



SAQs Team

# CASE 7

## Case Scenario:

A 10 years old female presents to the emergency department with a two days history of headache, nausea, vomiting and fever. She was seen by a physician two days ago who diagnosed otitis media and prescribed amoxicillin. She has taken six doses. Her immunizations are up to date. She is conscious, alert and complains of pain over the neck area. On examination she has pain on flexion of the neck area.

### Regarding the case:

Q1) What is the most likely diagnosis?

Meningitis.

Q2) What is Meningitis?

It's Is the inflammation of the protective membranes covering the brain and spinal cord known as the meninges.

Q3) Signs and Symptoms of Acute Meningitis ?

Fever, Headache, Stiff neck "Pain, itchy nick", Nausea & vomiting, Sensitivity to light, Confusion, bruises under skin & spread rapidly in advanced cases.

In infants:

Inactivity, Irritability, Vomiting, Poor feeding

Q4) What are the three most common bacteria that cause meningitis and what antibiotic covers them with close to 100% certainty?

Pneumococcus

Meningococcus

Haemophilus influenzae type B

antibiotic:

penicillins , 3rd generation cephalosporins (ceftriaxone)

Q5) A lumbar puncture is done on our patient "Results are shown in the table below." Gram stain of the CSF shows many WBCs and no organisms seen. Is this CSF analysis consistent with bacterial or viral meningitis? Which factors suggest one or the other?

|          | patient | normal range                  |
|----------|---------|-------------------------------|
| WBC      | 13000   | 5000-10000<br>mm <sup>3</sup> |
| Proteins | 0.20    | 0.15-0.35 g/l                 |

|         |     |                |
|---------|-----|----------------|
| Glucose | 3.1 | 2.8-4.4 mmol/l |
|---------|-----|----------------|

**viral meningitis**, because the protein and glucose levels are normal

**NOTE:** in bacterial meningitis there is increasing in the protein level in addition to decreasing in the glucose content.

**Q6) Management of Meningitis?**

1- (IV) Antibiotics

"the antibiotics vary depending on the age , type of pathogen ..etc but the most common antibiotics used with this disease are :

ceftriaxone , cefotaxime , vancomycin

2- (IV) Fluids . "normal saline and glucose drip"

3- Admitting the patient to the hospital.

**Q7) What are the risk factors of this disease?**

-Skipping vaccinations

-Age

-Pregnancy

-Compromised immune system

**Q8) List some of the Complications of Meningitis?**

1.Phlebitis

2.hydrocephalus

3.Septicemia

4.Focal cerebritis & seizures.

5. Cerebral abscess.

6. Cognitive deficit.

7. Deafness.

**General Questions (From theoretical lectures):**

**Q) What is another name for viral meningitis?**

Aseptic meningitis.

Q) What is the microscopic pathology in meningeal tuberculosis?

Granulomas composed of lymphocytes and large mononuclear cells – tubercle bacilli

Q) List the meninges surrounding the brain and spinal cord.

- 1•The outermost layer is the dura matter.
- 2•The middle layer is the arachnoid matter.
- 3•The innermost layer is the pia matter.

Q) The cranial dura mater is composed of two layers, what are they?  
periosteal.

meningeal.

The meningeal layer is folded and forms the "dural folds".

Q) List the reflection of dura that extend into the cranial cavity and elaborate on their characteristics.

The dural folds are: falx cerebri, and tentorium cerebelli.

Q)What forms the subarachnoid cistern?

The subarachnoid space it is varied in depth.

Q) In the spinal meninges, what separates the dura from the wall of the vertebral canal?

It's separated by the epidural space.

Q) The spinal cords ends at the level of L1-L2. Where do the meninges end?

The arachnoid and dural and, subarachnoid space, continue caudally to S2.

The pia extends downwards forming the filum terminale which pierces the arachnoid and dural sacs and passes through the sacral hiatus to be attached to the back of the coccyx.

Q) How are the ventricles interconnected?

The central canal of the spinal cord is continuous upwards to the 4 ventricle→4 ventricle is continuous up with the cerebral aqueduct,

that opens in the 3 ventricle → 3 ventricle is continuous with the lateral ventricle through the interventricular foramen (foramen of Monro).

**NOTE:** The flow starts from the lateral ventricles and so on.

**Q) Where is the CSF formed and how does it flow?**

It is produced by the choroid plexus, which is located in the lateral, third and fourth ventricles.

It flows: through the interventricular foramen into the 3rd ventricle and, by way of the cerebral aqueduct, into the 4th ventricle.

**Q) How does it leave the ventricular system and where does it go?**

Through the three apertures of the 4th ventricle (median foramen of Magendie & 2 lateral foramina of Lushka).

It enters the subarachnoid space.

**Q) How is the CSF reabsorbed?**

reabsorbed finally into the venous system along

1-arachnoid villi

2-arachnoid granulation that project into the dural venous sinuses , mainly superior sagittal sinus.

## BIOCHEMISTRY

**What is the daily rate of CSF formation?**

500 mL/day.

**What is the mechanism of formation?**

Selective ultrafiltration of plasma

Active secretion by epithelial membranes

**Describe 3 characteristics of CSF specimen collection.**

Obtained by lumbar puncture (At the interspace L3-4, or lower)

Using aseptic technique

CSF is separated into 2 aliquots:

-for chemistry & serology

-for microbiology

Immediate analysis

It's a precious sample: Preserve any remaining sample

List 3 contraindications and 3 indications of CSF collection.

