# Therapeutic Options

## Nonbehavioral and Behavioral Therapies for Spasticity

<table>
<thead>
<tr>
<th>Treatment/Class/Agent*</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td><strong>Pharmacotherapy</strong></td>
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<td><strong>Oral Medication</strong></td>
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<td><strong>Muscle Relaxants</strong></td>
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<tr>
<td>Baclofen</td>
<td>- Most effective in treatment of spasticity caused by multiple sclerosis or other diseases of the spinal cord⁴</td>
<td>- Weakness¹,³</td>
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<td></td>
<td>- Decreases frequency and severity of painful spasms, especially flexor spasms in spinal cord lesions¹,²</td>
<td>- May impair the patient’s ability to walk or stand¹,²</td>
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<td></td>
<td>- Reduces increased muscle tone¹</td>
<td>- Sedation¹,³</td>
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<td></td>
<td>- Improves range of joint movement³</td>
<td>- Fatigue²,³</td>
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<td></td>
<td>- Decreases frequency and severity of sudden painful spasms³</td>
<td>- Nausea²,³</td>
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<td></td>
<td></td>
<td>- Dizziness¹,³</td>
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<td></td>
<td></td>
<td>- Mental confusion¹,²</td>
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<td></td>
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<td>- Sudden withdrawal may cause hallucinations,³</td>
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<td></td>
<td></td>
<td>- Anxiety,¹, tachycardia,¹, or seizures¹</td>
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<td></td>
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<td>- Benefits less clear on functional skills, such as mobility or activities of daily living²</td>
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<tr>
<td>Dantrolene</td>
<td>- Exerts effects by direct actions on skeletal muscle¹</td>
<td>- Generalized weakness, which often negates the functional improvement¹,³; use may be limited to nonambulatory patients with severe spasticity³</td>
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<td></td>
<td>- Decreases clonus, hyperreflexia, muscle stiffness, and cramping⁵</td>
<td>- Hepatotoxicity¹,³, liver function testing required³</td>
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<td></td>
<td></td>
<td>- Drowsiness³</td>
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<td></td>
<td></td>
<td>- Diarrhea³</td>
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<td></td>
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<td>- Malaise³</td>
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<td></td>
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<td>- Photosensitivity⁶</td>
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<td><strong>Anxiolytics/Benzodiazepines</strong></td>
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<tr>
<td>Diazepam</td>
<td>- Reduction of muscle tone⁴ and frequency of spasms³</td>
<td>- Sedation²,⁴</td>
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<td></td>
<td>- Frequently used in combination with baclofen treatment; less commonly used alone³</td>
<td>- Weakness⁴</td>
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<td></td>
<td>- Relieves skeletal muscle spasm due to reflex spasm to local pathology as well as spasticity caused by upper motor neuron disorders⁷</td>
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<td></td>
<td>- Causes general relaxation²</td>
<td>- Attention or memory impairment²,³</td>
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<td></td>
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<td>- Reduced motor coordination²</td>
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<td>- Long-term use can cause dependence and tolerance⁵,⁷; true physiologic addiction can occur²</td>
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<td></td>
<td>- Abrupt cessation has been associated with seizures and other withdrawal symptoms²,³</td>
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<td>- Neutropenia and jaundice can develop during long-term therapy⁷</td>
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<tr>
<td>Clonazepam</td>
<td>- Suppresses nighttime spasms²</td>
<td>- Sedation,² drowsiness¹</td>
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<td></td>
<td></td>
<td>- Confusion²</td>
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<td></td>
<td></td>
<td>- Fatigue¹,²</td>
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<td></td>
<td></td>
<td>- Lethargy¹</td>
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<td><strong>α₂-Adrenergic Agonists</strong></td>
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<tr>
<td>Clonidine</td>
<td>- Reduction of muscle tone in patients with brain injuries³</td>
<td>- Dry mouth²,³</td>
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<td></td>
<td>- Supplement to baclofen treatment⁸</td>
<td>- Sedation⁸</td>
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<td>- Can be administered via a patch changed every 7 days³</td>
<td>- Bradycardia²,³</td>
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<td>- Decreases vibratory inhibition index in patients with spinal cord injury³</td>
<td>- Hypotension²,³</td>
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<td></td>
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<td>- Constipation²,³</td>
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<td></td>
<td></td>
<td>- Depression²,³</td>
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<tr>
<td></td>
<td></td>
<td>- Dizziness²,³</td>
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*Baclofen, dantrolene, diazepam, and tizanidine are currently approved for use in patients with spasticity.² Other compounds are being used off-label.³
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## Nonbehavioral and Behavioral Therapies for Spasticity

