

Spasticity and Increased Muscle Tone

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Objectives

- At the end of this lecture the student should be able to :
- (1) define what is meant by the term spasticity .
- (2) appreciate that spasticity is an important condition that is encountered in a broad spectrum of medical conditions frequently encountered in the Kingdom such as stroke , multiple sclerosis , cerebral palsy , traumatic spinal cord and brain injury , cerebral and spinal tumors , spinal cord disc lesions ; and in less common but important & preventable conditions such as tetanus and spinal cord infections such as tuberculosis of the spine . .
- (3) explain the neurophysiological basis of clinical features associated with multiple sclerosis , cerebral palsy , traumatic spinal cord injury , tuberculosis of the spine and tetanus .

Resources

- (1) Ganong's Review of Medical Physiology , 23rd edition . Barrett KE, Barman SM, Boitano S, Brooks HL , edotors . Mc Graw Hill, Boston 2010 .
Pages : 6, 163 , 244 ,,653 .
- (2) Dobkin BH. Principles and practices of neurological rehabilitation. In: Bradley WG, Daroff RB, Fenichel GM, Jankovic J, eds. *Bradley: Neurology in Clinical Practice*. 5th ed. Philadelphia, Pa: Butterworth-Heinemann Elsevier; 2008:chap 52.
- (3) Griggs R, Jozefowicz R, Aminoff M. Approach to the patient with neurologic disease. In: Goldman L, Ausiello D, eds. *Cecil Medicine*. 23rd ed. Philadelphia, Pa: Saunders Elsevier; 2007:chap 418.

Q: WHAT IS SPASTICITY ?

- Spasticity is an important medical conditions that is encountered in a broad spectrum of medical specialities such as pediatrics , surgery , neurology , rehabilitation medicine , and others
- Clinically spasticity is defined as velocity-dependent resistance to stretch .
- *{For further reading you can look up references such as Lance (1980), Ivanhoe CB and Reistetter (2004) }.*
- Clinically spasticity is defined as velocity-dependent resistance to stretch .
- It is caused by diseases that disrupt the normal physiological inhibition mechanisms of the the CNS → which leads to increased excitability of the stretch reflex → hypertonia & continuous , unremitting contraction of the muscles involved .
- This continuous contraction results in hypertonia , tightness & stiffness of the muscles concerned ; and , depending on which muscle groups are involved , posture , voluntary movement and speech can be interfered with .

- **Some conditions associated with spasticity :**
 - **(1) Spinal cord injury**
 - **(2) Cerebral palsy**
 - **(3) Stroke**
 - **(4) Multiple Sclerosis**

Spinal Cord Injury

Can be :

- (I) Complete transection of spinal cord
- (II) Hemisection of the spinal cord .

(I) Complete Transection of Paraplegia the Spinal Cord

Due to trauma , tumor , etc

- The higher the level of the section, the more serious are the consequences.
- If the transection is in the upper cervical region → immediate death follows, due to paralysis of all respiratory muscle

Quadriplegia

(e.g . bullet injury , fractures spine , etc)

- In the lower cervical region below the 5th cervical segment → diaphragmatic respiration is still possible, but the patient suffers complete paralysis of all four limbs (quadriplegia).

Paraplegia

- ✓ Transection lower down in the thoracic region allows normal respiration but the patient ends up with paralysis of both lower Limbs .

Stages of paraplegia

- A/ Spinal shock (2-6 weeks)
- B/ Recovery of reflex activity
- C/ Paraplegia in extension

A/ Spinal shock

In the immediate period following transection there is :

- (1) complete loss of spinal reflex activity below the level of the lesion .
- (2) Loss of all sensations (anesthesia) and voluntary movement (paralysis) below the level of the lesion , due to interruption of all sensory and motor tracts
- (3) Loss of tendon reflexes and superficial reflexes (abdominal , plantar & withdrawal reflexes) .
- (5) The loss of muscle tone (flaccidity) and absence of any muscle activity (muscle pump) lead to decreased venous return → causing the lower limbs to become cold and blue in cold weather

- (6) The wall of the urinary bladder becomes paralysed and urine retention is retained occurs
→ until the pressure in the bladder overcomes the resistance of the sphincter and → dribbling of urine occurs
→ This is known as retention with overflow
- (7) Loss of vasomotor tone occurs, due to interruption of fibers that connect the vasomotor centres in the medulla oblongata with the lateral horn cells of the spinal cord, which project sympathetic vasoconstrictor impulses to blood vessels. → vasodilatation causes a fall in blood pressure; the higher the level of the section, the lower the blood pressure.
- This stage varies in duration but usually lasts a maximum of 2-6 weeks, after which some reflex activity recovers.

