

“...Absent from School”

Nervous System- Case 5

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Trigger

Faiz Mansoor, a 10-year-old primary school student, is not feeling well. He has severe headache. His teacher takes him to the school nurse. The nurse measures his temperature and finds a reading of 40°C. While the nurse is trying to contact his parents on the phone, Faiz vomits once. His father rushes to the school and takes him to accident and emergency (A&E) department at King Khalid hospital.



Trigger (Problem)

Faiz Mansoor, a 10-year-old primary school student, is not feeling well. He has severe headache. His teacher takes him to the school nurse. The nurse measures his temperature and finds a reading of 40°C. While the nurse is trying to contact his parents on the phone, Faiz vomits once. His father rushes to the school and takes him to accident and emergency (A&E) department at King Khalid hospital.

Problems/Hypotheses

Headache

- Tonsillitis/ Pharyngitis
- Head trauma
- Errors of refraction (eyes)
- Otitis media
- Sinusitis
- Lack of sleep.
- Constipation
- Did not have breakfast (hypoglycaemia)
- Psychological (e.g., family problems)
- Teeth problems
- Meningitis.
- Fever.

Summary or other ways to discuss hypotheses (headache):

- Infection/inflammation
- Fever.
- Pain sensitive structures.



Problems/Hypotheses

Vomiting:

- Food poisoning
- Gastroenteritis
- Severe pain/ headache
- Psychological problems.
- Otitis media (reflex nerve stimulation)
- Upper respiratory tract infections.
- After repeated cough
- Stimulation of the vomiting centre in the brainstem

Further Questions

- Did Faiz have similar headache before?
- Any history of head trauma?
- Did Faiz have problems with his ears, eyes, or teeth?
- Any history of sore throat? Any pain on swallowing?
- Any problems with Faiz' bowel movements?
- Any history of shivering?
- Any problem with his urine?
- Any history of cough?
- Any history of loose bowel motions after vomiting?

History

At the A & E department Faiz is seen by Dr. Ghazi, the emergency registrar. Faiz's father says Faiz was well until last night when he had some headache and was a little unwell and irritable. He did not eat his dinner and went to bed early. In the morning he insisted to go to school because of the school sports day. But later in the day the school nurse called us because of his fever. On further questions, Faiz did not hit his head anywhere. His bowel habits are normal and he goes to the toilet each morning. He has no trouble with his vision or teeth. There is no history of prolonged exposure to sun. The father adds, "Faiz vomited twice while we were on our way to the A & E department".

Past Medical History

No history of hospital admission or surgery.

Family History

He has a younger brother five years old.

Medication and Allergy

Nil

Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- Identify Faiz' s new problems. Provide hypotheses for each problem.
- Use the new information obtained to refine your hypothesis.
- What further information would you like to know through clinical examination?

New problems

- Not eating well
- Irritable
- Went to bed early last night
- Was unwell last night

Tutor: Encourage students to generate hypotheses. These problems can be related. Students might work on the problem “irritable”.

Ranking/Hypotheses

Fever:

- Infections (Viral and Bacterial) +++
- Tonsillitis -
- Common cold/ flu ?/-
- Pharyngitis ?
- Pneumonia. ?/-
- Urinary tract infection ?
- Gastrointestinal infections ?
- Collection of pus somewhere e.g. abscess ++
- Meningitis ++
- Bacteraemia. ++
- Heat exhaustion/ heat stroke -



Hypotheses

Irritable:

- Fever +++
- Anxiety/psychological ?
- Loss of electrolytes ++
- Irritation of the brain and meninges +++
- Pain +/-

Clinical Examination

Faiz is drowsy and a little irritable. He has no skin rash and there is no pharyngitis or tonsillitis. Both his ears are normal. Urine dipstick test is normal.

Vitals Signs	Faiz results	Normal range
Temperature	40°C	36.6-37.2 °C
Pulse rate	120/min, regular	70-110/ min
Respiratory rate	25/min	15-25/ min
Blood pressure	100/60	90/50 – 110/70 mmHg

Discussion Questions

- Are there any terms that you do not understand?
- Summarize the key information that you have obtained from this progress.
- Identify if there are any new problems with Faiz. Provide a hypotheses for each problem.
- On the basis of the new information, how would you explain Faiz' s presenting problem?
- What do you think the doctor should do at this stage? (Choose one option only and justify your action)
 - Option 1: Send Faiz for a CT scan of the brain and neck.
 - Option 2: Admit Faiz for observation for 24 hours.
 - Option 3: Do a lumbar puncture and IV antibiotics.
 - Option 4: Prescribe oral antibiotics and allow him to go home.

