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Pathophysiology of Spasticity and Hypertonicity

Terry Winkler, M.D., CLCP

Abstract. *Life care planners often work with individuals who experience spasticity and hypertonicity as a result of catastrophic injury or disability. This article defines and differentiates spasticity and hypertonicity and offers information about the pathophysiology of these conditions. Beneficial effects are reviewed as well as discussion of specific treatment options which must be considered prior to development of a life care plan.*

Introduction

Spasticity is a velocity dependent increase in muscle tone with exaggerated tendon jerks resulting in a hyperexcitability of stretch reflex. This leads to an involuntary rhythmic contraction of the body part in response to a relatively quick movement. Hypertonicity is an increase in the resting tone of a motor group or muscle group which tends to make movement stiff or rigid and, in some cases, not possible at all. The life care planner may encounter both spasticity and/or hypertonicity in many different types of injuries and disease states which are characterized by upper motor neuron injuries. Some common causes include:

- Cerebral palsy
- Spinal cord injury
- Acquired brain injury
- Multiple sclerosis
- Stroke
- Central nervous system tumors

In general, spasticity remains the same or increases as the individual ages with the disability. Spasticity and hypertonicity have advantages and disadvantages. Decisions to treat or not to treat are based upon how the increased tone or spasticity interferes with functional activities or, in some cases, assists and supplements accomplishing functional activities.

REQUIRES TREATMENT

Interferes with activities of daily living (ADLs)
Interferes with transfers
Produces pain and discomfort
Interferes with rest or sleep
Interferes with mobility or balance
Interferes with range of motion, producing contractures
Interferes with sitting posture and positioning

BENEFICIAL EFFECTS

Improves functional activity, pinch or grasp
Improves transfers
Inhibits muscle atrophy
Inhibits osteoporosis

Many scales have been developed to quantify the severity of spasticity. One of the most commonly used is the Modified Ashworth Scale which ranges from 0 to 4.

- Grade 0 No increased tone.
- Grade 1 Slight increased muscle tone with some minimal resistance at the end of range of motion.
- Grade 1+ Slight increased tone and minimal resistance to range of motion through the range.
- Grade 2 Marked increased muscle tone through most of the range of motion.
- Grade 3 Passive movement is difficult.
- Grade 4 Rigidity is present, making range of motion not possible.

The life care planner must consider a variety of options available to treat hypertonicity or spasticity in the client they are evaluating. The general approach is to go from the least invasive interventions to the most invasive. Below are nine of the more common approaches to spasticity/hypertonicity treatment in which the life care planner must consider prior to developing a future plan of care.

Nutritional considerations: Hemingway (2001) reports approximately 30% of a child's caloric energy requirement is related to severe spasticity. Ayyangar (2002) reports that a child with spastic quadriplegia has calorie needs in the range of 2,900 to 4,600 kilojoules per day, requiring a formula with higher nutrient energy ratio to eliminate the risk of nutrient deficiency. Dietary consults and appropriate nutritional studies are mandatory in clients who have spasticity and should be included in the life care plan.

Reducing the stimulus: An important concept for treatment of spasticity or hypertonicity. This is accomplished by providing patient education via rehabilitation physician, physical therapists, and/or rehabilitation nurses with a goal of preventing or reducing noxious stimuli that can make spasticity worse and preventing complications of spasticity such as skin breakdown, joint dislocation, and contractures. Increasing spasticity and hypertonicity often is a sign of a hidden noxious stimuli and requires a thorough medical evaluation to rule out diseases, such as cholelithiasis (gallstones), occult fractures, coronary artery disease, renal calculi, or other sources of noxious stimuli, whose symptoms are partially hidden by the disability. An important adjunct to prevention or minimizing the stimuli for spasticity is proper positioning in the seating system, bed, or with splints. A daily range of motion (ROM) and stretching program is helpful with slow, steady, prolonged stretch provided by caregivers, splints or braces, and weightbearing activities as tolerated. Moderate or severe spasticity requires a much longer duration of stretch, potentially as long as six hours. Additionally, whirlpool treatment and hydrotherapy are important adjuncts to managing spasticity.

Therapy: Both physical therapy and occupational therapy are utilized to provide modalities such as icing or cooling, superficial or deep heat, therapeutic exercises, electrical stimulation, custom-made splints or serial casting to manage spasticity.

