Spasticity & Increased Muscle Tone

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- Important
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Based on Females' Slides

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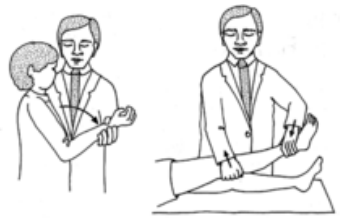
Hypertonia

Is a condition marked by an abnormal increase in muscle tension and a reduced ability of a muscle to stretch (passive stretch). It is caused by injury to motor pathways in the CNS, which carry information from the central nervous system to the muscles and control posture, muscle tone, and reflexes.

Spasticity	Rigidity
Involuntary	
Velocity dependent	Not velocity dependent
Unidirectional	Bidirectional
Resistance to movement	

Spasticity

- Velocity dependent increased resistance to passive movement of the muscle, due to:
- ✓ Abnormally high muscle tone (hypertonia) varies with the speed of displacement of a joint.
- The faster you stretch the muscle the greater the resistance.
- Neuronal in nature (UMNL)
- Uni-directional Agonist (only in flexors or extensors)
- Involves the corticospinal tract
- Muscles become permanently tight and interfere with walking movement & speech.
- Patients complain of stiffness and inability to relax.



Clinical features

Hyperflexia

Flexor spasticity in the upper limb and extensor in the lower limb.

Assessment of spasticity: Fast flexion or extension of selected joint. (Elbow or knee)

Clasp-knife spasticity* in UMNL: A sudden release of tone after an initial hypertonia of selected joint movement. EXPLAINED MORE IN THE NEXT SLIDES

Spasticity **+** increased muscle tone **=** contraction and deformity of a limb
We avoid by physiotherapy

*ناشفه أول بعدين تفك (مثل كسّارة البندق).

Spasticity, is a motor disorder; hyper-excitability of both types of stretch reflex:

Increase in tonic* static stretch reflex (muscle tone) as one component of the UMN syndrome

Exaggerated tendon jerks, resulting from hyper-excitability of the dynamic stretch reflex as one component of UMN syndrome

When there is loss of descending inhibition from the brain (higher motor inhibitory centers <medullary reticular formation and basal ganglia>) resulting in antagonized excitatory input from the brain stem excitatory centers (pontine RF and vestibular nucleus) through vestibulospinal and reticuospinal excitatory tracts to gamma motor neurons causing **hypertonia and spasticity of muscles**

*For example, the leg remains up for a time after a knee jerk.

Rigidity

- Increased resistance to the passive movement of a muscle which is constant throughout the movement and not related to the speed of movement
- Not velocity dependent
- Resistance is present in both agonist and antagonist (Bi-directional)
- Extrapyramidal in origin and includes that and other features of increased muscle tone but tends to be used more often when describing extra-pyramidal conditions.
- Associated with basal ganglia disease such as Parkinson's disease.
- Stiffness is different from rigidity; stiffness is a principle symptom due to continuous motor unit activity of the muscle itself.

Test for rigidity: Passively move the joint in both direction

Uniform rigidity in both agonist and antagonist muscle group

Cogwheel rigidity

Tremor superimposed with background increase of tone

Lead pipe rigidity

Features of UMN Syndrome

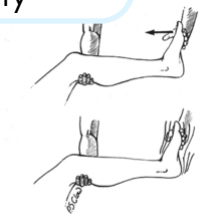
Weakness and decreased muscle tone

No remarkable muscle wasting, but diffuse atrophy

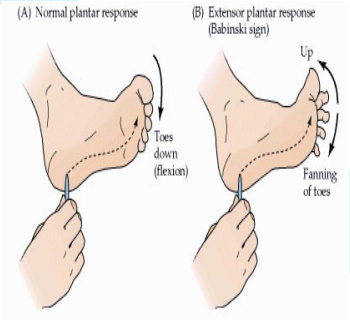
Exaggerated tendon jerks

Spasticity and hypertonia, frequently called "clasp knife" Increased resistance at the beginning of muscle stretch due to increased extensor muscle tone then a sudden collapse in resistance due to inhibition of extensor motor neurons by Golgi tendon organs.

