INTERNAL FEATURES OF BRAIN STEM (MEDULLA & PONS)

Department of human Anatomy and Embryology
Faculty of Medicine
Mansoura National University, Egypt

By

Dr. Fekry Shata

Intended Learning Outcomes (ILOs)

1. **Describe internal features of Medulla.**

2. **Describe internal features of Pons.**

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Agenda

1. **Internal features of Medulla.**
2. **Internal features of Pons.**

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Internal Features of Medulla

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Nuclear Groups Present In Medulla

- Gracile & Cuneate
- Cerebellar Relay Nuclei
- Cranial Nerve Nuclei

Gracile & Cuneate

Input

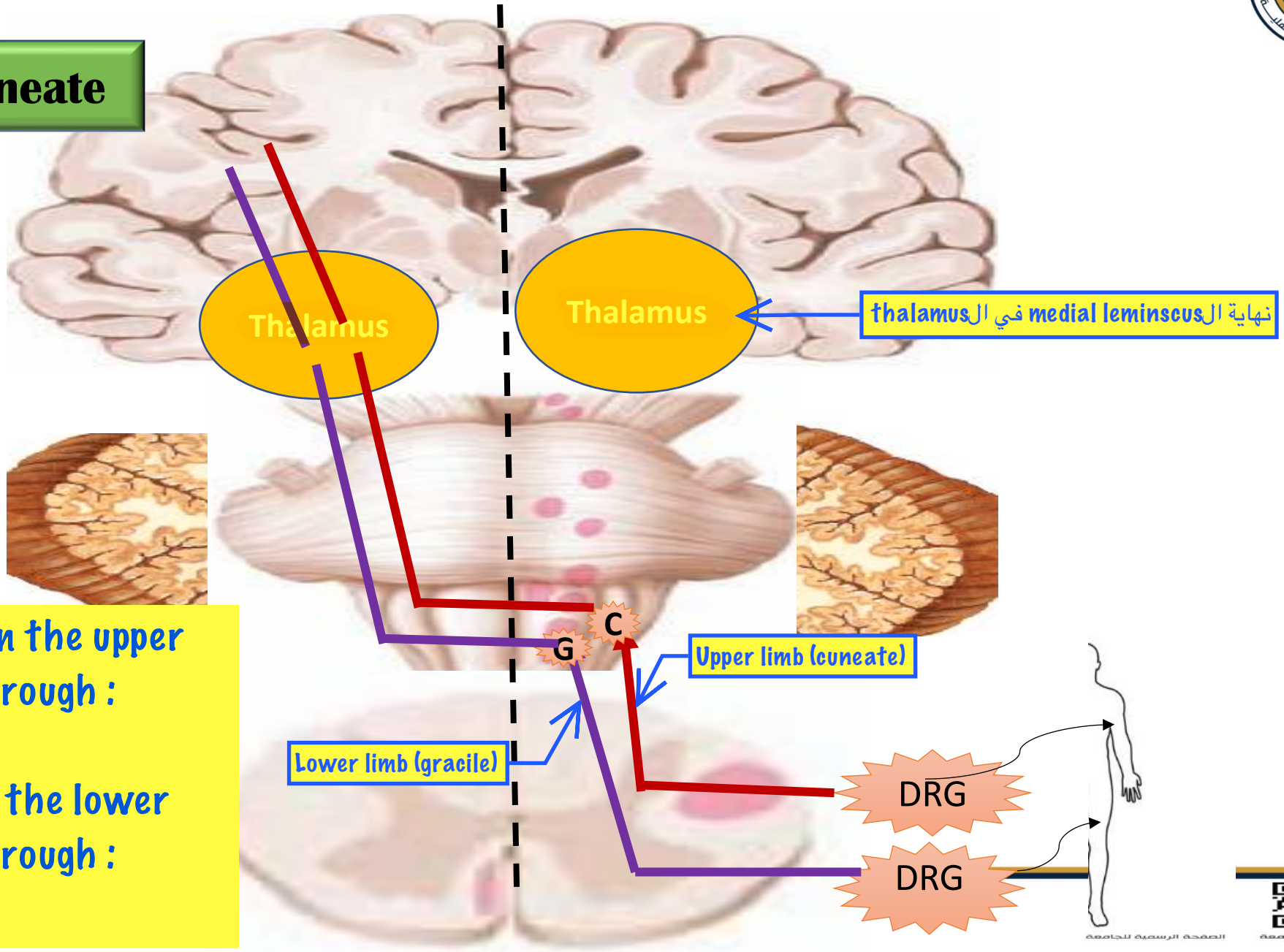
- They receive **gracile and cuneate tracts**. MCQ
- They receive sensory information for **kinesthesia**, (= sense of movement) MCQ **discriminative touch and vibration** from the same side of the body.

Output

- They contain the **2nd order neuron**, their axons form the **internal arcuate fibers** which cross to the opposite side in the sensory decussation which form the **medial lemniscus**. MCQ

MCQ : Medial lemniscus releated to which of the following: Gracile &cuneate - Kinesthesia, discriminative touch & vibration
MCQ : Medial leminscus receives sensation from : Gracile & cuneate

Gracile & Cuneate



MCQ : Kinethesia from the upper limb is transmitted through : Cuneate

MCQ : Kinehesia from the lower limb is transmitted through : Gracile

Cerebellar Relay Nuclei

1- Accessory cuneate:

Site: Lateral to cuneate nucleus.

Input:

Or kinethesia

It receive proprioceptive information from the upper limb.

Output:

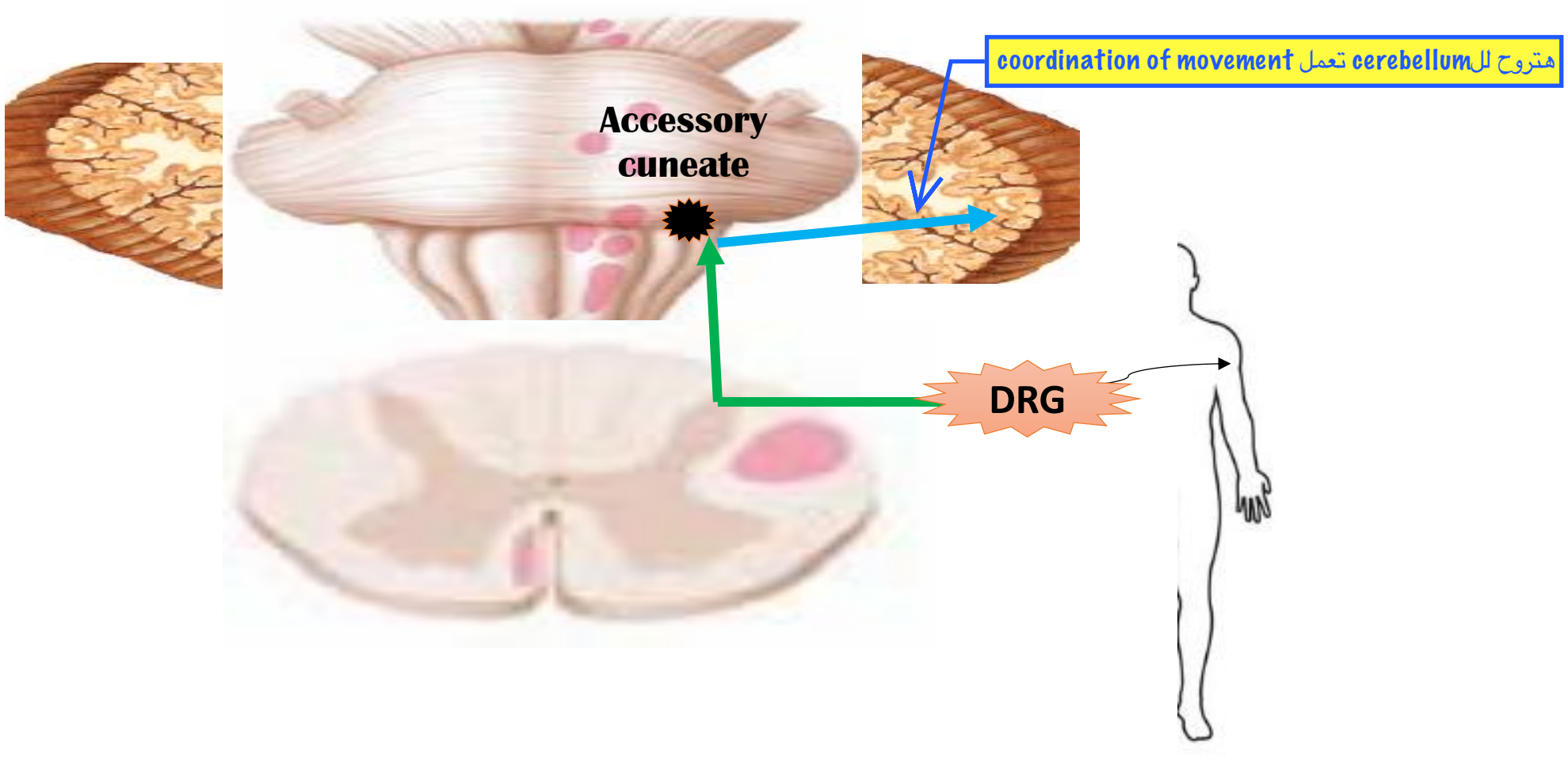
Its axons form cuneocerebellar tract (dorsal external arcuate fibers), which reaches the cerebellum through the inferior cerebellar peduncle.

