Objectives

Participants will be able to:

- Identify types of muscle overactivity and their clinical presentations
- Discuss the pathophysiology and origins of spastic muscle overactivity
- Discuss various treatment options for spastic muscle overactivity, including medical management and therapeutic management

What is “Spasticity?”

Most Common Definition: Spasticity is “…a motor disorder characterized by velocity dependent increase in tonic stretch reflexes with exaggerated tendon jerks, resulting from hyper excitability of the stretch reflex…”

(Lance, 1980)
What is “Spasticity?”

Clinically:
- Just one type of muscle overactivity that occurs with CNS lesions.
- Most “talked about,” but other types of overactivity are usually grouped together as “spasticity.”
- Triggered by stretch and velocity
- By itself, may not cause a high level of disability

Other Types of Muscle Overactivity in CNS lesions

Spastic Dystonia
Muscle overactivity present at rest, which is spontaneous and has no primary triggering factor; causes deformation of joints and body postures. Frequently produces twisting or repetitive movements.

Hypertonic Rigidity
Similar resistance is felt with PROM regardless of the speed or direction of movement

Spastic Co-contraction
Unwanted activity of antagonistic muscle group during voluntary agonistic movements (ex: activation of triceps during voluntary elbow flexion).
Other Types of Muscle Overactivity in CNS lesions

**Contracture**

- Fixed resistance to passive stretching of muscles due to shortening or wasting (atrophy) of muscle fibers or the development of scar tissue (fibrosis) over joints. Not technically muscle overactivity, but can be confused with over-activity. This is non-neural, but can be caused by neural components.

**Pathophysiology**

- Immediate paralysis, leading to immobility
- Active and passive tissue changes:
  - Type I fibers (slow/tonic) change to Type II (fast twitch/fatigable)
  - Muscle extensibility decreases due to a decrease in the # of sarcomeres and connective tissue accumulation in extrafusal fibers
  - These tissue changes lead to increases in stretch transmission to muscle spindle
- Plastic changes within the CNS
  - Rerouting at spinal level
  - Recruitment of new motor pathways
Origins of Muscle Overactivity

- **Cerebral** - BI, CVA, CP, MS
  - Lack of inhibition messages being sent

- **Spinal** - SCI, MS
  - Inhibitory message is sent but cannot be received due to disruption of spinal cord

Some Causes of Increased Muscle Overactivity

- **Noxious Stimuli**
  - Noise, pain, cold, discomfort

- **Health of Patient**
  - Illness, infection, hydrocephalus, bowel or bladder retention

Definition of Spasticity

- Lance, 1980
  - A motor disorder characterized by a velocity-dependent increase in tonic stretch reflexes with exaggerated tendon jerks, resulting from hyperexcitability of the stretch reflex, as one component of the upper motor neuron syndrome
Spasticity is Only a Component of the Upper Motor Neuron Syndrome

HYPERTONIA

STRETCH-SENSITIVE
- Spasticity
- Co-contraction
- Clonus

NOT STRETCH-SENSITIVE
- Dystonia
- Rigidity
- Associated Reactions
- Synkinesis
- Cutaneous reflex

Treatment Options
Best Practices
Spasticity Management

EFFECTIVE APPROACH
- An integrated and multidisciplinary program of physical and medical interventions
- A clear individualized patient management strategy

WHEN AND HOW TO TREAT
- Significance, i.e. disabling
- Distribution of spasticity
- Chronicity, severity, and cause
- Concomitant conditions
- Cost
- It's never too late to treat spasticity

How can tx of spasticity facilitate motor recovery?

Brunstrom Stages of Recovery

STROKE

I Flaccidity

II Synergies

III Marked spasticity

IV Out of synergy spasticity

V Selective control of movement

VI Isolated/coordinate movement

Reversed "maladaptive plasticity"

Goal-Setting

PRIMARY EFFECTS
- Hypertonia
- Spasms
- Clonus

SECONDARY EFFECTS
- Limited function
- Pain
- Fatigue
- Disfigurement
- Quality of Life
Goal-Setting

**PRIMARY EFFECTS**
- Focus
- Tone reduction
- Spasm reduction
- Locus
- Central
- Peripheral

**SECONDARY EFFECTS**
- Symptom Relief
- Correct Deficit
- Exercise
- Compensation
- Restitution

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Goal-Setting

Spasticity is not the reason for treatment. Instead, it is the impact of spasticity on a person’s well-being.