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Facilitating Questions

What is the mechanism underlying the rise in his body temperature?

Generation of heat- How?

Loss of heat- How?

What is the significance of "no focal neurological signs"?

Functional areas of the brain have not been affected and cranial nerves are intact.

What is the significance of his neck stiffness?

What is the significance of his positive signs?

Tutor: *These issues are new to the students. They might add them to their learning issues.*

Progress

Because Faiz has a high fever, headache, vomiting, and has become drowsy, Dr Ghazi conducted a nervous system examination. The examination reveals that Faiz has meningeal irritation (positive Kernig's sign and Brudzink's sign). Such finding requires further assessment of the cerebrospinal fluid via a lumbar puncture. However, the doctor has to check if there is any evidence of increased intracranial pressure before doing a lumbar puncture. Increased intracranial pressure is usually associated with papilloedema and a focal neurological deficit (sensory or motor). Examination of Faiz's fundi by the ophthalmoscope reveals that there is no papilloedema. He also has no focal neurological deficit. These findings support that he is less likely to have raised intracranial pressure. The doctor progresses to arrange for a lumbar puncture.

New words

- Meningeal irritation
- Cerebrospinal fluid.
- Lumber puncture
- Increased intracranial pressure.
- Focal neurological deficit.
- Ophthalmoscope.

Facilitation Questions

What are the basis on which you select your antibiotic to manage Faiz problem?

- *Broad spectrum antibiotic.*
- *Ability to cross the blood brain barrier.*
- *Given IV.*
- *Low or no resistance to it.*
- *Able to eradicate infection.*
- *Limited or no side-effects.*

Do you know a Nobel prize winner whose work has helped in understanding a physiological principle related to this case. Discuss how his/her work helped in advancement of our knowledge in this area.

Learning Issues

(Tutor: Encourage students to identify their learning issues that reflect key issues raised in the case. They might need to edit their learning issues into sentences or questions. Usually learning issues are about 5-7 key principles. See examples shown below).

Tutorial Two

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Discussion Questions

Nobel Laureates

Do you know a Nobel prize winner whose work has helped in understanding a physiological principle related to this case. Discuss how his/her work helped in advancement of our knowledge in this area.

Students may spend 10 minutes discussing this issue. Those interested could submit a written submission to my on my email sazer@ksu.edu.sa

Please Read Progress 1

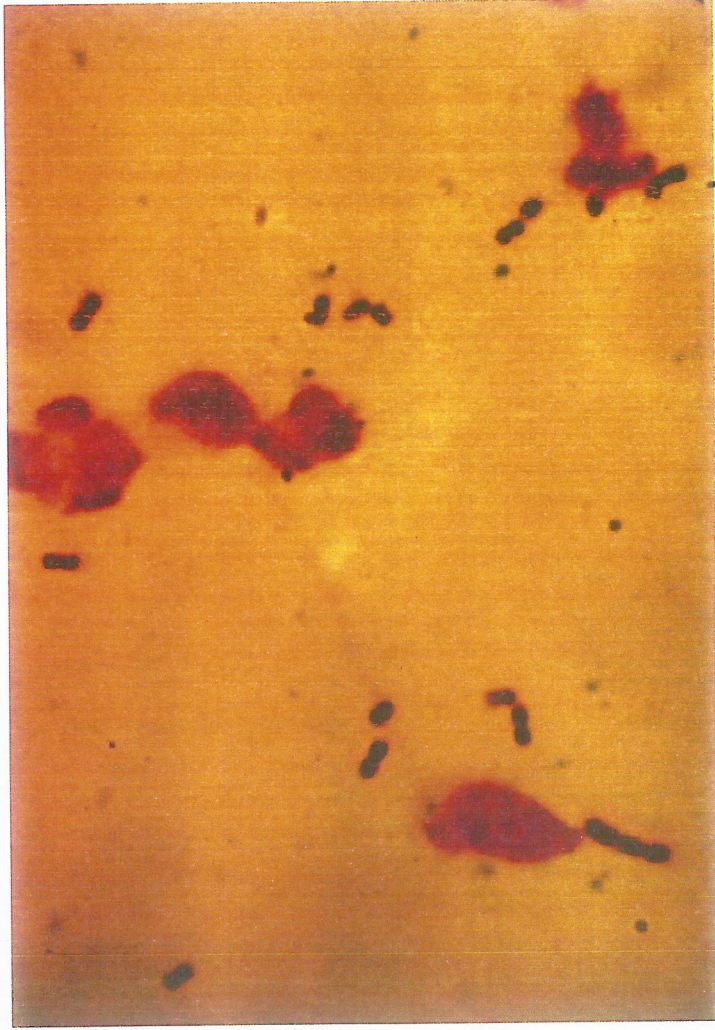
Progress 1

Full Blood Count

Blood Test	Patient	Normal range
Haemoglobin	12.5	11.5-13.5 g/100ml
White blood cell count	18000	5,000 -10,000 mm ³
Differential count		
- Segmented neutrophils	83%	50-70%
- Band neutrophils	5%	1-3%
- Eosinophils	1	0-4%
- Basophils	1	0.5-1%
- Lymphocytes	8	12-46%
- Monocytes	2	2-10%
Platelet count	280,000	160,000-500,000 mm ³

