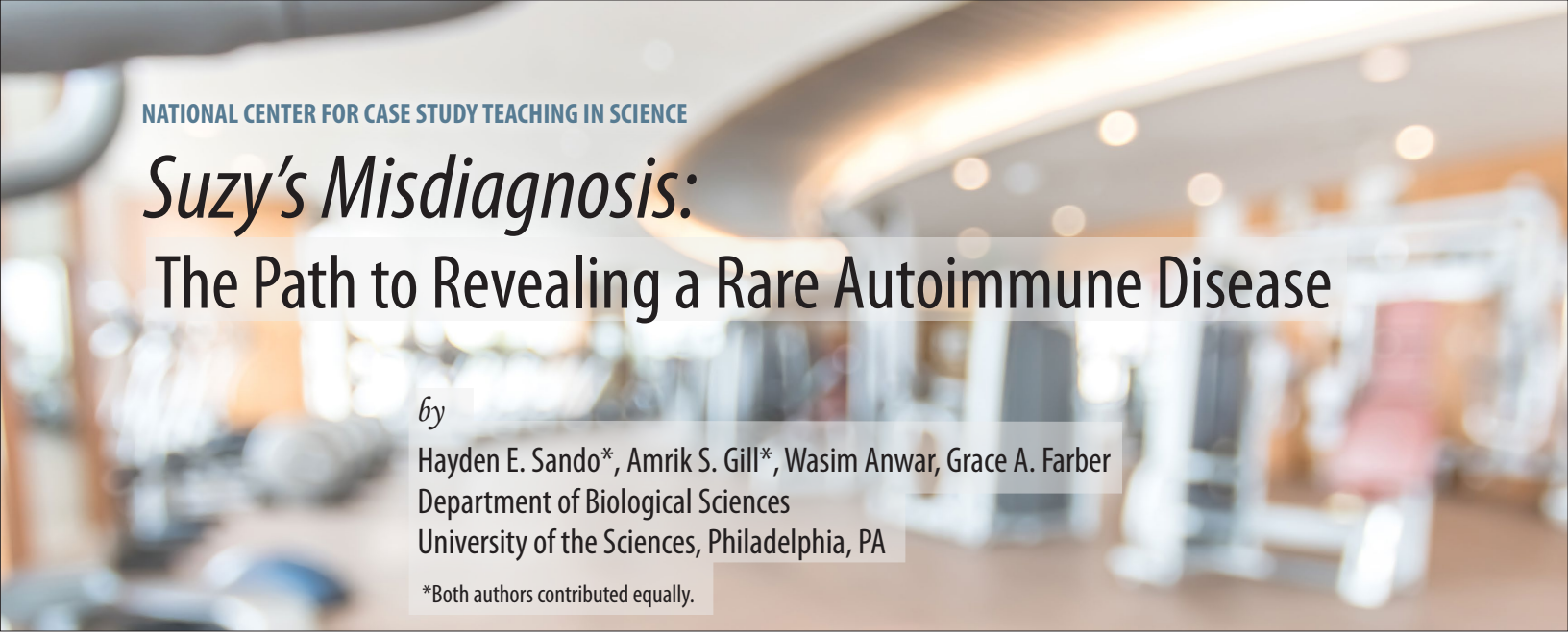

NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Suzy's Misdiagnosis:
The Path to Revealing a Rare Autoimmune Disease

by
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Part I – Rough Morning

Note: Watch the following video (4:09 min) before completing Part I.

Visual Field Processing by Ronald Sahyouni, Khan Academy, 2013. <https://youtu.be/aobWzlXIooQ>

Suzy Smith, a 30-year-old exercise physiologist, was having a rough Monday morning. She had just started working with her first client of the day when she noticed that her vision was a little blurry on her right side. This had happened to her many times in the last few years, so she was not too worried. She decided to wash her eyes and face with a moistened towel. This usually fixed the problem immediately, but it didn't help as much this time. Suzy decided to just push through it and go on with her day. The blurriness subsided by the end of the evening.