Significance, not severity, of spasticity should dictate need for treatment.

**Significant**, ie disabling, spasticity – regardless of severity, needs to be treated!

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Management Starts with Goal-Setting

**TECHNICAL**
- Decrease hypertonia (Ashworth)
- Decrease spasm frequency and severity
- Increase range of motion

**FUNCTIONAL**
- “PASSIVE”
  - Facilitating wearing of splints
  - Decreasing pain associated with abnormal posture and spasms
  - Improve nursing care
- “ACTIVE”
  - Increase performance
- OTHERS
  - Improve body image
The ultimate goal of all spasticity management is to facilitate the healing processes for recovery of function and minimize the secondary effects of unchecked abnormal tone.

When do we intervene?

- **PAIN**
  - Abnormal movement patterns
  - Increased energy expenditure
  - Altered postural control and alignment
  - Debilitating contractures
  - Body Image / Cosmesis
- **FUNCTION!!**
  - Hygiene affected
  - Increased potential for skin breakdown
  - Functional activities restricted
  - High Caregiver burden
  - Autonomic Dysreflexia
  - **FUNCTION!!**

✦ High MAS scores aren't enough!!
Management Options

✦ Medical Interventions:
  ✦ Baclofen (oral and intrathecal)
  ✦ Dantrium
  ✦ Zanaflex
  ✦ Valium
  ✦ Neurolytic Injections (Botulinum Toxin, Phenol)

Considerations for Management Choices

✦ When considering management choices for Cerebral Origin muscle overactivity, we need to be aware of the effect of the medications on the brain’s recovery process
✦ Many oral anti-spasticity medications have the side effect of making people sleepy, slowing cognitive processes, and may ultimately slow the recovery of function
✦ The challenge is to manage abnormal tone without interfering with brain healing/recovery

Management Options

✦ Medications:
  ✦ Baclofen
  ✦ Dantrium
  ✦ Zanaflex
  ✦ Valium
Management Options - Therapy

Medical Management should always be supplemented by therapeutic management for optimal improvement!

✦ Therapeutic Interventions:
  • Weight bearing
  • Serial Casting/Splinting
  • Locomotor Training
  • Positioning
  • E-stim
  • Strengthening

Management Options – Serial Casting

Children with CP (Park, et al, 2010)
✦ Serial Casting following Botox injections have shown greater reduction in tone, dynamic spasticity, and improvements in ROM than with Botox alone in ambulatory children with CP who have equinus foot
✦ Serial casting + Btx showed significant improvements in the standing dimension of the GMFM-66, but not the Btx-only group
✦ No changes in walking, running, jumping dimensions of GMFM-66 in either group

Adults with Chronic CVA (Yasar, et al, 2009)
✦ Retrospective study of 10 patients receiving Btx + serial casting
✦ Significant improvement of DF ROM and gait FIM scores
✦ Limitations – no control, retrospective study

Management Options – Serial Casting

Adults with severe acquired brain injury (Verplancke, 2005)
✦ 35 subjects randomly assigned to control group (“standard” PT), casting + saline injections, or casting + Btx injections to gastro-soleus complex
✦ ROM improvements:
  • Control: 4.59 degrees
  • Casting + saline: 11.69 degrees
  • Casting + Btx: 13.59 degrees
✦ MAS significantly decreased in both casting groups, but not control group
✦ Cast + Btx demonstrated significant improvement in Glasgow Outcome Scale
Management Options – E-Stim

Proposed mechanisms of action:
- Electrical stimulation of paretic muscles may lead to reciprocal inhibition of the overactive muscles through stimulation of spinal interneurons.
- Pure sensory stimulation thought to inhibit overactivity through influencing the excitability of the alpha motor neurons and triggering sensorimotor reorganization.
- Stimulation of the overactive muscles may lead to fatigue, thus decreasing activation.
- Minimal results published regarding long-term effects, but has been shown to have good short term effects.
- Increases in function are thought to be a result of increased motor control gained during brief inhibitory period following e-stim.

Management Options – Strengthening

Does strengthening a spastic muscle increase the overactivity?

