

# Facing the Pain: An Interrupted Case Study in Physiology

by

Ryan D. Doyle, Matthew J. Heslin, Michael B. Keller, and Philip Stephens  
Department of Biology  
Villanova University, Villanova, PA



---

## Part I – Good Morning

Lynn awoke with a smile. It was Sunday, and she could hear the baby giggling as her husband, John, lifted her out of the crib and changed her diaper. She was so glad John was home to help with Laura. He had been away on business, and they lived so far from their parents she could get no relief, as she called it. Lynn heard John's voice as he carried their daughter downstairs and put her into the high chair. Lynn could imagine the dog scurrying around, licking up the dry cereal that Laura dropped on the floor.

What a treat, thought Lynn, just to stay in bed and let someone else look after Laura. She had spent yesterday just being lazy. She was always tired these days, and John seemed happy to take care of Laura.

There was silence downstairs. Lynn got out of bed, pulled on old sweats and went downstairs to check on her husband and daughter.

"Are you okay, Babe? You don't look too good," said John.

"I feel worse," complained Lynn. "I am dizzy and tired, and I keep getting these blinding headaches." Lynn reached for the ibuprofen bottle and took a few tablets with some water.

"Do you think that it's okay to take them on an empty stomach?"

"I'm in pain and desperate," she said impatiently. "They don't seem to do any good these days. Maybe some fresh air and exercise will help. I think I'll take the dog for a jog around the block."

Lynn realized that she had been short with her husband, and he didn't deserve that. She smiled, but then grimaced as the right side of her face throbbed with pain.

Their dog Kratos stood by the front door wagging his tail. Lynn slipped the collar over his head and they walked out into the cool, fall morning. John watched his wife as she jogged down the street, but then soon changed her jog to a walk.

John was playing with Laura in the living room when he heard the front door open. Kratos came running into the house.

"I feel like a whale; I couldn't even make it around the block." Lynn slumped onto the sofa. "I have never been this fat. This headache isn't helping, either. I just wish it would go away."

John knew there was no consoling his wife when she was in this kind of mood, so he said nothing. Lynn went into the kitchen and reappeared with a donut in one hand and coffee in the other.

### *Questions*

1. List Lynn's physical ailments.
2. Does Lynn have any psychological problems?
3. What can John do to help his wife?
4. With the above signs and symptoms in mind, do you wish to speculate about Lynn's condition?

## Part II –The Accident

It was Monday morning and the telephone rang. It was the beginning of another busy work week, and John saw the caller ID. It was Lynn. He picked up the phone, afraid of what his wife was going to say. He knew that was a bad attitude, but he was tired and thought that Lynn didn't appreciate that he was under a lot of pressure, too.

"John? I've been in a car accident! Laura's okay and I've got a few little cuts. They are taking us to the hospital as a precaution. I drove off the road and hit a tree. I don't know what happened. My head began to pound, I felt dizzy, and it was like the earth moved."

John was annoyed and frustrated, but did not want to add to his wife's problems.

"Don't worry, Lynn, that's why we have insurance. As long as you and Laura are not hurt, that's all that counts. Are you sure you're okay?"

"We're fine; just a bit shaken."

"Let me wrap up here. It should take me about half-an-hour to get to the Emergency Room."

"Sorry," said Lynn as she hung up the phone.

John looked at his watch as he opened the doors to the ER. Good, he thought, 25 minutes. He could hear Laura crying. The nurse was trying to comfort her and was relieved when the baby stopped crying and started leaning towards John.

"I guess I don't have to ask," said the smiling nurse as she handed Laura to John.

"The doctor's in with your wife. He shouldn't be too long. There was a multi-car accident on the highway, and they are sending them to us. It's going to get busy very soon."

At that moment the doctor appeared, walked by John, spoke to the nurse, and walked outside to an ambulance that was pulling up to the ER.

John went to see his wife. She was pale, crying, and was holding the right side of her face in her hand.

"Oh John, I am so sorry about the car." John sat on the corner of the bed, holding Laura with one hand and his wife's hand with the other.

"Don't worry. Cars can be replaced, you girls can't. Are you okay?"

"Yes, but my face feels like one giant toothache."

Laura stretched her arms to her mother, and Lynn smiled as she took their daughter. John stood up and looked at the chart hanging on the bottom of the bed.