- B/ Stage of return of reflex activity
- As the spinal shock ends , spinal reflex activity appears again
- (1) Gradual rise of arterial blood pressure due to return of spinal vasomotor activity in the lateral horn cells. But, since vasomotor control from the medulla is absent, the blood pressure is not stable.
- (2) Return of spinal reflexes:
 - ✓ Flexor reflexes return earlier than extensor ones → Paraplegia in Flexion.
 - ✓ Extensor plantar reflex or complete Babiniski sign
- (3) Recovery of visceral reflexes: return of micturition, reflex → Automatic Bladder
- ✓ However , voluntary control over micturition and defecation are permanently lost .

Hemisection of the Spinal Cord (Brown-Sequard syndrome

A/ At the level of the lesion, all manifestations occur on the same side:

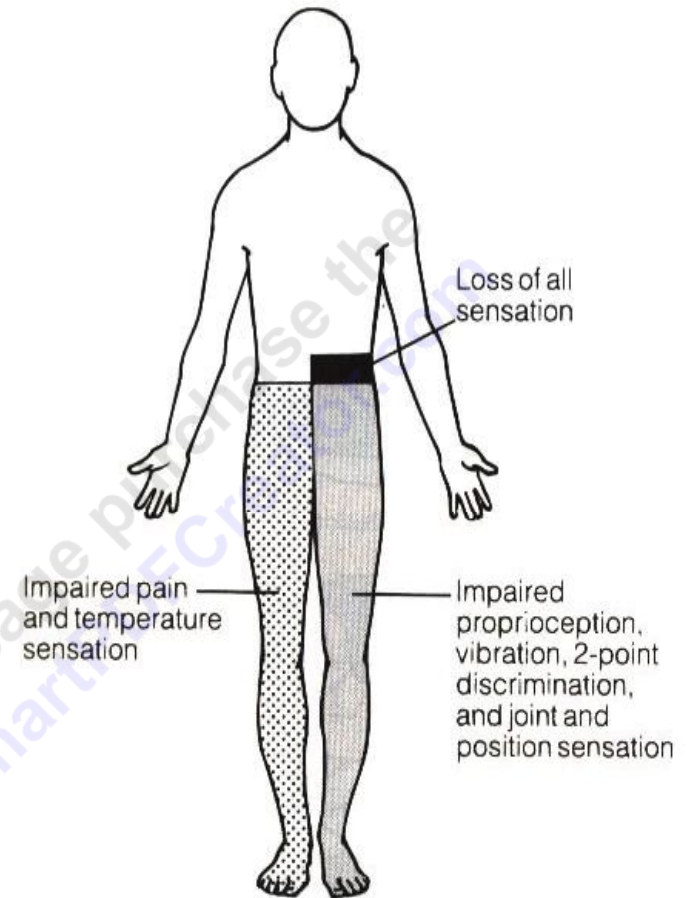
1. Paralysis of the lower motor neuron type
2. Loss of all sensations in the areas supplied by the afferent fibers that enter the spinal cord in the damaged segments

B/ Ipsilaterally below the level of the lesion :

1. spastic lower limb .
2. Fine touch, position and vibration sense are lost
3. Vasodilatation

C/ Contralaterally below the level of the lesion :

Pain and temperature sensations are lost, Why ?