MCQ : Cuneocerebellar pass in which peduncle : inferior cerebellar peduncle

MCQ : Pontocerebellar pass in which peduncle : middle cerebellar peduncle

MCQ : Tectocerebellar pass in which peduncle : superior cerebellar peduncle

1- Accessory cuneate:



2- Inferior Olivary Nucleus

Formed of 3 groups: **inferior , medial and dorsal** ← Olivary complex دول ال

Input:

- Sensory data from spinal cord via spino-olivary tract.
- Motor data from cerebral cortex via coricospinal tract.
- Motor data from basal ganglia & red nucleus via central tegmental tract. MCQ مهم جدا

Output:

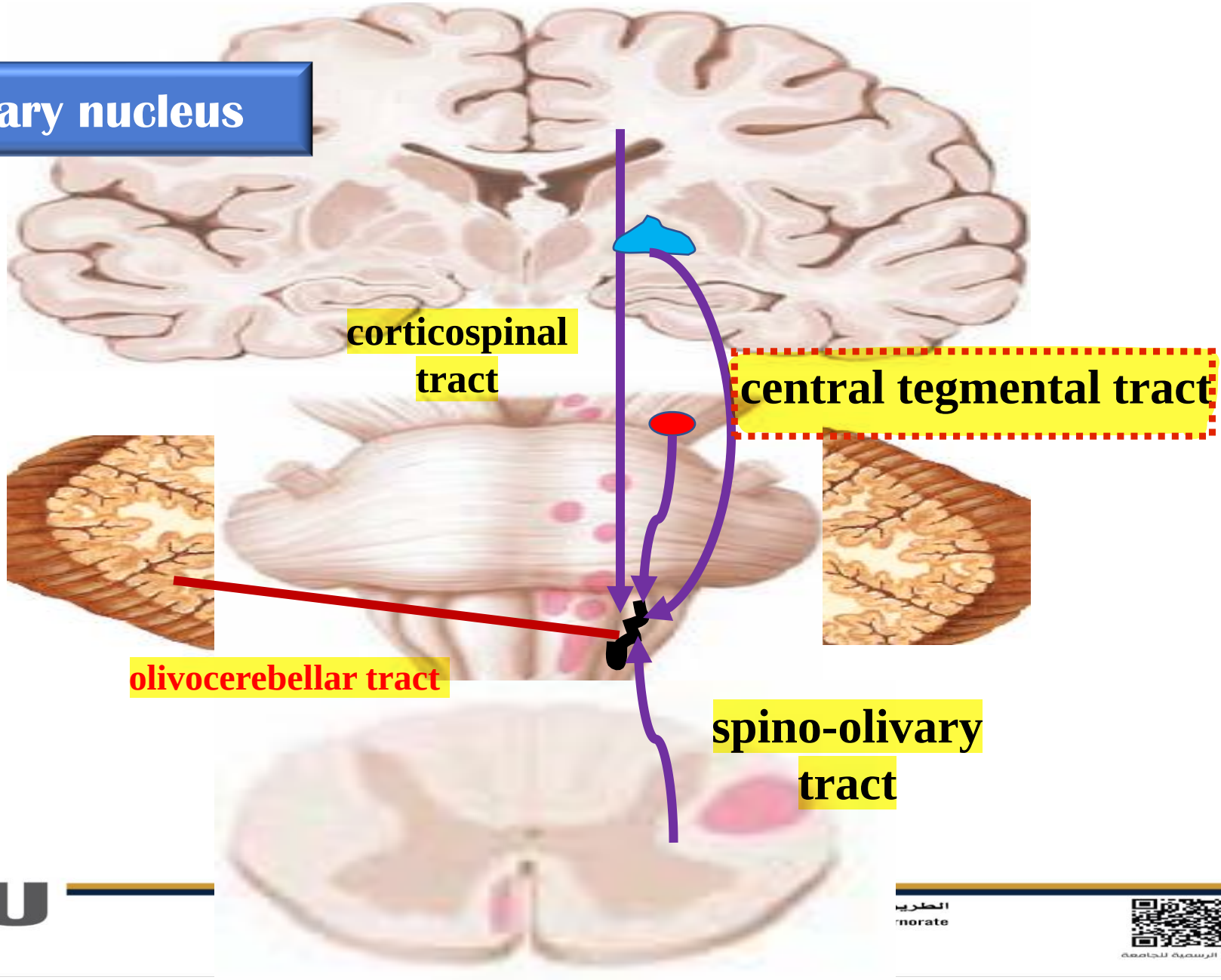
Axons form **olivocerebellar tract** which cross to opposite side and enter the cerebellum through the **inferior cerebellar peduncle**.

Function: Cerebellar control of movement.

Lesion: Cerebellar ataxia.

MCQ : Central tegmental tract transmits motor signals from the basal ganglia and red nucleus to the: inferior olivary nucleus

2- Inferior olivary nucleus



3- Reticular formation

Input:

- Receives motor data from the motor areas of the cerebral cortex.
- Receives sensory data from the spinal cord and special sense organs.

Output:

MCQ

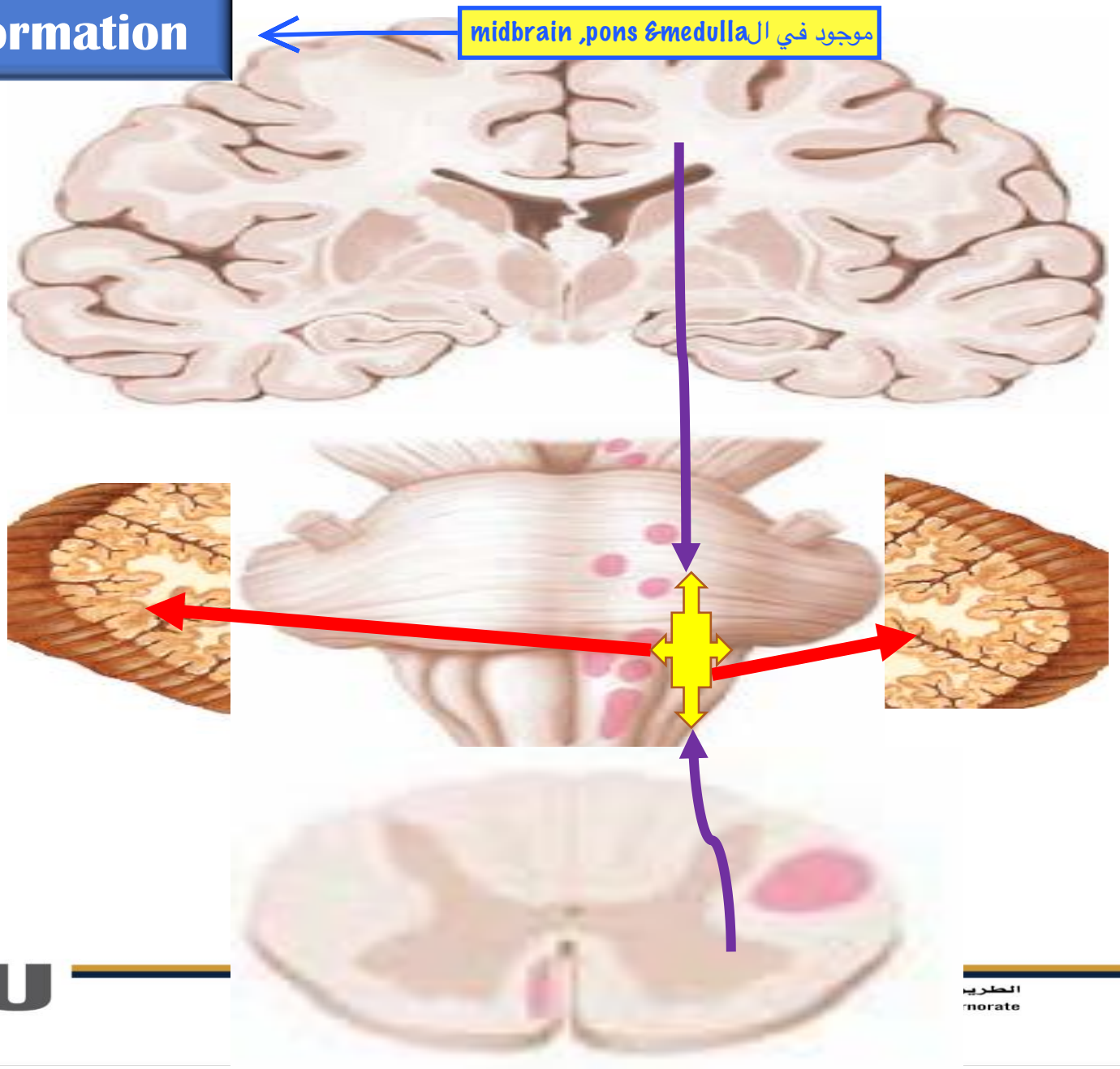
- It projects these data **to the cerebellum** through the inferior cerebellar peduncle

Function:

- It Reticular Activating System (**RAS**): responsible for the electrical activity of the cerebral cortex. It is important for alertness & arousal from sleep. MCQ مهم
- **Motor** Function: it influences the muscle tone. The medullary and pontine reticulospinal tracts facilitate the flexor and extensor muscles, respectively.
- **Autonomic** Function: it contains respiratory and cardiovascular centers.

