

“...Will I Achieve  
**My Dream?**”

**Nervous System - Case 1**

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# Learning Objectives:

This PBL Package targets the following objectives:

- Describe the anatomy and physiology of the brainstem and related cranial nerves (5th, 7th, 9th and 10th).
- Use knowledge from basic sciences to explain the symptoms and signs of a patient presenting with brainstem tumour.
- Discuss the mechanisms underlying taste sensations, swallowing, and voice production.
- Discuss the pain and temperature sensory pathways.
- Consolidate their knowledge about spinal reflexes and their use in localizing the level of a neurological lesion.
- Discuss the pathology and pathogenesis of brain tumours.
- Discuss the impact of serious illnesses on the patient and his family.

## Discussion Questions:

- Are there any difficult words you do not understand?
- List the key information about Ahmed.
- Identify Ahmed'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**

• **Taste sensations:** *The sense for the appreciation of the flavour of substances in the mouth. The taste buds are stimulated when the food dissolves in the saliva. Generally there are four basic taste sensations: sweet, bitter, sour and salt. Others are: alkaline and metallic.*

• **Swallowing:** *the process by which food is transferred from mouth to the pharynx. The process stimulates reflex action in which the larynx is closed by the epiglottis and the nasal passages by the soft palate.*

# Problem/Hypotheses

## Change in voice:

- Sore throat as in common cold.
- Problem in the larynx
- Problem with the vocal cords.
- Problem with the tongue, (ulcers and swollen tongue)
- Problem with soft palate.
- Problem with muscles of lips
- Problem with lower jaw
- Problem with cheek muscles
- Problem with sinuses.

## Facilitation Questions

**What are the structures and functions do we need to produce voice?**

- *Larynx*
- *Vocal cords*
- *Recumbent laryngeal nerve..*
- *Tongue*
- *Soft palate*
- *Palate*
- *Buccinators muscles*
- *Muscles of lips*
- *Maxilla and para nasal sinuses*
- *Normal lower jaw movement*

# **Please Read The History**

# History

## **Past Medical History**

He has always been healthy and well. He has never been admitted to hospital.

## **Family History**

He has no history of any medical problems in his family. His father and mother are alive and healthy. He has two elder brothers and both are healthy.

## **Tobacco and Alcohol**

Nil

## **Medication and Allergy**

Nil

## **Social History**

Ahmed has been married for two years and has a 9-month-old girl. He works as an engineer in an international construction company in Riyadh. He is planning to travel to Canada to study a Master in Engineering at the end of the year.



## **New Terms**

(Tutor: encourage students to use the medical dictionary)

- Tingling sensation
- Numbness
- Drooping
- Unsteady gait.
- Double vision.

# Problems/Hypotheses

## Tingling on the right-side of the face:

- Problem with sensory receptors in the skin.
- Problem with the sensory nerve.
- Problem with the nuclei of sensory nerve.
- Problem with higher centres in the cortex.

## Right sided face drooping:

- Problem with the 7<sup>th</sup> cranial nerve
- Problem with the nerve nucleus.
- Problem in the neuromuscular junction
- Problem in the muscles of the face.

## Numbness on left arm:

- Problem with the sensory receptors
- Problem with the sensory nerve
- Problem in the sensory nerve pathway, at the level of the spinal cord or at the brainstem, internal capsule cortex or higher centers

## Facilitation Questions?

**What could possibly cause numbness?**

- *Problem in receptors*
- *Problem in transmission along the sensory nerve*
- *Problem with sensory nuclei*
- *Problem with the higher cortical sensory areas.*

*Damage to blood supply to the nerve, myelin damage, Na<sup>+</sup>/K<sup>+</sup> pump dysfunction, disturbance of normal transmission of impulses etc...*

**What are the different sensory modalities?**

*A nerve may carry temperature, light and deep touch pain sensations, vibration and joint position sensation.*

*Some of these sensations are carried together by the same nerve fibres (e.g., pain and temperature). Other sensations will need different nerve fibres and different pathway.*

**Please Read  
The Clinical  
Examination**

# Clinical Examination

## Motor Power:

Gait: unsteady.

Increased lower limb muscle tone on the left.

Exaggerated left knee and ankle reflexes and left extensor plantar reflex.

Exaggerated left biceps, triceps, and brachioradialis reflexes.

## Sensory System Examination:

Loss of pain and temperature sensations on the entire left side of the body.