The next morning, Suzy was at the clinic and noticed her vision was worse than the previous day. Her vision on the right side was severely compromised and the wet towel did not help this time. Also, a new symptom had appeared. It was slightly difficult for her to walk because the entire right side of her body felt numb. This was starting to worry her clients and colleagues. She was asked to go home for the day. Suzy then frantically called her mother, a registered nurse, who told her to leave work and seek medical attention. Her mother also suggested that the blurriness may have been caused by a blow to the head that occurred last week when she slipped on ice and fell while on her way to work out at the gym. Suzy mentioned that her accident was probably not the reason because the issue had been plaguing her for months. Suzy scheduled an appointment with her primary care physician for later that day.

Questions

1. Why did Suzy's mom suggest that her symptoms may have been caused by her fall last week?

2. Complete the diagram below (Figure 1) representing the neuroanatomy and histology of the retina. Search for answers using your course textbook or materials on the internet.

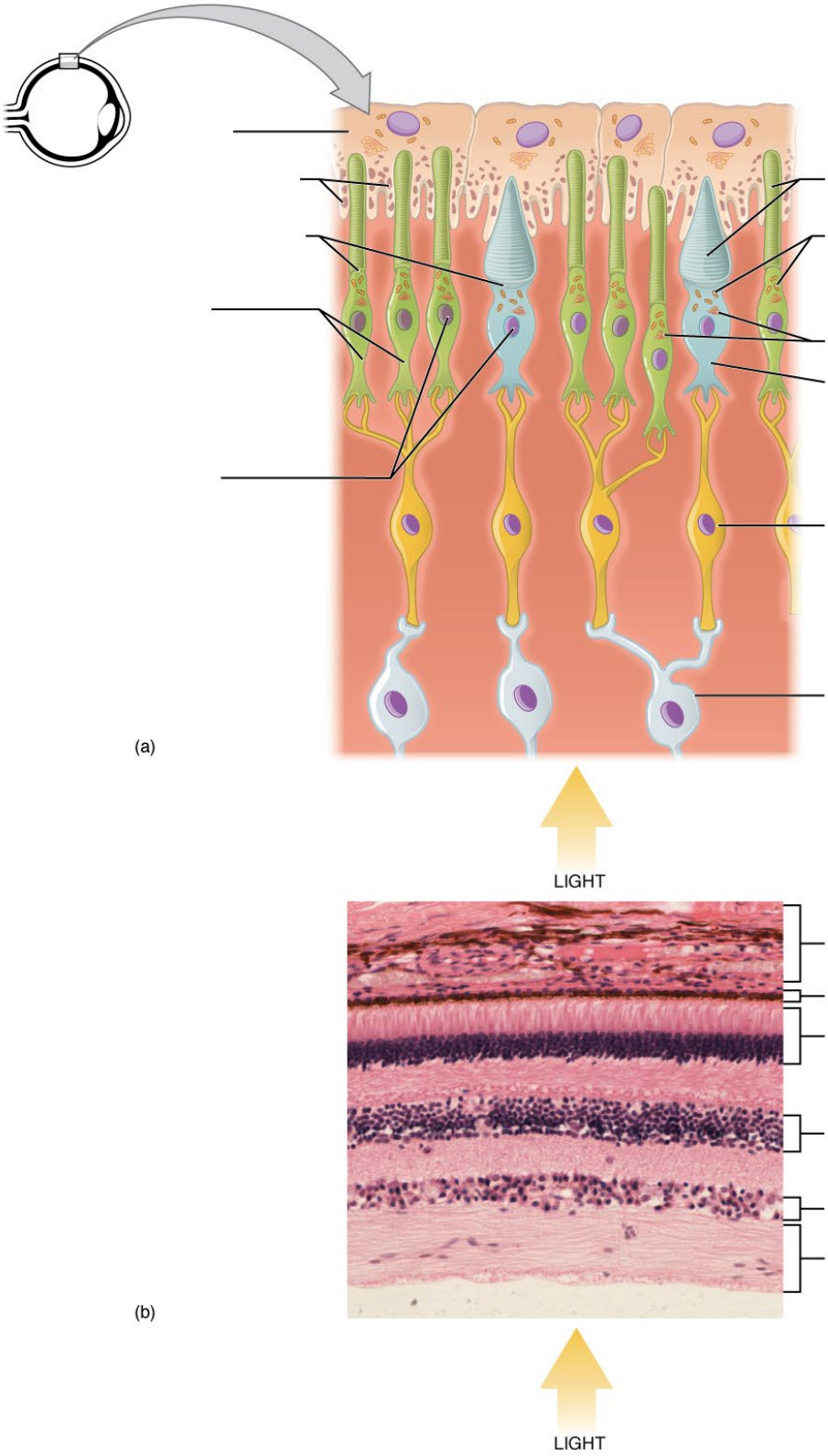

Figure 1. Cell layers of photoreceptor. *Credit:* OpenStax College, CC BY 4.0.
Access for free at <https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>.

