بسم الله الرحمن الرحيم

دفعة 427 **، شباب وشابات ، بعد السلام والتحية**

كما عوّدكم التيم في صياغة محاضرات البروف أشرف بشكل مستساغ

نكمل معكم المشوار ، بنفس الأسلوب ، ونفس المستوى -بإذن الله -

المصادر كانت مزيجاً من محاضرات البنات ، ونوتات الطلاب مع الدكتور أشرف

وكالعادة ، اطلع البروف على المحاضرة ، وقال

(يا حبيلكم يا 427 **، ، الله لا يحرمنا)** <<<< **للأمانة ، ، ما كانت بالنص كذا ، ، بس هذا اللي كان بخاطره** ☺

نشكر كل من ساهم و أعطى وقدم في سبيل إخراج هذا العمل في حلته الطيبة

اعذرونا على التقصير

لكم مني ومن فريق العمل كل الحب والتقدير

PHYSIOLOGY TEAM - GROUP B

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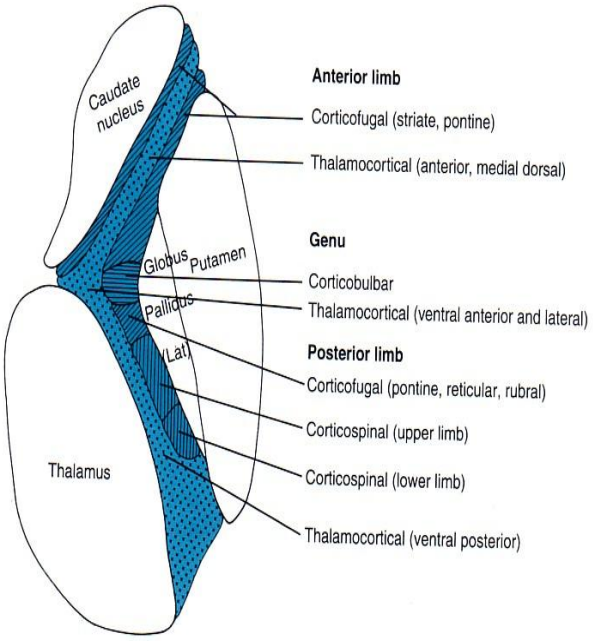
CORTICAL AND SPINAL LESIONS

:: INTRODUCTION ::

- **INTERNAL CAPSULE :**
  - ✓ **Definition:** Collection of axons between Caudate nucleus, thalamus medially, and Lentiform nucleus laterally.
  - ✓ V-shaped.
  - ✓ **Parts:** Genu, Anterior limb, Posterior limb.
  - ✓ Fibers of the pyramidal tract occupy the **GENU and Anterior ⅔ of posterior limb.**
  - ✓ Followed posteriorly by:
    - Sensory radiation.
    - Optic radiation.
    - Auditory radiation .



- **CEREBRAL DOMINANCE:**
  - ✓ Right-handed people have the speech area located in the left hemisphere.
  - ✓ Also, 95% left-handed people have the speech area located in the left hemisphere.
  - ✓ Only 5% of the left-handed people have the speech area located in the right side.
  - ✓ Dominant hemisphere is called **CATEGORICAL HEMISPHERE**.
  - ✓ Non-Dominant hemisphere is called **REPRESENTATIONAL HEMISPHERE**.

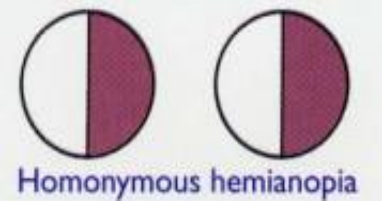
	Dominant Hemispheres	Non-Dominant Hemispheres
Name	Categorical	Representational
Functions	Language Math Logic	Spatial abilities Face recognition Visual imagery Music
Lesion results in	**[GRESTMANN's Syndrome] :-** 1. **Confusion** of Right. & Left Limbs. 2. **Finger Agnosia** (difficulty in distinguishing fingers) 3. **Acalculia** (disturbance of calculation) 4. **Agraphia** (disturbance of writing)	1. **ANOSOGNOSIA** (No longer aware of opposite limbs). 2. **Dressing Apraxia** (difficulty in dressing, e.g. getting arm into pyjamas) 3. **Constructional Apraxia.** 

- **Upper & Lower motor neuronal lesions :**
  - ✓ **UMN lesions** result from damage to neurons situated between motor area of cerebral cortex, down to contralateral anterior horn cells of the spinal cord.
  - ✓ **LMN lesions** result from damage to neurons between anterior horn cells of the spinal cord, down to peripheral nerves and muscles.
  - ✓ Difference between UMN & LMN lesions :
    Although both lesions result in paralysis of skeletal muscle (loss of voluntary motor activity) yet each has its characteristic manifestations.

