

# **SCI FORUM**

## **Spasticity: Part 1**

### **The Good, The Bad, and The Not-So-Ugly**

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<http://sci.washington.edu/spasticity/>



**Name:** Christine

**Age:** 42

**Medium:** Written/Spoken Word

**Spacticity Within—Friend or Foe?**

by Christine D.

A blessing to stand, dress, transfer, and walk,  
Sometimes a friend and sometimes a foe,  
Spasticity within, which way will it go?  
Compromise, confusion, crossed messages don't know,  
Are you my friend or are you my foe?  
I count my blessings one by one,  
Able to stand but one day I'll run.  
Walking was taken away for a while,  
Heartache and sorrow, not able to smile.  
The battle began, fierce, gruesome, and strong,  
The battle I'll win, no matter how long.  
Spasticity within, friend or foe?  
I'll keep your goodness, the rest gotta go!

# Overview: Spasticity

- Introduction: Spasticity
- Principles, goals and challenges in spasticity treatment
- Pharmacologic management
- Non-pharmacologic management
- Summary
- Questions

# What is spasticity?

- No single, or simple, definition
- Disorder of muscle movement
- State of increased muscle tone (tension) resulting from central nervous system injury, including SCI

# What is spasticity?

## Presentations vary in type and severity

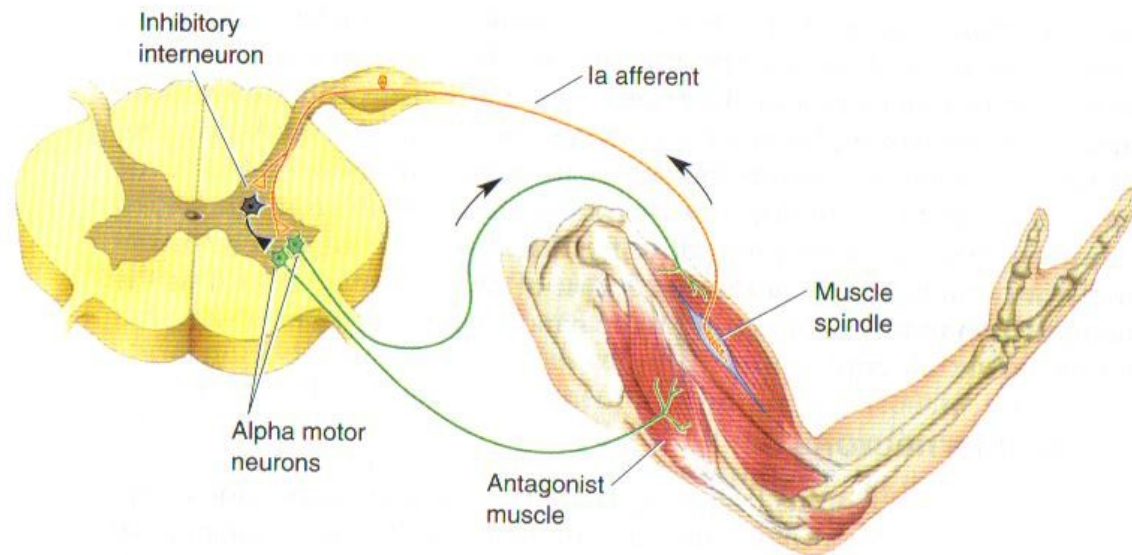
- Resistance to stretch: velocity (speed)-dependent
- Abnormal movements
  - Exaggerated reflexes
  - Intermittent or sustained involuntary muscle movements (ex. clonus)
- Flexor or extensor spasms or posturing

<https://www.youtube.com/watch?v=YppNNYt5Cbc>

# What causes spasticity?

- Disruption of complex nerve circuits that control muscle and stretch reflexes

## MOTOR CONTROL LOOP



**Figure 13.22**  
Reciprocal inhibition of flexors and extensors of the same joint.

# How common is spasticity in SCI?

## Fairly common

- 65%-78% of persons with SCI
- Problematic in 28%-43%
- Medications needed in 43%-49%
- An important factor that decreases quality of life

## Areas affected (distribution)

- Below injury level (exception: simultaneous brain injury)
- Upper or lower limb muscles, bowel/bladder

