Looking at Spasticity From a Patient's Point of View

Spasticity occurs when an upper motor neuron lesion in the brain or spinal cord causes a muscle to be hypertonic, stiff, and resistant to stretching. It tends to be "velocity dependent", such that, when one attempts to quickly stretch the muscle, it contracts reactively, with excessive force. It can present as intermittent spasms or sustained contractions.[1] The upper motor neuron lesion results in an imbalance of excitatory over inhibitory impulses, with hyperexcitability of the spinal cord reflex arc. Essentially the patient has less control over voluntary movement and is prone to involuntary movements. A spastic antagonist muscle may be paired with a spastic agonistic muscle, but the stronger muscle will dominate, with a net result of an abnormally flexed or extended limb.

The exact incidence and prevalence of spasticity is unknown, but it is estimated the half a million in the US and 12 million people worldwide experience spasticity.[2] It is common after a stroke, with 38% of stroke survivors experiencing spasticity within one year following a first stroke.[2] In patients with MS, 84% have spasticity, and in 34% of MS patients, spasticity affects activities of daily living.[2] Worldwide, 0.2 to 0.4% of children between 2 and 10 years old are affected by cerebral palsy[2], and 90% of patients with CP present with spasticity.[3] 40% of patients with spinal cord injury and 50% of those with TBI experience spasticity.[3] Spasticity can also occur with various degenerative, metabolic, or infectious insults to the motor cortex or spinal cord.

Gap #1. Clinicians may be unaware of the importance of recognizing spasticity and distinguishing it from other upper motor neuron symptoms, and of the impact it can have on the patient and caregivers.
Learning Objective #1. Recognize the varied causes and presentations of spasticity and its impact on individuals' quality of life.

Spasticity can range from subtle signs, such as hypertonic reflexes, to severe increased muscle tone leading to subluxation, dislocation and/or heterotopic ossification with deformation of joints.[3] **Spasticity thus affects mobility, posture, and ability to perform activities of daily living. It can lead to contractures, pain, pressure sores, urinary tract infections, and other complications of immobility.** Depression and anxiety are common, as patients lose independence and experience pain and discomfort.

Managing spasticity requires a thorough understanding of its physiological processes and of the mechanical properties causing the abnormal muscle synergy that occurs in response to the spastic muscle(s). **It requires an understanding of its natural history, and multidisciplinary care and therapy need to be continued and consistent over time.** [4]

Spasticity can occur alone, but usually is accompanied by other symptoms of upper motor neuron syndrome. There is often paresis, especially of the fingers, which can impair hand coordination.[1] Reduced dexterity, muscle weakness, and decreased postural responses can coexist with spasticity. Spasms do not only occur as velocity-dependent responses to stretch, but can occur in response to visceral, peripheral, or noxious stimuli.[4] Spasticity can have a domino effect, with co-contractions triggered in proximal muscles, disrupting muscle synergies, leading to non-physiologic postures, and ultimately, pain and disability. Two opposing muscles can both be spastic, but the stronger muscle will determine the posture of the limb; hence the classic flexed arm and hand often seen following a stroke.[4]

After a newly acquired neurologic insult and prior to the appearance of spasticity, a patient may present with flaccidity; it can take up to a year for spasticity to develop. Over time, intrinsic changes occur in the motor neurons, which are not sufficiently inhibited at the spinal cord. **As spasticity develops, the spastic muscle shortens, and without therapy, can lead to changes in the connective tissue and nearby muscles, causing contractures**. Stiffness in connective tissue can also occur without muscle contraction, and this cause of stiffness needs to be distinguished from that of spasticity; the former can be treated with stretching and splinting, whereas the latter may respond to medications. [4]

To assess the impact of spasticity, **patients and their caregivers were invited by email to participate in a "Burden of Spasticity" survey distributed by Carenity, a social media platform for patients with chronic illness**. 427 patients and 188 caregivers participated in the survey and reported the following: [5]

- **98% reported difficulty carrying things**
- **97% reported difficulty with walking**
- **96% reported difficulty with driving**
- **44% of the patients do not work or work part-time because of their condition**

