

# **Spasticity and Increased Muscle Tone**

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- **Spasticity is an important conditions that is encountered in a broad spectrum of medical specialities such as pediatrics , surgery , neurology , rehabilitation medicine , and others**
- **It is a feature of altered muscle performance, occurring in disorders of the central nervous system which give rise to the Upper Motor Neuron Syndrome (UMNS ).**
- **It can be defined as increased resistance to passive stretch that is velocity-dependent .**
- *{For further reading you can look up references such as Lance (1980), Ivanhoe CB and Reistetter (2004) }.*

- Some medical practitioners use the terms "spasticity" and "UMN syndrome" interchangeably ,
- However UMN syndrome is a term describing the constellation of clinical features arising from upper motor neuron lesion due to any cause
- Hence , UMN syndrome encompasses , in addition to spasticity , other features of upper motor neuron lesion .

# Features of UMN Syndrome

- (1) Weakness and decreased muscle control .**
- (2) No remarkable muscle wasting, except from disuse ( disuse atrophy)**
- (3) Spasticity ( hypertonia ) , frequently called “ clasp-knife spasticity ”**
- (4) Clonus**
- (5) Brisk ( exaggerated ) tendon jerks**
- (6) Extensor plantar reflex , Babinski sign  
( dorsiflexion of the big toe and fanning out of the other toes )**
- (7) Absent abdominal reflexes**

- In UMN syndrome the motoneurons are freed from the descending inhibitory influence of the Higher Motor-Controlling centers
- This results in →
- (1) State of ongoing ( unremitting ) contraction of muscles .( T : due to hyperactive gamma activity contraction, with
- (2) decreased ability to control movement
- (3) increased resistance felt on passive stretch.

- **Causes of UMNS syndrome include :**
  - **(1) Cerebral palsy**
  - **(2) Stroke**
  - **(3) Spinal cord injury**
  - **(4) Multiple Sclerosis**
  - **(5) Acquired brain injury ( trauma , etc )**