Clonus repetitive jerky motions (Clonus) especially when limb moved and stretched suddenly



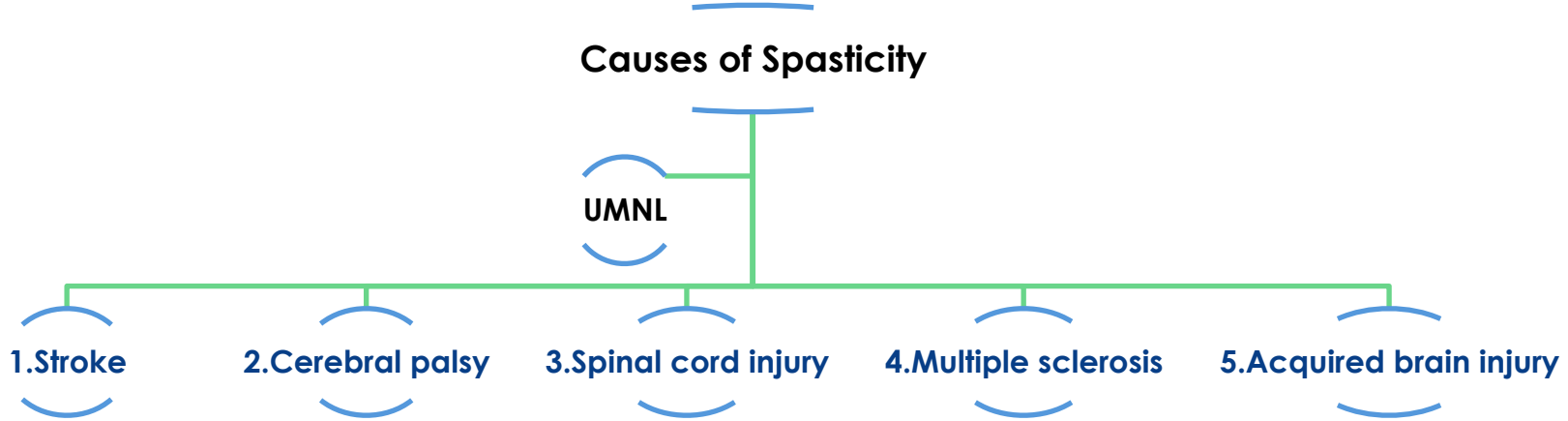
Extensor planter reflex = Babinski sign (dorsiflexion of the big toe fanning out of the other toes)



Absent abdominal reflexes

SAME AS THE UMNL FEATURES
RECALL LECTURE 25

Causes of Spasticity

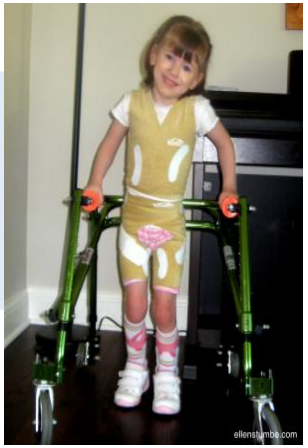


1.Stroke:

- ✧Death of brain tissue due inadequate blood supply.
- ✧Can be **A.** Hemorrhagic (cerebral hemorrhage) or **B.** Ischemic(thrombosis or embolism).
- ✓Both result in paralysis of opposite side of the body.

- ✧Stroke caused lesion have a picture of **UMNL**
- ✧Lesion in corona radiate on one side → Contralateral Monoplegia.
- ✧Lesion in the Internal Capsule on one side → Contralateral Hemiplegia or Hemiparesis

2.Cerebral Palsy:



- ✧is a group of permanent movement disorders (damage to motor control centers of developing brain) that appear in early childhood.
- ✧Caused by brain damage due to lack of Oxygen.-near suffocation[1].
- ✧Can occur during pregnancy, stressed childbirth or meningitis.