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| **Tizanidine**          | - Reduction of muscle tone and frequency of spasms\(^\text{3,4}\)  
- Reduces spasticity without altering muscle strength\(^3\)  
- Short-acting muscle relaxant\(^4\)  
- Potentially useful option in treating spasticity of spinal and cerebral origin in patients in whom weakness is more of a concern than potential sedation\(^2\) | - Sedation\(^2\)  
- Drowsiness\(^3,4\)  
- Dry mouth\(^2,4\)  
- Dizziness\(^2,3\)  
- Muscle weakness\(^3,4\)  
- Hepatotoxicity reversible with dosage reduction\(^3\)  
- Risk of potential hypotension; avoid concomitant antihypertensives\(^2,3\)  
- Hallucinations\(^2,3\) |
| **Anticonvulsants**     |            |               |
| **Phenytoin**           | - Stabilizes the threshold against hyperexcitability caused by overstimulation\(^9\) | - Decreased coordination\(^9\)  
- Confusion\(^9\)  
- Slurred speech\(^9\)  
- Abrupt withdrawal can cause seizures in patients with epilepsy\(^9\) |
| **Carbamazepine**       | - Reduces nerve pain\(^10\)  
- Reduces polysynaptic responses\(^10\)  
- Blocks posttetanic potentiation\(^10\) | - Drowsiness\(^1\)  
- Blurred vision\(^1\)  
- Nausea\(^1\)  
- Ataxia\(^1\)  
- Vertigo\(^1\)  
- Aplastic anemia and agranulocytosis\(^1,10\) |
| **Topiramate**          | - Anticonvulsant activity\(^11\) | - Metabolic acidosis\(^11\)  
- Somnolence\(^11\)  
- Psychomotor slowing\(^11\)  
- Difficulty with concentration\(^11\)  
- Speech, language problems\(^11\)  
- Mood disturbances, depression\(^11\) |
| **Gabapentin**          | - Reduces spasticity\(^4\)  
- Decreases pain\(^4,12\) | - Somnolence\(^12\)  
- Decreased concentration\(^4\)  
- Dizziness\(^12\)  
- Nausea\(^12\)  
- Peripheral edema\(^12\)  
- Long-term use for spasticity not established\(^4\) |
| **Ethosuximide**        | - Antagonistic activity in inhibitory neural systems\(^1\) | - Drowsiness\(^1\)  
- Dizziness\(^1\)  
- Nausea, vomiting\(^1\)  
- Lethargy\(^1\)  
- Headache\(^1\) |
| **Chemodenervation**    |            |               |
| **Phenol**              | - Produces a temporary nerve block lasting up to several months\(^4\)  
- Helps control muscle spasticity\(^4,13\)  
- Acts as a local anesthetic with no long-term effects at concentrations below 1%\(^13\)  
- Affects all neural tissues between 1% and 7%\(^13\); may cause permanent injury at concentrations >5%\(^14\) | - Local soft-tissue injury can result\(^13\)  
- Highly variable duration of action\(^13\)  
- Muscle necrosis\(^13\)  
- Postinjection pain\(^13\)  
- Dysesthesia\(^13\)  
- Vascular complications may include peripheral edema and rarely deep vein thrombosis\(^13\)  
- Location of injection should be verified with electrical stimulation technique\(^15\)  
- Pain of injections may require local anesthetic\(^13\) |

