

431

CNS System
central Nervous

Block

Physiology Team

Female Side

Male side

Done By :

Sara Al-Anazy

Abdulmalik AlMufarrih

Revised By:

Slide No.(1)

Spasticity and Increased Muscle Tone

Dr,Faten zakareia

Physiology Department , College of
Medicine , King Saud University ,
Riyadh, KSU

Team Notes :

There are 2 types of "Hypertonia" :

1- Spasticity:

Seen in pyramidal tract lesions

Classically termed 'Clasp knife spasticity' – more tone during the initial part of movement – as in opening a pocket knife


It is velocity dependant – should be elicited by fast movement of the muscle groups involved

2- Rigidity:

Seen in extrapyramidal lesions (like parkinsonism)

Velocity independent – doesn't vary with speed of movement of muscle groups involved.

You have to know that is spasticity differs from rigidity.



CNS System central Nervous

Block

Slide No.(2)

Increased Gamma efferent discharge is the main cause of increased muscle tone.how?


Team Notes :

Always remember that:

- Gamma Motor Neuron are responsible for muscle tone , and Alpha motor neuron responsible for contraction of the muscle.
- Gamma motor neuron receive impulses from supraspinla region (Brain) .

What areas are responsible for increased muscle tune?

1. Pontine Reticular Formation.
2. Vestibular nucleus
3. Motor Area 4
4. neocerebellum



CNS System central Nervous


Block

Slide No.(3)

- Spasticity (hypertonia) 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.
- Patients complain of stiffness & inability to relax
- Muscles become permanently "tight" or *spastic*.
- The condition can interfere with walking, movement, or speech.
- When there is a loss of descending inhibition from the brain to BRAIN STEM EXCITATORY CENTERS(pontine RF + vestibular N)
- vestibulospinal &reticulospinal EXCITATORY signals cause muscles to become overactive, & spastic .

Team Notes :

Most common cause of Upper motor neuron lesion is the hemorrhagic stroke of internal capsule.



CNS System central Nervous

Block

Slide No.(4)

- Spasticity is a motor disorder, characterised by:-

1- increase in tonic static stretch reflexes (muscle tone) as one component of the upper motor neurone (UMN) syndrome

2- Exaggerated tendon jerks, resulting from hyper-excitability of the dynamic stretch reflex as one component of the upper motor neurone (UMN) syndrome

Team Notes :

Nothing else was mentioned about this slide.

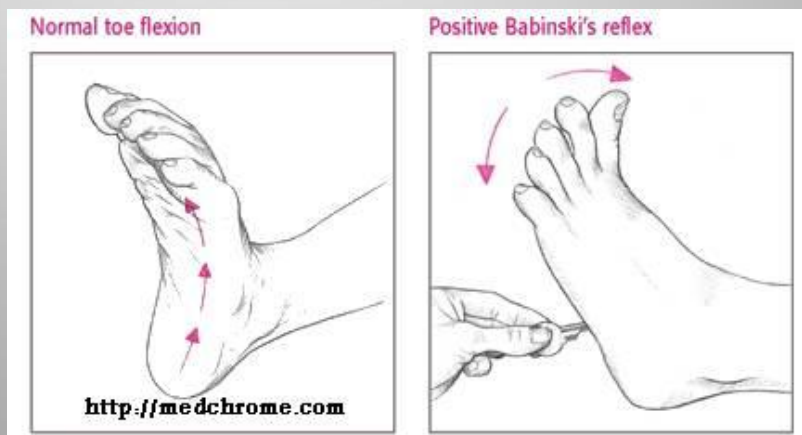
Slide No.(5)

Features of UMN Syndrome

- (1) Weakness and decreased muscle control .
- (2) No remarkable muscle wasting , but disuse atrophy
- (3) Spasticity (hypertonia) , frequently called “ clasp-knife spasticity ”= increased resistance at the beginning due to increased extensor muscle tone then a sudden collapse in resistance due to inhibition of extensor motor neurons by GTOs (golgi tendon organs)
- (4) Clonus Repetitive jerky motions (clonus), especially when limb moved & stretched suddenly
- (5) 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

Team Notes :

Babinski sign can happen **normally** in children under 2 years of age because their neurons are not myelinated. **(Important)**



- All superficial reflexes are lost including , abdominal ,withdrawal Rs.



CNS System central Nervous

Block

Slide No.(6)

- In UMN syndrome the motoneurons are free from the descending inhibitory influence of the Higher Motor-inhibitory centers(medullary RF, red nucleus, basal ganglia) resulting in unantagonized excitatory input (pontile RF, vestibular N) to gamma motoneurons causing hypertonia & pasticity

- This results in

- (1) State of ongoing (unremitting)contraction of muscles .(due to hyperactive gamma activity)
- (2) decreased ability to control movement
- (3) increased resistance felt on passive stretch.