# Spasticity Evolves

- Develops over time after SCI
- May get stronger in the course of a year
- Can have exacerbations (flares)
  - urinary tract infection or stones
  - skin breakdown
  - fractures



# Spasticity Can Be a Challenge

Definition:  
multiple or mixed  
characteristics,  
manifestations

Causes: uncertain,  
possible multiple  
mechanisms

Spasticity evolves

# Spasticity Can Be a Challenge

Inconsistent or  
episodic

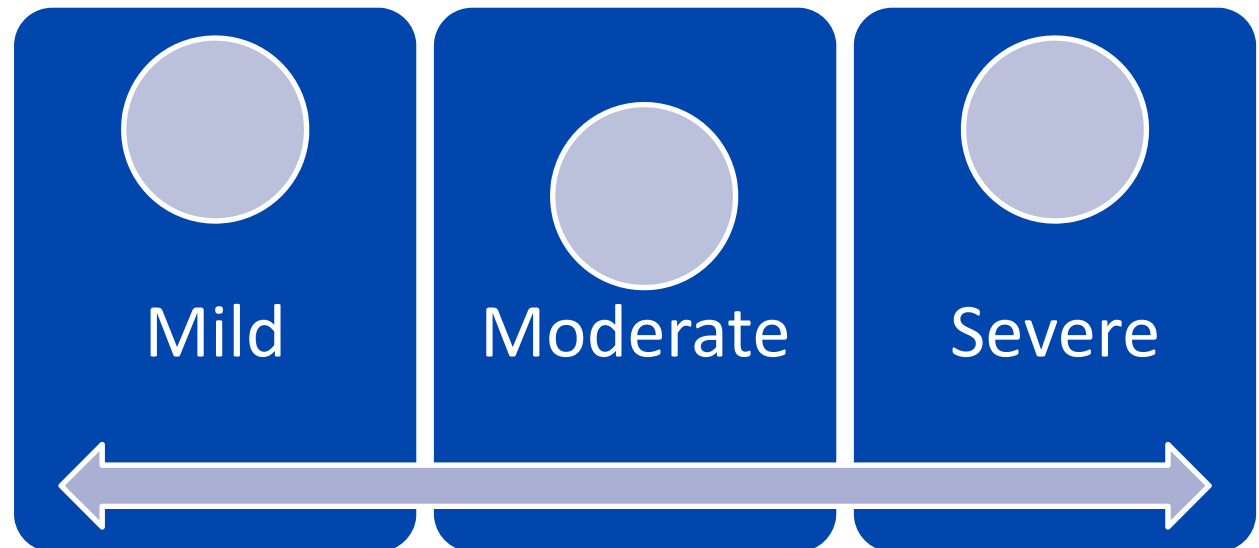
Positional

Static and dynamic  
qualities

Variable perceptions,  
experiences,  
responses, treatment  
approaches

# The Real Challenge of Spasticity

- Wide range of symptoms on a continuum, from desirable to undesirable
- Can be simultaneously beneficial and detrimental



# Understanding Spasticity

Spasticity can have beneficial and detrimental features

Understanding the impact and what aspects need treatment is the key to appropriate management

- When to treat
- How aggressively to treat

# Understanding Spasticity

## “The Good”

Compensates  
for muscle  
weakness

- May help transfers
- Creates muscle activity, ? muscle mass
- Strengthens grip
- Allows some bladder emptying
- Maintains bowel continence

Serves as early  
warning  
system

- Alerts to insidious, evolving health problems

Reported, but  
unproven  
benefits

- Bone health
- Circulation

# Understanding Spasticity

## “The Bad”

### Stiffness – resistance to stretch

- Hand/arm function
- Shoulder and hip ROM (dressing)
- Walking
- Personal care
- Abnormal limb/trunk position, or contractures

### May be painful

### Interfere with safety (seating/positioning)

- Driving
- Wheelchair pushing over uneven surfaces

### Bladder accidents

### Indirect effects - independence, work ability, care needs

# Understanding Spasticity Neutral Effects

Neither good nor bad

Present, but not bothersome

# Spasticity Treatment Principles

Keep in mind: Many people have a mixture of good, bad, neutral effects of spasticity

- Manage detrimental effects
- Maintain beneficial effects
- Learn to live with the neutral effects



# Reasons to Treat Spasticity

Minimize negative functional impact:

Pain

Prevent contracture

Skin breakdown

Positioning difficulties

Impaired motor control or active limb use; effects on gait

Safety concerns

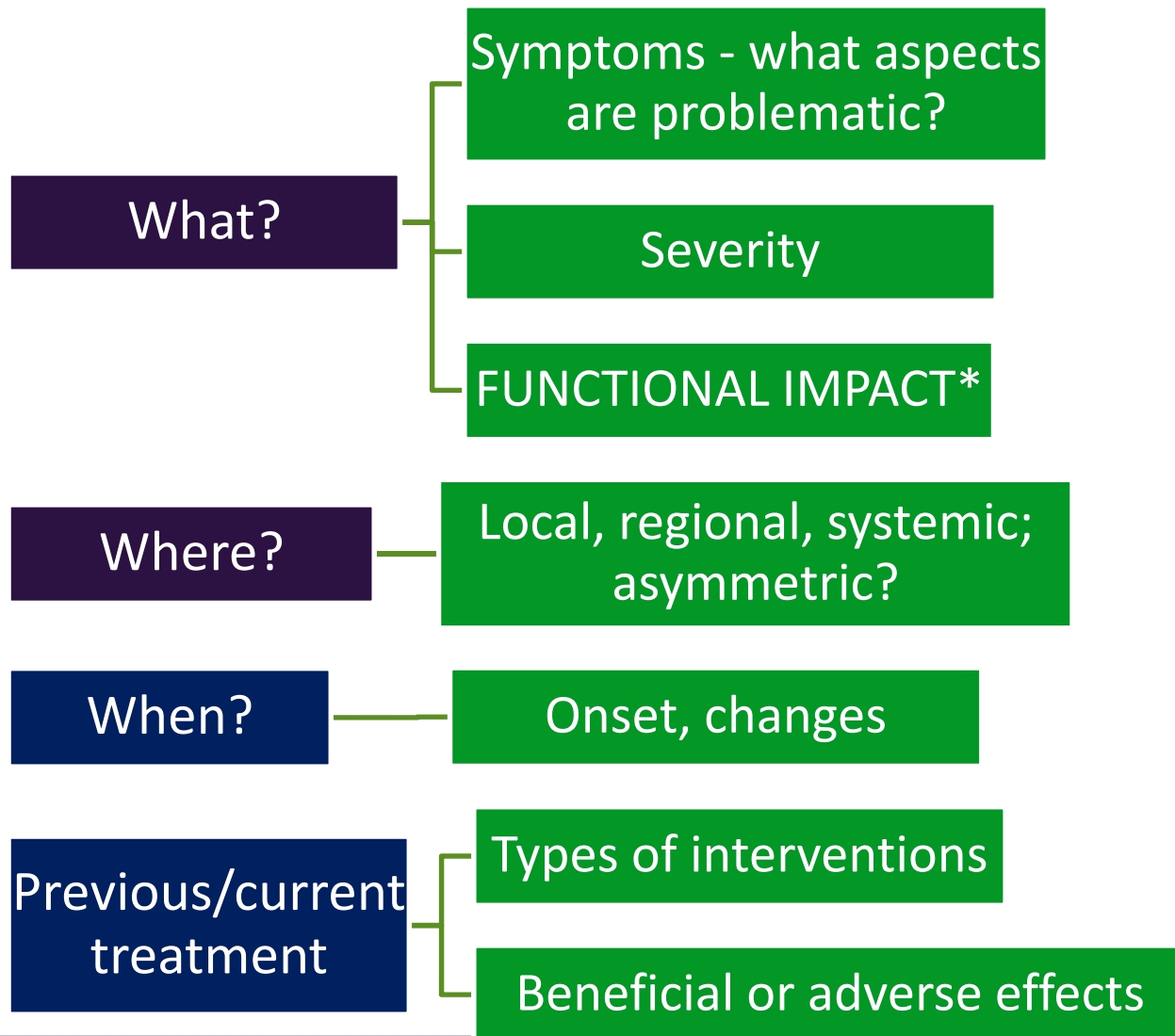
Impaired hygiene/personal care

Clonus

Bladder incontinence

Psychosocial impact: on sleep, spouse, body image

# Your Spasticity: What Your Health Care Team Wants to Know



# Spasticity: Ways to Evaluate

## Subjective assessment

- Surveys
- Penn Spasm Frequency Score

## “Objective” assessment

- Clinical/Qualitative
  - Modified Ashworth Scale
  - Tendon Tap
  - SCATS, SCI-SET
  - Pendulum Test
- Electrophysiologic/Quantitative