	UMNL	LMNL
Extent of paralysis	Widespread	Limited
Site of paralysis	Commonly contralateral	Only ipsilateral
Muscle Tone	Spasticity or Rigidity	Hypotonia or atonia
Tendon Jerks	Exaggerated with **Clonus** (repetitive contractions & relaxations of a certain muscle on maintained stretch)	Absent
Superficial Reflexes	Babiniski sign	Absent
Muscle Bulk	Normal (late disuse atrophy)	Marked wasting

Effect of Lesions of The Pyramidal Tract at Various Levels

- Lesions of pyramidal tract will cause paralysis of UMN lesion type below the level of the lesion. However the side affected & the extent of the paralysis vary according to the site of lesion.
  - ✓ **In Primary motor area :** restricted paralysis on the opposite side, e.g. monoplegia (paralysis of one limb) because area 4 is widespread (so it's rarely damaged completely).
  - ✓ **In internal capsule** :
    - ✓ Contralateral hemiplegia; because almost all fibers are injured .
    - ✓ Hemianesthesia : loss of sensation in the opposite side
    - ✓ Hemianopia : loss of half the vision in both eyes.



- ✓ **<u>In the brain stem</u>** : contralateral hemiplegia & ipsilateral paralysis of the cranial nerves of the LMN lesion type (due to damage of their nuclei in the lesion). This condition is called **<u>Crossed Hemiplegia</u>**, and the nerves affected differ in the following :
  A. **In the midbrain**: the 3rd, 4th cranial nerves are affected.
  B. **In pons**: the 5th, 6th, 7th and 8^{th}.
  C. **In medulla**: the 9th, 10th, 11th and 12th .
  D. Bilateral lesions in the brain stem are rare & lead to **Quadriplegia** (paralysis of the 4 limbs) & bilateral paralysis of cranial nerves.

- **<u>in the spinal cord</u>**:
  A. Bilateral lesions (e.g. complete section of the spinal cord) :
    - Upper cervical region → are fatal (interruption of the respiration).
    - In the lower cervical region (above brachial plexus) → quadriplegia.
    - Mid thoracic region (or lesion of lumbosacral nerves) → paraplegia (paralysis of lower limbs).
    - Conus Medullaris →
      - one leg is paralyzed (i.e. monoplegia).
      - urinary bladder paralysis.
      - loss of sensations around anus.

  B. Unilateral lesions (e.g. hemisection of the spinal cord):
    - In the cervical region → ipsilateral hemiplegia.
    - In the mid thoracic region → ipsilateral monoplegia (i.e. leg paralysis).

- In both conditions → there is also ipsilateral paralysis of the LMN lesion type of the muscle at the level of lesion due to damage of the anterior horn cells.

CMPLETE SECTION OF THE SPINAL CORD

- This is fatal if it was above the origin of the phrenic nerve (**above the 3rd cervical segment** e.g. hanging) due to paralysis of respiratory muscles.
- However at the lower levels, patients pass in 3 stages:
  - ✓ spinal shock.
  - ✓ Stage of recovery of spinal reflexes.
  - ✓ Stage of Failure of spinal reflex activity.

I. SPINAL SHOCK :

- The resting membrane potential of spinal motor neurons is 2-6 mv greater than normal because of excessive secretion of **GLYCINE** (needs more stimulus to be excited), so the neurons are hyperpolarized (inhibited).

- The manifestations of this stage are the following :
    a) Loss of all sensations below the level of the lesion.
    b) Quadriplegia or paraplegia (depending on the level of the lesion).
    c) Loss of the spinal reflex activity below the level of the lesion; because the spinal center at that part is damaged.
    d) Vasodilation below the level of the lesion due to interruption of the descending fibers from the **vasomotor centers** which may lead to **hypotension** in case of the high spinal lesion.
    e) Paralysis of bladder & Rectum.