# 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 .**

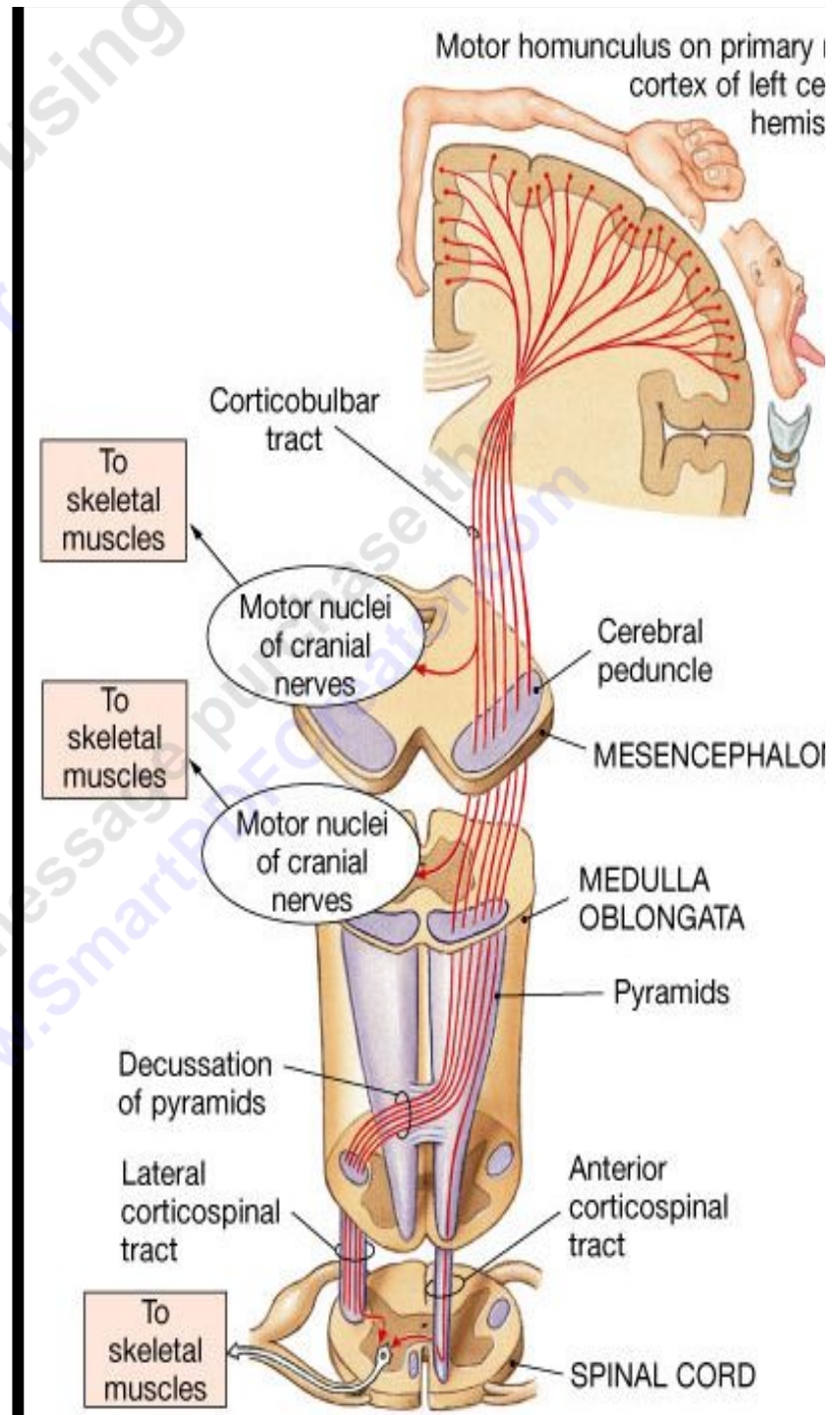


# Multiple Sclerosis (MS)

- **Multiple sclerosis is an auto-immune demyelinating disease , in which the body's own immune system attacks and damages the myelin.**
- **Loss of myelin sheath myelin (demyelination) prevents axons from conducting action potentials .**
- **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 .**
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- **The disease frequently remits and relapses , and during acute attacks intravenous corticosteroids can improve symptoms .**

# Stroke

- Causes :
- cerebral heamorrhage ,  
thrombosis or embolism →  
results inparalysis in the oppsite  
half of the body .
- A lesion in Corona Radiata on one  
side can cause Monoplegia in a  
contralateral limb (UL or LL ,  
according to site).
- A lesion in the Internal Capsule on  
one side may cause Hemiplegia or  
Hemiparesis on the contralateral  
side
- ( with the picture of upper motor  
neuron syndrome ).



# Spinal Cord Injury

Can be :

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

# **(I) Complete Transection of the Spinal Cord**

# Paraplegia

Due to complete spinal cord transection ( e.g. following tumor , trauma  
( e.g . bullet injury , fractures spine , 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 muscles;
- 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).
- Transection lower down in the thoracic region allows normal respiration but the patient ends up with paralysis of both lower limbs (paraplegia).

## **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 is retained until the pressure in the bladder overcomes the resistance offered by the tone of the sphincters and dribbling 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 this partial recovery may be due to increase in the natural degree of excitability of the spinal cord neurons below the level of the section ,
- Probably related to disinhibition of motoneurons as a result of absence of inhibitory impulses from higher motor controlling centers + sprouting of fibers from remaining other + denervation supersensitivity to excitatory neurotransmitters ).
- Features of the stage of recovery of reflex activity
- (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.
- ✓ Babiniski sign ( extensor plantar reflex) is one of the earliest signs of this stage +/- flexion reflex .
- ✓ Tendon reflexes also recover earlier in flexors.
- ✓ As a result, flexor tone causes the lower limbs to take a position of slight flexion, a state referred to as paraplegia in flexion.
- ✓ The return of the stretch reflex ( & cosequently muscle tone) , and vasoconstrictor tone in arterioles and venules → improve the circulation through the limbs.

## (2) Recovery of visceral reflexes: return of micturition, defecation & erection reflexes.

- ❑ However , voluntary control over micturition and defecation , and the sensation of bladder and rectal fullness are permanently lost.

- (5) Mass reflex appears in this stage →
- A minor painful stimulus to the skin of the lower limbs will not only cause withdrawal of that limb but will evoke many other reflexes through spread of excitation (by irradiation) to many autonomic centers. So the bladder and rectum will also empty, the skin will sweat, the blood pressure will rise
- Since effective regeneration never occurs in the human central nervous system, patients with complete transection never recover fully. Voluntary movements and sensations are permanently lost; however, patients who are rehabilitated and properly managed may enter into a more advanced stage of recovery.

