Spasticity Management in Stroke

Bridging the Gaps....

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Spasticity (Lance, 1980)

- Motor disorder
- Velocity dependent increase in tonic stretch reflexes
- Hyperexcitability of the stretch reflex
- Exaggerated tendon jerks
- One component of the upper motor neuron syndrome
- Altered activity patterns of motor units occurring in response to sensory and central command signals which lead to co-contractions, mass movements, and abnormal postural control (Wiesendanger, 1991)
Proposed Theory

- Imbalance between excitatory and inhibitory impulses to the alpha motor neuron
- Due to lack of descending inhibitory input to the alpha motor neuron
Pathophysiology of Spasticity
Possible Advantages of Spasticity

- Maintains muscle bulk
- Helps support circulatory function
  - May prevent formation of deep vein thrombosis
- May assist in activities of daily living
- May assist with postural control
Adverse Consequences

- Interferes with mobility, exercise, joint range of motion
- More often interferes with ADLs
- Cause pain and sleep disturbances
- Make patient care more difficult
- Can interfere with speech – spastic dysarthria
- ....and swallow – spastic dysphagia
Dynamic Muscle Tone

- Observation of Movement Patterns
  - Equinus gait
  - Scissor gait
  - Upper extremity flexion/adduction
  - Mass movement postures

- Observation
  - Try observing with and without orthoses or ambulation aids
  - Video taping can be very helpful
## Spasm Frequency Scale

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No spasms</td>
</tr>
<tr>
<td>1</td>
<td>No spontaneous spasm (except with vigorous stimulation)</td>
</tr>
<tr>
<td>2</td>
<td>Occasional spontaneous spasm and easily-induced spasms</td>
</tr>
<tr>
<td>3</td>
<td>More than 1 but less than 10 spontaneous spasms per hour</td>
</tr>
<tr>
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(Penn, 1989)
## Modified Ashworth Scale (MAS)

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(Bohannon & Smith, 1987)
Treatment Options for Patients with Spasticity

- Intrathecal Baclofen (ITB™) Therapy
- Oral Medications
- Rehabilitation Therapy
- Injection Therapy
- Orthopedic Surgery
- Neurosurgery
Rule out . . .

- Pain
- Infection - UTI, Pneumonia, osteomyelitis
- Constipation
- Reflux
- Decubitus ulcers
- Stress
- Anxiety
- Changes in underlying disease state (e.g., MS exacerbation, recurrent CVA)
Rehabilitation Therapy

- Stretching
- Casting
- Orthoses
- Positioning
- Weight bearing
- Rotary movements
- Electric Stim

- Cryotherapy
- Hydrotherapy
- EMG biofeedback
- Electrical stimulation
- Vibration of the antagonist
Oral Medications

Most common:

- Baclofen (Lioresal®)
- Diazepam (Valium®)
- Tizanidine (Zanaflex®)
- Dantrolene sodium (Dantrium®)
<table>
<thead>
<tr>
<th>Drug</th>
<th>Site of action</th>
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<tbody>
<tr>
<td>Baclofen</td>
<td>Central Nervous System</td>
</tr>
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<td>Diazepam</td>
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<tr>
<td>Dantrolene sodium</td>
<td>Peripheral: muscle</td>
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Injection Therapy

- Anesthetic / Diagnostic Nerve Blocks
  - Procaine
  - Lidocaine

- Neurolytic Nerve Blocks
  - Ethanol
  - Phenol

- Botulinum Toxin
Botulinum Toxin

- *Clostridium botulinum* injected into the muscle
- Interferes with release of acetylcholine at the neuromuscular junction
- No systemic effect
- May be administered without anesthesia
- EMG guidance for small muscles
- Results typically last 3-5 months
Injections

**Advantages**
- Not permanent
- Reduces focal spasticity, improves function, decreases pain
- Effects are localized - not systemic

**Disadvantages**
- Not permanent - may need to repeat injections
- Ethanol and Phenol: require greater skill to inject, increased risk of paresthesias, dysesthesias
- Botulinum toxin: more expensive than other injections, may develop antibodies
Neurosurgical Treatments