## Abdominal Examination:

Normal

## Cardiovascular and Respiratory Examinations:

Normal

## Refining the Hypotheses

### Most likely:

- Problem higher than the spinal cord, most likely in the brainstem, affecting these cranial nerves: 5,7,9, and 10. (mechanical pressure)
- The cause could be: vascular problem (less likely), or a tumour mass causing pressure on surrounding structures (most likely).

### Less likely:

- Skeletal muscle problem.
- Peripheral nerve problem.
- Neuromuscular problem.
- Spinal cord problem
- Internal capsule problem
- Cortical problem

## Learning Issues

- Anatomy and function of the brainstem.
- What are the anatomical structure responsible for the production of voice?
- What are the mechanisms responsible for initiating swallowing (in the oropharynx) and mechanisms responsible for taste sensation.
- What are the anatomical structures and functions of the cranial nerves number 5, 7, 9, and 10.
- What are the differences between cranial nerves and peripheral nerves.
- What are anatomical structures and functions of the motor system?
- The modalities of sensory sensations (pain and temperature) in regard to anatomical pathways and function.
- Pathology of brain tumours
- Impact of serious diseases on patients and their families.

## Discussion Questions

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

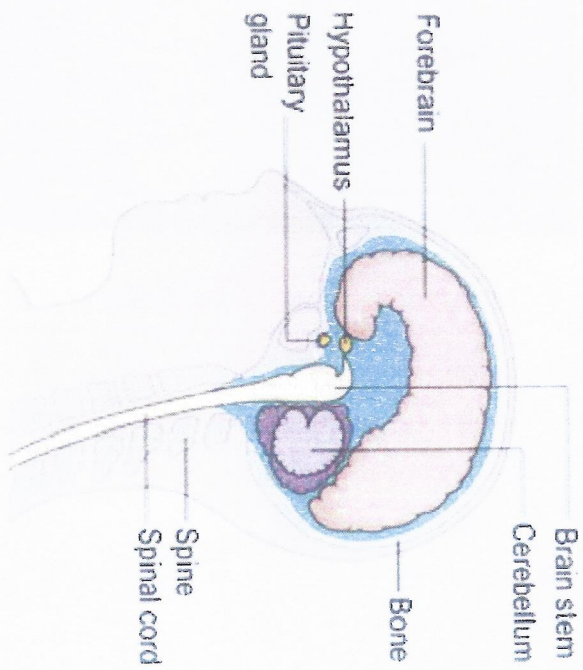
- How would you explain Ahmed's symptoms and signs? Explain the basic sciences behind them?
- Where do you think Ahmed's problem is? Let's talk about the level (Cortex, sub-cortex, brainstem, spinal cord, peripheral nerves, neuromuscular junction, or skeletal muscles).
- How would you explain the fact that he has more than one cranial nerve affected?
- What investigations would you like to order for Ahmed at this stage? Explain how each investigation you have suggested can help you.



# **Please Read Progress 2**

# Progress 1

## Normal Brain MRI Scan



Source: [http://bclab.vm.edu.tw/green\\_Eng.html](http://bclab.vm.edu.tw/green_Eng.html) (the diagram below will help you in identifying main anatomical structures)

## **Discussion Questions**

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- What is your final hypothesis?
- Summarise your management goals and your management options.

## Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- With these bad news in mind, what do you think the sources of Ahmed's stress? What is the role of the treating doctor in such situations?
- Construct a mechanism summarizing your final hypothesis with regard to the site of the lesion, the mechanisms underlying Ahmed's symptoms and signs.

## **Case Closure**

Over the next two weeks Ahmed was referred to a specialized centre for focal radiotherapy and further management. He recovered from the treatment procedure and was discharged two weeks later on corticosteroids (corticosteroids help in reducing the local oedema around the tumour mass). His family supported him a lot and he was regularly seen by his treating doctor. Ahmed, however, did not live long, He died 14 months later.

# Key Concepts

- Anatomy and physiology of the brainstem.
- Physiology and anatomy of cranial nerves (5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup>).
- Basic sciences behind the symptoms and signs of a patient with brainstem tumour.
- Pathology of brain tumours.
- Consolidation of spinal reflexes
- Pain and temperature sensations
- Impact of serious diseases on patient and family.

## Trigger

Ahmed Saleh, a 28-year-old construction engineer comes in to see Dr Salman in his clinic. Ahmed has noticed loss of taste sensations over the last few months. He also has changes in his voice which has been for some time. Over the last three weeks he noticed that he has difficulty in swallowing.

## Trigger (Problems)

Ahmed Saleh, a 28-year-old construction Engineer comes in to see Dr Salman in his clinic. Ahmed has noticed loss of taste sensations over the last few months. He also has changes in his voice which has been for some time. Over the last three weeks he noticed that he has difficulty in swallowing.



