18 Physiology of postural reflex

Sources

-Female slides

Objectives

- be able to define human posture .
- explain/define the concepts of " center of gravity '' and " support base, base of support ".
- Explain what are postural reflexes and their overall function .
- Know the centers of integration of postural reflexes .
- Explain the structure and function of the vestibular apparatus (utricle, saccule & semicircular canals) in maintenance of balance
- Describe decorticate rigidity and decerbrate rigidity and explain the mechanisms underlying them .

Sources

- Female slides

POSTURE & EQUILIBRIUM

Posture: It is maintenance of upright position against gravity (center of body is needed to be between the legs) it needs **antigarvity muscles.**

1-Up-right posture need postural reflexes.

2- posture depends on muscle tone (stretch reflex) (basic postural reflex)

3-The main pathways concerned with posture are:-

- **A- medial (reticulospinal-tectospinal- vestibulospinal) :**control proximal limbs & axial muscles for posture & gross movements
- **B- lateral pathways (corticospinal - rubrospinal)** control distal limbs.

Stretch reflexes & postural reflexes can be modified by coordinated activity ;-

1. Spinal cord
2. Medulla
3. Midbrain
4. Cerebral cortex
5. cerebellum

POSTURAL REFLEXES DEPENDS ON THE FOLLOWING RECEPTORS:-

1- vestibular apparatus receptors	2- visual & auditory receptors	3- Proprioceptors of muscles , tendons , ligaments & joints	
Maculae (utricle&saccule) & SCC cristea	Vision can **compensate** for loss of auditory, vestibular & proprioception Ex.in Tabes dorsalis +Rombergis(the tendency of a patient to sway يميل while standing still with feet close together and eyes closed; associated with loss of position sense).	**a- Neck Proprioceptors**	detect head position in relation to trunk
		b- Body Proprioceptors	proprioceptors of anti-gravity muscles
		c- pressure receptors	in sole of feet initiate positive supporting reaction **(magnet reflex** **=**A reflex in which light finger pressure on a toe pad causes a slow reflex contraction of the lower extremity,**)**

Postural reflexes are:-

A-Static reflexes **B-Phasic reflexes**

A-Static R (statotonic):- maintain posture at rest:-

A- spinal reflex	B- medullary reflexes	C-Righting reflexes (midbrain)

A. Spinal reflexes

(spinal R can be studied in spinal animal with cut at neck b/w the S.C& brain stem so all S.C is intact)

1- local static reflexes:	as positive supporting reaction **magnet reflex** (receptors are proprioceptors of flexors(contraction of both flexors&extensors)	
2 -Stretch reflex		
3- segmental static reflexes:	mediated by one segment of the spinal cord as :-	- Crossed extensor reflex
		- Negative supporting R which release +ve supporting reaction (receptors are proprioceptors of extensors of the released limb)

B. Medullary static Reflexes (center=medulla oblongata) are:-

1- Neck static reflexes (studied in a decerebrated animal cut above medulla + labyrinth destroyed)

Stimulus	changing head position (+) neck proprioceptors	
Types	A- ventroflexion of head	arms flexion+ extend hindlimb (as in decerebration)
	B-dorsiflexion of head	arms extended + flex hindlimb.
	C- turning head to one side	extention of limbs on that side + flexion of other side.

2- labyrinthine static reflex (in decerebrated animal) + elimination of neck proprioceptors)

Stimulus	gravity	
Types	A-ventroflexion of head (or prone position)	4 limbs flexion
	B-dorsiflexion of head (or supine position)	4 limbs extended

b- Righting reflexes

Types	a- visual righting reflexes	b- labyrinthine righting reflexes (cover eyes)	c- body on head righting reflexes	d- body on body	e- neck righting reflexes
Site	Cortical	Midbrain	midbrain	Midbrain	Midbrain
response	correct position of head & body if position is disturbed	otolith organs.	reflex correction of head .	reflex correction of body	righting of body.
stimulation	visual	Tilting the head	pressure on side of body.	pressure on side of the body (and head is fixed)	stretch of neck muscles
receptors	eye receptors	righting of head	trunk proprieoceptors	trunk proprieoceptors	muscle spindles of neck muscles