- Complications of the spinal shock:
    a) Hypotension.
    b) Bed ulcers due to prolonged compression of the body against bed; leading to ischemia.
    c) Urinary tract infection due to urine stasis.
    d) Fall of body temperature due to reduction of metabolic rate after loss of muscle tone (because of lack of movement).

II. STAGE OF RECOVERY OF SPINAL REFLEXES :

- About **2 weeks** after the stage of spinal shock, the spinal centers below the level of the lesion recover **GRADUALLY** (but the sensations & voluntary movements **never** recover because the tracts in the spinal cord cannot regenerate due to lack of neurolemma).
- The **knee jerk** is usually the first reflex to appear.
- Muscle tone recovers, resulting in the increase of metabolic rate, and so **the body temperature rises** towards normal level.
- The activity of the spinal vasomotor centers (lateral horn cells) is restored, leading to vasoconstriction. So the **Arterial Blood Pressure rises** (but it remains labile because its precise control mechanism by the Baroreceptors is absent).
- Appearances of the **mass reflex**.
- **Micturation & defecation reflexes return** but are autonomic (as in infants) due to absence to voluntary control.
- **Sexual reflexes recover** (stimulation of the external genitalia in males leading to erection).

- **Mass Reflex :**

  This is a hyperactive spinal reflex response that appears after a few months. Mild noxious stimuli applied to the skin below the level of the lesion results in a wide range spread effects due to irradiation of signals in spinal cord to involve multiple somatic & autonomic centers such effects includes :

  - ✓ Exaggerated withdrawal of the stimulated part.
  - ✓ Urination & defecation.
  - ✓ Skin pallor & profuse sweating.
  - ✓ Fluctuation of the arterial blood pressure.

III. STAGE OF FAILURE OF SPINAL REFLEX ACTIVITY:

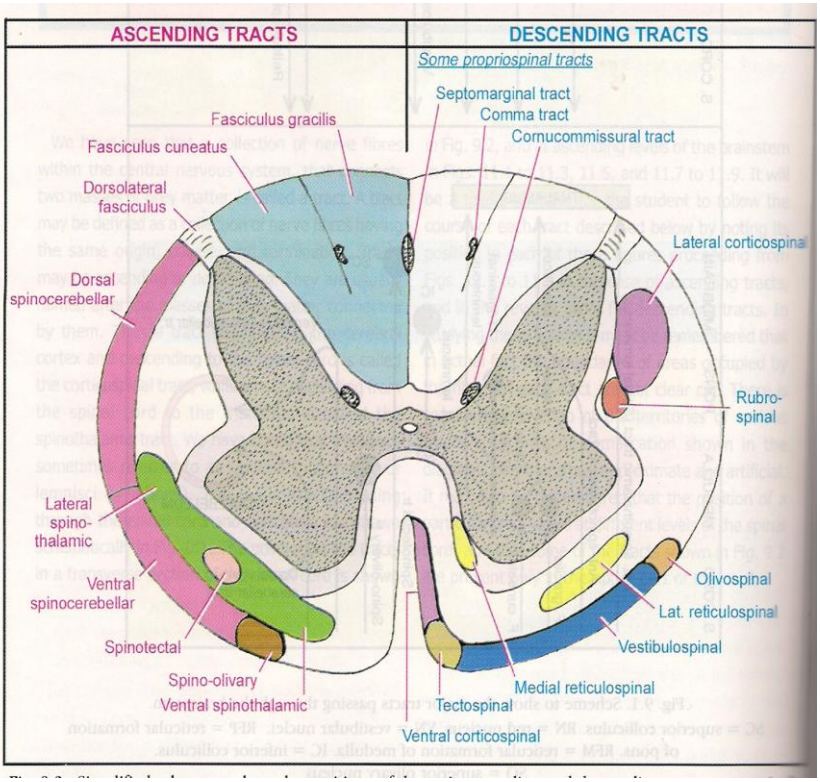
- This is a terminal (premortal stage) that usually results from:
  - Abscess formation at the level of cut end.
  - If the gap between two cut ends of spinal cord are far apart.
  - Cut ends become neuroma.
  - Other conditions during recovery stage.
- It is usually associated with general toxemia due to bed soars or urinary tract infections which may lead to uremia
- The spinal centers below the level of the lesion are depressed once more leading to the following :
  1- Loss of muscle tone & and all spinal reflexes.
  2- Body temperature falls.
  3- Loss of defecation & micturation reflexes resulting in constipation & urine retention.
  4- Loss of sexual reflexes.
  5- Hypotension due to depression of spinal vasomotor centers.