Progress 1

CSF microbiology



Report: The Gram-stain of the CSF indicates the presence of Gram-positive diplococci. The presence of pus cells supports the presence of infection.

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Facilitation Questions

- Why did Dr Ghazi decide to use ceftriaxone?
- What are the indications, side effects, and mechanism of action of ceftriaxone?
- What is the significance of his raised white cell count?
- What are band neutrophils? What is the significance of raised band neutrophils?
- What is the significance of raised segmented neutrophils and normal lymphocyte count?
- What is the significance of his CSF results?
- The Gram-stain of the CSF shows Gram-positive diplococci, which microorganisms do you think ? Give their name.

Progress 2

Over the next 12 hours, Faiz' s temperature drops to the range of 38-38.5 °C and there has been no changes in his nervous system examination. The paediatrician consultant re-examines him and decides to continue the same medication with no changes.

Two days later, the results of the CSF and blood cultures confirmed the growth of *Streptococcus pneumoniae*. See culture growth and report below.

Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- Construct a mechanism summarizing your final hypothesis with regard to the lesion, the mechanisms underlying Faiz' s problems. Provide supportive evidence from history, clinical examination and investigation results.

Case Closure

Over the next 5 days, Faiz shows significant improvement. His temperature is back to normal. He is not irritable or drowsy and his appetite is back to normal. He is discharged from hospital on day 10. All his blood tests are back to normal and he has been afebrile for the last 3 days before discharge. He is allowed to return to school and is asked to review the out-patient clinic in two weeks.

Later follow-up assessment of Faiz shows that he has not developed any complications such as deafness or impairment of the cranial nerves.

Learning Objectives:

This PBL Package targets the following objectives:

- Discuss the anatomy and physiology of meninges covering the brain and understand CSF circulation.
- Discuss the anatomical components of the blood-brain barrier , in regard to its function and selection of the antimicrobial treatment
- Discuss the physiological mechanisms by which our body maintains its temperature within the normal range.
- Discuss the microbiology, pathology and pathogenesis of meningitis.
- Use basic science to interpret the symptoms, signs and complications of a patient with meningitis.
- Interpret the CSF examination results from a patient with meningitis.
- Understand the pharmacological basis of drugs used in the treatment of meningitis.



Discussion Questions:

- Are there any difficult words you do not understand?
- List the key information about Mr Faiz.
- Identify Faiz' s presenting problems.
- For each problem, generate a list of possible causes (hypotheses).
- What further information would you like to know from history to refine your hypotheses?

New Terms/Difficult words

- *Headache*
- *Vomit*

Tutor: Encourage students to use a medical dictionary resource to discuss the meaning of each of these words.



Problems/Hypotheses

Fever:

- Infections (viral and bacterial)
- Tonsillitis
- Common cold/ flu
- Pharyngitis
- Pneumonia.
- Urinary tract infection
- Gastrointestinal infections
- Collection of pus somewhere e.g. abscess
- Meningitis
- Bacteraemia.
- Heat exhaustion/ heat stroke (malfunction of the regulatory centre)

Facilitation Questions

- What is headache?
- Normally we do not have headache. What are the anatomical structures and changes in function that could cause headache?
- What is the normal body temperature?
- How do you define fever?
- What are the mechanisms by which our body maintain its normal temperature within the normal range? (heat production and heat loss).
- What is the mechanism by which vomiting occur?
- What is the location of the vomiting centre?

Please Read The History

History

Pediatric and Vaccination History

Faiz was born via normal vaginal delivery after a full-term gestation. He weighed 3.5 kg on birth and has a normal growth and development. He was breastfed and has had no medical problems.

Vaccination history:

Faiz received BCG and Hepatitis- B vaccines at birth. He has also received Polio, DPT, and *H. Influenzae* vaccines at the age of 2, 4 and 6 months. Then Faiz received the MMR vaccine at the age of 1 year. Lastly Faiz was given Hepatitis-A vaccine at 2 years of age.

