

# Acute Bacterial Meningitis

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## Case #4

Bacterial meningitis is a life-threatening infection of the linings or meninges of the brain and spinal cord. Survivors may experience hearing loss or deafness, brain damage, seizures, and/or the retention of fluid on the brain. Symptoms may be mistaken for the flu. Find out what happens to a 14-year-old when bacteria invade his central nervous system

### *Case Objectives*

- 1) Use the following websites [Cranial Meninges](#), [functions of CSF](#), to review the basic structural elements and functions of the meninges and CSF to include:
  - a) Definition of meninges
  - b) Name 3 layers of the meninges
  - c) List 4 functions of CSF
- 2) Define blood-brain barrier and ways microorganisms may gain access to the normally sterile spinal fluid and meninges. (Don't get bogged down in the pathophysiology of the blood brain barrier. Review this site for your information. It is important to note that bacteria or viruses must cross the blood brain barrier to cause meningitis. Medications used must also be able to cross the blood brain barrier for treatment).

### [Blood Brain Barrier](#)

- 3) Define meningitis. Discuss the differences between bacterial and viral meningitis.
- 4) Describe diagnostic testing methods used to diagnose meningitis and determine the effect of the disease to include:
  - a) Lumbar puncture
  - b) Laboratory procedures including spinal fluid and blood analysis.
  - c) CAT scan
- 5) Define the key laboratory parameters (in spinal fluid and blood) that patient care individuals need for the diagnosis and treatment of meningitis. Which results are necessary for the physician to select appropriate treatment? Define normal as well as abnormal values.
- 6) Describe the advantages and disadvantages of a CAT scan over a standard X-ray.
- 7) Describe the signs and symptoms of bacterial meningitis.
- 8) Define the following as they apply to acute meningitis:
  - a) Petechiae
  - b) septicemia
  - c) Gram stain
  - d) blood culture
- 9) Describe common vaccines used for the prevention of meningitis.
- 10) Describe the modes of transmission of bacterial meningitis and why it poses such a public health hazard.
- 11) Briefly outline the protocol for managing people contacts that have associated with a patient that has acquired acute bacterial meningitis.

- 12) Define the roles of the health care workers in diagnoses, treatment, and prevention of meningitis to include:
- Nursing
  - Physician
  - Clinical laboratory scientist
  - Radiology technician
  - Epidemiologist
- 13) Define treatment protocol for patients with bacterial meningitis including the purpose of steroid drugs such as dexamethazone.
- 14) Describe the possible consequences of a missed or delayed diagnosis of a case such as the one we are studying. Include consequences for the patient and the community

A 14-year old male complained to his parents of feeling quite ill with headache, dizziness, nausea, and feeling very weak. After a rise in in his body temperature, an increase in the severity of his headache, and the development of a rash, his mother took him into their medical clinic where he was examined by a family nurse practitioner (FNP). Upon examination, the FNP noted the patient also complained of stiffness in his neck and nausea. The patient had a temperature of 103.5 and an increased heart rate. She noted a rash had developed on parts of the patient's extremities and wrists. Concerned with meningitis, she consulted the clinic's family practice physician and asked her to examine the patient.

1) *What symptoms did the patient exhibit that pointed to meningitis?*

Upon his examination, a complete blood count (CBC), blood for culture and [lumbar puncture](#) (LP) were performed since there was a strong clinical suspicion of [bacterial meningitis](#). The LP examination included tests for the presence of bacteria (Gram stain), cell count and differential, glucose and protein. A culture of the fluid is also a standard test and detects the type of bacteria, if any, that may be present. Radiology was called to perform a CAT scan on the patient.

- Which health professional would perform the lumbar puncture?*
- Which health professional would examine the CSF fluid?*
- What is meningitis?*
- What are common symptoms of meningitis?*
- How is bacterial meningitis treated?*
- How do people "catch" meningitis?*
- Have you had a vaccine for a strain of meningitis?*

### [CBC Results](#)

### [Laboratory Spinal Fluid Analysis](#)

9) *Which CBC and spinal fluid parameters are indicative of bacterial meningitis?*

From the information provided, coupled with the patient's clinical symptoms, the diagnosis of acute bacterial meningitis was made by the medical team. The morphological characteristics of the bacteria and the clinical picture strongly suggests an infection due to *Neisseria meningitidis*.

