

Driving Can Be Dangerous to Your Health: A Case Study in Physiology

Part I—The Grandparents Arrive

Dave pulled the cell phone out of his pocket, he had been expecting a call from his parents who were coming to visit their grandchildren. “Hi, Dave. We’re just a few minutes away,” said his father. “OK, see you soon.”

Dave looked at his wife Jen, who smiled and said. “They must have driven through the night to get here this fast. I guess they’re impatient to see their granddaughter. Mom never got over the fact that her hip replacement was scheduled at the same time that Laura was born.”

“I know, Jen. She takes being the only grandmother very seriously.” A car pulled into the driveway and Dave and Jen went out to greet their visitors. His mother was breathing heavily, which made Dave recall his childhood and what it had been like to grow up with an asthmatic mother.

“Hi Grandpa,” said Jason, as he ran into the kitchen in his pajamas. “Hi, big guy. Wow, you’ve grown. How old are you, now?” Jason smiled as he held up four fingers. Jen went upstairs to wake the baby.

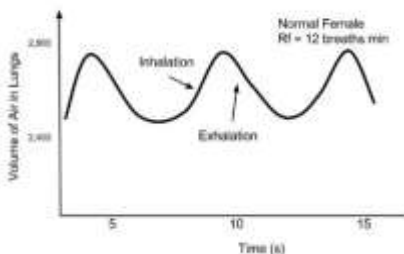
Dave’s wife and daughter appeared in the kitchen a few minutes later. Laura was holding a stuffed toy bear in her arms. “My goodness, is that your old bear, Dave?”

“Yes. We found it in one of the boxes you gave me, and Laura latched onto it. It’s a bit dusty, but we’ve been afraid to wash it because it may fall apart.” Laura giggled as her grandmother cooed to her while carrying her around the kitchen. “Should you be doing that?” Dave asked his mother. “With your hip and all.”

“I’m fine, just a little breathless.” She gave Laura back to her mother and sat down. Her breathing was labored, and Dave recognized the signs of an oncoming asthma attack. He rushed to the door and shouted to his father to get the nebulizer. Dave could hear his mother’s wheezing as she tried to breathe. Her breathing pattern rapid and shallow and each short breath seemed labored.

His father calmly placed the liquid medicine into the nebulizer cup, plugged in the machine, and turned on the compressor. He helped his wife hold the mask to her face. Soon, her breathing was regular. Jen noticed that Jason was alarmed, and she wondered whether he had forgotten that his grandmother had had some attacks during their last visit. “It’s okay, Jason,” she said. “Grandma sometimes has a problem with her breathing, but the medicine makes her better quickly.”

Questions



1. There are at least two things related to Barb’s medical history that may be of interest to a doctor. What are those two things?
2. What factors may have triggered this asthmatic episode?
3. Examine the graph of a normal breathing pattern. Draw a new line to show how Dave’s mother’s breathing pattern would look on the same graph. Pay attention to the paragraph where it described Barbera’s breathing.
4. Sketch the respiratory system and **label** the pharynx, larynx, trachea, bronchi, and bronchioles and lungs. Which of the airways do not contain rings of cartilage, and are therefore more likely to collapse?

Later that night, John awoke to the sound of his wife coughing. “Are you okay, Barb?” He set up the nebulizer, carried it into the bedroom, and gave the mask to his wife as he plugged it into the outlet. Her breathing became more regular, but it was fast; and she was still wheezing. Barb looked pale and anxious and the nebulizer didn’t seem to be working.

“I have this pain in my chest and neck, John, and it’s making its way down my left arm.” He reached for her hand and it felt cold and sticky. He placed his finger on the inside of her wrist and felt her pulse racing. “I think we need to go to the hospital, Barb.”

“I know, but the pain gets worse when I move. It was just an ache before you went to the bathroom, but now it really hurts and I feel like I am going to pass out.”