# Problems/Hypotheses

## Loss of taste:

- Problems with taste buds (drugs, damage)
- Problems with the sensory taste pathway
- Problems with taste center
- Acute problem with smell such as common cold.

## Difficulty in swallowing:

- Local causes (oropharynx, upper part of esophagus, or a mass in the lumen/wall or pressure from outside such as tumour).
- Problems with the nerve supply to the oropharynx, upper part of oesophagus. (glossopharyngeal, vagus and pharyngeal nerves)..
- Problem with the muscles.
- Problem with the swallowing center.
- Dry mouth and mouth ulcers.

## Facilitation Questions

**What are the structures and functions do we need to feel the taste of the food we eat?**

- *Tongue (taste receptors).*
- *Nerve supply*
- *Saliva*
- *Flavour of the food.*
- *Normal smell function.*

**Which food do you think we taste better, hot or cold food and why?**

- *Hot food because the smell receptors in the nose help in reinforcing the taste sensations.*

## Further Questions

- What do you mean by loss of taste sensation?
- Is this related to certain food?
- How long did you have this problem?
- What type of food do you find difficult to swallow? Soft, solid or liquid?
- Do you have any pain on swallowing?
- Do you have any other problems in addition to difficulty in swallowing?
- What changes did you notice regarding your voice?
- Are you on any medication?

## History

Ahmed has noticed loss of his taste sensations, over the last 3-4 months. He cannot remember a particular food but he stated that he does not taste food. He also has noticed changes in his voice, about the same time. His speech has become somewhat slurred. He first thought that his taste sensation loss and his voice changes are due to the flu, but these changes continued despite his recovery from the flu.

Three weeks before seeing Dr Salman, Ahmed noticed a numb and a tingling sensation in his right cheek. This was initially slight but gradually spread to involve most of his right face. His friends at work also noticed that the right side of Ahmed's face seemed to be drooping.

About three weeks ago, Ahmed noted difficulty in swallowing large pieces of food. He nearly choked three times during the last few days. He sometimes feels that his gait is unsteady. He has no double vision, headache, or changes in his hearing.

Yesterday, Ahmed noticed numbness in his left arm and because of these changes he decided to come and see his family doctor.

## **Discussion Questions**

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

## **Problems**

### **From the trigger:**

- Loss of taste sensation
- Change in his voice
- Difficulty in swallowing

### **From the history:**

- Tingling sensations of the right side of his face.
- Right sided face drooping
- Numbness of the left arm
- Unsteady gait

## Problem/Hypotheses

### Unsteady gait: (Balance system)

- Problem with proprioceptors.
- Problem with peripheral nerves.
- Problem with dorsal column
- Cerebellar problems
- Weakness of the pelvic girdle muscles.
- Problem with the musculoskeletal system (e.g., joints, muscles, etc).

## **Facilitation Questions?**

**What do we call nerves supplying structures of the head?**

*Cranial nerves.*

*(Tutor: ask students to use medical dictionary to find out more about cranial nerves).*

**Are these cranial nerves different from peripheral nerves such as those supplying the arms and legs? In what way are they different?**

**What is the motor nerve supply to the face and what is the sensory supply to the face?**

*Seventh cranial nerve and fifth cranial nerve, respectively*

**Which cranial nerves are involved here?**

**Tutor:** *Students might find these questions difficult to answer, they might use resources available and could consider some of them as part of their learning issues.*



# Clinical Examination

Ahmed looks a little anxious. His blood pressure, pulse rate, temperature, and respiratory rate are within normal range.

## Nervous System Examination

### Cranial nerves:

- Cranial nerves number: 1 (olfactory nerve), 2 (optic nerve), 3 (oculomotor nerve), 4 (trochlear nerve), and 6 (abducens nerve) are all normal

- The 5<sup>th</sup> cranial nerve (trigeminal nerve): Loss of corneal sensation on the right side, and loss of pain and temperature sensations on the right side of the face. Normal on the left side.

- The 7<sup>th</sup> cranial nerve (facial nerve): Weakness on the lower right part of the face.

- The 9<sup>th</sup> cranial nerve (glossopharyngeal nerve) and the 10<sup>th</sup> cranial nerve (vagus nerve): Right palatal movement is poor, and loss of sensation of the soft palate on the right side.

- Other cranial nerves: 8<sup>th</sup> (vestibulocochlear nerve), (11<sup>th</sup> (accessory nerve), and 12<sup>th</sup> (hypoglossal nerve) are normal

All cranial nerves on the left side are normal.