The patient was administered intramuscular antibiotic therapy, as well as a [steroid medication](#) called dexamethazone to reduce inflammation around the brain and it's associated seizure risk. The patient was promptly admitted to the hospital's critical care unit. Bacterial meningitis is a serious, life

threatening disease that requires prompt and intensive therapy. Click here for a [clinical overview](#). The rash seen on initial exam are called petechiae. As you recall, these are small hemorrhages (localized areas of bleeding) from the capillaries present in about 50-60% of patients with this form of acute bacterial meningitis. [View petechial rash](#)

- 10) *Why are steroids used to treat patients with meningitis?*
- 11) *What procedure has greatly reduced the incidence of bacterial meningitis?*
- 12) *How long must infectious airborne precautions be maintained after the start of antibiotics?*
- 13) *What causes the petechial rash in meningitis?*

Once the patient had been admitted to the hospital's critical care unit, intravenous fluids were started. Included were penicillin G, steroids, and essential fluid and nutrient replacements. Nursing care is intensive to include monitoring neurologic parameters for seizures, blood pressure, temperature, fluid replacement, administration and others.

The neurologist ordered a standard radiograph (X-ray), as well as a [computerized axial tomograph](#) (CAT) scan of the patient's cranium to determine the extent of swelling caused by the inflammatory presence of the bacteria.

- 14) *Can you explain how a CAT scan works?*
- 15) *Why would a physician request a CAT scan over an X-ray?*
- 16) *Why would an X-ray be ordered over a CAT scan?*

48 hours after the lumbar puncture, spinal fluid and blood cultures confirmed the presence of *Neisseria meningitidis*. Click here if you are interested in seeing the [nature of this organism](#) in the laboratory. (Don't be concerned with learning the material in this last website discussing testing methods for *N. meningitidis*. This gives you an idea of the steps a laboratorian would go through to detect *Neisseria meningitidis*.

- 17) *Which health professional would be responsible for running the tests to detect bacterial meningitis?*

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### ***Instructor's Notes:***

*Since bacterial meningitis is a highly infectious disease and poses a public health threat, states require physicians to immediately report the case to departments of public health. A state or county [epidemiologist](#), individuals trained to follow community diseases, follow standard protocols set forth by the Centers for Disease Control to assure proper follow-up with individuals that have been in close contact with the patient. Close contacts are defined as individuals who may have had contact with the patient's saliva through kissing, sharing drinking straws and a number of other interactions. These are usually household members and girlfriends/boyfriends. In these cases, the close contacts must be treated with prophylactic (preventative) antibiotics and closely watched for signs of the disease. Since the patient attended a school, the local health agency, usually the county health department, sends a notification to parents as a precaution. Such notices advise the parents of signs and symptoms of meningococcal meningitis and encourage the parent to seek medical care for their child quickly if the child exhibits any one of those symptoms.*

*For a more detailed description of this process, interested students can visit the CDC public health guidelines website listed in Additional Resources.*

The patient responded well to all medications and supportive care. He was kept in the hospital's intermediate care unit for several days and then discharged.