*Note: Baclofen, dantrolene, diazepam, and tizanidine are currently approved for use in patients with spasticity. Other compounds are being used off-label.
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| Alcohol                | Quick onset of action (<1 hour)<sup>13</sup>  
Acts as local anesthetic at concentrations of 5% to 10%<sup>13</sup>  
Higher concentrations (>45%) cause neural destruction<sup>13</sup>  
In adults, use of up to 100% in intramuscular injections is safe<sup>15</sup>  
In children, use of 50% to 60% of alcohol is preferred<sup>16</sup> | Associated pain; conscious sedation or general anesthesia is usually required<sup>13</sup>  
Skin irritation<sup>13</sup>  
Muscle discomfort<sup>13</sup>  
Muscle and soft-tissue damage may occur<sup>13</sup>  
Location of injection needs to be verified with electrical stimulation technique<sup>15</sup> |
| Botulinum neurotoxin   | No anesthetic required<sup>14,16</sup>  
Results in localized decrease in spasticity symptoms<sup>14</sup>  
Effective for reducing spasticity-related pain<sup>14,19</sup>  
Injection can concentrate on the relevant overactive muscle groups without causing systemic side effects<sup>18</sup>  
Injections can be guided into the appropriate muscle using electrical stimulation<sup>15,20,21</sup> or electromyography<sup>5,17,20,21</sup>  
Effect is reversible<sup>14,18,22</sup> | Transient weakness of muscles can occur due to local diffusion of botulinum neurotoxin, especially when large volumes are injected at one site<sup>17</sup>  
Tolerance can develop because of immunoresistance<sup>17,18</sup>  
Repeated injections are often required because effect is reversible<sup>18</sup>  
Should be complemented by rehabilitation therapy, splinting, and other therapies<sup>18,20,21</sup> |
| Physical Therapy       | Treatments designed to reduce muscle tone and improve range of motion, functional mobility, and muscle strength may reduce pain<sup>20</sup>  
Stretches muscles; helps prevent muscle shortening<sup>14</sup>  
Response to therapy improves when complemented by chemodenervation<sup>3,14,21</sup> | Direct effects of muscle relaxation are short-lived<sup>3</sup>  
Physiotherapy alone is often insufficient to treat symptoms<sup>3</sup>  
Pain may interfere with treatment<sup>14,23</sup> |
| Occupational Therapy   | Treatments designed to reduce muscle tone and improve range of motion, functional mobility, and muscle strength may reduce pain<sup>20</sup>  
Stretches muscles; helps prevent muscle shortening<sup>14</sup>  
Response to therapy improves when complemented by chemodenervation<sup>21</sup> | Direct effects of muscle relaxation are short-lived<sup>3</sup>  
Pain may interfere with treatment<sup>14,23</sup> |
| Surgery                | Direct administration of baclofen into the spinal cord allows a continuous supply of baclofen to the site of action<sup>3,4</sup>  
Useful for severe cases of spasticity that do not respond to other less invasive treatments<sup>3</sup> as well as for nonambulatory patients<sup>3</sup>  
Less central adverse effects as compared to oral baclofen because of reduced dose required<sup>3,16</sup>  
Reduces painful spasms<sup>3</sup>  
Reduces spasticity in terms of both muscle tone and frequency of spasms<sup>3,4</sup> | Surgical technique to install pump, reservoir, and intrathecal catheter<sup>3</sup>  
Risk of complications due to catheter or pump failure<sup>3,4</sup> and infection<sup>3</sup>  
Drowsiness<sup>3</sup>  
Headache<sup>3</sup>  
Weakness<sup>3</sup>  
Risk of drug withdrawal<sup>2,15</sup>  
Risk of death due to overdose or withdrawal in cases of pump dysfunction<sup>2,27</sup> |
| Neursurgery            | Useful for severe cases of spasticity that do not respond to other less invasive treatments<sup>3,14,19</sup>  
Reduces painful spasms<sup>3</sup> | Complications due to surgery |
| Surgical lengthening, transfers, and releases of individual muscles<sup>28</sup> | Fixed contractures may be better managed by surgical releases<sup>20</sup>  
May provide long-term muscle rebalancing<sup>28</sup> | Complications due to surgery |

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