لو شخص حصله جلطة فيها هتؤدي لـsudden death
* التطعيمات والفيروس ضد كورونا ممكن يسببوا جلطات في الbrain stem

3- Reticular formation



4- Arcuate nucleus

Site: ventral to the pyramid.

Input: receives fibers from the cerebral cortex via pyramidal tract.

Output:

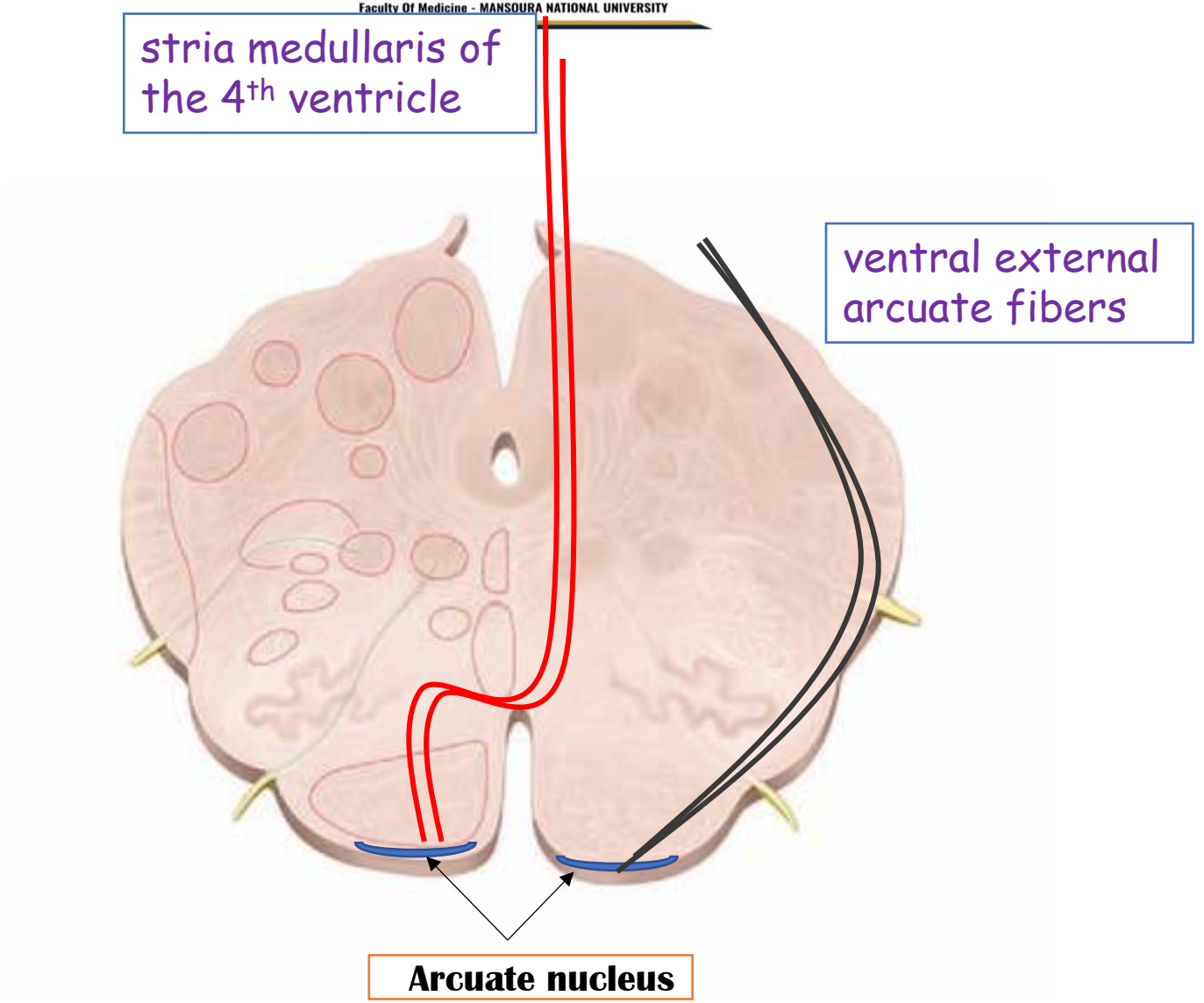
The axons form arcuatocerebellar fibers, reach the cerebellum through the **ICP** by 2 routes:

A- Ventral external arcuate fibers: to the cerebellum from the same side.

B- Stria medullaris of the 4th ventricle: to the cerebellum from the opposite side. MCQ مهم جدا

MCQ مهم جدا : Stria medullaries of the 4th ventricle is originally which type of fiber : Arcuate fibers

stria medullaris of the 4th ventricle



ventral external arcuate fibers

Arcuate nucleus

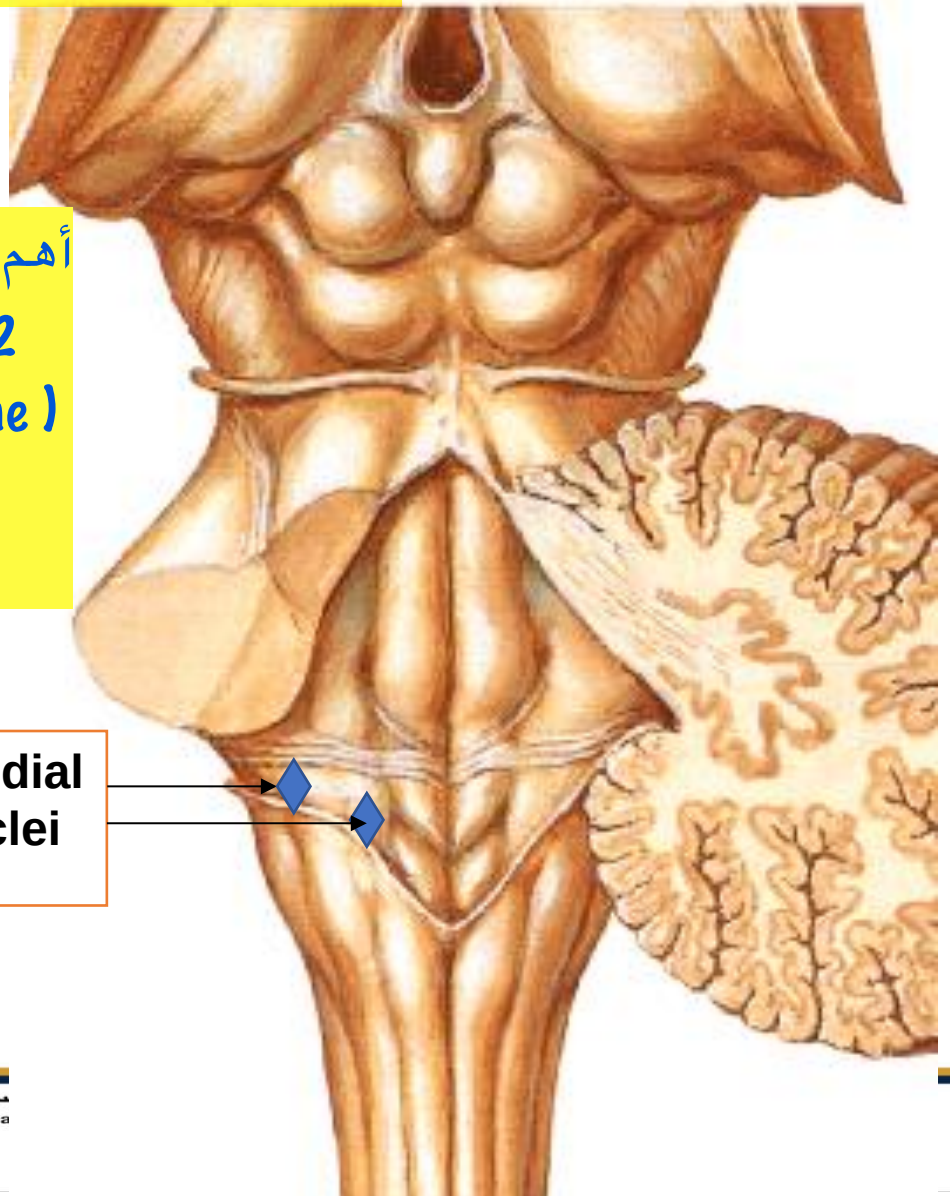
5- Vestibular nuclei

- They project vestibulocerebellar fibers by 2 routes:

1. Direct: from the vestibular nerve.
2. Indirect: from the vestibular nuclei

أهم حاجة في الجزئية دي :

* Vestibular nuclei (2 medullary + 2 pontine) in the floor of 4th ventricle .