## Case Summary

- 1) "Meningitis is an infection of the fluid of a person's spinal cord and the fluid that surrounds the brain. People sometimes refer to it as spinal meningitis. Meningitis is usually caused by a viral or bacterial infection. Knowing whether meningitis is caused by a virus or bacterium is important because the severity of illness and the treatment differ. Viral meningitis is generally less severe and resolves without specific treatment, while bacterial meningitis can be quite severe and may result in brain damage, hearing loss, or learning disability" (CDC Meningococcal Disease).
- 2) "High fever, headache, and stiff neck are common symptoms of meningitis in anyone over the age of 2 years. These symptoms can develop over several hours, or they may take 1 to 2 days. Other symptoms may include nausea, vomiting, discomfort looking into bright lights, confusion, and sleepiness. As the disease progresses, patients of any age may have seizures" (CDC Meningococcal Disease). In this case, the patient showed the effects of a meningococcal septicemia due to the petechial rash present on examination.
- 3) Diagnosis was made from the CBC and spinal fluid analysis. In bacterial meningitis, the WBC is elevated. The spinal fluid showed a gram negative diplococcus bacteria, an elevated protein level, and decreased glucose level, indicative of a bacterial meningitis. The presence of cellular material and bacteria in the spinal fluid increases the protein level. The bacteria are utilizing glucose as an energy source, therefore the total spinal fluid glucose is decreased. An XRay and CAT scan were ordered to detect the pressure on the brain from the meningitis. Increased cranial pressure can be very dangerous, leading to seizures and brain damage.
- 4) "Urgent treatment with antibiotics is essential for someone with bacterial meningitis. The sooner someone with bacterial meningitis is diagnosed and treated, the greater chance there is they will make a full recovery" (Meningitis Foundation of America). Appropriate treatment with antibiotics reduces the risk of dying to below 15%. Anti-seizure medication (steroids) is used to alleviate intracranial pressure.
- 5) Meningococcal meningitis occurs predominantly in males. Epidemics occur in about 10-year cycles. Most cases of meningitis are isolated and not related to other cases. "Bacterial meningitis is fairly uncommon, but can be extremely serious. It is fatal in one in 10 cases and one in 7 survivors is left with severe handicap, such as deafness or brain injury" (Meningitis Foundation of America).
- 6) There are vaccines against many of the strains of bacteria that cause meningitis. The Hib vaccine has been very effective in reducing the rate of childhood meningitis. Pneumococcal vaccine works against the strain of bacteria causing meningitis primarily in elderly people. Other vaccines may be utilized to control outbreaks. Since meningitis is a reportable, communicable disease, the medical teams must promptly notify state and county public health officials. These individuals then follow the protocols for notifying persons who may have had direct contact with the patient.

- 7) Many healthcare workers interacted in this case to diagnose and effectively treat the patient. Physicians ordered key tests, made the diagnosis, and ordered treatment. Nursing personnel worked around the clock monitoring vital signs, giving intravenous antibiotics and fluids, and administering steroid medications. Clinical laboratory scientists provided key information for the diagnosis in the form of a CBC, and spinal fluid results. Radiologic technologists performed Xrays and a CAT scan to detect the level of intracranial pressure. Radiologists read and interpreted the images. Public Health officials played a key role in containing a communicable disease. They alerted individuals that had been in close contact with the patient to watch for symptoms that might indicate meningitis. These individuals were advised to notify a physician immediately at the appearance of any possible symptoms.

## Answers to Case Questions

### Question 1

Symptoms include fever, increased heart rate, headache, rash, stiffness in neck, and nausea.

### Question 2

Physician

### Question 3

Clinical Laboratory Scientist

### Question 4

Meningitis is an infection of the fluid of a person's spinal cord and the fluid that surrounds the brain. People sometimes refer to it as spinal meningitis. Meningitis is usually caused by a viral or bacterial infection.

### Question 5

High fever, headache, stiff neck.

### Question 6

Antibiotics given early in the course of the disease.

### Question 7

Through respiratory and throat secretions. It may be spread through coughing or kissing. It is not as contagious as the common cold or other easily spread diseases.

### Question 8

Most children are now given the Hib vaccine which protects against a strain of bacteria that causes meningitis in children. Another common vaccine, the pneumococcal vaccine, protects elderly people against a strain of meningitis they are most susceptible to.

### Question 9

WBC is elevated in the CBC. Spinal Fluid: Elevated WBC, protein. Glucose is decreased. Cells and bacteria present in spinal fluid.

### Question 10

To reduce inflammation and swelling around the brain. This reduces the chance of seizures.

### Question 11

Vaccination

### Question 12

24 hours

### Question 13

Hemorrhage

### Question 14

A series of x-ray beams from many different angles are used to create cross-sectional images of the patient's body. The computer assembles these images into a three-dimensional picture.

### Question 15

Organs, bones, and tissues can be displayed in great detail in a three-dimensional picture in a CAT scan. An X-ray only shows a single dimension. Much more can be seen from a CAT scan.

### Question 16

In many cases, an X-ray picture is all that is needed. It is significantly more inexpensive than a CAT scan.

### Question 17

Clinical Laboratory Scientist

## Health Professionals Introduced in this Case

[Family Nurse Practitioner](#)

[Family Practice Physician](#)

[Physician with a Neurology specialty](#)

## Health Professionals Previously Introduced

[Radiology Technician](#)

[Nursing](#)

[Clinical Laboratory Scientist](#)