Historical thought was…YES
Research says….NO

Management Options – Strengthening

- Research shows us that spastic muscles are weak muscles.
- Strengthening (post-CVA) has been shown to:
  - Increase function
  - Decrease perceived limitations & increase perceived QOL
  - Increase gait speed
  - Has not been shown to increase spasticity (as measured by Pendulum test or MAS).
Assessment of Muscle Overactivity

<table>
<thead>
<tr>
<th>Assessment</th>
<th>What are we assessing?</th>
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<tbody>
<tr>
<td>Ashworth/Modified Ashworth</td>
<td>Resistance to passive range of motion (including, but not exclusive of, resistance due to spasticity)</td>
</tr>
<tr>
<td>Tardieu/Modified Tardieu Scale</td>
<td>Spasticity angle, Quality of movement at multiple velocities</td>
</tr>
<tr>
<td>Passive Range of Motion</td>
<td>Amount of passive movement allowed by the joint, soft tissue, muscle, etc.</td>
</tr>
<tr>
<td>Active Range of Motion</td>
<td>How much active movement can be performed against the specific antagonist (NOT strength)</td>
</tr>
<tr>
<td>Functional activities</td>
<td>Quality of movement, speed of movement, postural alignment, energy expenditure, etc.</td>
</tr>
<tr>
<td>Patient/caregiver report</td>
<td>Pain, ease of care, transfers, quality of life, etc.</td>
</tr>
</tbody>
</table>

Ashworth/Modified Ashworth Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>No increase in tone</td>
</tr>
<tr>
<td>1</td>
<td>Slightly increased tone, with a catch &amp; release or minimal resistance at terminal ROM</td>
</tr>
<tr>
<td>1+</td>
<td>Slight increase, catch followed by minimal resistance throughout the remainder of the range (&lt;1/2 of the ROM) (only in MAS)</td>
</tr>
<tr>
<td>2</td>
<td>Marked increase through most of the ROM, but affect part is easily moved</td>
</tr>
<tr>
<td>3</td>
<td>Considerable increase, passive ROM difficult</td>
</tr>
<tr>
<td>4</td>
<td>Affected part is rigid</td>
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</tbody>
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Passive movements of muscle groups should be performed over a one-second time frame.

Active Range of Motion

Objective measure of how much the agonist can move against the overactive antagonist

- Example — To assess overactive biceps, we could measure the degrees of active extension that a patient can achieve.
- NOT looking at the strength of the extensors, but rather how much the overactivity of the flexors can be overcome
- Following treatment, would want to reassess to see if the patient can achieve more active movement,
- May be a more functional measurement than passive measurements
Functional Evaluation

Ask Questions!
- How is this impacting their lives? **Severity ≠ Significance**
- What are their goals of treatment?

Observe!
- Watch them walk, transfer, propel w/c, eat, dress, etc
- How are they positioned?
- Video, video, video!!

Be Objective when you can!
- Use measures such as 10MWT, Gaitrite assessment, Modified Frenchay Arm Test, Disability Assessment Scale

Botulinum Toxin Clinical Efficacy
67/male, TBI, Anoxia, Stroke

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Outcome
Team approach to spasticity management

- 37-yo male who suffered a severe traumatic brain injury from an assault two years earlier
- Completed one month of inpatient rehabilitation
- Was sent home just as he was emerging from a coma

Outcome
Team approach to spasticity management

- Home therapy cannot do much because of posture
- Drugs and injections to treat muscle tightness did not work
- Surgery?
Before Any Therapy Can be Done:
- INFECTIOUS DISEASES CONSULTATION
- Antibiotics for groin abscess
- ORTHOPEDICS
- Hip contracture release
- Groin abscess I&D;
- NEUROSURGERY
- Intrathecal Baclofen therapy
Inpatient rehabilitation

Physical and Occupational Therapy

Botulinum toxin injections to neck

Speech Therapy

Improved speech and swallowing

Orthopedic Surgeon

Knee flexion contracture

Repeat botulinum toxin injections to wrists and neck

More therapies

Outcome Before
Summary

- Clinicians often focus on the direct effects of spasticity; however, it is the indirect/disabling effects of spasticity that most impact patients’ daily life.
- Effective rehabilitation consists of appropriate assessment, and an individualized, interdisciplinary approach that may incorporate both pharmacologic and nonpharmacologic treatments.
- Spasticity and other chronic stroke complications should be assessed and managed on a continual basis to sustain functional gains.

References

- www.wemove.org
References

- Summerhagen, K. Stok Using the Ashworth scale for the assessment of spasticity [letter]. J Neurol Neurosurg Psychiatry 2010; 81:2

Additional Resources

Additional Resources