## Functional assessment

- Gait (walking) analysis
- Transfers

### PENN SPASM FREQUENCY SCORE (PSFS)

- 0 No spasms
- 1 Mild spasms induced by stimulation
- 2 Infrequent spasms occurring 1x/hour
- 3 Spasms occurring >1x/hour
- 4 Spasms occurring >10X/hour

### MODIFIED PSFS

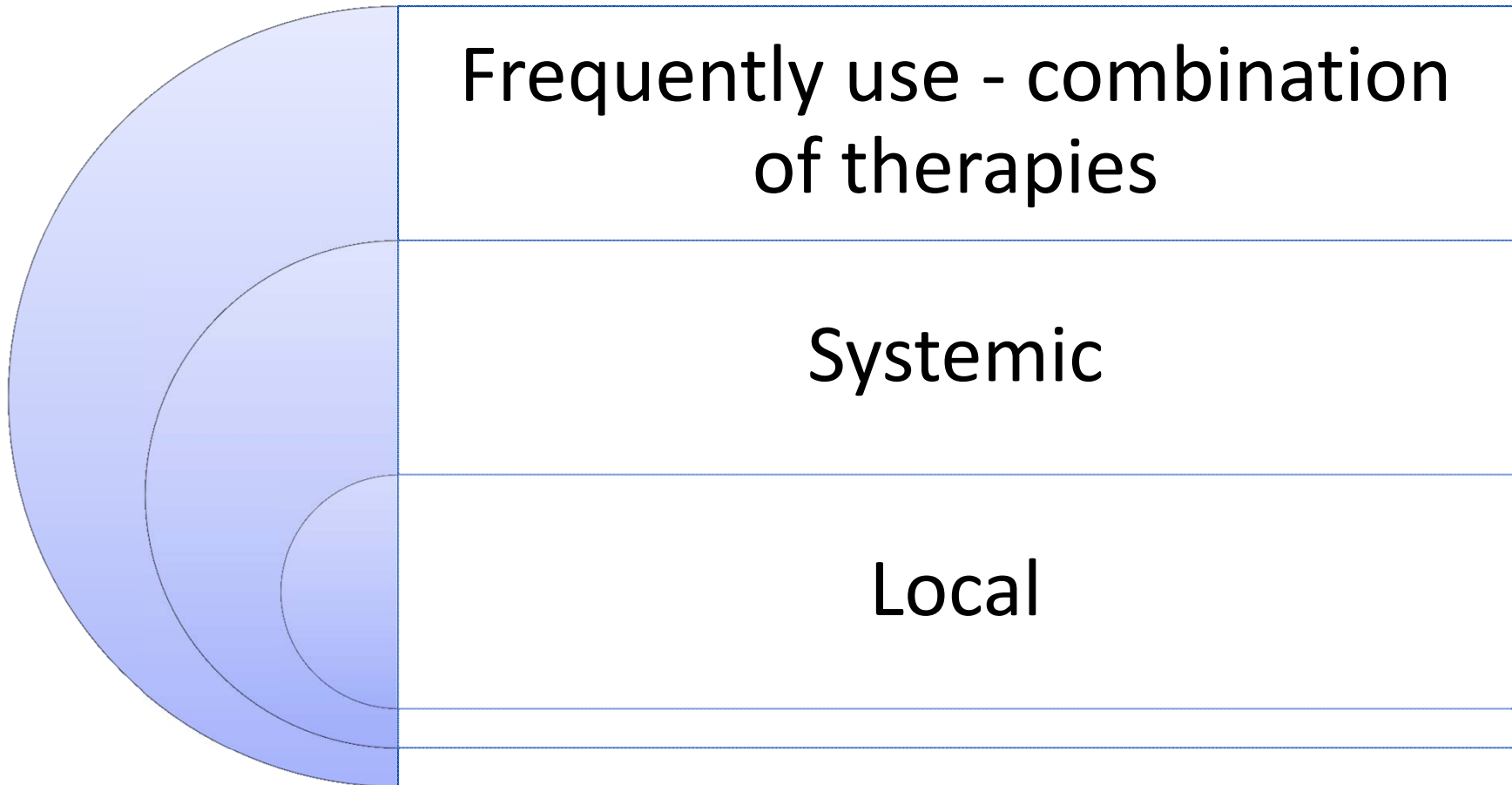
- 1 Mild
- 2 Moderate
- 3 Severe

# SPASTICITY:

Evidence-Based  
Treatment  
Approaches

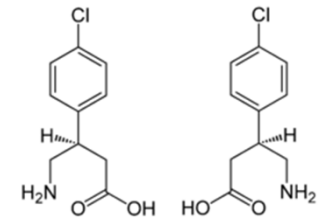


# Pharmacologic Treatment



# ORAL MEDICATIONS

## Baclofen



Mainstay in spasticity treatment

How does it work?

- GABA receptors
- spinal cord and brainstem
- Depresses neuronal reflex circuits that facilitate spasticity

Drug lifespan:

- Peaks: within 2 hours
- Half-life = 3.5 hours (2-6 hours)
- Typically used 3-4x/day

# ORAL MEDICATIONS

## Baclofen Considerations

- High efficacy reported anecdotally
- Good strength of evidence (Level 1), but few studies
- Side effects
  - sleepiness/fatigue (most common)
  - sexual dysfunction
  - nausea, dizziness
  - hallucinations, nightmares
- Wide range of effective doses
- BUT, limited absorption into the spinal fluid and cord
- **The Bottom Line:**  
**Good efficacy, but tolerance varies primarily due to drowsiness**

# ORAL MEDICATIONS:

## Alpha-2 Adrenergic Agonists

Clonidine (*NOT FDA-approved for spasticity*)

- Oral or patch formulations
- Good evidence basis (Level 1, 8 studies)
- Head-to-head studies showed superiority to:
  - Clonidine-desipramine combination
  - Diazepam
  - Placebo
- But inferior performance relative to:
  - Baclofen
  - Cyproheptadine



# Alpha-2 Adrenergic Agonists: Clonidine

## Drug lifespan:

- Peak effect: 2-4 hours (oral) or 2-3 days (patch)

## Considerations:

- Risk for low blood pressure, low heart rate
- Pregnancy Category C
- Avoid abrupt withdrawal (reflex high BP)
- Possible contact dermatitis from transdermal