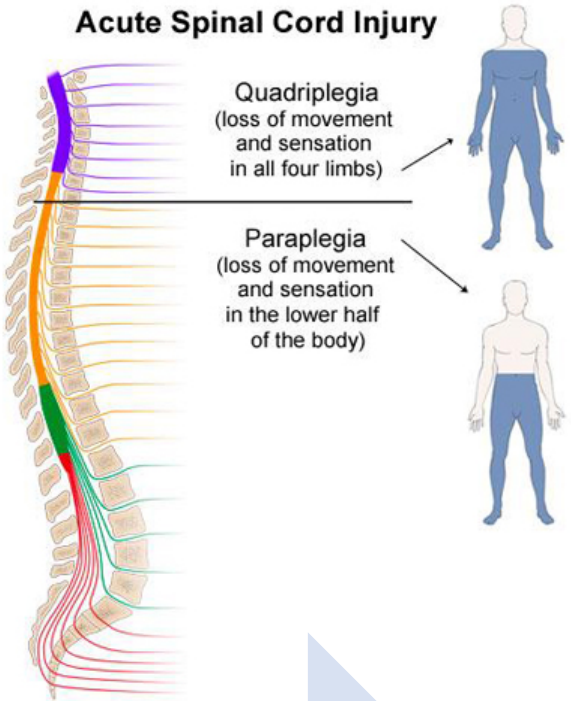
3.Multiple Sclerosis (MS)

- ✧Autoimmune demyelinating disease occur in attacks remits (in demyelination functions restore)and relapses (return of symptoms due to demyelination).
- ✧Usually effect young adults more in females
- ✧ in it prevention of axonal salutatory conduction occur causing weakness & wasting of muscles.
- ✧When it demyelinate descending motor tracts in brainstem and spinal cord → subject develop spasticity and other UMNS signs
- ✧In acute attacks IV corticosteroids improve symptoms

1: إختناق

4.Complete Transection of Spinal Cord

- ✧Can be caused by a trauma or tumor
- ✧The higher the level of the section, the more serious are the consequences.
- ➢ In upper cervical region above 5th segment ⟶ immediate death due to paralysis of all respiratory muscles.
- ➢In lower cervical region below 5th cervical segment ⟶ respiration is still possible, complete paralysis of all four limbs (quadriplegia).
- ➢In thoracic region ⟶ normal respiration but paralysis of both lower limbs (paraplegia).



Stages of Complete transection of spinal cord

Spinal shock → **Recovery of reflex activity** → **Paraplegia in extension**

4. Complete Transection of Spinal Cord cont.

Stage 1 : Spinal shock 2-6 weeks

- ✧Loss of all sensations (anaesthesia)
- ✧Loss voluntary movement (paralysis) below the level of the lesion
- ✧Complete loss of spinal reflex activity below the level of the lesion. Deep and superficial e.g (abdominal , plantar & withdrawal reflexes)
- ✧ The loss of muscle tone (flaccidity)
  - ✓Absence of any muscle activity including muscle pump → decreased venous return → cold and blue lower limbs in cold weather.
- ✧ Paralysis of urinary bladder wall → urine retention → pressure in the bladder overcomes the resistance tone of the sphincters → dribbling occurs. This is known as (retention with overflow).
- ✧Loss of vasomotor tone → vasodilatation → fall in blood pressure **Why ?**

Due to interruption of fibers that connect the vasomotor centres (in medulla oblongata) with the lateral horn cells of the spinal cord (no sympathetic vasoconstrictor impulses)

4. Complete Transection of Spinal Cord cont.

Stage 2 : Recovery of reflex activity

✧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.
- ✓ Disinhibition of moto-neurons.
- ✓ Absence of inhibitory impulses from higher motor centers.
- ✓ Spreading of fibers from remaining neurons.
- ✓ Denervation super-sensitivity to excitatory neurotransmitters.

✧**Features that recover:**

1. **Arterial blood pressure (gradual rise):**

- Return of spinal vasomotor activity in the lateral horn cells but vasomotor control from medulla is absent → blood pressure is not stable.
- Vasoconstrictor tone in arterioles and venules improve the circulation through the limbs.

