



Physiology Team



Lecture : 20

Physiology of postural reflex

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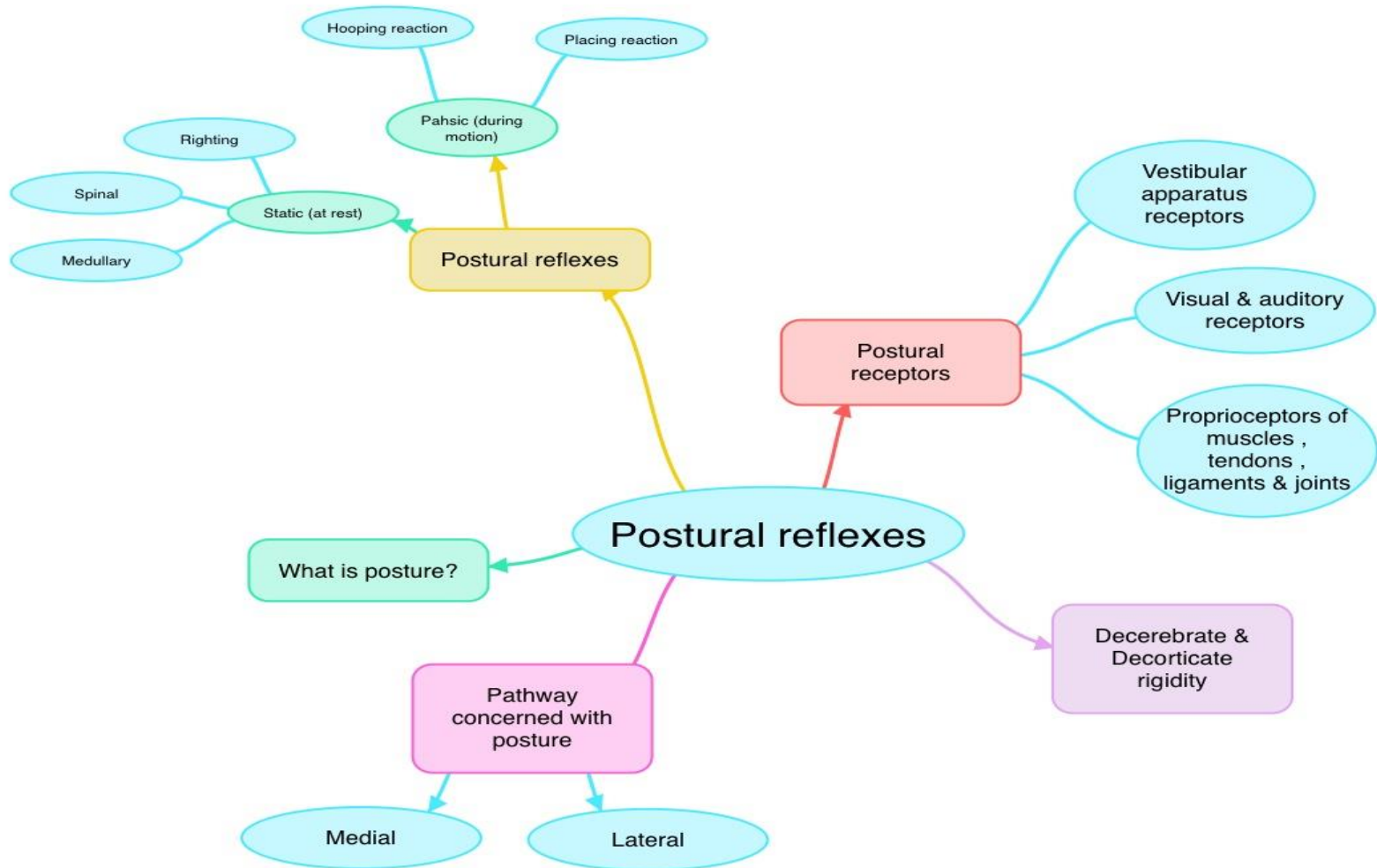
Reviewed By: Mohammed Jameel

OBJECTIVES

At the end of this lecture, student should be able to describe:

- 1- Postural reflexes are needed to keep the body in a proper position while standing, moving.
- 2- Body posture is suddenly altered it is corrected by several reflexes. At spinal cord, medulla, mid-brain and cortical levels.
- 3- Students are required to know posture regulating parts of CNS.
- 4- Understand these reflexes lesions in the various part of CNS.
- 5- To define spinal shock and able to describe the initial and long term changes in spinal reflexes that follow transaction of the spinal cord

MIND MAP



POSTURE & EQUILIBRIUM

Q- what is posture?

