed he had been feeling somewhat weak for the past month. His diet

consisted mostly of junk food, with very few fresh fruits and vegetables, and almost no dairy products. Blood labs were ordered and revealed the following.

Serum Component	Lab Value	Reference range
Calcium	4.5 mg/dL	8.7 – 10.0 mg/dL
Ionized calcium	0.6 mMol/L	1.12 – 1.32 mMol/L
Sodium	140 mMol/L	136 – 146 mMol/L
Potassium	4.0mMol/L	3.6 – 5.0 mMol/L
Phosphorous	5.0 mg/dL	2.5 – 4.3 mg/dL
Magnesium	1.5mg/dL	1.5 – 2.3 mg/dL

The orthopedic surgeon fixed the broken femurs with screws to hold the bone ends together. Darius also had a bone density scan (dual-energy x-ray absorptiometry, DXA) after the surgery that revealed his bones had an abnormally low density.

Darius spent about two weeks in a physical rehabilitation clinic, in which he did physical therapy and was given supplemental calcium, Vitamin D and a multivitamins. He was released with instructions to have a more complete diet, including dairy, and to take a Vitamin D supplement. A followup bone scan six months later showed that Darius's bone density had increased significantly.

CASE ANALYSIS

1. Identify the potential issues and major topics in the case. What is this case about? Underline terms or phrases that seem to be important to understanding this case. Then list 3 or 4 physiology related topics or issues in the case.

2. What specific questions do you have about these topics? List what you already know about this case in the "What Do I know?" column. List questions you would like to learn more about in the "What Do I Need to Know?" column.

What Do I Know?	What Do I need to Know?

3. Put a check mark by one to three questions or issues in the "What Do I Need to Know?" list that you think are most important to explore.

4. What kind of references or resources would help you answer or explore these questions? Identify two different resources and explain what information each resource is likely to give that will help you answer the question(s). Choose specific resources.

CORE INVESTIGATIONS

I. Critical Reading

- a. Marieb A and P Endocrine and Bone Chapters
- b. Lite, J. (2009, March 23). Vitamin D deficiency soars in U.S., study says. In *Scientific American*. Retrieved April 16, 2009 from <http://www.sciam.com/article.cfm?id=vitamin-d-deficiency-united-states>
- c. Markel, H., Farrell, M.H. & Oski, J.A. (2000) *The Portable Pediatrician*. Ann Arbor Michigan: Elsevier Health Sciences. Retrieved April 14, 2009 from <http://books.google.com/books?id=vh2nikDjcJQC&pg=RA3-PA367&dq=rickett+disease+and+x+ray&ei=VBLQSDqzDorClQSa-IGIAQ#PRA3-PA368,M1>
- d. Singer, F. (Ed.) *Diseases of Bone and Mineral Metabolism*. In Endotext.org : Your Endocrine Source. Retrieved April 14, 2009, from <http://www.endotext.org/parathyroid/parathyroid8/parathyroid8.htm>
- e. <http://pediatrics.aappublications.org/cgi/reprint/118/5/2226.pdf>

II. PhysioEx Endocrine Lab

III. Concept map the production and activation of Vitamin D

IV. Concept map the body's homeostatic mechanisms controlling serum calcium levels

V. Questions

1. What is vitamin D and how does it work in the body?
2. What are sources of vitamin D – food, supplements, sunlight, how much do you need per day? How much is normal circulating levels?
3. What factors are involved in risks for vitamin D deficiency?
4. How prevalent is vitamin D deficiency in the US?
5. How do you treat vitamin D deficiency?
6. Why did the kid's bones break? How do you treat the fractures?

7. What diagnostic tests would you do to gain more information about a patient who is suspected of having vitamin D deficiency?
8. What symptoms and signs are associated with vitamin D deficiency?
9. Is there a connection between race and vitamin D deficiency, between skin color and vitamin D deficiency. Explore the connections.
10. How much sunlight do you need to get enough vitamin D? What effect do latitude, air pollution, hole in the ozone layer have on vitamin D production?
12. What are the radiographic signs of Ricketts? Explain the bone density absorptiometry test.

REFERENCES

Lite, J. (2009, March 23). Vitamin D deficiency soars in U.S., study says. In *Scientific American*. Retrieved April 16, 2009 from <http://www.sciam.com/article.cfm?id=vitamin-d-deficiency-united-states>

Markel, H., Farrell, M.H. & Oski, J.A. (2000) *The Portable Pediatrician*. Ann Arbor Michigan: Elsevier Health Sciences. Retrieved April 14, 2009 from <http://books.google.com/books?id=vh2nikDjcJQC&pg=RA3-PA367&dq=rickett+disease+and+x+ray&ei=VBLQSDqzDorClQSa-IGIAQ#PRA3-PA368,M1>

Singer, F. (Ed.) *Diseases of Bone and Mineral Metabolism*. In Endotext.org : Your Endocrine Source. Retrieved April 14, 2009, from <http://www.endotext.org/parathyroid/parathyroid8/parathyroid8.htm>

<http://pediatrics.aappublications.org/cgi/reprint/118/5/2226.pdf>

Image from Everydaycitizen.com