Orthotics: Custom-made tone reduction orthoses, commonly referred to as inhibitory orthoses, can be made to help in reducing increased tone in the upper extremities or lower extremities.

Medications: Often required to manage spasticity. Perhaps the most commonly used oral agent is Baclofen which is safe and efficacious in both pediatric and adult spasticity; has a short half life of 2 1/2 to 3 hours, and generally requires four times a day dosing in most situations. If Baclofen is utilized, the life care planner must make certain their recommendations provide adequate supplies and access to physicians to monitor the medication, since abrupt withdrawal can lead to seizures and hallucinations which may be life threatening. Other spasticity medications include Valium, Zanaflex, Dantrium. Dantrium is commonly used in spasticity of cerebral origin and requires careful monitoring of liver function tests, particularly in people over age 30 to 40.

Nerve and/or motor point blocks: Motor point block techniques have been used for a number of years and require injection of an anesthetic or neural ablating agent, such as phenol or alcohol, close to the motor point in a muscle. To be effective, this technique should be done by physicians who use electromyography (EMG) machines to guide the placement of the neural blockade agent. Common agents used include Lidocaine, Marcaine, Phenol, ethyl alcohol and Botox. One disadvantage of this technique is that it is time limited, the spasticity generally returns anywhere from one to six months, and repeat blockage is required. There is a small chance of dysesthesia or a causalgia type pain developing if a mixed nerve, which has both motor and sensory fibers, is blocked. Botox injections are typically very effective if placed appropriately and have less chance for negative side effects when used properly.

Intrathecal Baclofen pump: Can be used when other forms of spasticity management have failed. Due to its expense and potential for complications, this intervention is one of the last resorts for spasticity management. However, many individuals with moderate to severe spasticity or hypertonicity do require this intervention. As with all items of service recommended by a life care planner, the cost to implant a Baclofen pump, ongoing pump monitoring and evaluations, pump refills with medication, and replacement of the pump generally on average every 5-7 years must be carefully researched with the vendors providing the service and included in the life care plan.

Surgical interventions: A dorsal root rhizotomy is a surgical procedure used in children with cerebral palsy, typically age 4 to 8, when spasticity interferes with upper extremity use or causes scissoring of the lower extremities when the child attempts to ambulate. In this procedure, a multi-level laminectomy is performed by the neurosurgeon and the dorsal afferent nerve roots, which are involved in the spastic and hypertonicity response, are cut in a selective fashion. Following dorsal root rhizotomy, the child will have strict limitations on range of motion of the trunk and lower extremities from 4 to 8 weeks. This will be followed by a requirement for intensive physical therapy for up to one year to try to learn how to take advantage of the changes in the spasticity and tone.

Additional surgeries: Options may include contracture releases, tendon lengthening procedures, arthrodesis of a joint, hip abductor releases, and Achilles' tendon lengthening.

Conclusions

Spasticity is a common problem for clients often seen by life care planners. In clients with spinal cord injury alone, almost 80 percent will experience spasticity and over 90 percent with tetraplegia will have spasticity. Half of those will require medications. Spasticity, untreated or under treated, can lead to many complications for the client; some of which include nutritional depletion, skin breakdown, joint contractures, joint dislocation, and reduced or impaired function. Considering the parameters discussed in this brief overview of spasticity, taking a careful history regarding spasticity and hypertonicity from the client/caregiver, and consulting with knowledgeable health care providers who manage spasticity, will allow the life care planner to develop a reasonable and prudent approach to lifetime management of spasticity and hypertonicity and a reduction of potential complications for the client.

References

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About the Author

Terry Winkler, M.D., CLCP, Board Certified Physical Medicine and Rehabilitation and Spinal Cord Injury Medicine Physician, private practice, Springfield, MO. In his practice, Dr. Winkler specializes in traumatic and acquired brain injury, spinal cord injury, amputations, and life care planning. He holds academic appointments as Clinical Associate Professor at the University of Florida, Gainesville, FL, and Clinical Professor at Louisiana State University Health Sciences Center, New Orleans, LA. In addition, Dr. Winkler serves on committees that review grants in spinal cord injury research for the Paralyzed Veterans of America and the National Institute on Disability and Rehabilitation Research. He has several publications in the area of life care planning.