3. (a) Complete the diagram below (Figure 2) by drawing the visual system from the retina to the primary visual cortex. Use a colored writing utensil to indicate pathways for the right visual field. Label at least five major landmarks in the visual pathway. You can use the video you watched as a guide.

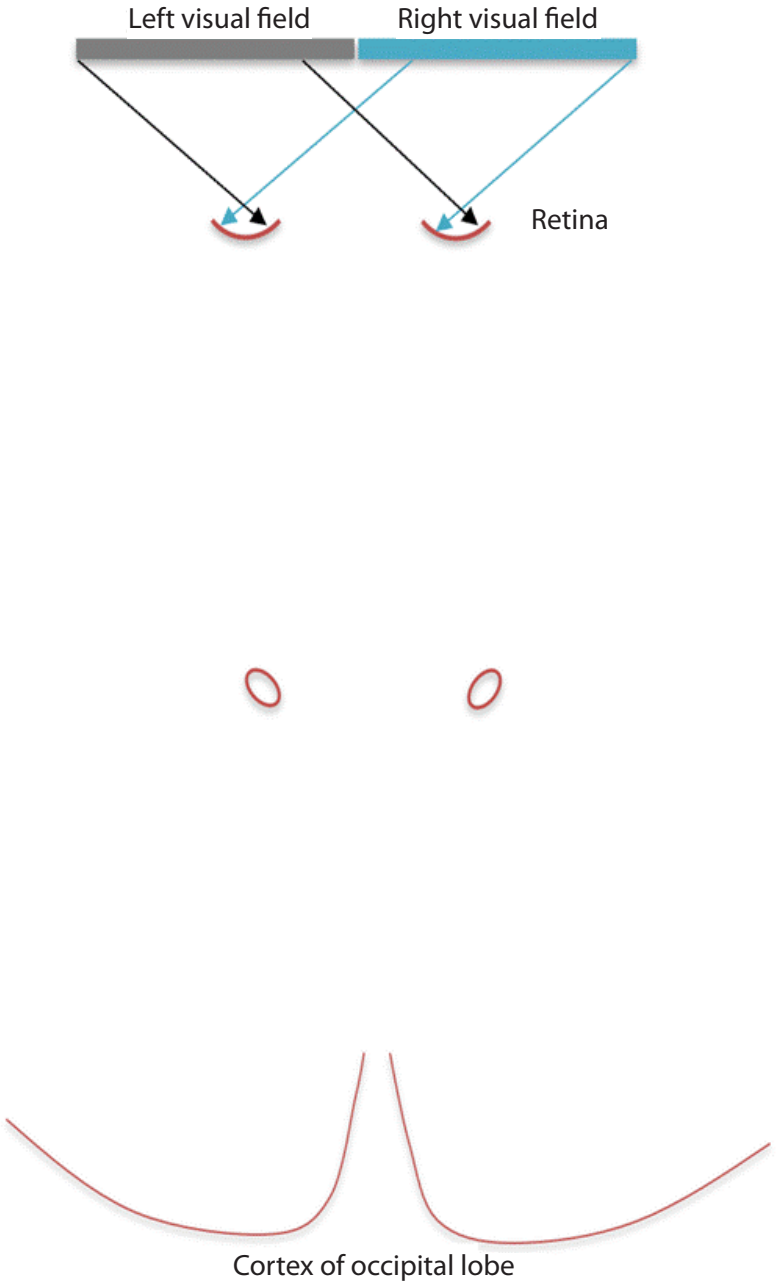

Figure 2. Visual pathway.

3. (b) Starting from the retina and ending at the visual cortex, describe the pathway you drew above.

4. What regions of the retinas could be compromised, giving a potential explanation for why vision is disrupted in only the right hemifield of binocular vision? How do these regions in both eyes correlate to this specific field of vision?

5. If head trauma were the cause of the symptoms, what parts of the brain could still successfully integrate and relay the sensory impulses? Be specific. What brain region would likely be affected by such trauma?