# Alpha-2 Adrenergic Agonists: Tizanidine

- Structurally like clonidine, but  $1/10^{\text{th}}$  to  $1/50^{\text{th}}$  in cardiovascular potency
- How does it work?
  - Reduces excitatory substances (amino acids, etc.) and enhances inhibitory substances in nerve communication circuits
  - Spine and brain
- A “day-in-the-life” of tizanidine
  - Peak: 1 hour
  - Half-life = 2-4 hours
  - Typically used up to 3x/day

# Alpha-2 Adrenergic Agonists: Tizanidine

## Considerations

- Gradual dose adjustment needed!
  - Drowsiness in 41-46%
- Blood work monitoring needed
  - Risk for liver dysfunction and blood count abnormalities
- Blood pressure drop when upright, dry mouth, visual hallucinations, dizziness, fatigue
- Possible drug interactions: ciprofloxacin, fluvoxamine (increased risk for drop in BP, HR)
- Avoid abrupt discontinuation at high doses
- Pregnancy category C

# Alpha-2 Adrenergic Agonists: Tizanidine Efficacy

- Good evidence
- Muscle power not affected
- **The Bottom Line:**  
**Effective. May cause sedation and low blood pressure. Needs cautious dose adjustment. Consider drug interactions and lab monitoring with tizanidine.**

# ORAL MEDICATIONS:

## Dantrolene

Peripherally acting anti-spasticity agent (muscle)

How does it work?

- Decreases strength of muscle contraction
- Little effect on cardiac, smooth muscle

Drug Lifespan:

- Peak 3-6 hours
- Active metabolite peaks: 4-8 hour
- Half-life: 8.7 hours (oral)

# ORAL MEDICATIONS:

## Dantrolene

### Considerations

- Can be mildly sedating
- Nausea/vomiting, dizziness, diarrhea, tingling sensation
- Liver toxicity (<1% vs 1.8%?),
  - Females >30 yrs old taking >300 mg/day for more than 60 days
  - Usually reversible; fatality <0.3%
  - Not felt to be safe for use in people with liver dysfunction
- Therefore, use lowest effective dose and follow liver tests!