Test	Result
ECG	Normal
Heart Rate	84 b/m
Blood Pressure	160/98
Breathing Rate	16

## *Questions*

1. Is Lynn exhibiting any new signs or symptoms?
2. Are the data from any of Lynn's tests above or below normal levels?
3. Could any of the new signs or symptoms have been caused by the accident?
4. Are any of Lynn's problems consistent with the data on her chart?
5. What circulatory problems could arise from Lynn's signs and symptoms?
6. With the above signs and symptoms in mind, do you wish to speculate about Lynn's condition?

## Part III –Ow!

The curtains moved and startled John. He tried to put the chart back, but it slipped from his hand and clanged on the floor. There was silence as the nurse watched him pick up the chart. As he stood up, John hit his elbow on the metal bed frame.

“Ow! Hit my funny bone. Ow, ow,” John danced around the room; the women laughed and even Laura joined in. Lynn suddenly grasped her face with a pained expression.

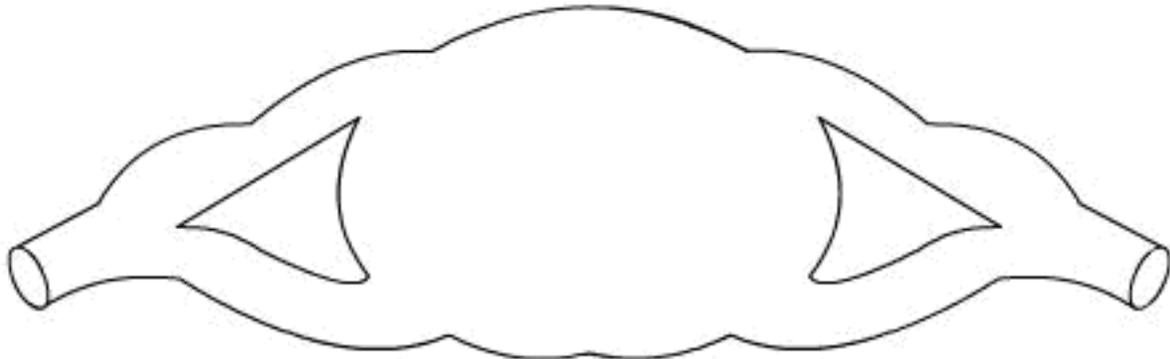
“Are you still getting that pain, Hon?” asked the nurse as she turned to Lynn.

“Yes. It’s been getting more intense over the last few days. It aches most of the time and I feel pain in my jaw, other times it’s around my eye, but always in my right cheek. It’s usually a stabbing pain, but my dentist said that my teeth are fine,” replied Lynn.

“The doctor told me about your pain. He said that we will be admitting you so that we can do tests. Maybe you should give your husband a list of personal things you need from home.”

### Questions

1. Below is an outline of a cross section of a human spinal cord. Draw the circuit for a simple reflex; include (and label) a sensory neuron, a motor neuron, an interneuron (or second order sensory neuron), and an axon that ascends to the brain. Use arrows to show the direction of action potential conduction along the axons, and indicate the dorsal and ventral surfaces.



2. What sensations do you feel in your hand when you hit your funny bone?
3. What part of the hand seems to be stimulated when you hit your funny bone?
4. Are these sensations created by stimulation of the sensory receptors in the hand, or by some other mechanism?
5. Where is pain registered in your central nervous system?
6. Which cranial nerve supplies your cheeks and jaw?
7. With the answers to questions 2 through 4 in mind, if there is no physical stimulation of Lynn’s face, what is causing the sensation of pain in the right side of her face?
8. Do you wish to speculate about Lynn’s condition?
9. What tests would you perform to determine Lynn’s problems? State the possible result for each test.

## Part IV –The Results

John had spent most of the past two days sitting in the semi-private room, either talking with his wife or waiting for her to return from one test or another. He had seen their daughter that morning as he snatched a quick breakfast between taking a shower and coming to the hospital.

“Laura’s just fine. She’s got my parents wrapped around her finger,” John said to his wife as they waited for the doctor.

Lynn looked at the door as the doctor entered the room; John quickly stood up.

“Good morning, Dr. Samson.”