International Coastal Road - 15th of May District - Gamasa City - Da
medic@mansnu.edu.eg

أهم حاجة في المحاضرة وأشهر سؤال Written يجي

Cranial Nerve Nuclei

Eight nuclei for cranial nerves:

Two sensory:

spinal nucleus of trigeminal and nucleus **solitaries**.

Two motor:

hypoglossal nucleus and nucleus **ambiguous**.

Two vestibular nuclei:

medial and inferior **vestibular** nuclei.

Two parasympathetic nuclei:

inferior **salivatory** nucleus and dorsal motor nucleus of **vagus**..

Two sensory nuclei SAQ

1. Spinal Nucleus of Trigeminal:

Site:

located in **medulla** ascends to the pons and descends to C3 of the **spinal cord.**

Input:

It mediates the pain, temperature and light touch sensations from the same side of the face , oral cavity and external ear via (**5th, 7th, 9th and 10th** cranial nerves). MCQ

MCQ : Spinal trigeminal nucleus give : 5, 7, 9, 10

Output:

Axons cross to the opposite side and form **trigeminal lemniscus** which end in the VPMN of **thalamus**.

2. Nucleus solitaries

Input:

Divided into

Upper third: receives **taste** sensation from the tongue via (7^{th}, 9^{th} and 10^{th} cranial nerves). MCQ

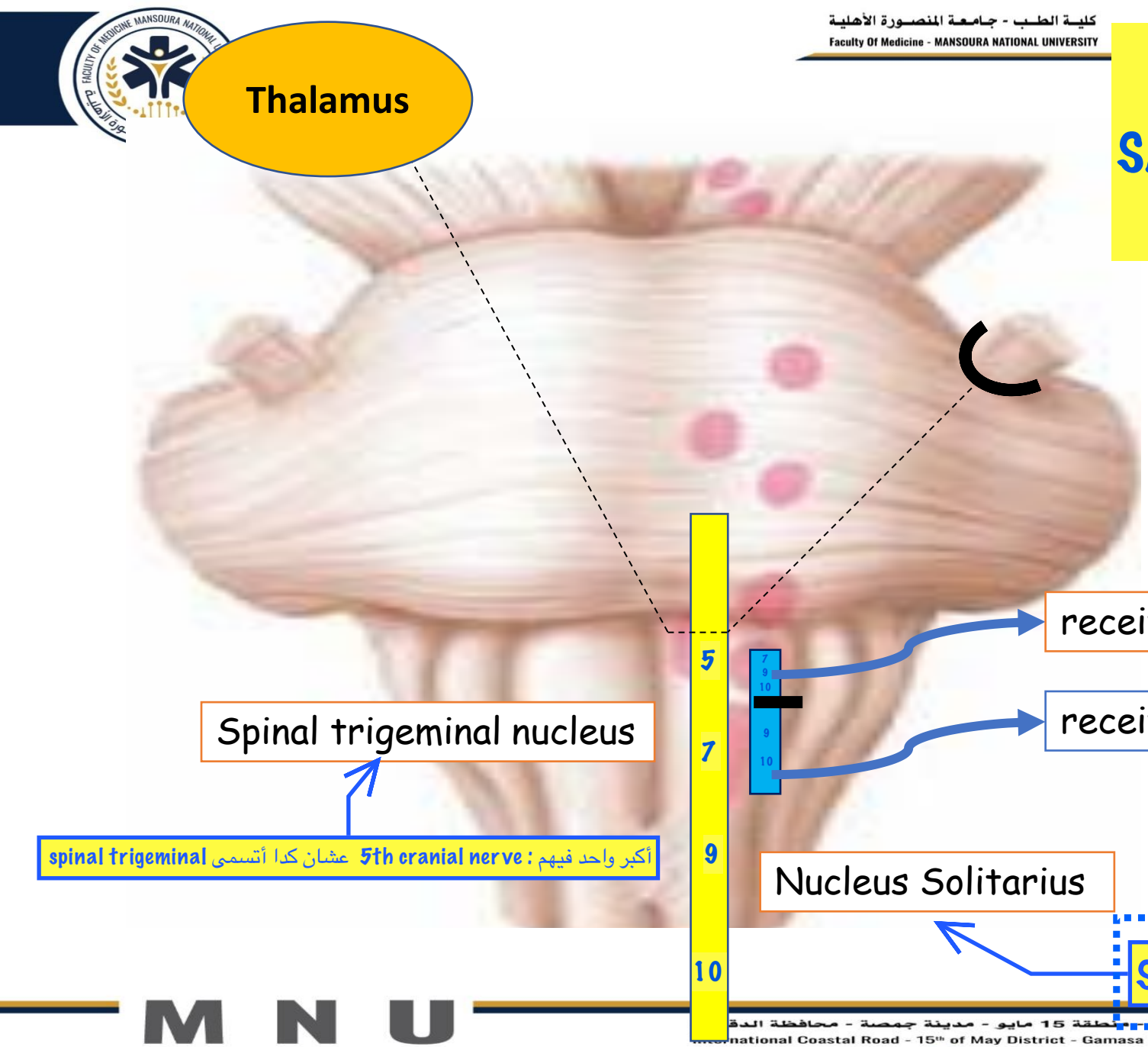
Lower 2 thirds: receive **general** sensation from viscera supplied by (9^{th} and 10^{th} cranial nerves). MCQ

Output:

Axons cross the opposite side and terminate in the thalamus

السلايد دي مهمة جدا

SAQ : Describe the sensory nuclei of cranial nerve in the medulla ?



سلايد مهمة جدا

Two motor nuclei: SAQ

Hypoglossal Nucleus:

Site: in the floor of the 4th ventricle. MCQ

Function: supply **all muscles of the tongue EXCEPT palatoglossus muscle.**

Platoglossus supplied by vagus (vagoaccessory)
الدكتور قال نكتبها !

Nucleus Ambiguous:

= Vagoaccessory complex

Divided into 3 parts

Upper part: for the 9th cranial nerve.

middle part: for the 10th cranial nerve.

lower part: for the to 11th cranial nerve

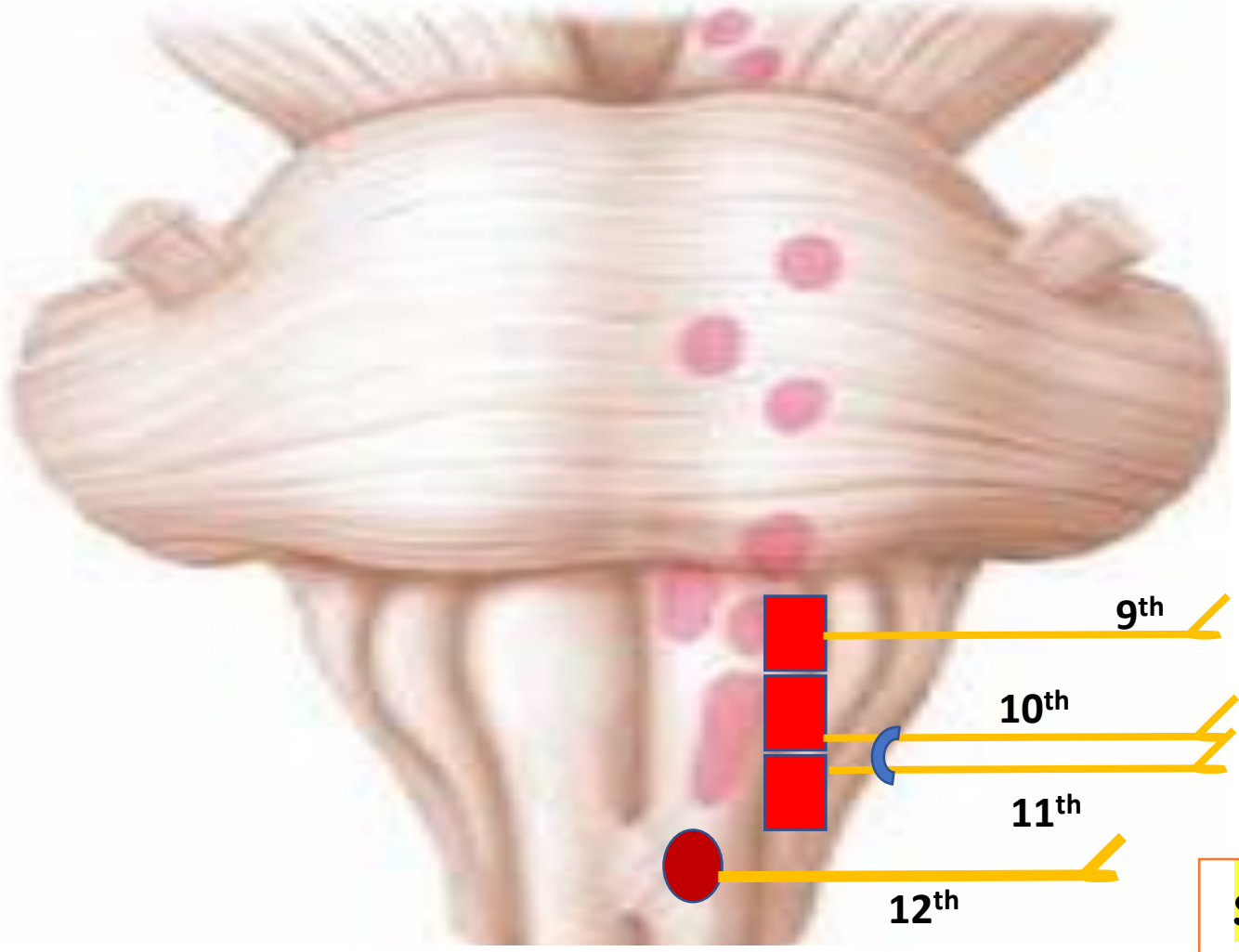
Function:

Supply **all muscles of pharynx, larynx, palate EXCEPT tensor palate muscle**

Tensor palate supplied by trigeminal

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محا
Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

SAQ: Describe the 2 motor nuclei in medulla ?



Supply stylopharyngeus muscle

Supply all muscles of pharynx, larynx, palate except tensor palate

supply all muscles of the tongue except palatoglossus muscle.

Two parasympathetic nuclei SAQ

Dorsal Motor Nucleus of Vagus.

Motor to viscera

Site: floor of the **4th ventricle.** MCQ

Function: بتتبعت لل vagus

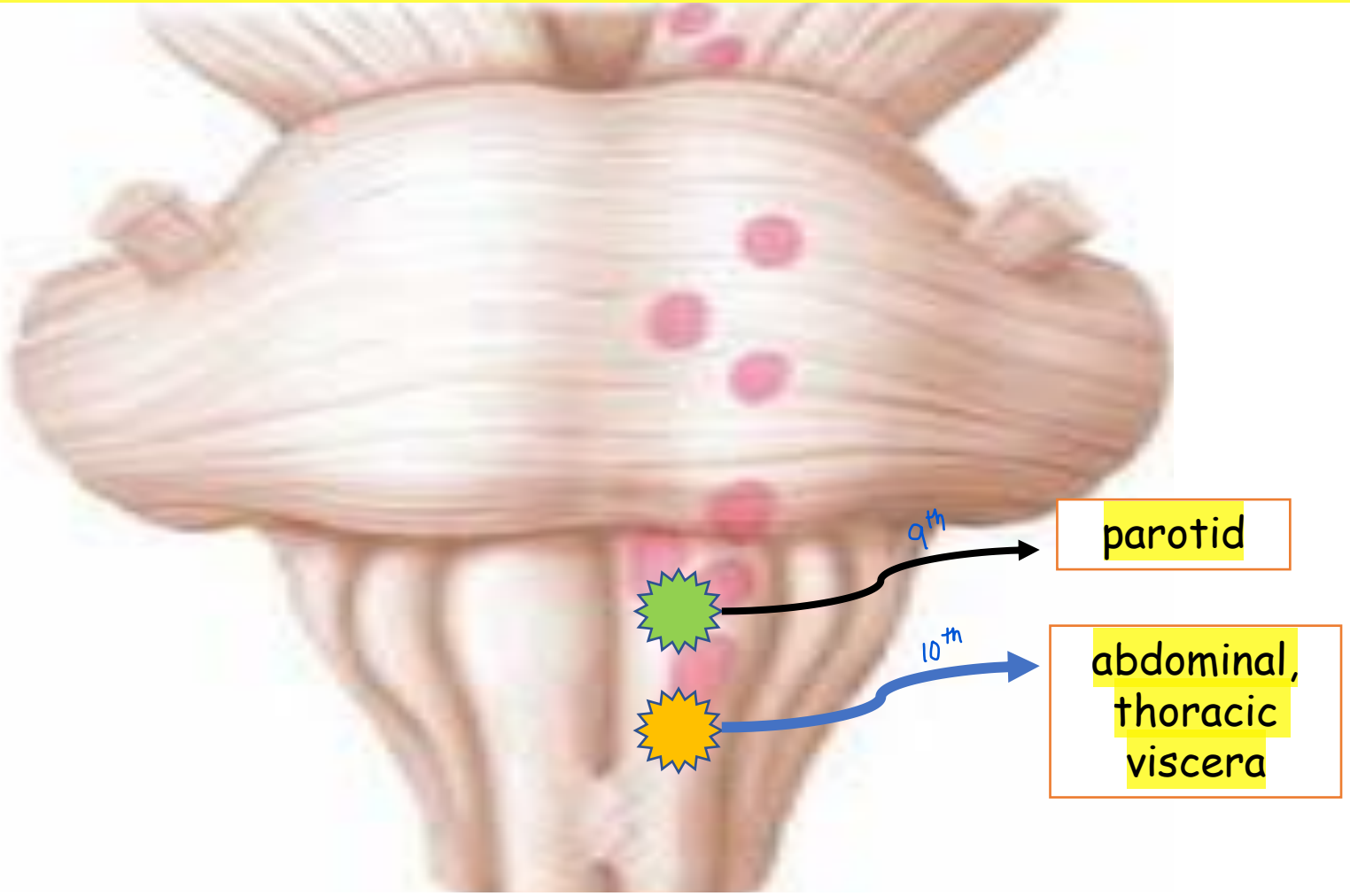
Supplies the glands, smooth muscles and **blood vessels** of the **thoracic** and **abdominal** viscera via **10th cranial nerve** MCQ

Inferior Salivatory Nucleus:

Function:

Supplies the **parotid** gland MCQ through the **9th cranial** MCQ

SAQ: Describe the 2 parasympathetic nuclei in medulla ?