## **Discussion Questions**

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- Use the new information to refine your hypotheses.
- Work out as a team to identify your “learning issues”.

# Learning Issues

# Tutorial Two

## Discussion Questions

### **Nobel Laureates**

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

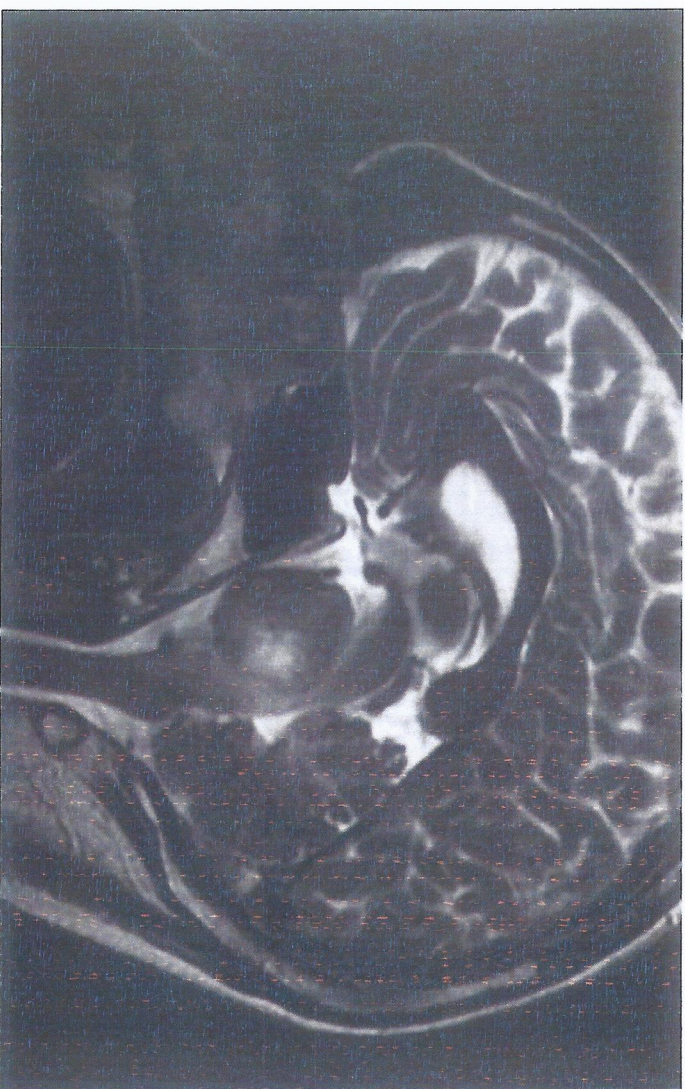
Students may spend 10 minutes discussing this issue. Those interested could submit a written submission to my on my email [sazer@ksu.edu.sa](mailto:sazer@ksu.edu.sa)

## **Progress 1**

Dr Salman explains to Ahmed that there is a need for further investigations. He discusses with Ahmed his arrangements and explains why these investigations are needed. He contacts a local neurologist and arranges for Ahmed to be admitted at a local hospital. The result of Ahmed's investigation (brain MRI scan) is shown below. A normal MRI scan is also provided for comparison.

# Progress 1

Ahmed's MRI Scan



Source:

<http://www.healthcarerepublic.com/news/bulletin/60/article/949763/?DCMP=EMC-HealthcareRepublicpreviews-thelatesteditionofGP>

Report: MRI scan showing a mass occupying the brainstem, most likely a brainstem glioma.

## **Progress 2**

The consultant re-examines Ahmed and reviews his MRI scan. He discusses the diagnosis with the family and the nature of Ahmed's problem. After preparing Ahmed and the family, the consultant says, "...the clinical examination and the images (MRI scan) reveal that you have a serious problem. It appears that there is a mass in your brainstem that has been gradually growing and caused your trouble...So the symptoms you have told me are all related to the pressure caused by the tumour mass on surrounding structures." The consultant answers Ahmed's questions and explains to him the need to see a neurosurgeon for further assessment.

The news shocked Ahmed and his wife. He asked the consultant about the nature of his illness and if there is a cure. Ahmed and his family were very stressed with these news. Over the next a few days, Ahmed saw the neurosurgeon who reviewed his case and examined him. The neurosurgeon explained to Ahmed that surgery is difficult because of the location of the tumour. However, focal radiotherapy could help in reducing the tumour mass and hence its pressure on the surrounding brain structures. After some discussion, Ahmed agreed to be treated with focal radiotherapy.



# Please Read the Closure