HEMI-SECTION OF THE SPINAL CORD (BROWN-SEQUARD SYNDROME)

- This is a unilateral transverse lesion in the spinal cord that interrupts the continuity of both descending and the ascending tracts at only one side, such lesion cause the following :

ABOVE THE LEVEL OF THE LESION

- Cutaneous **hyperalgesia** (increase sensitivity to pain) occurs in the ipsilateral dermatoms that are innervated by dorsal nerve root entering the spinal cord just above the level of the lesion.



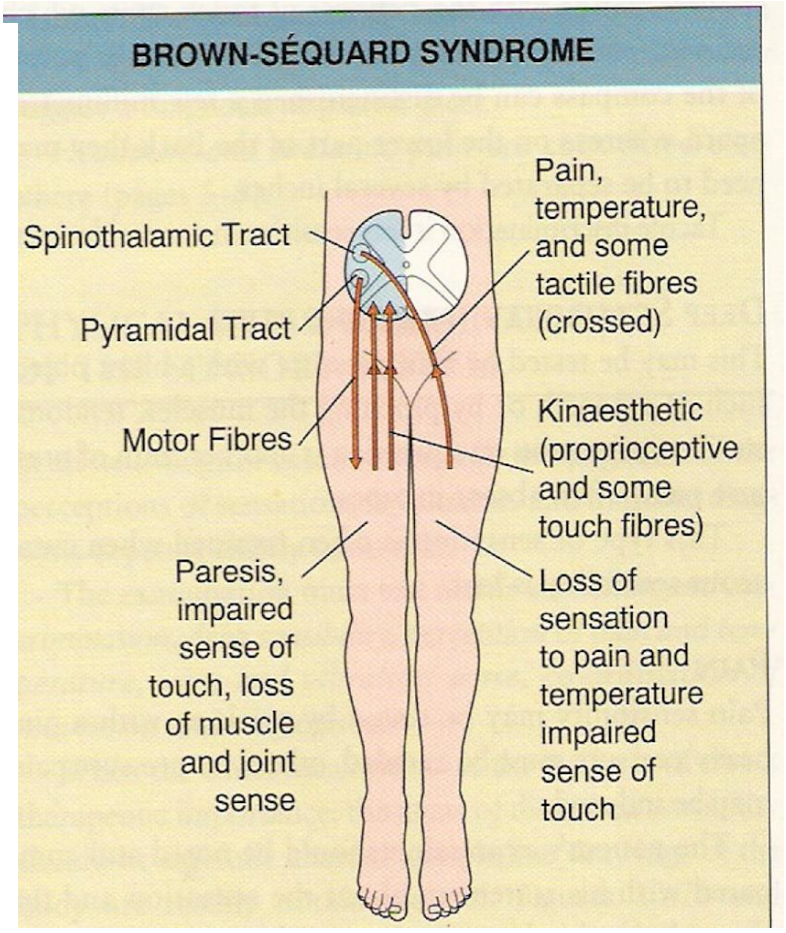
AT THE LEVEL OF THE LESION

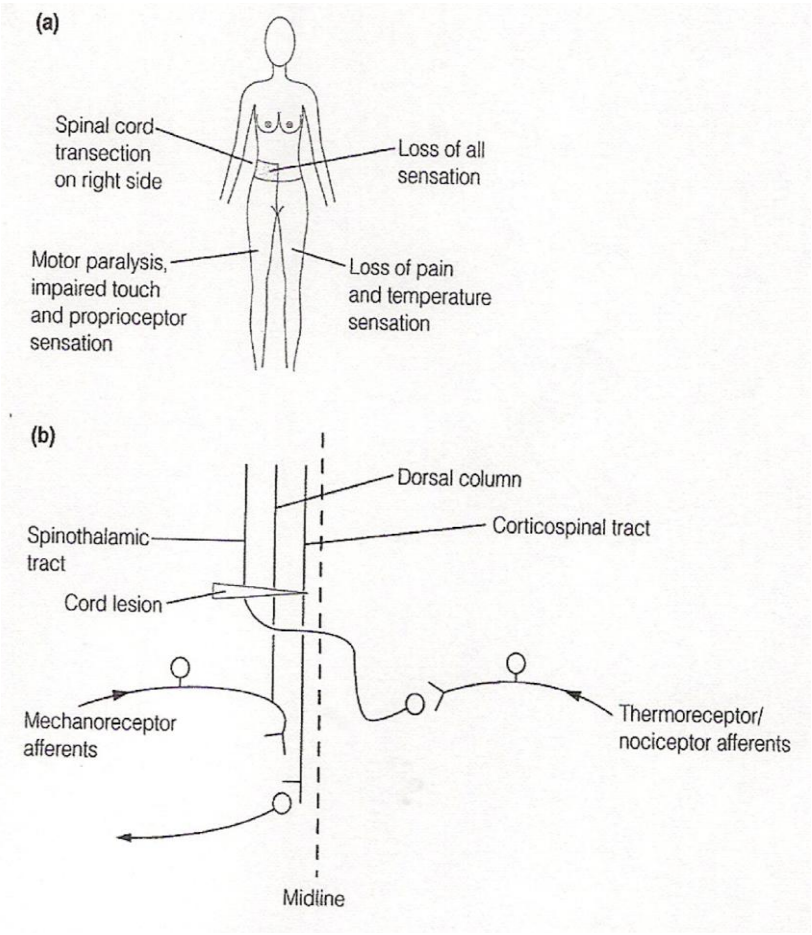
All the following effects occur at the same side :

- Loss of all sensation in the areas innervated by the afferent nerve that enter the damaged segment.
- Paralysis of the muscles supplied by the efferent nerves that arise from the damaged segment which is of LMN lesion type due to damage of the spinal motor neurons.
- Loss of all reflexes mediated by damaged segment.
- Vasodilation of the blood vessels which receive VC fibers from damaged segment.

BELOW THE LEVEL OF THE LESION

- Paralysis of the muscles of UMN lesion type on the same side due to interruption of the descending tract (motor tract).
- Vasodilation in the same side due to interruption of the descending vasomotor tract (this is temporally because the lateral horn cells soon recover and discharge leading to Vasoconstriction).
- Ipsilateral loss of the fine tactile, proprioceptive, pressure and vibration sensation due to interruption on the dorsal column.
- Contralateral **ANALGSIA** and **ATHERMIA** (loss of pain and temperature) due to interruption of the ascending fibers of the **lateral spinothalamic** tract of the opposite side.