# ORAL MEDICATIONS:

## Dantrolene

- Evidence:
  - Preferred by patients over diazepam; placebo controlled (Glass 1974)
  - Superior to placebo in treating spasticity due to chronic SCI (Weiser 1978)?
  - Current evidence (since 1980) not found to support efficacy
- **The Bottom Line:**

**Most useful if strength is good (or where loss of strength will not be problematic), or if cognitive side-effect is a concern. Check, monitor liver function tests.**

# ORAL MEDICATIONS

## BENZODIAZEPINES: Diazepam

- Multiple uses:
  - Anti-spasticity, anti-seizure, anxiolytic, sleep aid
- Multiple dosing forms: oral, IV, etc.
- How does it work?
  - Works on brain and spinal cord circuits (inhibitory)
- Pharmacokinetics:
  - Peaks at 1 hour
  - Very long half-life: 15-80 hours (depends on how given)



# ORAL MEDICATIONS

## BENZODIAZEPINES: Diazepam

### Effectiveness:

- Limited good evidence, but plenty anecdotally
- Open-label trial comparison to baclofen: comparable efficacy but greater sedation, confusion, fatigue (MS, SCI)

### Long track record of use

### Other benzodiazepines used

- Technically not FDA approved for spasticity
- More limited experience

# ORAL MEDICATIONS

## Benzodiazepines

- Considerations
  - Long period of drug effect
  - Drowsiness/CNS depression
  - Impaired coordination
  - Tolerance/dependence
  - Pregnancy Category D

- **The Bottom Line:**

**Likely not first line treatment. May be effective adjunct treatment. Minimize dose due to cognitive side effects and becoming accustomed to dose and needing a higher dose to be effective. Possibly best at night and for emergency, in-hospital use.**

# Other Systemic Treatment Options: Medical Marijuana (Cannabis)

- Resource:
  - SCI Forum/SCI Wellness Summit (June 7, 2014) by Dr. Greg Carter and Fall 2014 SCI Newsletter
- Efficacy: needs further study, but commonly used with reported efficacy
- No associated constipation, respiratory depression, overdose
- Considerations
  - Legal status (State vs Federal)
  - Method of consumption, “Start low and go slow”
  - Cautions: disinhibition, relaxation, euphoria, confusion, agitation, paranoia, impaired balance/stability, impaired memory or judgment (impact on driving safety)

# FOCAL TREATMENT

Blocks  
(Injections)

# FOCAL TREATMENT: Blocks (Injections)

- Preferred to control regional spasticity and avoid systemic adverse drug effects
- Can be administered prior to/ with bracing/stretching/other interventions to enhance therapeutic benefit
- Temporary block may:
  - provide info re: spasticity vs contracture
  - allow assessment of clinical effect or impact of blocking muscle over activity
  - Unmask function concealed by spasticity

# FOCAL TREATMENT: Blocks (Injections)

Longer-acting: 2-5 months

- Neurotoxin injections: Botulinum toxin
- Neurolytic injections: Phenol 3-7%
  - Chemical nerve destruction
  - Mixed nerves or motor point blocks (motor only)
  - Theoretical risk for nerve pain involving sensory component of nerve injected
  - Typically hip adductors, but possibly individual motor point blocks

# FOCAL TREATMENT OF SPASTICITY: Blocks (Injections)

- Other types – phenol, alcohol, RF ablation
  - Perineural/open nerve blocks
  - Lumbosacral – hip flexors
  - Paravertebral
    - Usually if no prospect of motor recovery

# FOCAL TREATMENT OF SPASTICITY: Blocks (Injections)

## Phenol

- Temporary effect: months
- Requires stimulator to localize
- Longer time required due to technical demands
- Often no special pre-authorization required (low cost)
- No antigenicity
- Few concerns about dose limits
- Best for nerves with minimal sensory control or to target motor branches to muscle groups

## Neurotoxin

- Temporary effect : months
- Electrical /ultrasound guidance sometimes used
- Easy to administer (shorter time to complete)
- Often requires pre-authorization (more expensive)
- Antigenicity possible
- Dose limits
- Any muscle that can be reasonably accessed is a target