- All static labirynthine reflexes have **macula** as receptors

- Phasic reflexes (statokinetic reflexes):

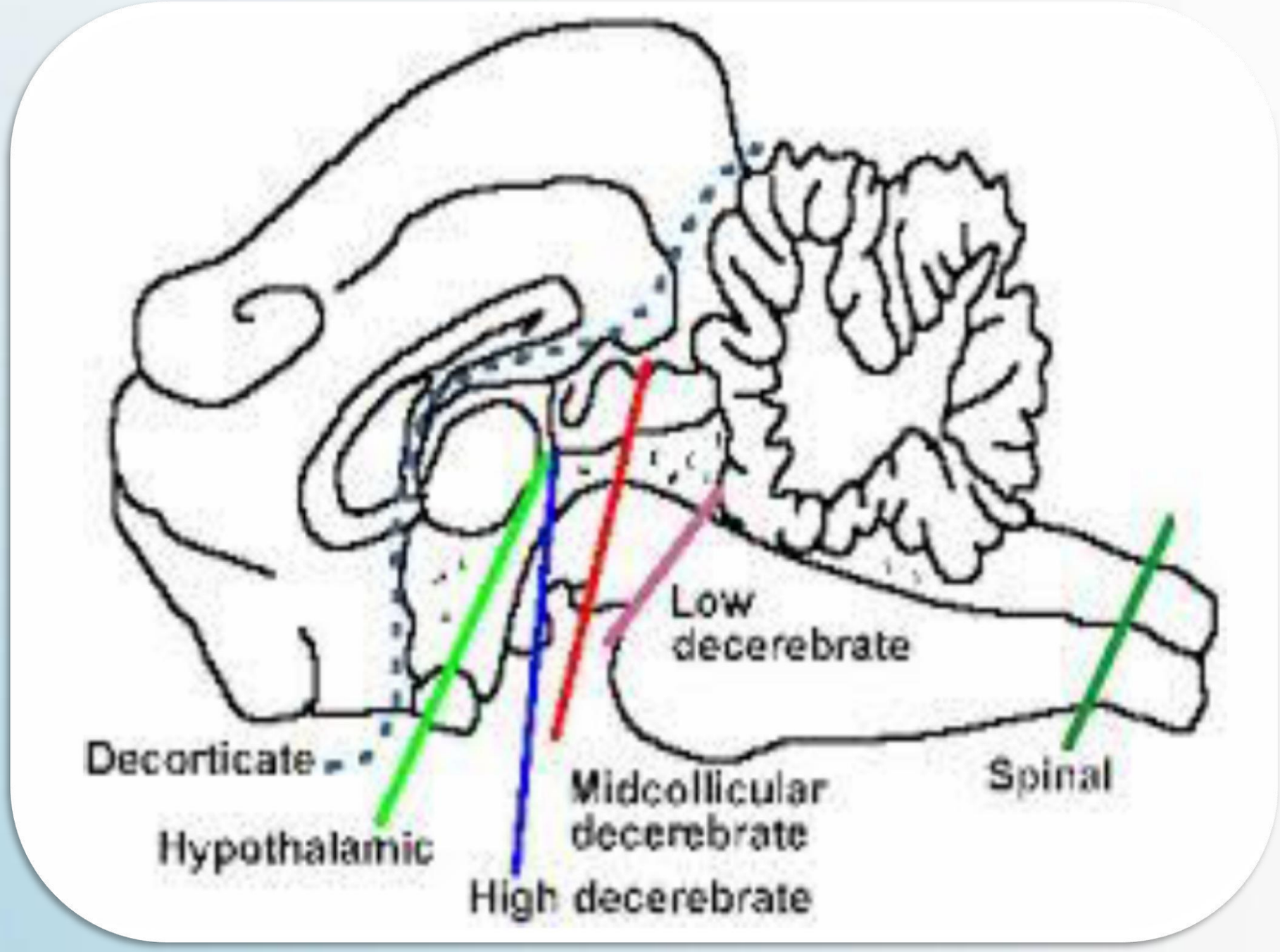
Def: maintain posture during motion

Center: **cerebral cortex**

Types	1- Hopping reaction:-	2- Placing reaction:-
Characteristic	when animal is pushed laterally > reflex hopping to keep limbs in position to support body.	blind folded animal suspended in air & moved towards a supporting surface, the feets will be placed firmly on the supporting surface معصوب العينين ومعلق في الجو سيحاول أن يلمس برجله اي قاعدة ثابته لدعمه
Receptors	**muscle spindles.**	**touch receptors& proprioceptors in soles of feet**

- but statokinetic reflexes during motion. (**macula act in linear & SCC receptors act in angular acceleration)**

Decerebrate rigidity & Decorticate rigidity



Decorticate rigidity

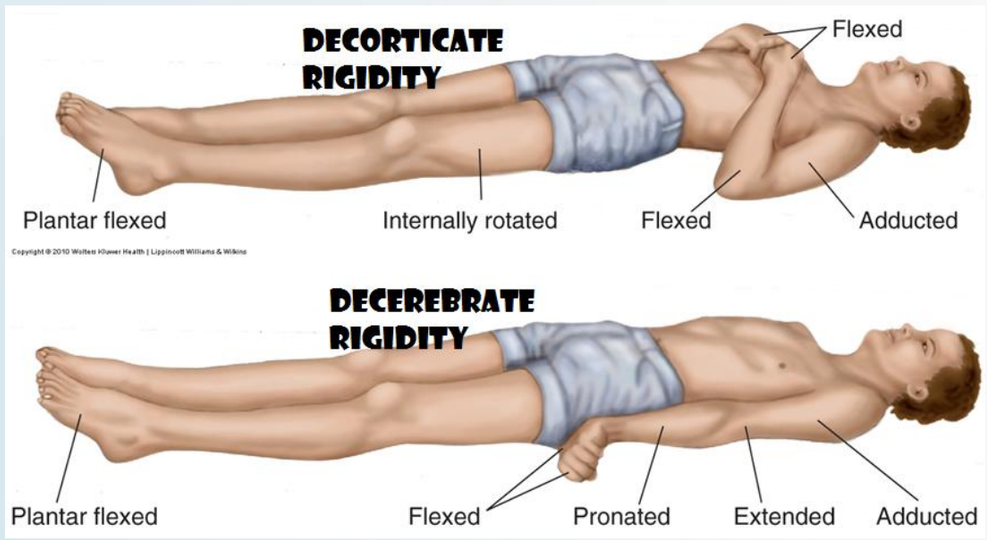
1- lesion in cerebral cortex but brain stem is intact
2-Medullary tonic neck & tonic labyrinthine reflexes present
3-Righting midbrain reflexes present
4-Visual righting, placing & hopping reflexes **lost**
5- it causes extensor rigidity in legs & moderate flexion of arms if head unturned , as supine position (tonic neck reflexes)

- the hands are clenched (pic) into fists, and the legs extended and feet turned inward

- Tonic neck reflexes are produced by turning the head to one side e.g to the left > extension of limbs on left side & flexion of RT . Since the corticospinal tract is interrupted, the pontine reticulospinal and the medial and lateral vestibulospinal extend L.L& disinhibition of the **red nucleus** with facilitation of the **rubrospinal tract** flex U.L

- The effects on these two tracts (corticospinal and rubrospinal) by lesions above the red nucleus is what leads to the characteristic flexion posturing of the upper extremities and extensor posturing of the lower extremities.

-- (as what seen in hemiplegic pts on affected side after Hge of internal capsule, there is loss of inhibitory cortical signals to gamma motor neurons via reticulospinal (from suppressor area 4 strip in the anterior edge of precentral gyrus)



Decerebrate rigidity :-

mid-collicular lesion (in section between superior & inferior colliculi of midbrain)> block normal inhibitory signals (from brain & red nucleus in midbrain to tonically active pontile R.F & Vestibular N)

- causing:

1- **maintained medullary tonic neck & labyrinthine R** (tonic static postural reflexes that support animal against gravity).