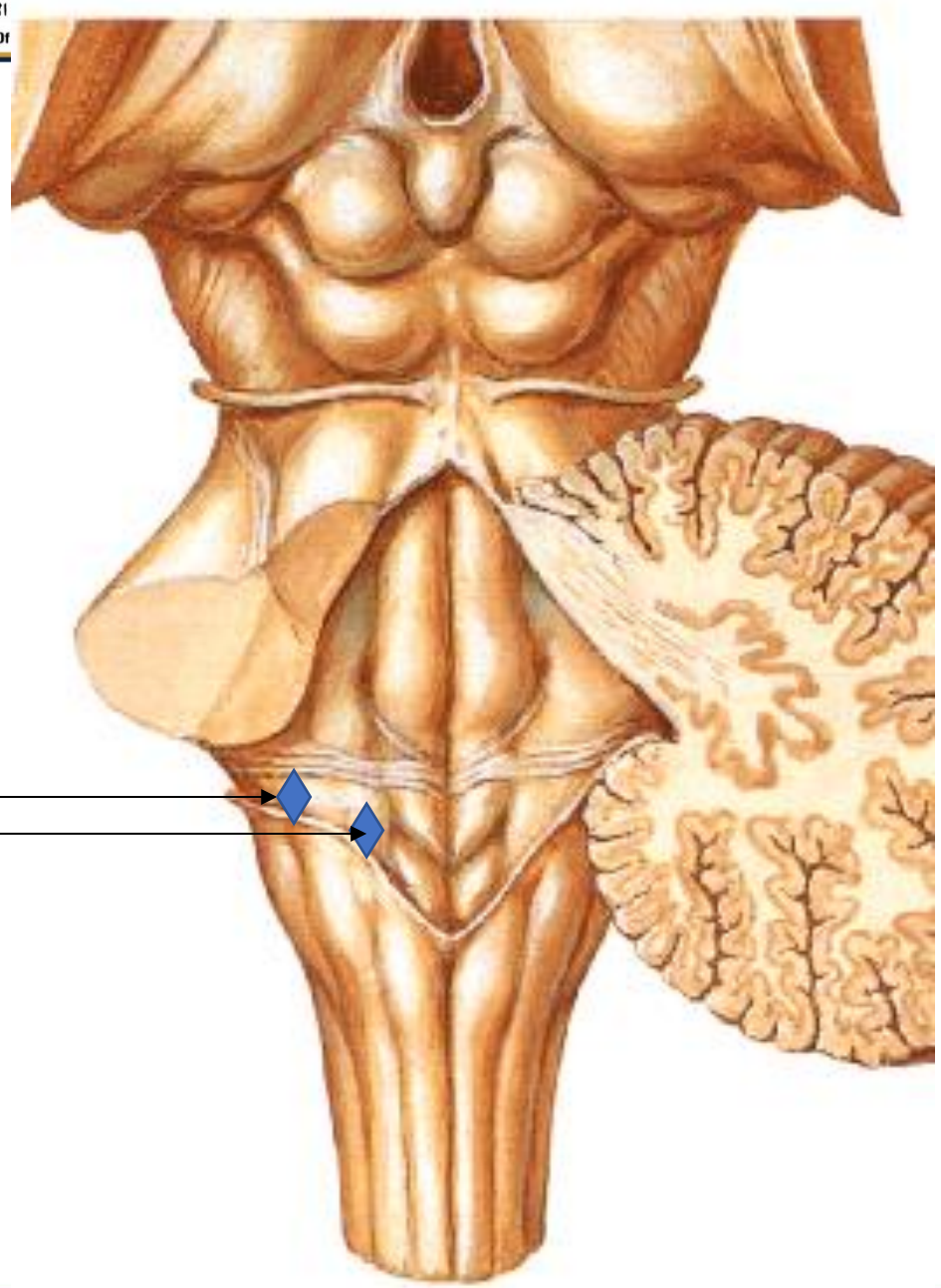


Two vestibular nuclei

Medial and Inferior vestibular nuclei

Site: In the floor of the **4th ventricle**

Function: Maintain balance and **equilibrium**



Inferior and Medial Vestibular nuclei

Lesions of the Medulla

A- Medial Medullary Syndrome (anterior spinal artery syndrome)

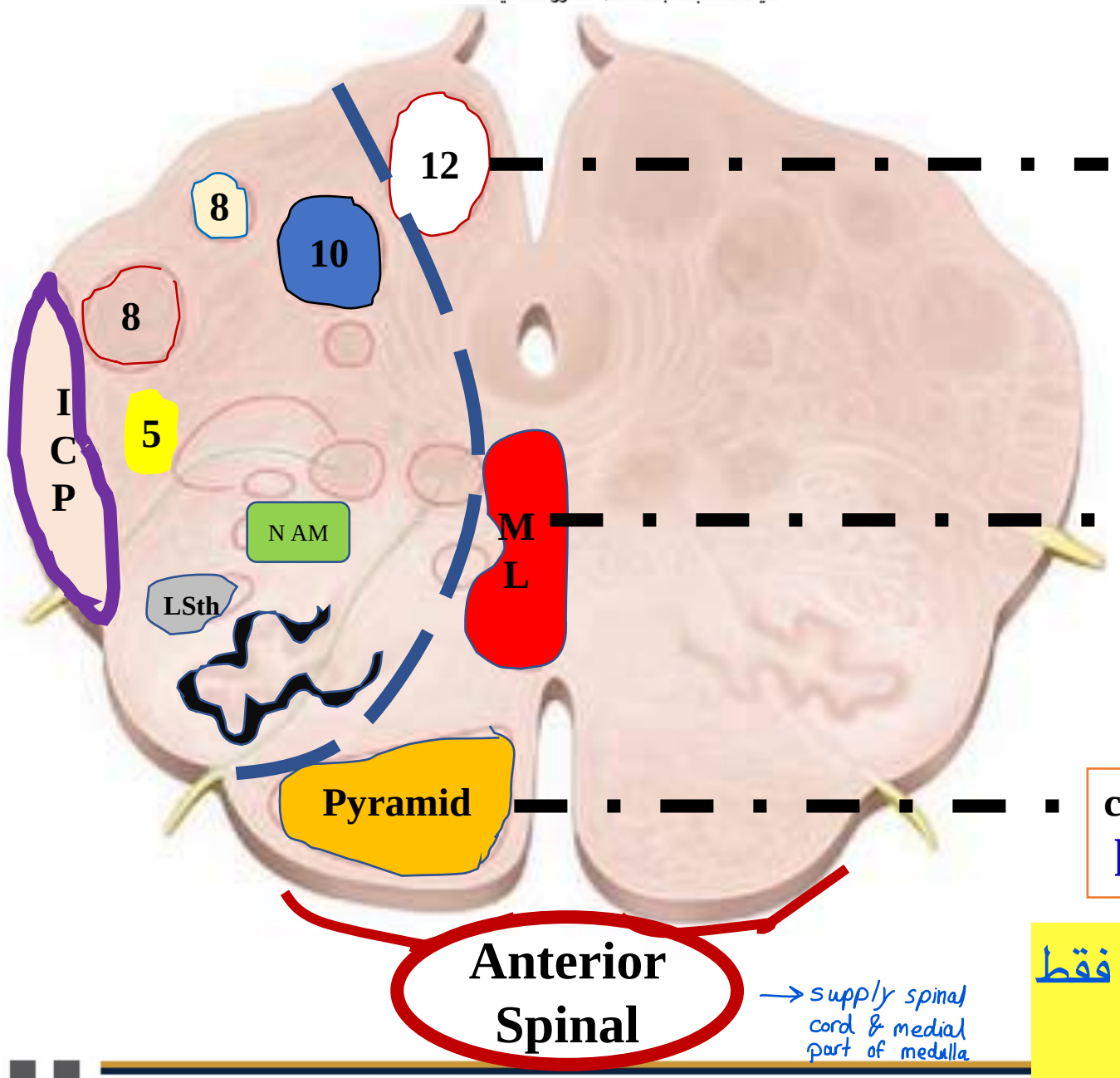
Cause: obstruction of anterior spinal artery

1. **Corticospinal tract** lesions: result in **contralateral spastic hemiplegia.**
2. **Medial lemniscus** lesions: result in **contralateral loss of proprioceptive and vibration** sensation from the trunk and extremities.
3. **Hypoglossal nucleus** lesions: result in **ipsilateral flaccid hemiparalysis of the tongue**. When protruded, the tongue points to the side of the lesion.

مش جاية في الامتحان .. للفهم فقط

 # Nice to know

PICA
↓
lateral part of medulla



supply spinal cord & medial part of medulla

ipsilateral **paralysis of the tongue**.
When protruded, It points to the side of the lesion

contralateral **loss of proprioceptive** and vibration sensation from the trunk and extremities

contralateral spastic **hemiplegia**

مش جاية في الامتحان .. للفهم فقط
Nice to know

مش جاية في الامتحان .. للفهم فقط
Nice to know

B. Lateral Medullary (Wallenberg Syndrome)
(Posterior Inferior Cerebellar Artery[PICA] Syndrome)

Cause: obstruction of Posterior Inferior Cerebellar Artery [PICA]

1. **Vestibular nuclei.** Lesions result in nystagmus, nausea, vomiting, and **vertigo**.
2. **Inferior cerebellar peduncle.** Cerebellar **ataxia**.
3. **Nucleus Ambiguous.** Lesions result in ipsilateral laryngeal, pharyngeal, and palatal hemiparalysis (**dysarthria, dysphagia, and hoarseness**).
4. **Spinothalamic tracts (spinal lemniscus).** contralateral **loss of pain & temperature sensation**
5. **Spinal trigeminal nucleus and tract.** ipsilateral **facial loss of pain & temperature sensation**
6. **Descending sympathetic tract.** ipsilateral **Horner syndrome (ptosis, miosis, enophthalmos & anhydrosis)**