2. **Return of spinal reflex**

- **Flexor tendon reflexes return earlier than extensor ones.**
- **Babiniski sign** (extensor plantar reflex) is one of the earliest signs of this stage.
- **Return of muscle tone in Flexor spastic tone form** cause paraplegia in flexion : fixation of the paralyzed legs in a flexed posture
- Return of stretch reflex (muscle tone)

Was Discussed in **Lecture 25**

Complete Transection of Spinal Cord

Stage 2 : Recovery of reflex activity

- **Recovery of visceral reflexes**
  - Micturition &Defecation: voluntary control, and the sensation of bladder and rectal fullness are permanently lost. "Automatic micturition"
  - Erection
  - Other characteristics of this stage:
- ✧Mass reflex : (appearance of flexor withdrawal reflex)

Normal	Mass effect
Minor painful stimulus to the skin of the lower limbs → only withdrawal of that limb (flexor withdrawal)	Minor painful stimulus to the skin of the lower limbs →withdrawal of that limb + excitation (by irradiation) to many autonomic centers + micturition + defecation+ skin sweat +blood pressure will rise

- ✧Voluntary movements & sensation are permanently lost but with rehabilitation subject may advance to a new stage of recovery
- ✧**Effective regeneration in human CNS never occur**.

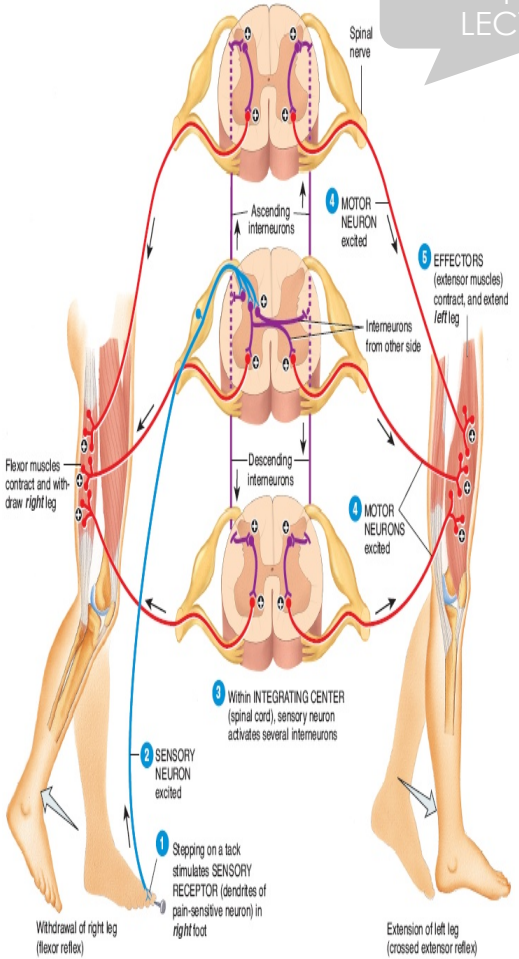
Was Discussed in **Lecture 25**

Complete Transection of Spinal Cord

Stage 3 : Paraplegia in extension

Remember me ☺
if not please review
LECTURE 3 &4

- 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 :
  - ✓Tendon jerks
  - ✓Appearance of clonus (a series of involuntary, rhythmic, muscular contractions and relaxations)
- Positive supportive reaction becomes well developed and the patient can stand on his feet with appropriate support.
- The flexor withdrawal reflex (appeared in stage 2) is associated during this stage with the crossed extensor reflex.