Dave knocked on the open bedroom door and entered his parents’ room. His father was dressed and his mother was clearly distressed. “I heard Mom coughing. Is everything okay?” “I’m not sure. This is the worst attack she’s ever had. I think we need to get her to the hospital.” Dave pulled on some clothes and in no time he and his father had his mother in the backseat of the car. The hospital was only a few miles away.

5. What additional symptoms does Barbara exhibit?

6. What evidence points to the episode being something other than an asthma attack? Propose another explanation for her symptoms.

Part II—The Hospital

John pulled up in front of the hospital and opened the back door of his car. He saw Dave holding a bloody tissue as they picked up his wife and carried her into the Emergency Room. The nurse saw the two men holding the older woman and the blood on the tissue, and ushered them into a cubicle. The nurse put a clip on Barbara’s finger and turned on the heart monitor. The two men could hear the fast beeping sounds and saw “95 bpm” appear in the lower right corner next to the heart icon. The nurse started an IV, and took Barbara’s blood pressure (90/58). Finally, she put a plastic ring around Barbara’s head and a tube up each nostril.

“What’s that for?” asked John, concerned for his wife. “It’s called a nasal cannula. It’s used to administer oxygen, should the doctor decide that it’s necessary.” The nurse stepped back when the doctor entered the cubicle and she began to examine Barbara. John told her about the asthma attack that afternoon, and the second unusual attack that had happened in the last hour.

“Did your wife complain of chest pain?” “Yes, she said that it was in her chest, neck and left arm. I thought that she was having a heart attack.” “That is possible,” continued the doctor. “Are your wife’s legs usually swollen?” John explained that his wife’s legs often swelled when they took road trips because they were in the habit of driving long distances without stopping.

The doctor frowned at John. “Did you notice that the swelling is worse in her right leg?” “No doctor,” replied John. “But her right hip was replaced about six months ago.” “Your wife had major surgery, and you drove how far?”

“That was my fault,” said Barbara. “My granddaughter was born around the time I had my hip surgery, and I wanted so desperately to see her.” “If my initial prognosis is correct,” the doctor continued, “you may be staying here for a few days.”

She reached down and turned on the flow of oxygen through the nasal cannula, and made notes on a chart. “An orderly will take you to your room. I’ll schedule you for some tests.” The bed was pushed out of the cubicle and John went to follow. The doctor turned to John and continued, “Perhaps you should go to Admissions while we get your wife settled in. I am afraid there’s a mountain of paperwork waiting for you.”

7. What is Barbara's heart rate? What is the normal range? .
8. What is Barbara's blood pressure? What is the normal range?
9. Why was the doctor concerned about how long they had to drive?
10. What is **edema**? (Google it if you're not sure.) Does Barb have edema? What could cause edema?

Part III— Scanners

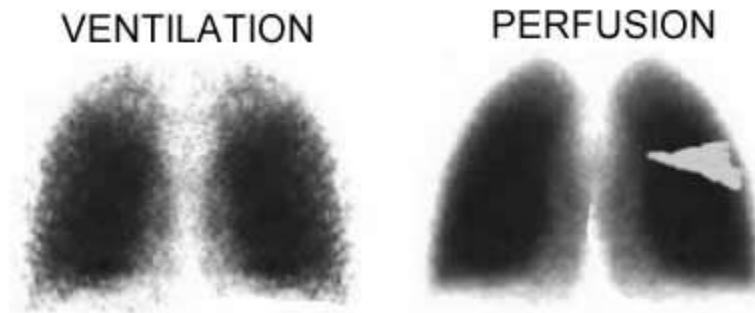
John held his wife's hand. The hip replacement surgery had worried her, but at least she understood what was going on. Tests using computers and X-rays were something else because she did not understand them. He smiled as he remembered how she would spend hours on the Internet doing research before surgery.