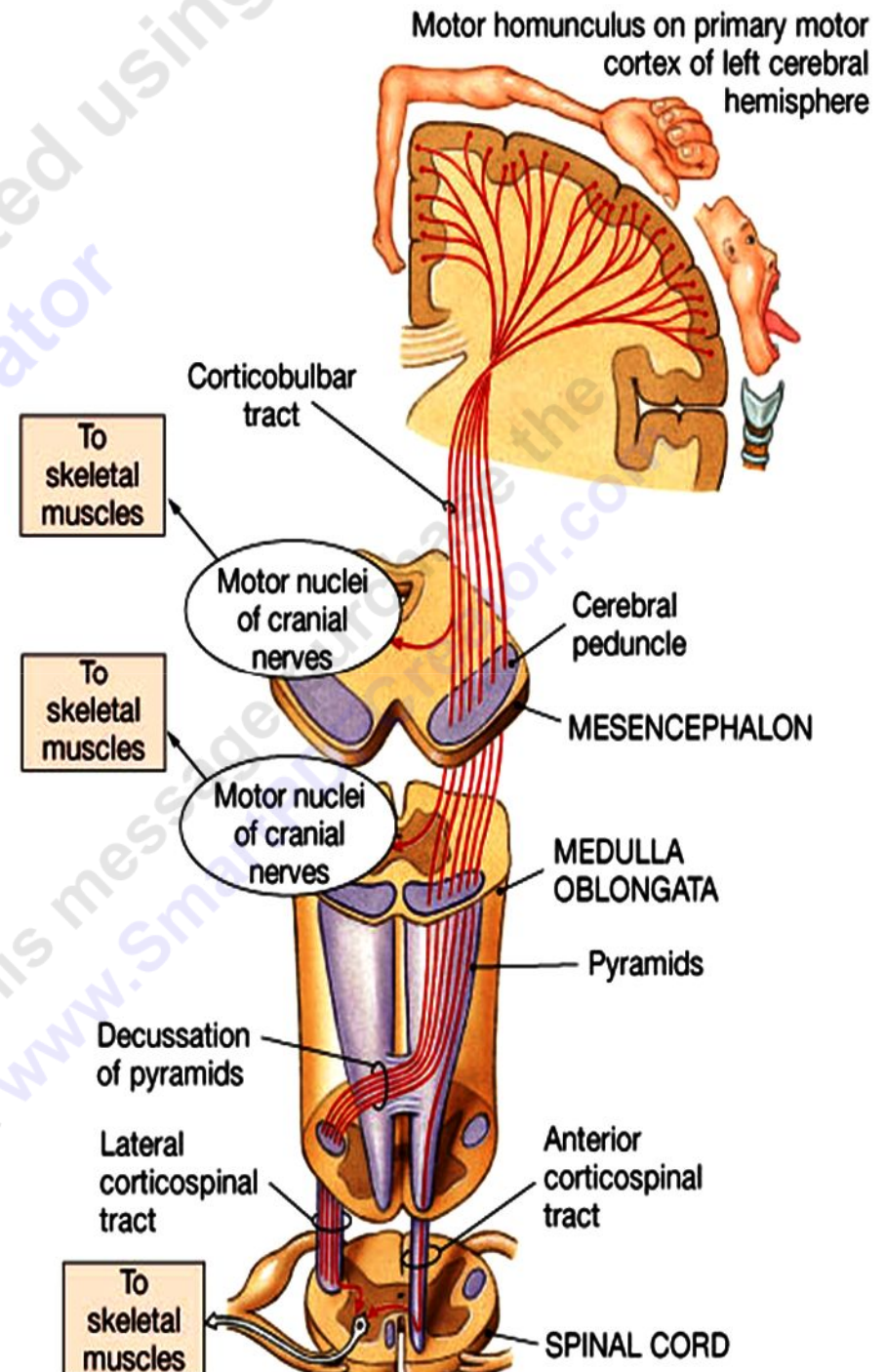


Cerebral Palsy

- Cerebral palsy (CP) is an umbrella term encompassing a group of non-progressive , non-contagious motor conditions that cause physical disability in human development , chiefly in the various areas of body movement .
- Cerebral palsy is caused by damage to the motor control centers of the developing brain and can occur during pregnancy , during childbirth or after birth up to about age three

Stroke

- Causes :
- cerebral heamorrhage , thrombosis or embolism in the Internal Capsule
→ results in paralysis in the oppsite half of the body .



Multiple Sclerosis (MS)

- **Multiple sclerosis** , MS is an auto-immune demyelinating disease , in which the body's own immune system attacks and damages the myelin.
- Disease onset usually occurs in young adults, and it is more common in females .
- The disease can attack any part of the CNS , and when it causes demyelination of motor tracts in the brainstem , the subject develops spasticity and other signs of UMNS . .
- The disease frequently remits and relapses , and during acute attacks intravenous corticosteroids can improve symptoms .

Thank You