6. What is the basic difference between visual sensation and perception?

Part II – The Investigation

Note: Use the PubMed search engine (link below) to find a recent review article on multiple sclerosis. Explore the basic mechanisms of this disease before completing Part II and use what you learn to address the questions in this section. Provide a properly formatted citation for the review article you select.

- PubMed: https://www.ncbi.nlm.nih.gov/pubmed/
- Insert the citation of the article you selected here:

By the time Suzy was ready to go to the hospital, she could barely see anything on her right half of vision in both eyes and the right side of her body was extremely numb. She told her mother that it felt like there was a curtain blocking the right side of her vision. Her mother had to drive her to the hospital. At the hospital, a physician set up a dilated fundus examination. The doctor determined that she was suffering from severe optic neuritis, because her retinas were very inflamed and swollen. This finding, together with the compromised motor function, persuaded the physician to order a blood exam, spinal tap and magnetic resonance imaging of her brain. The results of the MRI indicated inflammatory changes, with multiple disturbances in the prefrontal cortex, left posterior parietal lobe, and corpus callosum. The spinal tap results indicated a very minor increase in total proteins and white blood cell count. A neurologist shared this information with Suzy and her mom. The neurologist suggested that the inflammation in Suzy's eyes and brain was likely due to the immune system attacking the protective covering of her nerves. Given the test results and observations, the team of doctors decided to prescribe a first-line disease-modifying medication, beta interferon 1b. However, the team noticed Suzy's symptoms were not getting better with this medication, so they then prescribed Tysabri (natalizumab) injections, which were supposed to treat the autoimmune disorder and reduce vision loss by about 47%.

The MRI image indicated brain lesions (Figure 3).

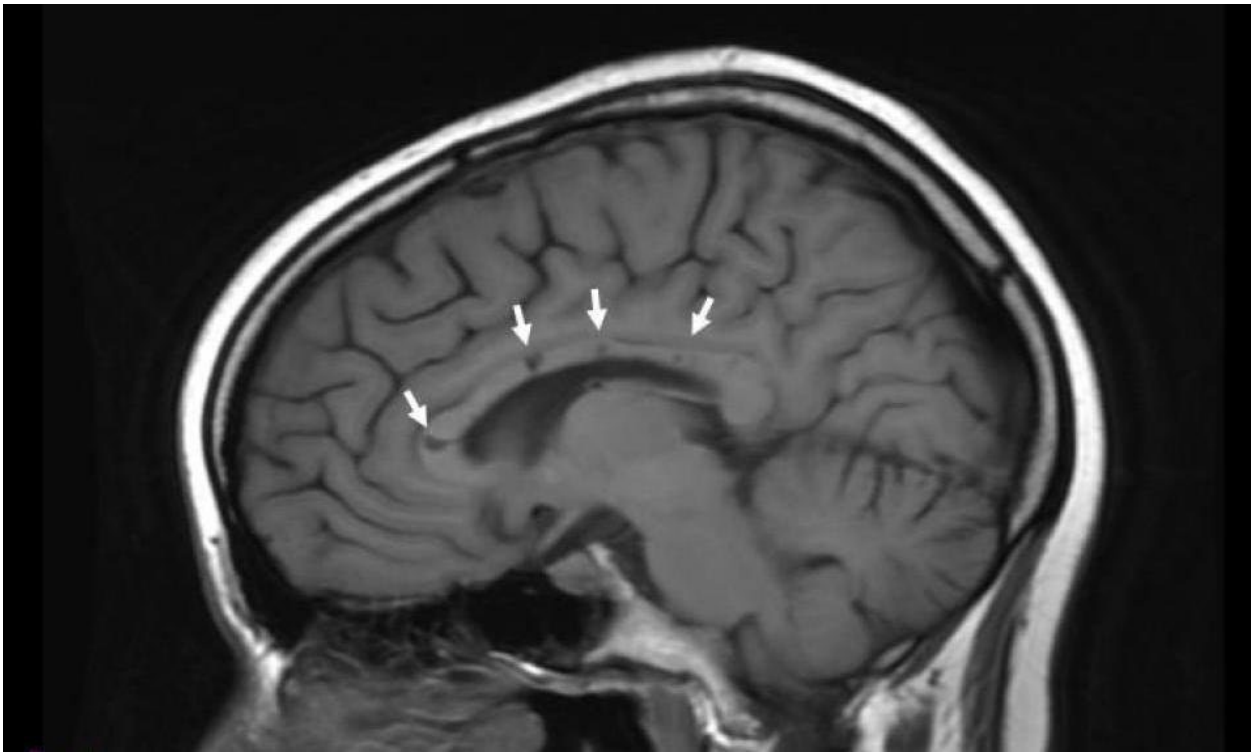

Figure 3. Brain MRI. *Credit:* Rennebohm *et al.*, 2008, CC BY 2.0.