# BLOCKS

## Botulinum Neurotoxin

- Protein made by *Clostridium botulinum*
- At least 7 distinct toxin serotypes and receptors; 2 commercially available in U.S. (A & B)
- More about the drug
  - Onset 2-6 days
  - Peak 1-4 weeks
  - Duration approximately 3 months (2-6 months)
- Injected into spastic/overactive muscle
  - Limbs/neck/trunk/face
  - Bladder
  - Vocal cords

## BLOCKS

# Botulinum Neurotoxin - Efficacy

### Evidence in mixed spasticity populations

- Insufficient SCI evidence, but use is “cautiously” supportive
- Commonly used

### Combination or adjunctive therapy

- FES applied within 30 min after BoNT injection enhances duration of effect (controlled case series)
- With stretching, had greater reduction in MAS and subjective measures (Giovannelli M et al 2007)

### Consensus Statements

- AAN 2008: should be offered as option to treat spasticity
- Wissel et al, European group 2009: should be provided as part of an integrated program

## BLOCKS

# Botulinum Neurotoxin (BoNT)

- Considerations
  - excessive weakness lasting several months
  - spread of medication: dosage limitations: prioritize use!
  - drug cost and insurance coverage issues
  - Cumulative dosing and risk of developing neutralizing antibodies
    - Coordinate injections to minimize “booster” effect
  - Uncertain individual response, dosing.

- **The Bottom Line**

**The treatment is only as good as the proper identification and localization of the target muscle.**

Use to treat focal spasticity problems, possibly in combination with other medications and interventions.



# SURGICAL TREATMENT

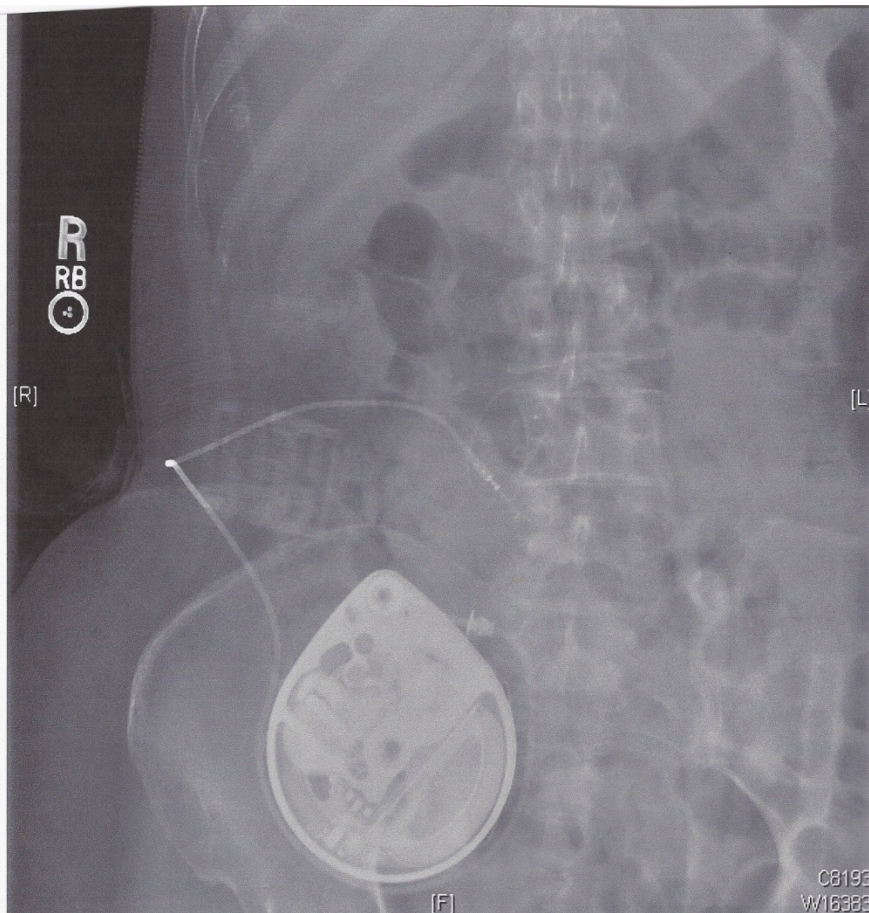
# SURGERY

## Intrathecal Baclofen Pump

- Indication: Approved by FDA to manage severe spasticity resulting from spinal cord or cerebral (brain) disease or injury
- Delivers precise, programmable dose of liquid baclofen directly into the intrathecal space
- Intrathecal delivery 100x more potent than oral (Dralle 1985)
- Minimize systemic adverse side-effects
- Reversible