Team Notes :

Nothing else was mentioned about this slide.



CNS

System
Nervous
central

Block

Slide No.(7)

Causes of spasticity:-

A-(UMNS) syndrome include :


- (1) Cerebral palsy
- (2) Stroke
- (3) Spinal cord injury
- (4) Multiple Sclerosis
- (5) Acquired brain injury (trauma , etc)

B-Parkinsonism

C- Decerebrate & decorticate rigidity

Team Notes :

Nothing else was mentioned about this slide.



CNS System central Nervous

Block

Slide No.(8)


- **(1) Cerebral palsy**

-**Caused by** brain damage due to lack of oxygen, as(near drowning or near suffocation) that cause **damage to the motor control centres of the developing brain**

- **it can occur during pregnancy , during stressed childbirth (or after birth up to about age three by meningitis)**

Team Notes :

Nothing else was mentioned about this slide.



CNS System central Nervous

Block

Slide No.(9)

(2) Multiple Sclerosis

- is an auto-immune demyelinating disease , in which the body's own immune system attacks and damages the myelin sheath of myelinated nerves mainly of brain, SC ,and optic nerve
- Loss of myelin sheath (demyelination) prevents axons from saltatory conduction of action potentials causing muscle weakness& wasting.
- 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 descending motor tracts in the brainstem & spinal cord , the subject develops spasticity and other signs of UMNS .
- The disease frequently remits and relapses because of remyelination & restore of function
- during acute attacks intravenous corticosteroids can improve symptoms

Team Notes :

Nothing else was mentioned about this slide.

CNS System central Nervous Block

Slide No.(10)

3-STROKE:-Causes :

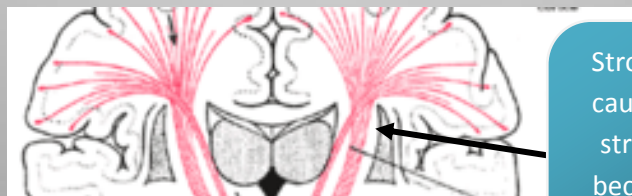
- a-Haemorrhagic stroke as in cerebral hemorrhage
 - b- Ischaemic stroke as in thrombosis or embolism in brain
- bl.v
- Both cause death of brain tissues □
results in paralysis in the opposite half of the body .
- A lesion in Corona Radiata on one side can cause Monoplegia in a contralateral limb (UL 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 UMNL).

Team Notes :

Monoplegia: a paralysis of a single limb.

Hemiplegia: is total paralysis of the arm, leg, and trunk on the same side of the body.

Hemiparesis: weakness on one side of the body.



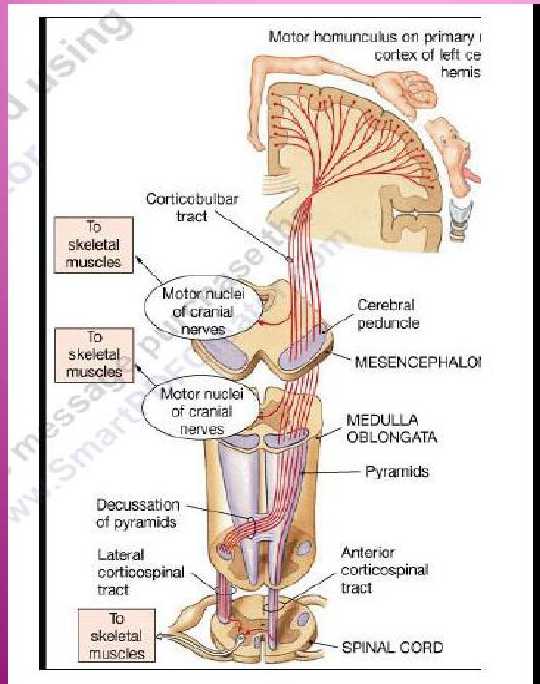
Stroke in internal capsule cause more damage than stroke in corona radiate because fibers in internal capsule are more dense.

CNS System


central Nervous

Block

Slide No.(11)



Team Notes :



CNS System central Nervous

Block


Slide No.(12)

4-Complete transection of spinal cord:- e.g. following tumor or trauma

- The higher the level of the section, the more serious are the consequences.
- 1- If the transection is in the upper cervical region immediate death follows, due to paralysis of all respiratory muscles;
- 2- 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).
- 3- Transection lower down in the thoracic region allows normal respiration but the patient ends up with paralysis of both lower limbs (paraplegia)--

Team Notes :

If the cut is below the 5th segment of cervical part of the spinal cord, the patient will survive with diaphragmatic respiration because the phrenic nerve is supplying the diaphragm.