- Neurectomy
- Myelotomy
- Anterior Rhizotomy
- Selective Dorsal Rhizotomy
- Cordectomy
- Thalamotomy

(Simpson, 1995)
Orthopedic Surgery

- Soft-tissue operations
  - lengthenings
  - releases
  - tendon transfers
- Bony operations
  - osteotomies
  - fusions
Intrathecal Baclofen (ITB™) Therapy
Intrathecal Delivery of Baclofen

- Acts as $\text{GABA}_b$ – receptor agonist
  - GABA (gamma-aminobutyric acid) is an inhibitory CNS neurotransmitter
  - Two receptor types ($\text{GABA}_a$ and $\text{GABA}_b$)
- Mechanism of action is probably presynaptic inhibition
  - Inhibits release of calcium into presynaptic terminals
  - Thereby impedes release of excitatory neurotransmitters
- Baclofen is delivered directly into CSF in intrathecal space
Site of Action of Intrathecal Baclofen

Animal F GABA_b specific binding
Pharmacokinetics of Baclofen

- Intrathecal
  - 600 mcg/day dose: 1.24 mcg/mL IT lumbar concentration
  - Lumbar to cervical concentration is 4:1 with lumbar catheter tip placement
  - Therapeutic dose is 1/100 of oral

- Oral
  - 60 mg dose: 0.024 mcg/mL IT lumbar concentration
  - Half-life 3-4 hours

(Knutsson et al, 1974; Kroin & Penn, 1991)
SynchroMed® Infusion System
Components

**Pump**
- infuses drug at programmed rate

**Catheter**
- delivers drug to the intrathecal (subarachnoid) space of the spinal cord

**Programmer**
- allows for precise dosing
- easily adjustable dosing
Indications for ITB

- Positive response to the screening test
- Patients with spasticity of spinal origin:
  - unresponsive to oral antispasmodics
    - and/or experience unacceptable side effects

Patients with spasticity of cerebral origin must be one year post brain injury to be considered for ITB Therapy
Patient Selection Goals

- Low level patients
- Improve positioning
- Facilitate hygiene
- Improve orthotic fit
- Decrease caregiver burden
- Pain control due to nighttime spasms

Patient Selection Goals

- High level patients
  - Improve mobility
    - Prevent long term consequences of poor biomechanics
    - Increased speed and safety of gait
    - Improved quality of gait

- Improve ADLs
  - Dressing
  - Independence in hygiene
  - Decrease time to perform tasks
Anticoagulation is not a contraindication
  - Set up protocol to stop AC or switch to LMW heparinoids
History of seizures does not rule out ITB Therapy
Minimal surgical risk
No weakness in normal side
  - Will only unmask weakness of affected side
Age and time from stroke are not contraindications
Use 75mcg to 100mcg to see improvement in UE spasticity
Screening Test Flow Chart

Bolus: 50 mcg

+ → +
- → -

24 hrs after Bolus: 75 mcg

+ → +
- → -

24 hrs after Bolus: 100 mcg

+ → +
- → -

Not a Candidate

+ = Positive Response “Implant”
- = Negative Response “No Implant”
Assessment During the Screening
Test: Adverse Effects

- Drowsiness
- Lightheadedness
- Dizziness
- Somnolence
- Respiratory depression
- Seizures
- Rostral progression of hypotonia
- Loss of consciousness (can progress to coma)
Examination During the Screening Test

- Typically assess at 2 and 4 hours post bolus
- Ashworth or Modified Ashworth Scales (AS or MAS) – PT/OT measure
- Passive/Active Range of Motion -PT/OT measure
- Observe movement patterns - Video
- Spasm Scale
- Pain Scale
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(Bohannon & Smith, 1987)
Assessing the Screening Results

- Looking for decrease in muscle tone
- Looking for decrease in pain
- Looking for improvement in ROM
- Excessive loss of tone is not a contraindication for ITB Therapy
- Are the deviations due combination of: weakness, spasticity, biomechanical factors, motor planning?
ITB therapy does not... 