Was Discussed in **Lecture 25**

Hemisection of the Spinal Cord (Brown-Sequard Syndrome)

Caused by **unilateral lesion or hemisection** (one half) of the spinal cord can be due to (stab injury ,tumor, bullet,& car accidents)

On the same side at the level of lesion

- ✧Paralysis of the lower motor neuron type → only the muscle supplied by the damaged segments.
- ✧ Loss of all sensations in the areas supplied by the afferent fibres that enter the spinal cord in the damaged segments → band of hyperesthesia (abnormally increased sensitivity to stimuli)

Ipsilaterally	Contralaterally
• UMNL/spastic lower limb (spasticity) &CLONUS • Fine touch, two-point discrimination, position and vibration sense are lost	• Pain and temperature sensations are lost
Why?	
Because the lost functions are carried by dorsal column tracts that decussate at mid medulla level	Because these functions are carried by spinothalamic tract which decussate after it synapse with 2nd order neuron contralateral in spinal cord

Was Discussed in **Lecture 25**

Causes of Rigidity

1-Parkinsonism rigidity is of two types:

1. **Cog-wheel rigidity :**

In cogwheel rigidity one feels the resistance in rhythms when applying a passive movement.

It is thought to be the product of an underlying resting tremor which is masked by the rigidity but can be felt on passive movement.

Cog-wheel rigidity = lead-pipe rigidity + tremors

2. **Lead-pipe rigidity**:

Lead pipe rigidity describes a constant resistance when moving a joint.

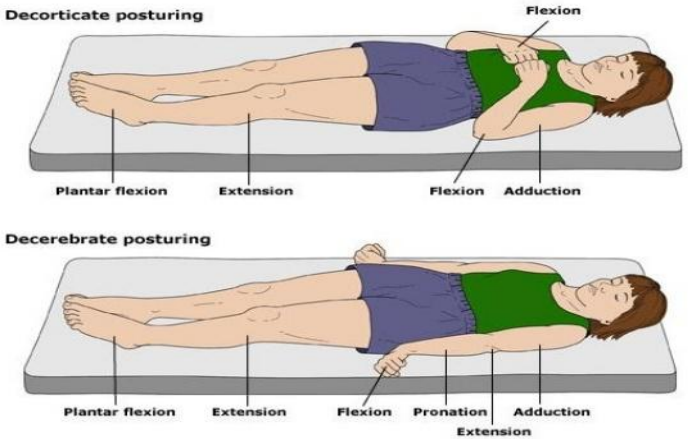
- Decerebrate rigidity

(extension of head & 4 limbs extensors)

- Decorticate rigidity

(extensor rigidity in legs & moderate flexion of arms if head unturned)

Discussed in lecture 17 ;)



1- A condition marked by an abnormal increase in muscle tension and a reduced ability of a muscle to stretch

A. Hypotonia
B. Hypertonia
C. Akinesia
D. Hypokinesia

2- Spasticity is increased resistance to passive movement of the muscle, which is not Velocity dependent

A. True
B. False

3- A 26 year old female came to the hospital, the doctor examined her and noticed that she had, hyperflexia and flexor spasm in the upper limb and extensor in the lower limb. Based on the clinical findings, which term is associated with her condition.

A. Spasticity
B. Rigidity
C. Cogwheel
D. None of the above

4- injury in which of the following structures can cause a monoplegia on contralateral side?

A. Corona radiate
B. Spinal segment
C. Internal capsule
D. Medulla

5- a 18 years old male had a sever trauma to his spinal cord which lead to the paralysis of all his four limbs on which level it might be

A. lower Thoracic segment
B. lower cervical under 5^{th} segment
C. Upper cervical
D. Upper thoracic segment

6- which on of the following function well be lost on contralateral side in Brown-Sequard syndrome

A. Fine touch
B. Postion
C. Muscle tone
D. Pain

1. B
2. B
3. A
4. C
5. B
6. D

MCQs

1- Name two clinical findings in rigidity?

Cogwheel and lead pipe rigidity.

2- What is the difference between Rigidity and Stiffness?

Stiffness is a principle symptom due to continuous motor unit activity of the muscle itself.

Rigidity is increased resistance to the passive movement of a muscle which is constant throughout the movement and not related to the speed of movement.

3- what are the possible injuries or diseases that cause Spasticity ?

. 1-Cerebral palsy 2- Stroke

3-Spinal cord injury 4-Multiple Sclerosis

5- Acqiured brain injury

4- at what level does a complete spinal transection causes immediate death?

. upper cervical region above 5th segment

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK

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