“Good morning. How are you feeling this morning, Lynn?”

“I feel a little better, but the stabbing pains are keeping me awake at night. Did you find out what the problem is?”

“I have the results from the cerebrospinal fluid test we did.”

“You mean the fluid they took with the spinal tap needle? I will remember that needle until the day I die; I didn’t know they made them that long.”

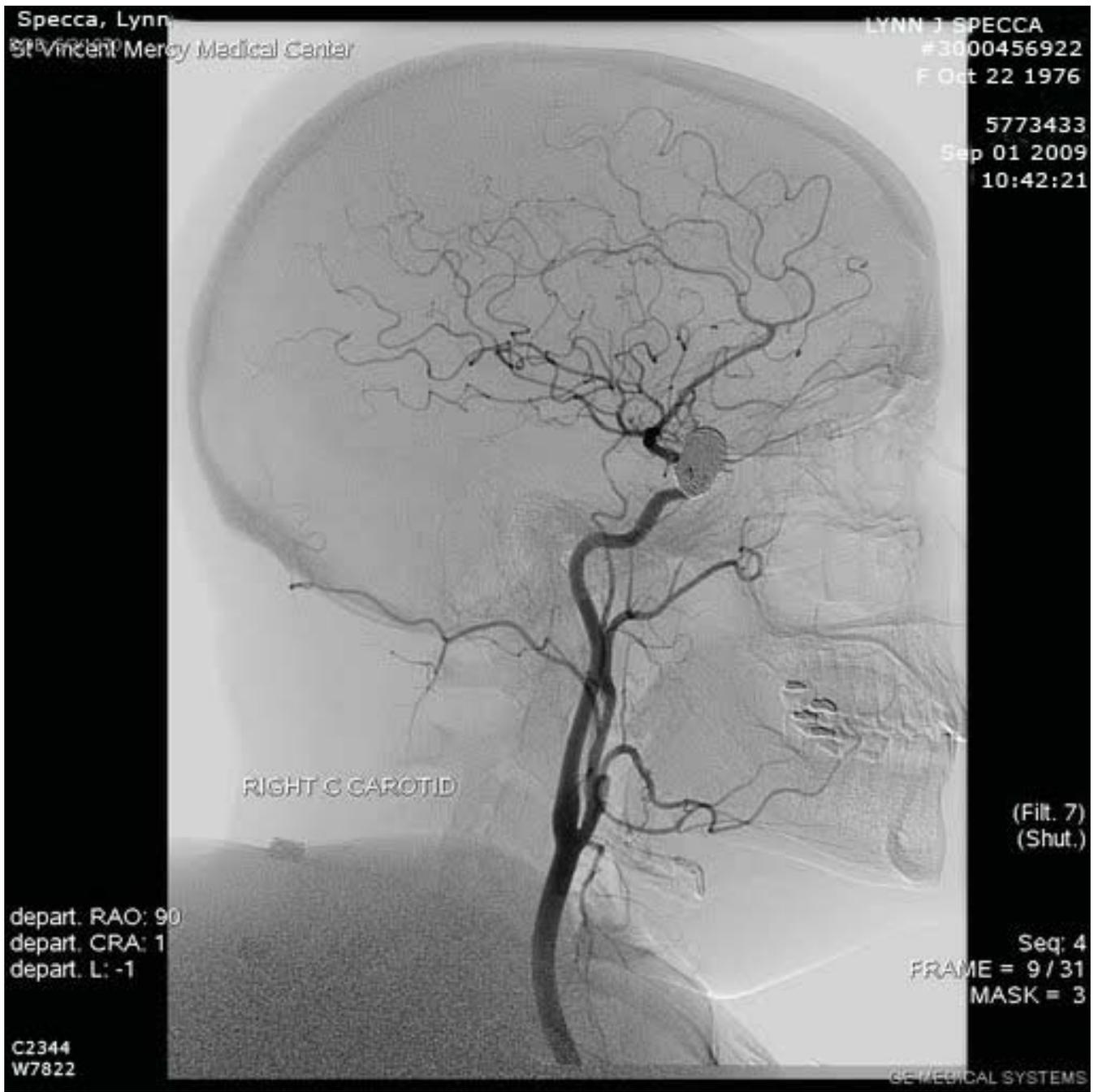
Cerebrospinal fluid test results	
IgG antibodies	Not elevated; within normal limits
Oligoclonal bands	Not elevated; within normal limits
Myelin breakdown	No evidence

The doctor walked to the light box on the wall and pushed in x-rays into the lightbox (see figure on next page).