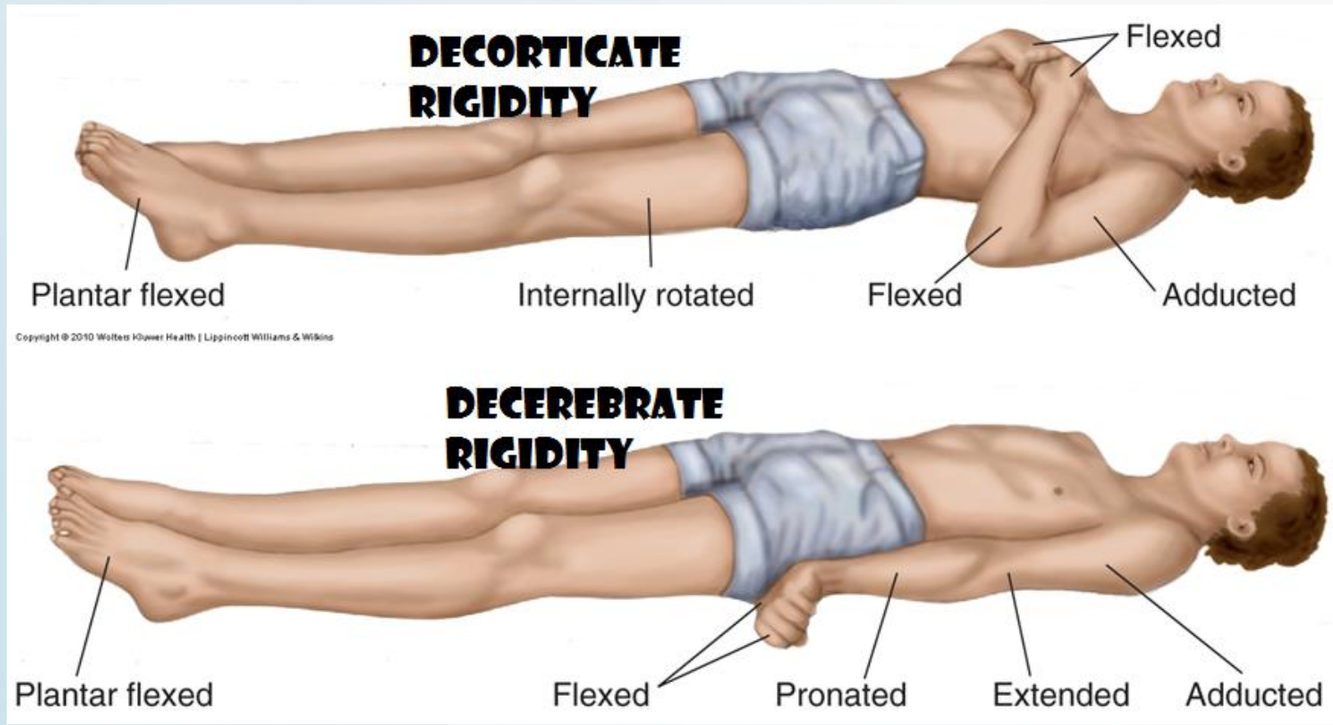
2-Absent midbrain righting R

3-**extension** of head & 4 limbs extensors, The jaw may be clenched(pic) with the neck hyperextended due to increased extensor tone from vestibulospinal & reticulospinal tracts to extensor motor neurons

