SURGICAL MANAGEMENT OF ABNORMAL TONE

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DISCLOSURES

• No financial disclosures to report
OBJECTIVES

• Identify candidates for surgical management of increased tone

• Describe surgical options for appropriate candidates

• Identify risks, benefits, and alternatives of surgery
ABNORMAL TONE

- Spasticity
- Dystonia
- Chorea
- Athetosis
- Rigidity
- Atonia
**INCIDENCE**

- Cerebral palsy
  - 1 in 3000 live births
- Stroke
- Head injury
- Brain tumor
- Hereditary
- Idiopathic
MULTIDISCIPLINARY MANAGEMENT

- Pediatrician
- Neurologist
- Neurosurgeon
- Physiatrist
- Physical therapist
- Occupational therapist
- Speech therapist
SPASTICITY

• “resistance to externally imposed movement that increases with increasing speed of stretch and varies with the direction of joint movement, and/or resistance to externally imposed movement that rises rapidly above a threshold speed or joint angle”

• Varies with movement, alertness, pain, anxiety

• Isokinetic, not hyperkinetic

• Most common type of abnormal tone

• Affects 60% of cerebral palsy patients; stroke, head injury, idiopathic

• Classified by affected limbs – spastic diplegia, spastic hemiplegia, spastic quadriplegia, spastic monoplegia
SPASTICITY
MANAGEMENT

• **Goals of treatment**
  • Improve function
  • Facilitate care
  • Reduce contractures
  • Reduce pain

• **Oral medications**
  • Baclofen (GABA agonist), diazepam, tizanidine

• **Botox injections**

• **Therapy**

• **Surgery**
# Evaluation

## Modified Romberg Scale for Grading Spasticity

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no increase in muscle tone</td>
</tr>
<tr>
<td>1</td>
<td>slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension</td>
</tr>
<tr>
<td>1+</td>
<td>slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM</td>
</tr>
<tr>
<td>2</td>
<td>more marked increase in muscle tone through most of the ROM, but affected part(s) easily moved</td>
</tr>
<tr>
<td>3</td>
<td>considerable increase in muscle tone, passive movement difficult</td>
</tr>
<tr>
<td>4</td>
<td>affected part(s) rigid in flexion or extension</td>
</tr>
</tbody>
</table>

**GMFCS Level I**
Children walk indoors and outdoors and climb stairs without limitation. Children perform gross motor skills including running and jumping, but speed, balance and coordination are impaired.

**GMFCS Level II**
Children walk indoors and outdoors and climb stairs holding onto a railing but experience limitations walking on uneven surfaces and inclines and walking in crowds or confined spaces.

**GMFCS Level III**
Children walk indoors and outdoors on a level surface with an assistive mobility device. Children may climb stairs holding onto a railing. Children may propel a wheelchair manually or are transported when traveling for long distances or outdoors on uneven terrain.

**GMFCS Level IV**
Children may continue to walk for short distances on a walker or rely more on wheeled mobility at home and school and in the community.

**GMFCS Level V**
Physical impairment restricts voluntary control of movement and the ability to maintain antigravity head and trunk postures. All areas of motor function are limited. Children have no means of independent mobility and are transported.
SELECTIVE DORSAL RHIZOTOMY
**INDICATIONS/CONTRAINDICATIONS**

**TABLE 227-1  Indications for Selective Dorsal Rhizotomy for Spastic Cerebral Palsy**
- Diagnosis—spastic diplegia or quadriplegia
- Age—2 to 40 years
- History of premature birth or neonatal asphyxia
- Emerging locomotive functions
- Potential for significant postoperative functional gain

**TABLE 227-2  Contraindications to Selective Dorsal Rhizotomy for Spastic Cerebral Palsy**
- CP associated with intrauterine encephalitis
- Mixed CP with predominant dystonia or ataxia
- CP caused by a widespread neuronal migration disorder
- Severe head injury and hypoxic encephalopathy, such as after drowning
- Familial spastic paraplegia and other progressive neurological disorders
- Severe basal ganglia damage in children younger than 5 years
- Severe thoracolumbar scoliosis
- Severe lumbar lordosis
- Multiple previous muscle and tendon releases
- Profound motor impairment with no head control
- Psychiatric disorders in adults
- Lack of commitment to carry out postoperative therapy
RISKS

- Bleeding
- Infection
- CSF leak
- Spinal deformity
• https://youtu.be/IcFcDgNEwUE
• https://youtu.be/wA7TKfI2WeM
Intrathecal baclofen pump

- Intrathecal catheter with subcutaneous pump/reservoir
- 20cc or 40cc reservoir
- Suitable for pts >10kg

- Catheter tip can be cervical or thoracic
- Can titrate dose to effect

IT baclofen – 396ug/day = CSF level 400ng/ml
PO baclofen - 60mg/day = CSF level 12ng/ml
RISKS