- It is maintenance of upright position against gravity (center of body is needed to be between the legs) it needs **antigravity** muscles

- Up-right posture need postural reflexes
- posture depends on muscle tone (stretch reflex) (**static**) (basic postural reflex)

The main pathways concerned with posture are:-

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

Postural reflexes depends on the following receptors:

1-vestibular apparatus receptors as:

- Maculae (utricle&sacculle) & semicircular canals cristea

2-visual (vision)& auditory(hearing) receptors:-

- Vision can compensate for loss of auditory, vestibular & proprioception (Tabes dorsalis + Rombergism)

Romberg's test is a neurological exam that examine the 3 senses; proprioception, vestibular & vision. Loss of balance (when eyes are closed) is interpreted as possitive Romberg's test.

3-Proprioceptors of muscles , tendons , ligaments & joints:-

- **Neck Proprioceptors:-** detect head position in relation to trunk
- **Body Proprioceptors:-** proprioceptors of anti-gravity muscles
- **pressure receptors:-** as in sole of feet initiate positive supporting reaction (magnet reflex)

Postural Reflexes

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

- Spinal Cord
- Medulla
- Midbrain
- Cerebral cortex
- Cerebellum

Postural reflexes are:-

A-Static reflexes (maintain posture **at rest**)

B-Phasic reflexes (maintain posture **in motion**)

A- Static reflex (statotonic): maintain posture **at rest**

1-Spinal reflexes	2-Medullary static reflexes Center in the medulla oblongate	3-Righting reflexes
<p>1-local static reflexes: as positive supporting reaction (magnet reflex) (receptors are proprioceptors of flexors) flexors and extensors are contracted, so there is no reciprocal inhibition</p>	<p>1-Neck static reflexes (studied in a decerebrated animal cut above medulla + labyrinth destroyed) Stimulus is:- changing head position Receptors: neck proprioceptors</p> <p>A. ventroflexion of head → arms flexion+ extend hind limb(as in decerebration) B. dorsiflexion of head → arms extended + flexed hindlimb. C. turning head to one side → extention of limbs on that side + flexion of other side.</p>	<p>Slide 8</p>
<p>2 -Stretch reflex: discussed earlier</p>		
<p>3-segmental static reflexes:-mediated by one segment of the spinal cord as Crossed extensor reflex</p>		
<p>4- Negative supporting Reflex(which release +ve supporting reaction) receptors are proprioceptors of extensors of the released limb</p>	<p>2-labyrinthine static reflex:-(in decerebrated animal) + elimination of neck proprioceptors)- Receptors are otolith organs (maculae) Stimulus is gravity</p> <p>A. ventroflexion of head (or prone position)→ 4 limbs flexion B. dorsiflexion of head (or supine position)→ 4 limbs extended(as in decortication)</p>	
<p>N.B spinal reflexes can be studied in spinal animal with cut at neck b/w the S.C & brain stem so all S.C is intact.</p>		

3-Righting static reflex

when upright posture is disturbed as in falling down

studied in a decerebrated animal(cut above midbrain)

The Center is midbrain except the visual in cerebral cortex

Midbrain Center

Reflex	Stimulus	Receptor	Response
Visual (center in cerebral cortex)	Visual stimulus	Eye receptors	Adjustment of posture according to the visual image
labyrinthine righting reflexes	Covered eyes and tilting the head	otolith organs to stimulate neck muscles to correct the head level	righting of head
body on head righting reflexes	pressure on side of body	trunk proprioceptors	reflex correction of head.
body on body	Pressure on side of the body and head is fixed	trunk proprioceptors	reflex correction of body
neck righting reflexes	stretch of neck muscles(if head is corrected & body still tilted) → righting of shoulders & body.	muscle spindles of neck muscles	righting of body.