4- spasticity &rigidity & extension in antigravity muscles

-In human by vascular lesion of brain stem between red N& vestibular nucleus

- Decorticate rigidity more common in human than decerebate rigidity



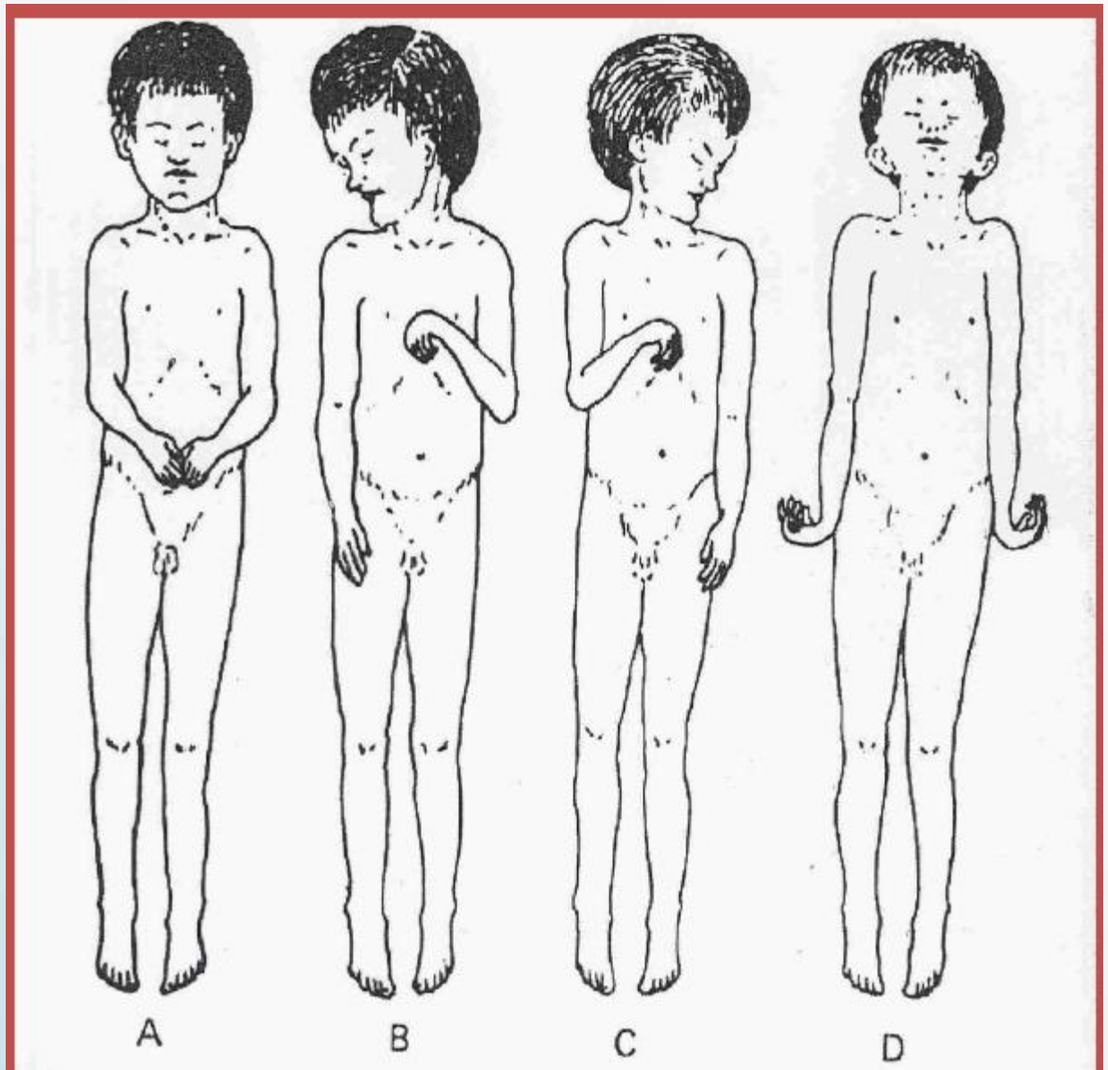


Figure 12–7. Human decorticate rigidity ***(A–C)*** and true decerebrate rigidity ***(D).*** In ***A*** the patient is lying supine with the head unturned. In ***B*** and ***C,*** the tonic neck reflex patterns produced by turning of the head to the right or left are shown. (Reproduced, with permission, from Fulton JF [editor]: *Textbook of Physiology,* 17th ed. Saunders, 1955.)

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