Social History

Faiz has just entered grade-5. The new school session started in the beginning of September. Faiz lives with his family in Riyadh. There is no history of travel abroad. He has no pets at home.

New Terms

(Tutor: encourage students to use their medical dictionary to find out more about these words)

- Irritable
- Bowel habits.
- Full-term gestation.
- BCG and Hepatitis- B vaccines
- Polio, DPT, and *H. Influenzae* vaccines.
- MMR vaccine
- Hepatitis-A vaccine.

Tutor: Encourage students to use a medical dictionary resource to discuss the meaning of each of these words/phrases.

Ranking/Hypotheses

Headache

- Tonsillitis/ Pharyngitis -
- Head trauma -
- Errors of refraction -
- Otitis media -
- Sinusitis -
- Did not sleep well -
- Constipation -
- Did not have breakfast (hypoglycemia) +
- Psychological (e.g., family problems) -
- Teeth problems -
- Meningitis +

Hypotheses: Ranking

Vomiting:

- Food poisoning -
- Gastroenteritis -
- Severe pain/ headache ++
- Psychological -
- Otitis media ?/-
- Upper respiratory tract infection ?
- After repeated cough -
- Stimulation of the vomiting centre in the brainstem ?

Please Read The Clinical Examination

Continue- Clinical Examination

Neurological Examination

- Cranial nerves are normal.
- No focal neurological signs (no sensory or motor loss).
- Fundus examination shows no papilledema
- There is stiffness in the neck
- Kernig's sign is positive: When Faiz is lying in supine position in bed and his hip and knee are flexed, extension of his knee joint causes him to feel pain and resist the doctor (normally no pain or resistance should be perceived on extension of the knee).
- Brudzinkin's sign is positive: When Faiz is lying in supine position and the doctor flexes his neck, Faiz suddenly flexes his hip joints. (Normally no flexion of hip joint occurs).

Cardiovascular and Respiratory Examinations:

- Normal

Abdominal Examination:

- Normal

Difficult words

- Urine dipstick
- Papilloedema.
- Kernig' s sign
- Brudzinkin' s sign
- Neck stiffness

Please Read The Progress

Discussion Questions

- Are there any terms that you do not understand?
- Summarize the key information that you have obtained from this progress.
- Explain why there is a need for a lumbar puncture?
- Why do we need to assess for an increased intracranial pressure before doing a lumbar puncture?
- Work out with your group your “learning issues”?

Facilitation Questions

What could possibly cause meningeal irritation?

- *inflammation.*
- *Blood*
- *Infection*

What are the meningeal lining of the brain?

- *Pia matter*
- *Dura matter*
- *Arachnoids*

How CSF is formed?

If the problem due to infection, what are the underlying mechanisms?

In what way can CSF examination of a help?

- *Isolation of the causative organism.*
- *Culture and sensitivity tests.*
- *Differentiate between bacterial and viral infections.*

What could possibly cause increased intracranial pressure?

- *Infection*
- *Inflammation of the brain (oedema)*
- *Intra-cerebral bleeding*
- *Tumours, other space occupying lesions.*

Hypotheses: Ranking

Most likely:

Faiz has an acute infections causing inflammation of his meninges (those covering the brain and the spinal cord) and infection of the cerebrospinal fluid. This condition is called meningitis

Evidence: *Fever, headache, vomiting, drowsiness, irritability, neck rigidity, signs suggesting of meningitis (positive signs).*

- There is no evidence of increased intracranial pressure.
- There is no evidence of focal neurological deficit.

Less likely:

- Encephalitis (no neurological deficit, not in coma)
- Intra-cerebral heamorrhage (no neurological deficit).
- Otitis media/sinusitis
- Teeth, vision problem
- Upper respiratory tract infection
- Urinary tract infection.
- Vascular headache/tension headache
- Heat stroke/heat exhaustion
- Pneumonia.

Learning Issues

- Structures and functions of the meninges.
- Cerebrospinal circulation and blood-brain barrier.
- Microbiology, pathogenesis and pathology of meningitis.
- Interpretation of patient's clinical symptoms and signs.
- Use of biochemical and microbiological tests in the diagnosis of meningitis.
- Pharmacology of drugs used in the treatment of meningitis.

Discussion Questions

After the students spent about 60 minutes addressing their learning issues. You might spend 10-15 minutes on these questions:

Discussion Questions:

1. What is your final hypothesis? Explain why?
2. Discuss the pathogenesis of his infection and the possible source for his infection.
3. What should the doctor do at this stage?

Discussion Questions

Answer to Q3:

- Take blood for blood culture and other tests
- Send the CSF collected via lumbar puncture for biochemical, microbiological and culture tests.
- Start IV antibiotic immediately.
- Conduct regular monitoring of Faiz every 1 hour (check for any neurological changes, vital signs, and any complications).