# Intrathecal Baclofen Pump



# SURGERY

## Intrathecal Baclofen Pump

- Screening single intrathecal dose needed to assess candidacy
- Clinical efficacy
  - Few high quality studies; insufficient population with SCI
  - Available limited evidence
    - strongly supportive of test dose efficacy
    - some support for long-term use, functional improvement, cost effectiveness

# OTHER SURGICAL TREATMENT OPTIONS

- Ablative targets
  - Nerve roots: Selective Dorsal Rhizotomy
    - Culprit dorsal sensory roots
    - Primarily used for spastic diplegia/CP
    - Small case series for pediatric SCI
  - Spinal cord (myelotomy)
  - Peripheral nerve: neurectomy
- Stimulation
  - Spinal cord, brain
  - Conflicting results
- Orthopedic
  - Tendon lengthening or transfer

## MOTOR CONTROL LOOP

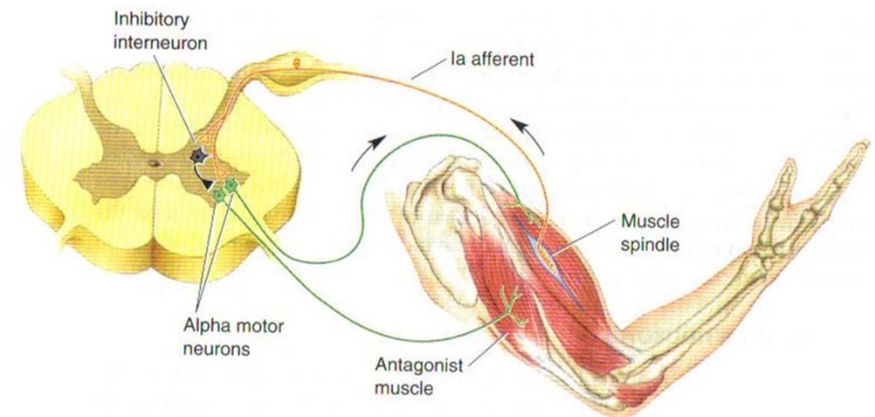


Figure 13.22  
Reciprocal inhibition of flexors and extensors of the same joint.

Neuroscience: Exploring the Brain, 2<sup>nd</sup> ed.



# Surgical Treatment

## The Bottom Line

- **Currently viewed as option when nonsurgical treatments exhausted, not feasible.**
- **Intrathecal Baclofen**  
**For spasticity (primarily in legs) that fails to respond to usual care, or where baclofen causes unacceptable sedation at the effective dose.**  
**For those accepting of surgical and intrathecal drug risks, and motivated to maintain with pump refills.**

# SPASTICITY MANAGEMENT SUMMARY

## Which treatments would best suit me?

- What are your goals for treating your spasticity?
- How important is it that the treatment can be reversed or stopped?
- What are the possible short-term and long-term side-effects of each treatment?
- Are there other health conditions that would influence the treatment choice?

# SPASTICITY MANAGEMENT

## Summary Points

The experience and impact of spasticity has characteristics that are unique to each individual.

Spasticity has beneficial, detrimental, and neutral qualities that often simultaneously co-exist in the same person.

Treatment focuses on managing the detrimental effects, preserving the beneficial effects.

# SPASTICITY MANAGEMENT

## Summary Points

Evidence-based treatment for spasticity can present a challenge

- Subjective and objective components
- Varied presentations and responses
- Assessment tools not reliably able to capture spasticity objectively or subjectively

“There is insufficient evidence to assist clinicians in a rational approach to antispastic treatment for SCI.”  
*(Tarrico M et al, 2006)*

# SPASTICITY MANAGEMENT

## Summary Points

Combination treatments are typically needed

- Different medications
- Medications and non-medication options

Successful treatment requires careful appraisal by the person affected and the team

- What aspects and muscles are responsible for negative impact
- To design effective treatment regimen based on the individual needs and responses to different treatment approaches

# Questions?

Thank You!

We would appreciate your  
feedback via the evaluation  
forms.

