

# **Immunology, Musculoskeletal, Integumentary (IMIS)**

## **Week 1 Case # 1**

### **Meningitis and Innate Immunity**

#### **Student Version**

**GOAL:** To understand the diagnosis and treatment of Meningitis. To understand the role of complement in defending the body against bacterial pathogens.

#### **CASE REPORT:**

Toshimitsu Nakamoto is an 18-year-old male who just started his first semester at University of Arizona and who uses the name Toshi in the United States. He is majoring in Biology with the hope to eventually go to Veterinarian School. He is originally from Japan, but has a scholarship and a student visa to study in the United States. He has been in Tucson for about 3 months and is starting to get the hang of classes. His roommate, Andre Wilson, is also pursuing a Biology degree in the hopes of being a physical therapist. They spend a lot of time in the dorms studying and making study groups with others in the same major.

Toshi has been more stressed recently. He has finals coming up and he is finding Chemistry labs challenging. He doesn't typically get headaches but for the last week, he has had a mild global headache. He thinks that it is likely from the stress and lots of reading causing eye fatigue while staying up late to study. He has been taking acetaminophen and ibuprofen, which has been helpful, but he has been very concerned that the headaches keep coming back. He told his roommate about this, and Andre told him to go to the student clinic. He said that he would wait until next week after his finals are done.

A few days go by and Andre becomes very worried. Toshi keeps saying that it is 2010 and he is back in his home country running with his sister. He also seems to forget Andre's name and periodically reverts to speaking Japanese. Andre decides to take Toshi to the hospital.

Toshi is brought to the emergency room by Andre. Dr. Courtney Reynolds is the physician in the emergency room, and she greets Toshi and Andre, and introduces herself. Initially, Toshi is lucid and consents to care. He describes the headaches, and that he has been feeling really cold, even though the heat was on in the dormitory. He also relays that a couple of times over recent days, he has woken up sweating, and his headaches have been getting worse. However, over the course of a short period, Toshi becomes confused and is not making sense, so Andre describes to Dr. Reynolds what has been happening. Andre relates that to him it seemed like Toshi has been swinging between periods of lucidity and confusion over the last couple of hours.

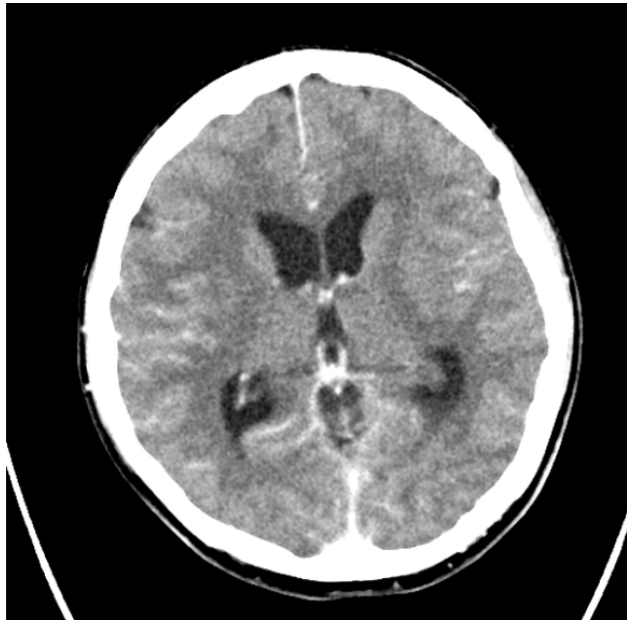
Dr. Reynolds is concerned about Toshi and tries to ask for more information. He is not able to cooperate. She asks Andre if Toshi has any medical problems. Andre says, "The only thing that Toshi told me was that he was admitted to the hospital as a child to the ICU. He said that he had a really bad infection in his head." Dr. Reynolds asks if he has been having any other symptoms in the past week. Andre says that the light was hurting Toshi's eyes. He made sure that all the lights were off while in the dorm. Andre also says that Toshi threw up a few times. He can't think of any other symptoms that Toshi was having.