- Crude touch is diminished (but not lost) on both sides because crude touch is transmitted by the ventral spinothalamic tract as well as by the dorsal column tract.
- Micturation is often not affected by hemi section because the vesicomotor tracts partially decussate in sacral region.





PERIPHERAL NEVRS LESIONS

- Here are some examples of LMN lesions (peripheral nerves lesions) :

1. **Median Nerve :**
   - **Sensory supply :** Lateral 3.5 fingers.
   - **Motor supply :** muscles of the thenar eminence [**LOAF**]:
   (2 lumbricals , Opponens pollicis, Abductor pollicis brevis, &Flexor pollicis brevis).
   - **Lesion:** Injury of median nerve at different levels causes different syndromes. The most common site of injury is the wrest joint causing paralysis and atrophy of the thenar muscles, giving an apelike pattern (e.g. as in the case of **Carpal Tunnel Syndrome** → median nerve compression at wrist).

2. **Ulnar Nerve :**
   - **Sensory supply :** Medial 1.5 fingers.
   - **Motor supply :** muscles of the Hypothenar eminence
   - **Lesion:** Injury of the ulnar nerve at the wrist will result in **Claw-Shaped hand**.

3. **Radial Nerve :**
   - **Motor supply :** Triceps and the extensors of the forearm.
   - **Lesion:** loss of extensors & triceps Actions → Wrist Drop.
   - Most common cause of radial nerve lesion is compression of the nerve in the spiral groove (e.g. lying on the arm when sleeping).

4. **Common Peroneal Nerve :**
   - **Lesion:** Foot Drop.

- **REFERANCE :**

Review of Medical Physiology by Gannon (22nd edition) , pages (203-210) .