B-Phasic reflexes (statokinetic reflexes)

Center is in the cerebral cortex. Maintain posture during motion

Reaction	stimulus	Receptor	Response
Hopping reaction	when animal is pushed laterally. (lateral displacement while standing)	muscle spindles	reflex hopping to keep limbs in position to support body against gravity.
Placing reaction	blind folded animal suspended in air & moved towards a supporting surface, (various stimulus; visual exteroceptive, proprioceptive)	touch receptors & proprioceptors in soles of feet	the feet will be placed firmly on the supporting surface

Decerebrate rigidity	Decorticate rigidity (more common in human)
<p>In section between superior & inferior colliculi of midbrain & block normal inhibitory signals (medulla) from brain & red nucleus of midbrain to tonically active pontile RF & Vestibular N (activation of pontine RF will increase the muscle tone) causing:</p> <ol style="list-style-type: none"> 1-maintained tonic static postural reflexes that support animal against gravity (medullary tonic neck & labyrinthine reflexes). 2-Absent midbrain righting reflex (because the cut is in the midbrain) 3- extension of head & 4 limbs extensors due to increased extensor tone from vestibulospinal & reticulospinal tracts to extensor motor neurons 4-spasticity, rigidity & extension in antigravity muscles 	<ol style="list-style-type: none"> 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 (because they're in the cerebral cortex) 5-it causes extensor rigidity in legs & moderate flexion of arms if head unturned, as supine position (tonic neck reflexes) 6- Tonic neck reflexes are produced by turning the head to one side e.g turning the head to the left → extension of limbs on left side & flexion of right side.
<p>It happens in human by vascular lesion of brain stem between red nucleus & vestibular nucleus</p>	<p>In hemiplegic patients on affected side after hemorrhage 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)</p>

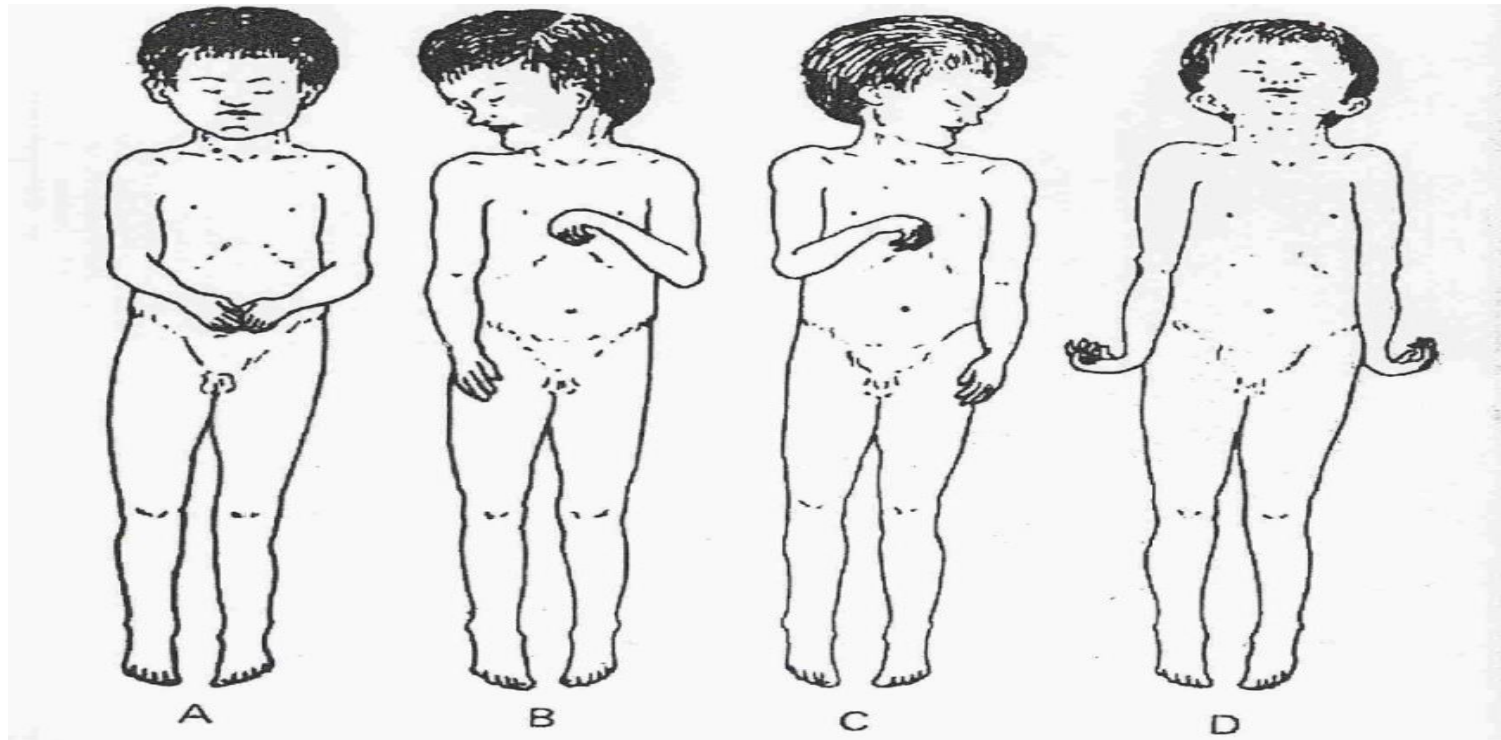


Figure 12-7. Human decorticate rigidity (**A-C**) and true decerebrate rigidity (**D**). In **A** the patient is lying supine with the head unturned. In **B** and **C**, the tonic neck reflex patterns produced by turning of the head to the right or left are shown. (Reproduced, with permission, from Fulton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