The survey found that overall quality of life was impacted for almost all patients, and was greatly impacted for 50%, and that the condition had the most impact on sexual life, self-esteem, and mental-health.[5]

Caregivers were also surveyed and 29% reported that they worked part-time or were unemployed, in order to take care of the patient.[5] **It was found that caregivers of stroke survivors with spasticity had poorer physical and emotional health compared with the general population.**[6] As for socioeconomic burden, health care costs for stroke survivors with spasticity are 4 times higher than those for stroke survivors without spasticity.[6]

GAP #2. Clinicians may not be aware that current validated assessment tools may not give an accurate picture of a patient's overall function.

Learning Objective # 2. Clinician will utilize integrated and validated assessment tools to evaluate spasticity and its effect on the patient's overall function.

Several tools are available to quantify spasticity, in somewhat limited terms. The Ashford scale has been validated to measure muscle rigidity. Gait and range of motion can be assessed and noted on the Physicians Rating Scale. Spasms can be counted and quantified on the Spasm Scale. The Tardieu Scale measures muscle response to stretch at given velocities.[7] The Modified Frenchay scale, assessing hand use, and the walking test, assessing lower limb activity, are also validated and useful assessment tools.[8]

While these tools are helpful, there is a need to look at patient holistically. Historically, the focus has been on the effect of spasticity on a single joint,[8] whereas the totality of function is more important. Improvement in a single joint does not necessarily mean improvement in function or in quality of life. Spasticity is not merely velocity dependent, but is also affected by joint position and muscle length, and these variables are constantly changing with "realistic, active movements", and are thus "movement dependent."[8] **Merely eliminating spasticity without looking at the effect of an intervention on the patient's functional goals may not lead to clinical improvement even if there is "improvement" in the spastic muscle. [8]**

An integrated assessment tool was developed and used on patients with upper arm spasticity, participating in a large, multi-center, non-interventional study (Upper Limb International Spasticity Study, or ULIS-III).[9] This two-year study was designed to a reflect outcomes of real-world practice, in terms of patients preferences, capabilities, and functional goals. Outcomes were measured with a hybrid tool that utilized the Goal Attainment Scale (GAS), which translates goal attainment into metrics[9], wedded to a scale consisting of functional domains chosen and weighted by the patient. Thus, each patient's unique outcomes are quantified based on goals valued by the patient. **This tool, the Goal Attainment Scale - Evaluation of Outcomes for Upper Limb Spasticity (GAS-eous) allows patients to choose domains of function that are of priority to the patient, and integrates these with appropriate, focused, and validated measurements or SMART tools, selected based on their relevance to the chosen goal domains.[10]**

Gap # 3. In spite of the benefit of goal-setting for patients, physicians often have limited time to set goals with patients, evaluate outcomes, and revise plans. It is also apparent that many physicians are not aware of level A recommendations to offer BoNT-A to patients with spasticity.

Learning Objective #3. Develop individualized treatment strategies based on shared goals and available treatment options.

Following a brain or spinal cord injury, a patient may present with "self-imposed hypoactivity" which then leads to decreased neuronal recruitment and decreased brain plasticity, causing disuse syndrome and continued decline.[8] **Patients who experience a stroke often have significant residual arm and hand disability, even after formal rehabilitation. One study followed patients for two years after a first stroke, and found that 50% of the survivors living in the community needed help from a caregiver, and many reported a "lack of meaningful activity" [11]**

Goal setting can be helpful in engaging the patient in rehabilitation, increasing personal agency, and providing daily structure, which can also have a positive effect on mental health. Physical rehabilitation has been shown to benefit stroke survivors, but effective rehabilitation requires long-term and consistent adherence by patients and caregivers. For example, stretch postures of target muscles can help in lengthening muscles to prevent contractures, if held for an adequate duration, and on a daily basis as shown in a randomized controlled trial.[12] This and other beneficial exercises are time consuming, and it has been noted that more than an hour of rehabilitation per day is needed Appropriate goal setting and guided self-rehabilitation can provide structure and motivation for patients who may feel otherwise overwhelmed by the challenges they face.