"I didn't know that they could do another X-ray so soon after the ones I had for the surgery, but the technician said that it was necessary to rule out a lot of possibilities. Did you go on the Internet, as I asked you? What did you find out about the V/Q scan I had?" Barbara asked John.

"The Internet is a wonderful, thing, Barb. I think I may be your first convert," said John as he fumbled in his pocket. He put on his glasses and read his notes on the folder paper. "Did they get you to inhale a powder and take pictures, and then take more pictures after they injected something into your vein?" asked John.

"Yes. The technician said that they were radioactive tracers, but the radiation was at such low levels that it was not dangerous." "Well, that sounds right. This ventilation quantification scan, or V/Q scan as you called it, allows them to see air flow and blood flow through your lungs," said John. "It is used to rule out a pulmonary embolism."

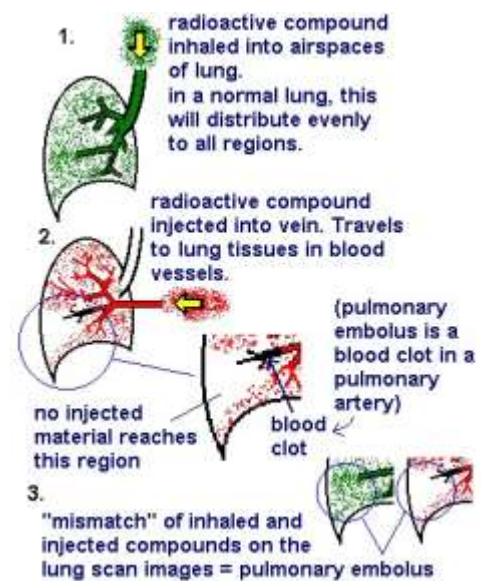
11. What is a V/Q scan? Why is Barbara worried about x-rays and radiation?
12. What is a pulmonary embolism? (look this up if you need to)
13. John flipped the page and found an image of the VQ scan, but he couldn't make sense out of it. **Ventilation** shows where air flows in the lungs, **perfusion** shows where blood flows in the lungs. He pulled up an image on google to help him understand the VQ scan.



Based on the images above, do you think Barbara has a blood flow problem or an airflow problem. **Explain** why you think this.

Part IV: The Chart

"What I don't understand," Barbara continued, "is why they scanned my legs with the CT and then did an ultrasound. I know my legs are swollen, perhaps a little worse than usual, but they always swell up after long car trips." John stood up and walked around the bed. He picked up the chart hanging on the bottom of the bed and glanced at the notes written when his wife was admitted.



Test	Barbera	Normal
Heart Rate (b/m)	95	75
Blood Pressure	90/58	110/65
Arterial PO ₂	78	100
Arterial PCO ₂	49	40
Blood Creatine Phosphokinase (CPK)	2.7 nanograms/mL	3.0 nanograms/mL
Blood Troponin-I	1.9 micrograms/L	<3 micrograms/L
Breathing Rate	20; labored	12 per minute

PO_2 = oxygen partial pressure / PCO_2 = carbon dioxide

A **troponin test** measures the levels of troponin I proteins in the blood. These proteins are released when the heart muscle has been damaged, such as occurs with a heart attack. The more damage there is to the heart, the greater the amount of troponin T.

Creatine phosphokinase (CPK) is an enzyme found mainly in the heart, brain, and skeletal muscle. When the total **CPK level** is very high, it usually means there has been injury or stress to muscle tissue, the heart, or the brain.

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11. What vital signs would you look at to determine if Barbera was having a problem with her **lungs**?
 12. What vital signs would you look at to determine if Barbera was having a **heart attack**?
 13. Diagnosis: Choose which of the following diagnosis for Barbara and provide at least two pieces of evidence from the case to support your claim. You can also include evidence that eliminates a choice as the likely cause of the symptoms.
 - a) severe allergic reaction to dust or cat
 - b) pulmonary embolism
 - c) cardiac infarction (heart attack)