- Does not help apraxia
- Does not cure aphasia
- Does not make the impaired side ‘normal’
- Does not take away the CVA
- Does not cure neurogenic bladder/bowel issues
Pump Implant
Pump Implant

- Abdominal incision
  - make a pocket for the pump no deeper than 2.5 cm
    or 1 inch
Pump/Catheter Placement

- UE spasticity
  - C5 to T4
  - Bolus dosing
- LE spasticity
  - T10
  - Simple continuous or bolus dosing
- Do not suddenly stop oral baclofen when pump is placed
Titration Period

*After First 24-Hour Period*

- Increase dose slowly
- Increase only once every 24 hours until desired clinical effect achieved
  - Adults with spasticity of spinal origin
    - 10-40% increments
  - Adults with spasticity of cerebral origin
    - 5-20% increments
- Pediatrics
  - 5-20% increments
Stroke Ambulatory patient (Francisco and Boake)

- 10 patients
- Average time of implant: 28.6 months
  - Follow up interval: 8.9 months
- Customary walking speed (50ft)
  - Improved from 36.6 to 52 cm/s (p<0.05)
- Normal muscle strength preserved in unaffected limbs

**Therapist Role Post-Implant**

- Determine appropriate therapy venue
- Propose treatment plan
- Provide input regarding dosing
- Strengthening
- Neuromuscular retraining
- ‘Unlearning’ bad habits ....synergy patterns
Potential Risks of ITB Therapy

- Common side effects: (bolus)
  - Hypotonia
  - Somnolence
  - Nausea/vomiting
  - Headache
  - Dizziness
  - Paresthesias

- Catheter and procedural complications may occur

- Overdose (rare)

- Withdrawal
Baclofen Overdose

- **Symptoms**
  - Drowsiness
  - Lightheadedness
  - Dizziness
  - Somnolence
  - Respiratory depression
  - Seizures
  - Rostral progression of hypotonia
  - Loss of consciousness (possible progression to coma)

- **Take patient to emergency department!**
Baclofen Withdrawal

- **Symptoms**
  - Increased spasticity
  - Itching without rash
  - Tingling, paresthesias, skin "crawling"
  - Hyperthermia
  - Headache
  - Hypotension
  - Seizures
  - Hallucinations
  - Altered mental status
  - Autonomic dysreflexia

- A medical emergency!
ITB Therapy

- **Advantages**
  - Reversible
  - Non-invasive dose adjustments
  - Fewer side effects than oral drugs
  - Improves function (quality of function), comfort and care
  - Decreases risk of contractures and skin breakdown
  - Allows development of strength and coordination

- **Disadvantages**
  - Complications: infection, catheter problems, overdose, baclofen withdrawal
  - Refills – approximately every 3 months
  - Cost
Reassess for other interventions

- Botulinum toxin, Myobloc
- Motor point blocks
- Orthopedic interventions
- Decrease oral meds
CVA Patient

- 56yo male with left CVA – spastic R hemiplegia
- Ambulatory with SBQC, pain in arm, leg
  - “Thalamic pain syndrome” – Pain score 9/10
- Dependent for dressing and bathing
- MAS RUE 4, RLE 3-4
- Poor sleep
- Frequent falls
ITB Trial dose 50mcg

- Pain score 0
- UE MAS 2 with active shoulder abduction and elbow extension
- LE MAS 1-2
- Ambulated with cane – much improved hip/knee and ankle motion, better balance, able to move LUE during gait, improved speed
Conclusions

- ITB therapy is well tolerated and controlled spasticity in stroke patients
- No evidence of increased disability or weakness associated with early treatment
- Effective for ambulatory and non-ambulatory patients
- Increased spastic hypertonia is associated with worsening disability
- Revision of catheter to cervical – thoracic location is associated with improved control of UE tone
- Bolus dosing paradigm appears to be more effective than continuous dosing
Who’s on the “team”?

- Patient and family
- Physicians
  - physiatrist or neurologist
  - neurosurgeon
  - orthopedic surgeon
- Case Manager
- Nurse / Nurse Practitioner
- Physical therapist
- Occupational therapist
- Speech/Language Pathologist
- Dietician
- Psychologist
- Social Worker