• Mechanical failure
• Catheter fracture/migration
• Infection
• CSF leak
• Need for lifelong follow up
• Risk of withdrawal or overdose
• https://youtu.be/JdwCbH77MYg
Table 76.3: Treatments for Spasticity

<table>
<thead>
<tr>
<th>Method</th>
<th>Age (y)</th>
<th>Diagnosis</th>
<th>Characteristics</th>
<th>Expected results</th>
<th>Follow-up care</th>
<th>Outcome</th>
<th>Side effects, risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral medications</td>
<td>Any age, most often 2 to 5</td>
<td>Spastic quadriplegia, traumatic brain injury</td>
<td>Diffuse spasticity</td>
<td>Mild decrease in spasticity in arms and legs</td>
<td>PT, OT as needed</td>
<td>SPRs or ITB often needed later</td>
<td>Drowsiness</td>
</tr>
<tr>
<td>Botox injections</td>
<td>Any age, less often older than 16</td>
<td>Spastic diplegia, spastic quadriplegia</td>
<td>Isolated spasticity; too young for ITB, SPRs</td>
<td>Decrease in spasticity in injected muscle(s) for 2 to 4 months</td>
<td>PT, OT to increase range of motion and to increase strength</td>
<td>Improved gait, sometimes improved arm function</td>
<td>None with usual doses</td>
</tr>
<tr>
<td>Rhizotomy (SPRs)</td>
<td>4 to 8 (most common), care after 16</td>
<td>Spastic diplegia or quadriplegia, capable of ADLs</td>
<td>Good leg strength, no severe contractures, motivation for PT</td>
<td>Marked; permanent, nonadjustable decrease in spasticity</td>
<td>Extensive PT, OT</td>
<td>Improved walking, improved ADLs, decrease in orthopedic operations</td>
<td>Infection, 2%; wound, 1%; CSF leak, 3%</td>
</tr>
<tr>
<td></td>
<td>Older than age 3, before multiple contractions</td>
<td>Spastic diplegia or quadriplegia, not capable of ADLs</td>
<td>Severe leg spasticity interfering with care</td>
<td>Minimal</td>
<td>Easier care</td>
<td>Infection, 2%; wound, 1%; CSF leak, 3%</td>
<td>Infection, 2%; wound, 1%; CSF leak, 3%</td>
</tr>
<tr>
<td>Baclofen (ITB)</td>
<td>Older than age 3, big enough to insert pump</td>
<td>Spastic quadriplegia, spasticity in legs greater than or equal to spasticity in arms, capable of ADLs</td>
<td>Severe spasticity, positive response to test dose, spasticity limiting function</td>
<td>Adjustable decrease in spasticity</td>
<td>Frequency of PT, OT depends on goals</td>
<td>Improved walking, improved ADLs, improved speech, decrease in orthopedic operations, easier care</td>
<td>Infection, 5 to 10%; wound, 5 to 10%; CSF leak, 5 to 10%</td>
</tr>
</tbody>
</table>

Abbreviations: ADLs, activities of daily living; CSF, cerebral spinal fluid; ITB, intrathecal baclofen; OT, occupational therapy; PT, physical therapy; SPRs, selective posterior rhizotomies.
Dystonia

- “a movement disorder in which involuntary sustained or intermittent muscle contractions cause twisting and repetitive movements, abnormal postures, or both”

- Hyperkinetic

- Focal, segmental, hemidystonia, generalized

- Primary (hereditary – DYT genes) vs secondary (CP, stroke, head injury, tumor)

- Affects 15-25% of cerebral palsy patients
MANAGEMENT

• Goals of treatment
  • Improve function
  • Facilitate care
  • Reduce contractures
  • Reduce pain

• Oral medications
  • Baclofen, trihexyphenidyl (Artane), dopa

• Botox injections

• Surgery
**INTRATHECAL BACLOFEN PUMP**

- Intrathecal catheter with subcutaneous pump/reservoir
- 20cc or 40cc reservoir
- Suitable for pts >10kg
• Most experience is with adult movement disorders (Parkinson’s disease, essential tremor)
• Has been used in pediatric dystonia
• Appears more effective for primary dystonia
• Typically target is globus pallidus interna
• Modulates the cortical-basal ganglia-cortical loop
ATHETOSIS/CHOREA

• Athetosis = “slow, distal, wormlike, writing movements of the extremities, with fanning or hyperextension of the digits”

• Chorea = “a state of excessive, spontaneous movements, irregularly timed, nonrepetitive, abrupt in character, involuntary, rapid, brief, unsustained, dancelike movements”

• Do not respond well to surgical management – important to distinguish from dystonia
• https://youtu.be/XCzdUiSo8Y8
UNM TONE CLINIC

• First Friday of every month

• Staff
  • James Botros, MD and Barbara Bell, NP, Neurosurgery
  • John Phillips, MD, Neurology
  • Denise Taylor, MD, PM&R
  • Angela Kouri, PT
  • Catherine Burke, PT

• Send referrals!
REFERENCES