A tool such as GAS-eous can be used to involve patients in their own rehabilitation by giving them choices in the goals that are important to them. It can also serve as an outcome report for the care team to use to evaluate their interventions. The GAS-eous tool also enables the patient to report on quality of life and to list all interventions, so that relationships can be observed between interventions, quality of life, and attainment of patients weighted goals.[10, 13]

While goal-setting and rehab are the cornerstone of treatment for spasticity, medications are available which can help facilitate rehabilitation by relieving pain and stiffness. A first line treatment of spasticity is baclofen, a GABA agonist, that works primarily at the spinal cord, and has been shown in studies to improve clonus, flexor spasm frequency, and joint range of motion. It must be used carefully in renal patients as it is cleared by the kidneys. It can cause weakness, ataxia, fatigue, and sedation. Abrupt withdrawal should be avoided as it can cause hallucinations, agitation, psychosis, malignant hyperthermia, seizures, dyskinesia, and increased spasticity. Baclofen taken orally, can induce tolerance, requiring dose increases that may induce sedation beyond an acceptable level. [7] This can be especially concerning in the case of children with spasticity, as it can interfere with schooling, therapy, and development. Baclofen can also potentiate depressant effects of other sedating drugs often used to treat spasticity.

The sedating effects of oral baclofen can be circumvented by using intrathecal baclofen (ITB), which, because it avoids the GI tract, can be given in smaller doses. In a study comparing 198 patients using intrathecal baclofen with 315 patients using oral baclofen, those using ITB had lower levels of spasticity, fewer spasms, and less leg stiffness and pain than did those using oral baclofen.[14]

ITB requires a surgical procedure to place a small pump in the abdomen, which releases the medication as programmed, via a catheter that goes into the intrathecal space. The ITB requires expertise in management as it can present some complications, including pump or catheter malfunction and infection. In spite of this small risk**, ITP is preferred by many patients because it reduces spasticity, improves sleep and facilitates independence, self-care, and urinary function. [14]**

In a database of over 17,501 patients with multiple sclerosis and spasticity, baclofen was the most commonly used medication, followed by gabapentin, tizanidine and diazepam.[14] A study reported in 2018 found gabapentin was not superior to placebo in the treatment of spasticity with MS. [15] **Tizanidine and diazepam showed similar efficacy to baclofen in clinical trials, and they can be used adjunctively with baclofen to decrease dose-dependent side effects.[16]**

Dantrolene sodium acts on muscle fibers, reducing muscle tone, clonus and spasm, and is less likely to cause adverse cognitive effects than other commonly used agents. This makes it especially useful to patients with traumatic brain injury and cerebral palsy. Hepatotoxicity can occur, but in less than 1% of patients, and elevated liver function tests are seen especially in adolescents and in women treated for more than 60 days at dosages greater than 300 mg/day.[17] **Dantrolene should not be used with tizanidine as both can be hepatotoxic.**[17]

As an adjunct to oral and intrathecal treatments and rehabilitation, botulinum neurotoxin can be injected directly into target muscles to reversibly decrease tone for weeks to several months**. In 2016, the American Academy of Neurology (AAN) gave Level A recommendations for the treatment of adults with upper-limb spasticity to three formulations, abobotulinumtoxinA (aboBoNT-A), incobotulinumtoxin-A (incoBoNT-A), and onabotulinumtoxin-A (onaBoNT-A). For treatment of adults with lower-limb spasticity, Level A recommendations were given for aboBoNT-A and onaBoNT-A.** [18]

AboBoNT-A is approved for treatment of lower limb spasticity in children, and onaBoNT-A was approved in June for the treatment of upper limb spasticity in children age 2 to 17years. Treatment with botulinumtoxin can allow pediatric patients the mobility to participate in rehabilitation and may facilitate brain plasticity.[8] In children with CP, 80% of which are of the spastic subtype, BoNT-A has shown a positive effect on range of motion, spasticity reduction, and gait pattern.[18]