CONTRAINDICATIONS:

1. Bleeding diathesis
2. Increased intracranial pressure
3. Infection at site of needle insertion

INDICATIONS:

1. CNS infection
2. Demyelinating diseases
3. CNS Malignancy
4. Hemorrhage in CNS

What are the normal characteristics of the CSF?

Colorless

Clear

Free of clots

Free of blood

The CSF glucose analysis of a patient were low. Give 3 possible differentials.

1. Disorder in carrier-mediated transport  
e.g. TB meningitis, sarcoidosis
2. Active metabolism of glucose by cells or organisms:  
e.g. acute purulent, amebic, & fungal meningitis
3. Increased metabolism by the CNS  
e.g. by CNS neoplasm

What protein will you mainly find upon CSF protein examination?

What is the source of CSF protein?

Mostly albumin (synthesized in the liver) is found in the CSF -80% from plasma by ultrafiltration and 20% from intrathecal synthesis.-

The analysis of CSF total protein were found to be elevated. Give 3 possible differentials.

Lysis of contaminant blood (traumatic tap)

● ↑ permeability of the epithelial membrane due to:

-Bacterial or fungal infection

-Cerebral hemorrhage

● ↑ production by CNS tissue in:

-Multiple sclerosis (MS)

-Subacute Sclerosing Panencephalitis (SSPE)

● Obstruction e.g. in:

-Tumors

-Abscess

Where does CSF IgG arise?

plasma cells within CSF

blood through BBB

What does ↑ [IgG] and normal [Alb] of CSF suggest?

Local production of IgG, e.g.,

Multiple sclerosis (MS)

Subacute sclerosing panencephalitis (SSPE)

What should a physician do in the case of ↑ CSF protein?

Perform electrophoretic separation

If multiple banding (oligoclonal bands) of the  $\gamma$ -globulin is detected, the following differential diagnosis is suspected:

**MS**

SSPE

inflammatory diseases

Fill in the table regarding CSF analysis in each case.

| Parameter                  | Condition                       |                              |                           |
|----------------------------|---------------------------------|------------------------------|---------------------------|
|                            | Bacterial Meningitis (pyogenic) | Tuberculous Meningitis       | Viral Meningitis          |
| Appearance                 | Often turbid                    | Often turbid with fibrin web | Usually clear             |
| Predominant cell           | Polymorphs                      | Mononuclear (lymphocytes)    | Mononuclear (lymphocytes) |
| Cell count/mm <sup>3</sup> | 90-1000+                        | 10-1000                      | 50-1000                   |
| Bacteria/virus             | +ve smear & culture             | Often none in smear          | -ve smear or culture      |

## Further important information :

| Falx cerebri  | Tentorium cerebelli  |
|---|--|
| <ul style="list-style-type: none"> <li>● In the midline,</li> <li>● It is a vertical sickle-shaped sheet of dura, extends from the <b>cranial roof</b> into the <b>great longitudinal fissure</b> between the two cerebral hemispheres.</li> <li>● It has an <b>attached border</b> adherent to the skull.</li> <li>● And a <b>free border</b> lies above the corpus callosum.</li> </ul> | <ul style="list-style-type: none"> <li>● A <b>horizontal shelf of dura</b>.</li> <li>● It <b>lies between the posterior part of the cerebral hemispheres and the cerebellum</b>.</li> <li>● It has a <b>free border that encircles the midbrain</b>.</li> <li>● <b>In the middle line it is continuous above with the falx cerebri</b>.</li> </ul> |

| Pia  | Arachnoid  |
|--|--|
| <ul style="list-style-type: none"> <li>● <b>The pia mater</b> is the <u>innermost, thin, delicate &amp; highly vascular</u> membrane that is <u>closely</u> adherent to the gyri and fitted into the sulci.</li> </ul> | <ul style="list-style-type: none"> <li>● <b>The arachnoid mater</b> is a <u>soft, translucent membrane</u> <u>loosely</u> envelops the brain.</li> <li>● The arachnoid mater is <u>separated from the dura</u> by a</li> </ul> |



|   |                                |
|---|--------------------------------|
| <ul style="list-style-type: none"> <li>Between the <u>pia</u> and <u>arachnoid mater</u> lies the <b>subarachnoid space</b> which contains; fibrous trabeculae, main blood vessels and <u>CSF</u>.</li> </ul> | narrow <b>subdural space</b> . |
|---|--------------------------------|

## Subarachnoid cistern

|  |   |
|--|---|
| 1. The <u>cisterna magna</u> , or <u>cerebellomedullary cistern</u>  | 2. The <u>interpeduncular cistern</u> ,   |
| <ul style="list-style-type: none"> <li>lies between the inferior surface of the <u>cerebellum</u> and the back of the <u>medulla</u>.</li> <li>At this cistern <u>CSF flows out of the 4<sup>th</sup> ventricle</u></li> </ul> | <ul style="list-style-type: none"> <li>It is located at the <u>base of the brain</u>, where the arachnoid spans the space <u>between the two cerebral peduncles of midbrain</u>.</li> <li><b>This cistern contains</b> the <u>optic chiasma &amp; circulus arteriosus of Willis</u>.</li> </ul> |

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