Questions

1. According to feedback from the neurologist, why do you think multiple sclerosis was the presumed diagnosis for Suzy?

2. What specific structures are affected by this disease, and how does it alter the function of neurons?

3. Why is magnetic resonance imaging a good tool for successfully diagnosing this illness? What is a spinal tap and how does it further support this diagnosis?

4. In multiple sclerosis, activated inflammatory cells may cross the blood-brain barrier and cause myelin damage. Research online materials to provide a brief summary for the general mechanism of action for Tysabri.

Part III – The Resolution

Note: Read the abstract of the following article prior to completing Part III.

- Susac, J.O., R.A. Egan, R.M. Rennebohm, and M. Lubow. 2007. Susacs syndrome: 1975–2005 microangiopathy/autoimmune endotheliopathy. *Journal of the Neurological Sciences* 257(1–2): 270–2. https://doi.org/10.1016/j.jns.2007.01.036.

Within days after receiving the first infusion of Tysabri, Suzy noticed that her visual and motor symptoms worsened. She began to develop severe headaches and motor aphasia. As Suzy became depressed and lost patience, she became very hopeless about her diagnosis. Suzy's mother urged her to seek a second opinion from a different team of physicians. Suzy finally agreed and decided to take a three-hour drive to the nearest research-based university hospital. At the hospital, the physicians performed the same dilated fundus examination as the first team of doctors did, but the examiners noticed more than just swelling and inflammation. There were multiple obstructions in the arteries supplying blood to the retina. The physicians decided to perform a fluorescein angiography to better measure blood flow, and the results led the physicians to diagnose Suzy with branch retinal artery occlusions (BRAO) caused by immune dysfunction. The fluorescein angiography confirmed that the symptoms Suzy was experiencing were due to endothelial cell degradation instead of myelin breakdown.

This diagnosis led the team of doctors to perform a second MRI for Suzy. The MRI results were almost the same as the first imaging test. But this time, the doctors suggested that the multiple disturbances in the prefrontal cortex, left posterior parietal lobe, and corpus callosum were likely due to blood vessel damage caused by the immune system. Suzy's team of physicians diagnosed her with Susac syndrome, a form of autoimmune endotheliopathy. Thus it was immediately decided that Suzy stop using Tysabri. In making this recommendation, the neurologist cited a study he had read about a patient with Susac syndrome who was misdiagnosed with MS, with the patient's symptoms severely exacerbated by Tysabri. The doctors revised Suzy's treatment plan to include a regimen of intravenous immunoglobulin therapy and methylprednisolone. In just one week of treatment, her symptoms subsided dramatically and by the end of the month, her vision improved and most of her numbness disappeared.

Figure 4 below demonstrates how fluorescein angiogram differentiates BRAO from normal optic vascularity. Normal vascular integrity is indicated in the picture on the left (retina of the left eye); BRAO pathology is indicated in the picture on the right (retina of right eye).

Figure 4. Images of the retina with fluorescein angiography. *Credits:* Left panel by L. Bacud, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?title=File:Fluorescein_angiography.jpg&oldid=307383254>. Right panel by Maria Sieglinda von Nudeldorf, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?title=File:Retinal_branch_occlusion_ratkaj.jpg&oldid=323475453>.

Questions

1. What is fluorescein angiography and how does this help to diagnose autoimmune endotheliopathy?

2. Which symptom among the classic triad for Susac syndrome did Suzy not experience? Give a possible explanation as to why.

3. The doctors prescribed methylprednisolone and immunoglobulin therapy, which targets the immune system. Briefly explain why this treatment would help Suzy's vision.

4. Considering the physical regions compromised by reduced blood flow, why do you think Suzy was inflicted with right-side body numbness? In what way is this different than the cause of symptoms associated with vision loss?

5. Give a brief explanation for why Tysabri did not work for Suzy.