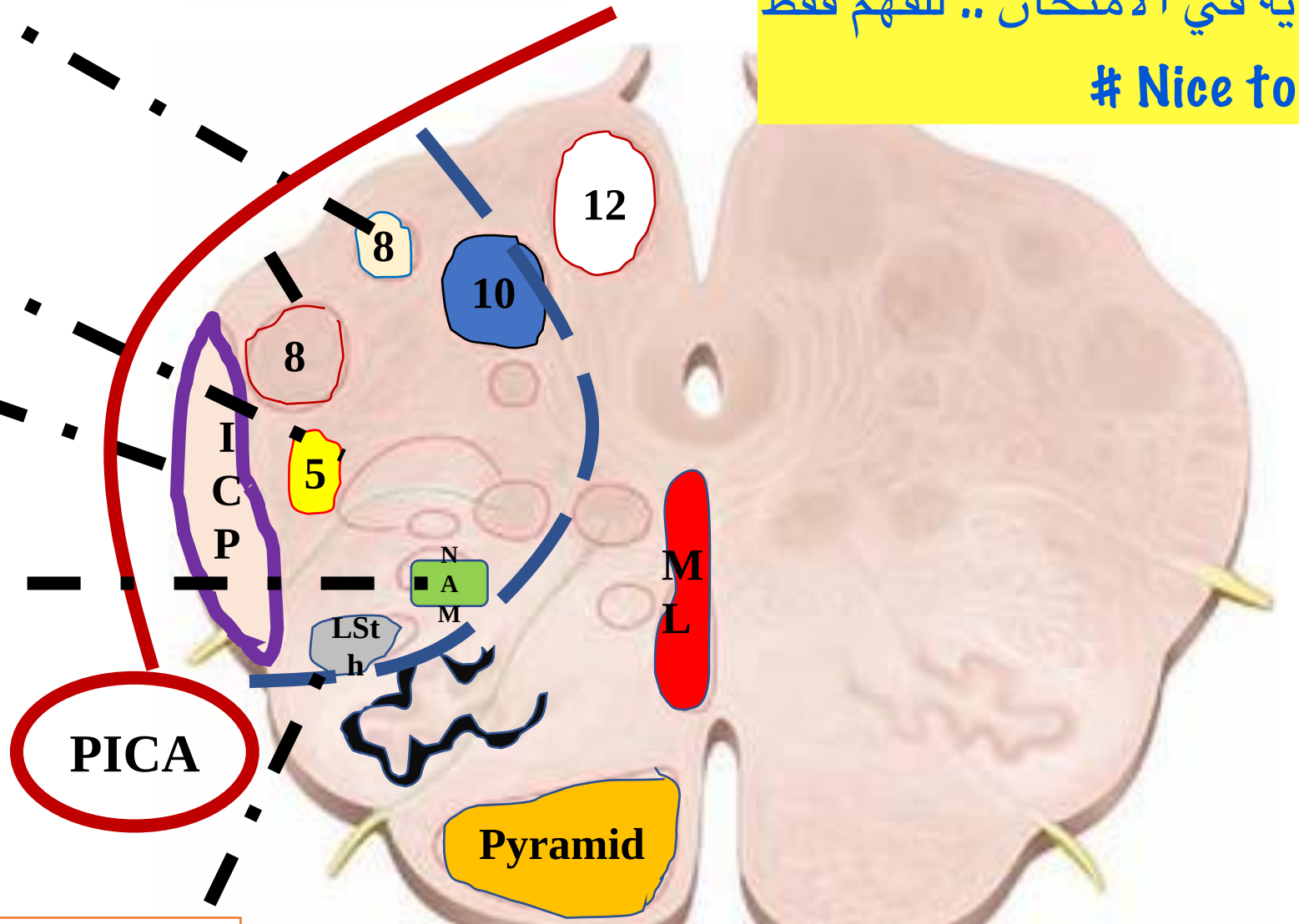
مش جاية في الامتحان .. للفهم فقط
Nice to know

Nystagmus, nausea, vomiting, and vertigo.

Ipsilateral loss of pain and temperature sensation from the face

ATAXIA

In ipsilateral laryngeal, pharyngeal, and palatal hemiparalysis, dysarthria, dysphagia, and dysphonia, hoarseness)



Contralateral loss of pain and temperature sensation from the body

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة -
al Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Internal Features of Pons

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

INTERNAL STRUCTURES OF THE PONS

BASIS PONTIS
Anterior part

TEGMENTUM
Posterior part

مهم نحفظ السلايد وخصوصا اللي مكتوب بالأحمر وممكن يجي SAQ

BASIS PONTIS

Is the **Anterior** part of the Pons, it contains:

Bundles of the pyramidal tract fibers: Corticospinal fibers and Corticobulbar fibers

Pontine nuclei: **2nd order neurons of the cortico-ponto-cerebellar Pathway.**

Transverse pontine fibers: **axons of pontine nuclei**

Fibers of the middle four cranial nerves: **on their way outside the pons**

SAQ : Enumerate contents of basis pontis ?

TEGMENTUM

Is the **posterior part** of the Pons, it contains **4 lemnsci** and **4 cranial nerve nuclei**

TRACTS

1-Four lemnisci: medial lemniscus, trigeminal lemniscus, spinal lemniscus and lateral lemniscus. مهمة ونحفظها

2-Medial longitudinal fasciculus (MLF): it connects the **vestibular nuclei** with motor nuclei that move the eyes (**3rd,4th and 6th** cranial nerves).To coordinate the eye movements

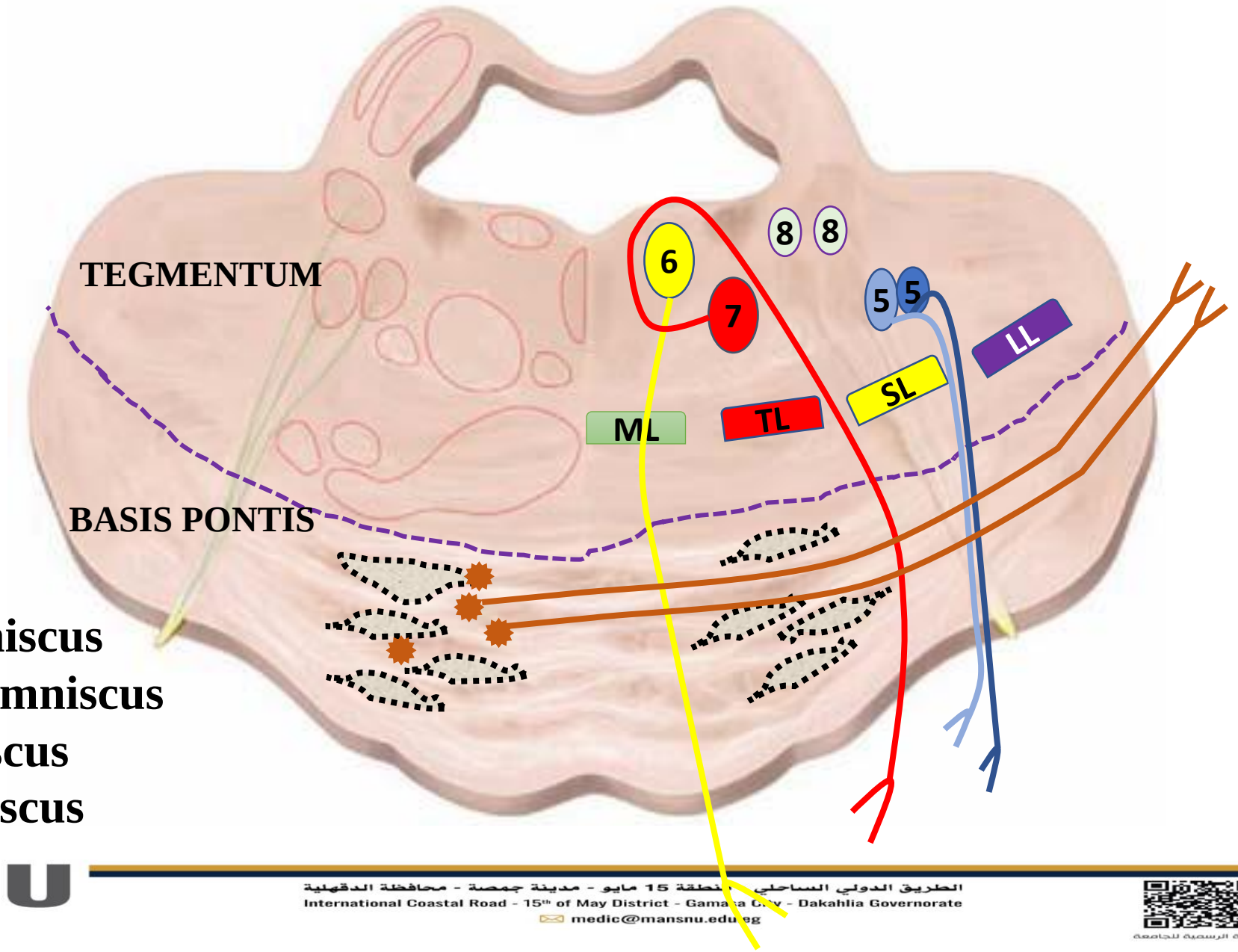
وظيفته مهمة وبتيجي MCQ

3-Other tracts: e.g: tectospinal, rubrospinal, central tegmental tract and other tracts

Nuclei

Nuclei of the middle 4 cranial nerves: 5th, 6th , 7th and 8th .