Spinal Shock

Spinal Shock	Suddenly transected of spinal cord in the upper neck, cord reflexes, immediately become depressed to the point of total silence
After a few hours to a few weeks	The spinal neurons gradually regain their excitability
Functions affected in spinal shock :	<ul style="list-style-type: none"><input type="checkbox"/> Arterial blood pressure falls to as low as 40 mm hg.<input type="checkbox"/> Skeletal muscle reflexes are blocked then return to normal; some reflexes become hyperexcitable.<input type="checkbox"/> The sacral reflexes for control of bladder and colon evacuation (Constipation) are hidden few weeks after cord transection, but in most cases they eventually return.

SUMMARY

- **POSTURE** is the maintenance of upright position against gravity and it needs antigravity muscles.
- **THERE ARE TWO MAIN PATHWAYS CONCERNED WITH POSTURE**; medial and lateral pathways.
- **POSTURAL REFLEXES DEPEND ON** vestibular, visual & auditory receptors and proprioceptors of muscles, tendons, ligaments & joints.
- **POSTURAL REFLEXES ARE** static and phasic.
- **STATIC** maintains posture at rest and has spinal, medullary and righting reflexes.
- **PHASIC** maintain posture at motion by hooping and placing reactions.

- **Clinically**, there are two types of rigidity, decerebrate and decorticate. The last is more common in human and the lesion in the cerebral cortex. The first is less common in human and the lesion in the brainstem between red nucleus and vestibular nucleus.

SUMMARY

Table 12–2. Principal postural reflexes.

Reflex	Stimulus	Response	Receptor	Integrated In
Stretch reflexes	Stretch	Contraction of muscle	Muscle spindles	Spinal cord, medulla
Positive supporting (magnet) reaction	Contact with sole or palm	Foot extended to support body	Proprioceptors in distal flexors	Spinal cord
Negative supporting reaction	Stretch	Release of positive supporting reaction	Proprioceptors in extensors	Spinal cord
Tonic labyrinthine reflexes	Gravity	Contraction of limb extensor muscles	Otolithic organs	Medulla
Tonic neck reflexes	Head turned: (1) To side (2) Up (3) Down	Change in pattern of extensor contraction (1) Extension of limbs on side to which head is turned (2) Hind legs flex (3) Forelegs flex	Neck proprioceptors	Medulla
Labyrinthine righting reflexes	Gravity	Head kept level	Otolithic organs	Midbrain
Neck righting reflexes	Stretch of neck muscles	Righting of thorax and shoulders, then pelvis	Muscle spindles	Midbrain
Body on head righting reflexes	Pressure on side of body	Righting of head	Exteroceptors	Midbrain
Body on body righting reflexes	Pressure on side of body	Righting of body even when head held sideways	Exteroceptors	Midbrain
Optical righting reflexes	Visual cues	Righting of head	Eyes	Cerebral cortex
Placing reactions	Various visual, exteroceptive, and proprioceptive cues	Foot placed on supporting surface in position to support body	Various	Cerebral cortex
Hopping reactions	Lateral displacement while standing	Hops, maintaining limbs in position to support body	Muscle spindles	Cerebral cortex

QUESTIONS

1- in negative supporting reflex what will happen to the muscles of the released limb?

- A- extension B- flexion C- extension & flexion

2- in the labyrinth static reflex if the head is dorsiflexed what is the response on the limbs?

- A- 2 limbs flexed + 2 limbs extended B- 4 limbs extended
C- 4 limbs flexed

3- what is the receptor for labyrinth righting reflex?

- A- muscle spindle B- otolith organs C- trunk proprioceptors

4- which on of the following reflexes would be lost in case of hemorrhage of the internal capsule?

- A- midbrain righting reflex B- visual righting reflex
C- labyrinth reflex

4-B
3-B
2-B
1-A

THE END

**If there are any Problems or Suggestions,
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THANK YOU