“Is everything okay?” asked John as he looked over the doctor’s shoulder.

### Questions

1. Lynn’s cerebrospinal fluid showed normal levels of IgG antibodies and oligoclonal bands, and no myelin breakdown. What do these findings indicate?
2. What does Lynn’s x-ray show (see next page)?
3. Lynn’s blood pressure was 160/98. From what type of blood vessel is blood pressure measured; artery, capillary, vein?
4. The values given for blood pressure represent the systolic and diastolic pressures, but what does blood pressure really mean? Is it the pressure along the inside of the vessel, across the vessel wall, outside the vessel?
5. What correlation is there between Lynn’s high blood pressure and what you see in her x-ray?
6. What procedures do you think Dr. Samson will suggest to alleviate Lynn’s high blood pressure, the problem shown in the x-ray, and the pain she is experiencing in her face?
7. With the above signs and symptoms in mind, do you wish to speculate about Lynn’s condition?



Arteriogram of Lynn's head very soon after a tracer dye was injected into her right carotid artery.\*

\*Image used with the permission of Mercy Health Partners, Toledo, Ohio. Patient information has been altered in order to preserve the privacy of the original patient, with whose consent the image has been used.

## Part V – The Doctor

The doctor looked at the x-ray results from the tests on Lynn's cerebrospinal fluid.

"Well that's good. The brain scans show no tumors, and these results give no indication of multiple sclerosis."

Lynn sat holding the right side of her face with her hand. The pain was still bad, although she hoped that it would soon disappear.

"Does your face still hurt, Lynn?"

"I'm not sure if it's getting any better."

"I think we should be able to solve that problem reasonably quickly. All of those tests we put you through indicate one diagnosis; you are suffering from *trigeminal neuralgia*. The trigeminal nerve contains sensory axons that provide sensation in your face. Put simply, the axons are producing extra signals, called action potentials, which are being registered in the cortex of your brain; this gives you the sensation of pain."

"Can you stop these extra signals?"

"Yes, but we need to act in the short term and the long term," replied the doctor. "I think that the underlying cause of your pain is high blood pressure. This x-ray is one of many we took, and it shows an artery in your brain that has become enlarged; it looks like a balloon and is called an aneurysm. It is pushing on the trigeminal nerve, and this compression is producing action potentials, which are going to your brain."

"Is that like when you hit your funny bone?" asked John.

"Exactly," replied the doctor. "Now, we must fix this problem because it could be very dangerous or even lethal if the aneurysm ruptures and blood enters your brain. I think that we caught it in time, and the medication we gave you to lower your blood pressure should help. But, I'm concerned that the stabbing pain is still bad, especially since this is the biggest aneurysm I have ever seen. I'll check our scheduling and get you set up for a surgery."

"Isn't there some other option?" asked Lynn.

"In some cases a procedure called microvascular decompression can be performed to alleviate the stabbing pain; that's when a soft Teflon cushion is placed between the blood vessel and the nerve. But although that might help with the pain, it would not address the aneurism. I'm afraid for that we'll need to perform surgery to repair the blood vessel.

"In the long term, we must also work to lower your blood pressure; we'll keep you on the medication, which I see has lowered your blood pressure a little. You will need to go on an exercise program and eat a low salt diet."

"I'll do almost anything to get rid of this stabbing pain, doctor."

### Questions

1. Why is the pain only on the right side of Lynn's face?
2. Why did the doctor prescribe a low salt diet and an exercise program?
3. Why wouldn't the surgeon simply tie off the artery, between the heart and the aneurysm?

Case copyright ©2009 by the [National Center for Case Study Teaching in Science](http://www.sciencecases.org). Originally published September 15, 2009 at [http://www.sciencecases.org/face\\_pain/case1.asp](http://www.sciencecases.org/face_pain/case1.asp). Photo in title block © Monika3stepsahead | Dreamstime.com. Please see our [usage guidelines](#), which outline our policy concerning permissible reproduction of this case study.