- C/ Stage of return of reflex activity
- (1) During this stage the tone in extensor muscles returns gradually to exceed that in the flexors. The lower limbs become extended. Extensor reflexes become exaggerated, as shown by brisk tendon jerks and by the appearance of clonus. The positive supportive reaction becomes well developed and the patient can stand on his feet with appropriate support.
- (2) The flexor withdrawal reflex which appeared in the earlier stage is associated during this stage with the crossed extensor reflex.

# Hemisection of the Spinal Cord (Brown-Sequard syndrome)

- Occurs as a result of unilateral lesion or hemisection of the spinal cord ( e.g. due to stab injury, bullet , car-accident, or tumor ). Let us take an example of such injury involving the thoracic spinal cord : The manifestations of the Brown-Sequard syndrome depend on the level of the lesion.

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

- 1.Paralysis of the lower motor neuron type, involving only the muscle supplied by the damaged segments.
3. Loss of all sensations in the areas supplied by the afferent fibres that enter the spinal cord in the damaged segments +/- band of hyperesthesia

B/ Ipsilaterally below the level of the lesion :

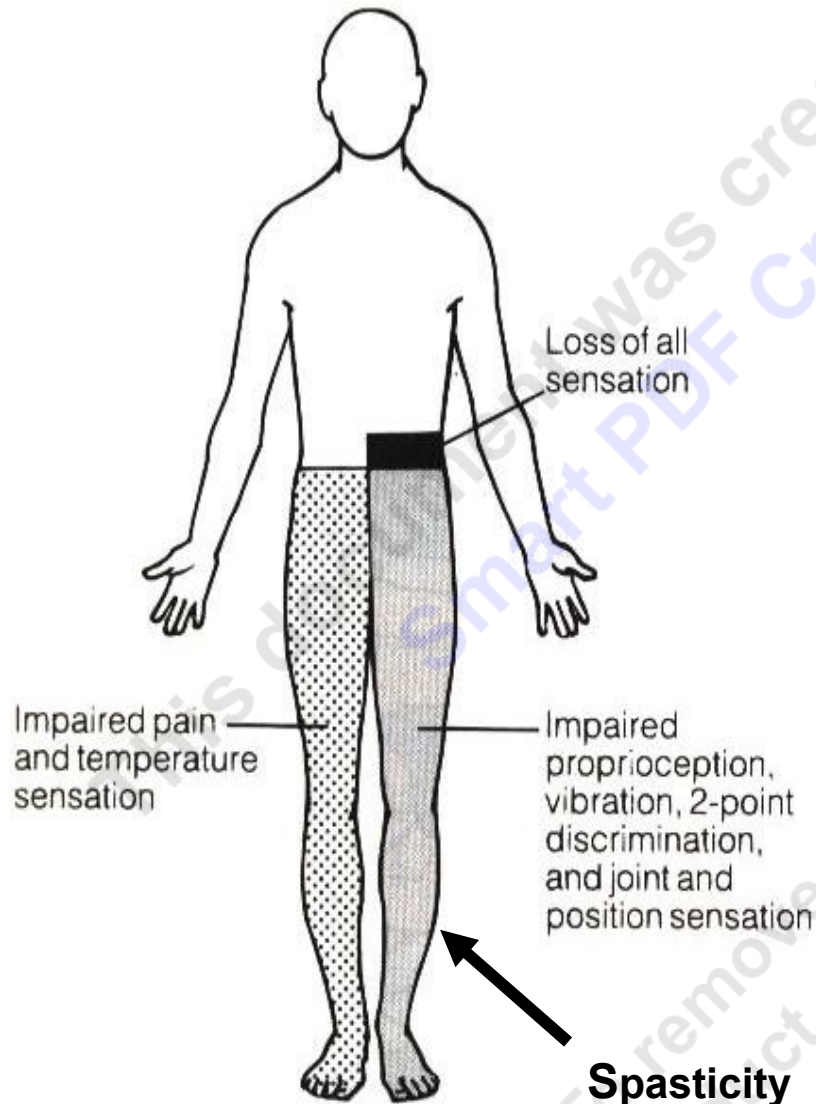
1. spastic lower limb .
2. Fine touch, position and vibration sense are lost
3. Vasodilatation

C/ Contralaterally below the level of the lesion :

Pain and temperature sensations are lost, Why ?



## Brown –Sequard Syndrome (2)



### A/ Below the level of the lesion on same side

- (1) UMNL ( spasticity , increased reflexes , clonus)
- (2) Loss of vibration , position and two-point discrimination . Why ?

### B/ Contralaterally (on the opposite side ) :

loss of pain and temperature sensibility  
Why ?