Progress 1

In addition to lumbar puncture, Dr. Ghazi uses a wide caliber needle to withdraw blood from Faiz' median cubital vein and arranges for urgent blood tests. Dr Ghazi also arranges for blood culture tests. The later tests require collection of blood under aseptic precautions. Dr Ghazi arranges for the CSF samples to be sent immediately for biochemical and microbiological and culture tests. He also commences Faiz on intravenous (IV) antibiotics, Ceftriaxone, twice daily and IV Fluids, (normal saline and glucose drip). Dr Ghazy arranges for admitting Faiz to the hospital.

Over the next a few hours Faiz blood test results become available. These results are shown below:

Progress 1

Blood Biochemistry

Blood Test	Patient	Normal Range
Serum Sodium	139	135-145 mmol/L
Serum Potassium	3.5	3.5-5.0 mmol/L
Blood urea	4.5	2.5-8.3 mmol/L
Blood creatinine	0.09	0.05-0.11 mmol/L
Blood glucose	3.9	3.6-5.3 mmol/L

CSF Examination

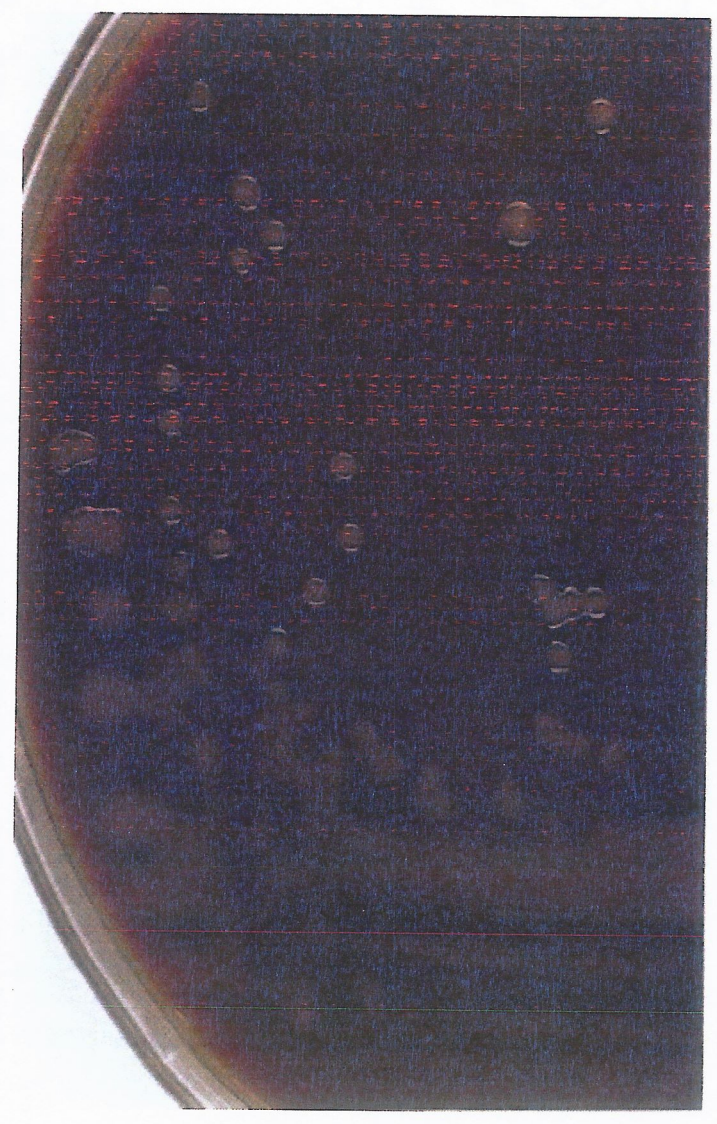
CSF	Patient	Normal Range
Appearance	Turbid	Clear
Cells	960 (predominantly neutrophils)	0-5 cells per mm ³
Proteins	1.7	0.15-0.35 g/L
Glucose	1.6	2.8-4.4 mmol/L
Pressure	17	10-18 cm H ₂ O (patient is lying on his side)

Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- On the basis of the new information, what is your final hypothesis?
- Discuss your management goals and management options.

Please Read Progress 2

Continue- Progress 2



Report: *Streptococcus pneumoniae* grown on chocolate agar. This strain of *S. pneumoniae*, appears mucoid when grown on blood agar. The mucoid appearance is related to the capsule production.

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الوصف الآتي

**Please Read the
Closure**

الوجه الآخر [28]