Pontine reticular formation



ML: medial lemniscus
TL: trigeminal lemniscus
SL: spinal lemniscus
LL: lateral lemniscus

Lesions of the PONS

مش جاية في الامتحان .. للفهم فقط
Nice to know

A- Basal Pontine Syndrome

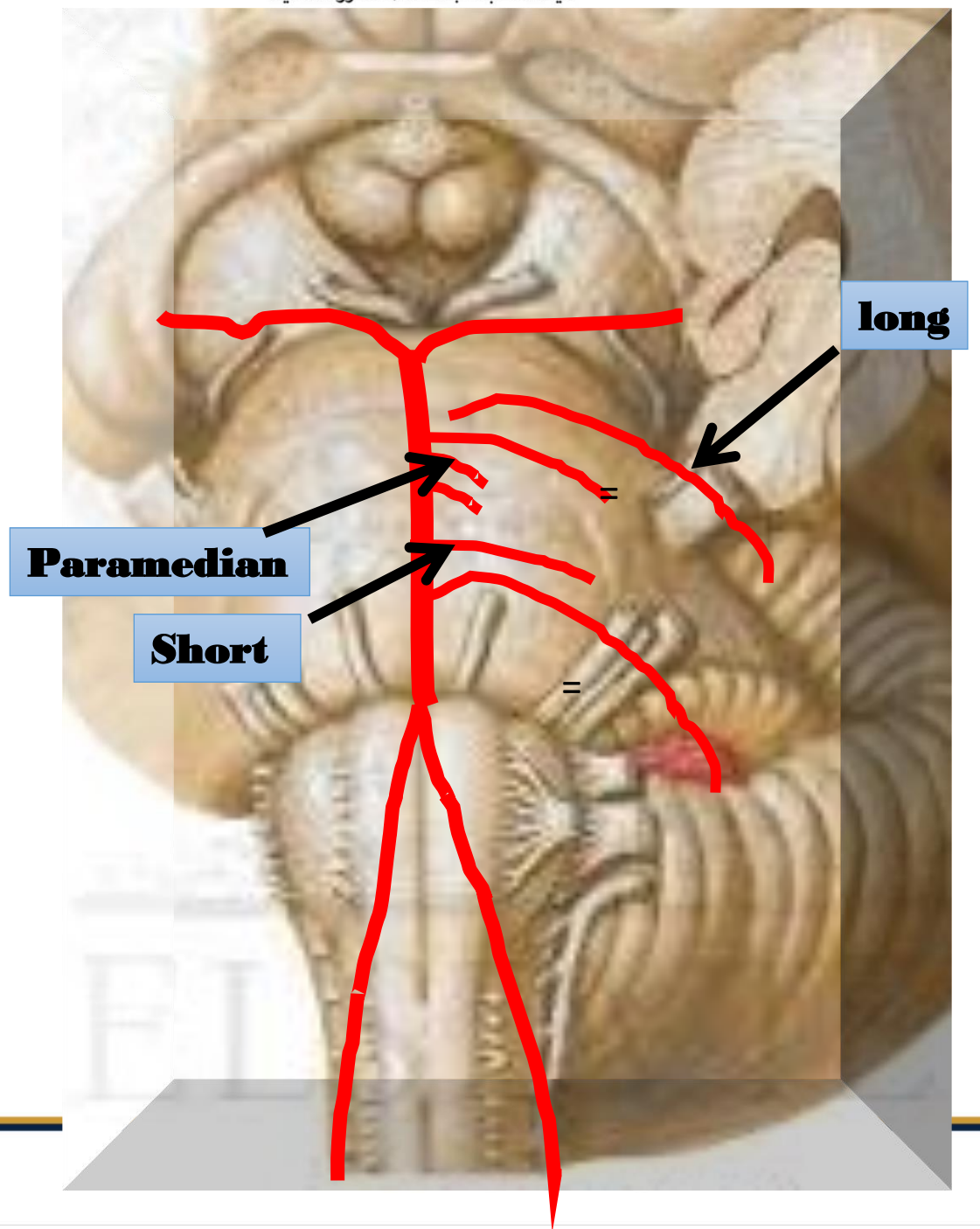
1- Caudal

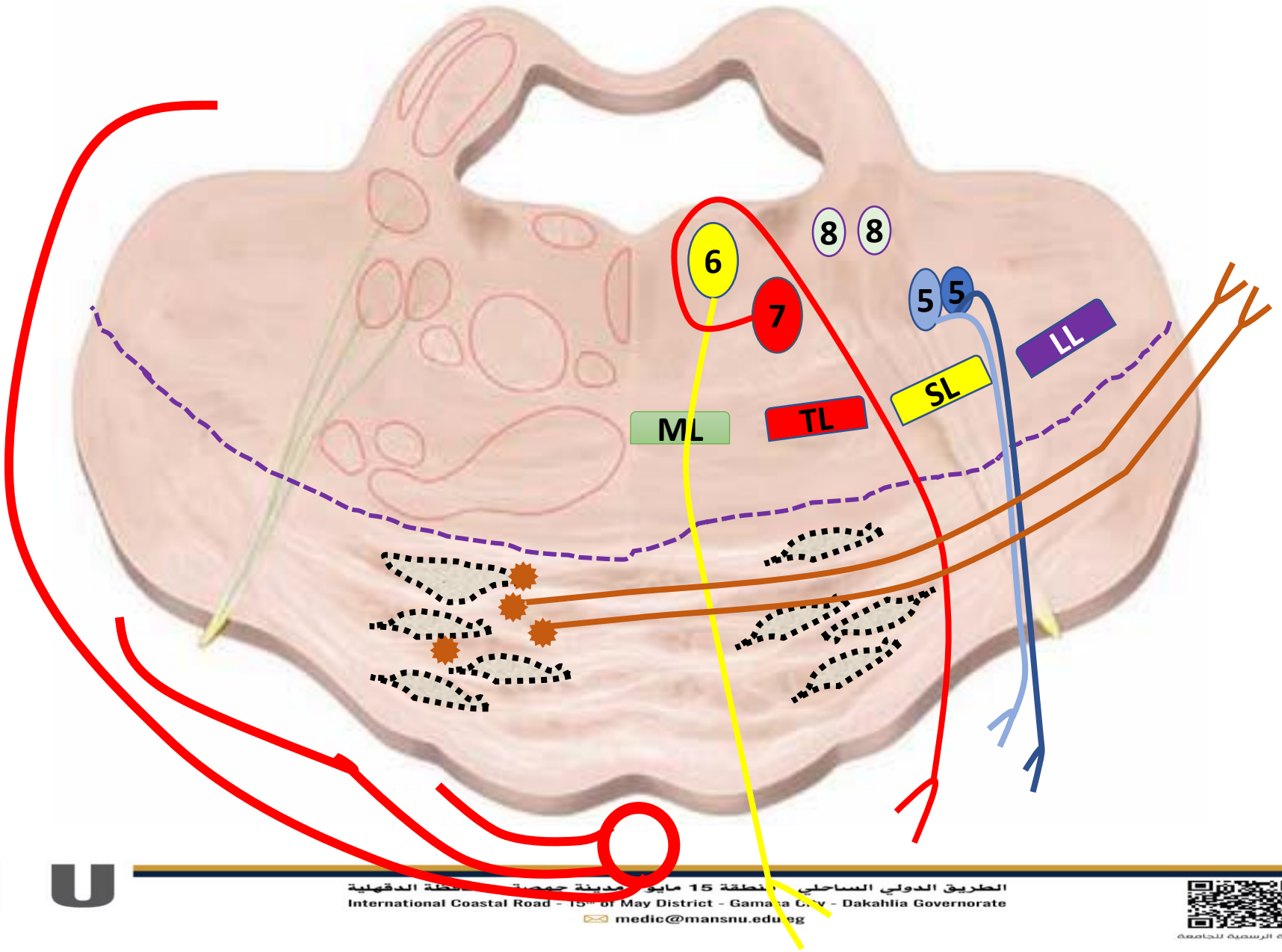
2- Rostral

1- Caudal

Due to occlusion of **paramedian** branches of **basilar artery**

Structure affected	Signs
Corticospinal tract.	contralateral spastic hemiplegia.
Abducent nerve	ipsilateral lateral rectus paralysis
Facial nerve	Ipsilateral facial paralysis LMNL


long
Paramedian
Short


6
7
8
8
5
5
ML
TL
SL
LL

2- Rostral

مش جاية في الامتحان .. للفهم فقط
Nice to know

Due to occlusion of **short circumferential** branches of **basilar artery**

Structure affected	Signs
Corticospinal tract.	**contralateral spastic hemiplegia**
Trigeminal nerve	**ipsilateral paralysis of trigeminal:** **a. Paralysis of muscles of mastication on the same side.** **b. loss of sensation from the face on the same side.**

Lesions of the PONS

B- Tegmental Pontine Syndrome

Due to occlusion of long circumferential branches of basilar artery

Structure affected	Signs
Medial lemniscus.	contralateral loss of Proprioceptive discriminative touch and vibration sensation from the trunk and extremities.
Abducent nucleus.	ipsilateral paralysis of lateral rectus muscle. Ipsilateral Paralysis of lateral gaze
Facial nerve.	Ipsilateral facial paralysis LMNL

مش جاية في الامتحان .. للفهم فقط

Nice to know

وجزئية الـlesion كلها مش هتفهمها إلا بعد ما تاخد الblood supply .. إسكيب 😌

Quiz

1. Nucleus solitarius is responsible for which sensation

A. Taste
B. Equilibrium
C. Proprioception
D. Pain and temperature
F. Touch

Answer: A

Quiz

1. Nucleus Ambiguous is a motor nucleus for which cranial nerve

A. 3^{rd} & 4^{th}

B. 5^{th} & 6^{th}

C. 7^{th} & 9^{th}

D. 9^{th}, 10^{th} & 11^{th}

F. 10^{th}, 11^{th} & 12^{th}

Answer: D

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

References for further readings

- Oxford Handbook of Clinical Medicine (3rd edition).
- Gray’s anatomy for students
- The Clinical Practice Of Neurological and Neurosurgical Nursing Fourth Edition.

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg


الحمد لله
Thank You
Thank You