CNS System central Nervous

Block

Slide No.(13)

Stages :-

- 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) Loss of all sensations (anaesthesia) 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) =complete loss of spinal reflex activity below the level of the lesion .
- (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

Team Notes :

Nothing else was mentioned about this slide.



CNS System central Nervous

Block

Slide No.(14)

(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 fibres 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;

-This stage varies in duration but usually lasts a maximum of 2-6 weeks, after which some reflex activity recovers.

Team Notes :

Complication of (retention with overflow) is **urinary bladder infection** which is most common cause of **death** in these patients.



CNS System central Nervous

Block

Slide No.(15)

• As the spinal shock ends , spinal reflex activity appears again this partial recovery may be due to:-

- increase in degree of excitability of the spinal cord neurons below the level of the section , due to :_

1-disinhibition of motoneurons as a result of absence of inhibitory impulses from higher motor centres

-sprouting of fibres from remaining neurons

-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

- vasoconstrictor tone in arterioles and venules improve the circulation through the limbs.

Team Notes :

Sprouting of fiber means: neurons surrounding the affected area send collaterals to supply that area.

Denervation supersensitivity: in the site of the cut , excitatory neurotransmitters are coming out to excite motor neuron.



CNS System central Nervous

Block

Slide No.(16)

2) Return of spinal reflexes:

- Flexor tendon reflexes return earlier than extensor ones.
- Babiniski sign (extensor plantar reflex) is one of the earliest signs of this stage +/- flexion reflex .
- **Flexor spastic 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 (**muscle tone**) ,
-

(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.**(AUTOMATIC MICTURITION)

Team Notes :

Nothing else was mentioned about this slide.



CNS System central Nervous

Block

Slide No.(17)

(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 centres. So the bladder and rectum will also empty, the skin will sweat, the blood pressure will rise

-Voluntary movements and sensations are permanently lost;


-however , patients who are rehabilitated and properly managed may enter into a more advanced stage of

recovery .

(Since effective regeneration never occurs in the human central nervous system, patients with complete transection never recover fully.)

Team Notes :

Irritation : spread of impulses to different segments in the spinal cord.



CNS System central Nervous

Block

Slide No.(18)

- C/ **Stage of extensor paraplegia**
- (1) During this stage the tone in extensor muscles returns gradually to exceed that in the flexors. The **lower limbs become spastically extended.**
 - Extensor reflexes become exaggerated, as shown by 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.

Team Notes :

Nothing else was mentioned about this slide.



CNS System
central Nervous

Block

Slide No.(19)

Hemisection of the Spinal Cord (Brown-Sequard syndrome)

Team Notes :



CNS System central Nervous

Block

Slide No.(20)

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

On the same side at the level of lesion

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

Team Notes :

Hyperesthesia: increase sensation because the neurotransmitters are coming out from the site of the cut.
Rarely happens.



CNS System central Nervous

Block

Slide No.(21)

B/ Ipsilaterally below the level of the lesion :

1. UMNL/spastic lower limb (spasticity)&CLONUS
2. Fine touch, two-point discrimination, position and vibration sense are lost.why?

C/ Contralaterally below the level of the lesion :

Pain and temperature sensations are lost, Why ?

Team Notes :

From(Motor Lesion lecture) :

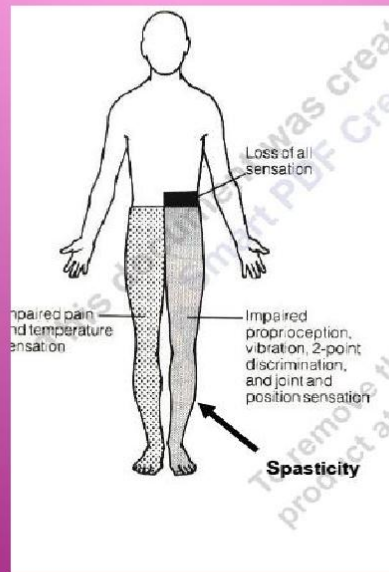
- Dorsal column sensations are lost.
- Touch is impaired (but not lost) because the dorsal column is transected. Yet, crude touch sensation still persists because of its transmission by the opposite intact ventral spinothalamic tract.
- Loss of pain & temperature sensations due to cut of lateral spinothalamic tract coming from intact side

CNS System


central Nervous

Block

Slide No.(22)



Team Notes :



CNS System central Nervous

Block

Slide No.(23)

-Parkinsonism rigidity is of two types:-
-Cog-wheel rigidity
-Lead-pipe rigidity

Team Notes :

Cogwheel Rigidity tension in a muscle which gives way in little jerks when the muscle is passively stretched

lead-pipe rigidity stiffness and inflexibility that remains uniform throughout the range of passive movement