RimaBoNT-B was given a Level B recommendation for treatment of adult upper-limb spasticity.[18] Botulinum toxin can induce antibody formation and drug resistance in some patients, and it has been suggested that treating patients with an alternative serotype might induce a response in a patient that has developed resistance to BoNT-A.[19] Indeed, **recombinant technology is allowing for the development of new neurotoxins with the goal of producing products that have faster onset of action, faster onset of maximal effect, greater peak effect, and shorter duration of action.[20]**

The Spasticity Study Group has made dosage recommendations based on consensus agreement, and this includes the recommendation that injections be given in 3 to 6-month intervals, and no closer than every 3 months, to prevent antibody formation.[21] **Administering BoNT-A is a skill, and it is suggested that clinicians should be well trained on patient assessment relevant to spasticity and function, dosages, injection technique, and side effects.[21]**

Decreasing spasticity does not always lead to better function, as a patient's ability to walk or transfer may depend on the rigidity of the spastic leg muscle. Without spasticity, the opposing weak muscles may be unable to support function. In deciding which muscle to inject, clinician should look at the whole muscle group involved. Treatment of only the agonist muscle may reveal that the weaker, antagonist muscle is actually also spastic, and this can create unanticipated problems; thus a clinician might choose to treat the antagonist muscle as well.[22] **However, injection techniques are not the only important consideration; Molenaers et al. found that successful outcomes also depended on amount of physical therapy per week, post-injection casting, and frequency with which day and night orthoses were used after injection.[23]**

While BoNT-A has been well-studied in clinical trials, the Carenity survey looked at real-world experiences of patients receiving BoNT-A in addition to other treatments and evaluated efficacy of treatments based on patients' chosen goals. 87% of patients did say that treatment goals were discussed with doctors. **Of special concern to patients were fear of injections (312/427 patients; 73%), costs of getting injections (324/427; 76%), frequency of injections (335/427; 78%) and availability of timely appointments (339/427; 79%). In spite of these concerns, 92% of patients, reported that BoNT-A treatment resulted in improvements in overall satisfaction with life, and for the individual domains, improvements were reported for 81 to 94% of patients .[20]**

In spite of AAN recommendations, and the positive responses of patients, the Carenity survey also found that there was an average delay of 4.6 years between time of diagnosis and initiation of BoNT treatment. Physicians who are hesitant to prescribe Bont-A may be more comfortable with an assessment tool similar to GAS-eous, as it will allow them to get a more complete picture of the efficacy of treatments. It will also prompt thorough documentation which can be helpful to patients concerned with costs. It has been noted that payers may only reimburse for standard doses and frequencies, but a clinician may choose to deviate from standard dosing due to the particular response of a patient. **Payers are more likely to reimburse unconventional usage if a rationale is documented, and assessment tools like GAS-eous would facilitate thorough documentation. [23]**

The manufacturers of incoBoNT-A, onaBoNT-A and aboBoNT-A provide assistance with financing and/or payer negotiations, and patients should be referred to these programs, if necessary. **Several of the manufacturers also provide physician training on BoNT-A dosing and injection techniques. [24]**

Social media can provide support to patients and caregivers, and physicians can encourage patients to seek out these resources. Carenity.com has patient education and forums, and its surveys are used to provide anonymous data which can be used to advance research on treatments.[25] This can be an important source of meaning and purpose for patients. **Life With Spasticity** is an educational and motivational platform designed by, and for, stroke survivors with spasticity. In a statement that illustrates the benefit of patient engagement, patient ambassador Kasia Siewruk states, "In my experience as a stroke survivor, even mild spasticity can be a huge problem. It affects your quality of life; it is uncomfortable and painful. Yet, the problem is not widely recognized by doctors and patients. It is impossible to fight an unknown enemy, and that is why I'm very happy to be a part of this project, which provides reliable information about spasticity. I'm sure that this project will help a number of people who struggle with neurological problems."[26]

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