Dr. Reynolds performs her physical exam. She sees that his vitals are Temp: 39.5 C, BP: 105/60 HR: 120, RR: 25, Sat 98% on RA. She observes that Toshi appears to be his stated age and that he shows signs of acute distress. He is sweating, and intermittently breaks out loudly in Japanese. He is unable to say where he is and is difficult to redirect. She observes a diffuse rash on his skin that is small punctate red dots. The rash does not blanch with pressure and covers his whole body including his palms, soles, mouth, and eyelids.

Dr. Reynolds is concerned that an infection is underlying his signs and symptoms. She is most concerned for sepsis, most probably a bacterial meningitis. She sends appropriate labs and starts treating for systemic inflammatory response syndrome (SIRS) with fluids. Given his confusion, she also orders a CT of his head that is shown below.



**Figure 1A. Axial, non-contrast head CT**



**Figure 1B. Axial, post-contrast HCT. Findings: Generalized abnormal leptomeningeal enhancement is noted. No basal enhancement is otherwise evident. No focal enhancing brain intraparenchymal lesion. Prominence of 3rd ventricle as well as temporal horns of both lateral ventricles with early generalized effacement of cortical sulci.**  
(<https://radiopaedia.org/cases/bacterial-meningitis>)

Dr. Reynolds performs a lumbar puncture, and the laboratory results come back as below.

Appearance	Turbid
Opening Pressure (cmH <sub>2</sub> O)	25.0
Absolute Neutrophil Count (Cells/microliter)	1532
Protein (mg/dL)	347
Glucose (mg/dL)	10

The available laboratory results and radiology support Dr. Reynolds concern for bacterial meningitis. She sends off a culture from the lumbar puncture that will come back in two days. They are able to do a gram stain of the CSF that shows

gram negative diplococci. She admits Toshi to the intensive care unit (ICU) under the care of Dr. Rajesh Khan.

The symptoms combined with the available laboratory results allow Dr. Kahn to calculate a bacterial meningitis score of at least 3, indicating a significant risk of Kyle having bacterial meningitis. As a result, Dr. Kahn initiates treatment with ceftriaxone to cover the most likely organisms that cause bacterial meningitis in a patient Toshi's age.

The CSF culture grows *Neisseria meningitidis*, which confirms the initial suspected diagnosis. As Toshi had a prior infection that caused admission to the ICU, Dr. Khan is very interested to know if Toshi might have an immunodeficiency or autoimmune condition, including ones that would require treatment with the antibody eculizumab. Toshi's parents are reached briefly via phone in Japan and are distraught to hear of his illness when informed via interpreter; they vow to get on the next plane to Houston and consent to Toshi's treatment at the hospital but aren't able to offer a detailed medical history.

In conjunction with the infectious disease specialists, Dr. Khan requests laboratory analyses for complement levels. It is found that Toshi is deficient in complement C8 which Dr. Khan recognizes as likely contributing to his current condition, through it being a component of the innate immune response.

While Dr. Kahn is considering his next steps, he is approached by Andre who asks about himself. He says, "Given that Toshi and I have spent a lot of time together as roommates, am I at risk of catching meningitis?" In reply, Dr. Kahn asks, "Have you been vaccinated for Meningococcal meningitis?" Andre relays that he might have been vaccinated when he was a child, but he wasn't sure, and that meningitis was not on the list of vaccines he had to get to attend University of Arizona. He further relays that he and Toshi only share physical space, they don't share drinking glasses, and they go to the cafeteria and use their meal plans for every meal. Dr. Khan prescribes rifampin for him and advises that he should

follow up with the infectious disease clinic to make sure that he does not develop symptoms.

Dr. Kahn discusses recent meningitis cases in the ICU unit with a fourth-year medical student, Mr. Harlan Brown. When discussing a case of meningitis caused by a *Streptococcus pneumoniae* infection, Dr. Kahn stresses just how valuable antibiograms of local resistance data can be when selecting appropriate antibiotics.

Forty-eight hours later, Toshi is clinically improving. He is able to be downgraded to the floor from the ICU in a few days and is able to be discharged after spending a total of 5 days in the hospital. He goes back to school and is thankful to Andre for saving his life.