Review

Spasticity: a review of methods for assessment and treatment

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Spasticity is the condition resulting of corticispinal damage as occurs in some neurological diseases. The aim of the article is to review the literature on assessment and treatment of spasticity and spastic limbs. The assessment and treatment methods are studied the study involves different method of mangement of spastic limbs in depth. Different method of evaluation of spasticity, including biomechanical and clinical assessment are reviewed and also some of the most common treatment methods of spasticity are studied. A number of methods for assessment and treatment of spasticity are reviewed, some of methods commonly used for assessment or management of spasticity, depend on the condition of the patient and the aim of the therapist a method may empoyed.

Key words: spasticity, spastic limb, assessment of spasticity, management of spasticity

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Introduction

Spasticity, derived from the greek word *spastikos* (to tug or draw) is characterised by resistance to passive movement of a joint, usually in a variable manner so that there is a velocity dependent increase in resistance often associated with a sudden giving way (so called claps-knife effect) (1).

Patients with brain lesions often display hypertonia, or spasticity; spasticity is a motor disorder characterized by a velocity-dependent increase in tonic stretch reflexes with exaggerated tendon jerks, resulting from hyperexcitability of the stretch reflex (2)

The prevalence of cerebral palsy was reported to be 3.6 per 1000 in 8-years-old children and the majority of children with cerebral palsy are affected by spasticity(3). More than 80% of people with spinal cord injury have spasticity, and many have greater disability because of Spasticity develops gradually over several months after injury (4). In spasticity the normal reciprocal innervation is disturbed and during movements undesirable co-contraction of different muscle groups occures and prevents skillful movements causing loss of function in patients Colin and Daly(5) stated that movements disorders as a result of upper motor neuron damage are known as either positive or negative symptoms. They described that the positive and negative symptoms of spasticity are independent symptoms and depend on the place and amount of lesion and spontaneous improvements. that positive symptoms (dynamic assessment) are abnormal behaviour including all exaggeration of normal phenomena, ie; hyperreflexia. The negative symptoms (static assessment) are motor control or preference deficits including weakness, loss of function and dexterity .

Spasticity occurs in many neurological condition, depending on the nervous system involvement the characteristic of the spasticity is variable, spasticity not only limits function but may lead to existing flexion contractture (6).

Spasticity is present in a group of muscles rather than a particular muscle. When spasticity is present, all muscles of the related limb are adopted to the pattern of spasticity (flexion or extension), in the case of the patient with spasticity in extensor muscles of the lower limb, spasticity will present in extensors, adductors and medial rotators of the hip, extensors of the knee and plantar flexor of the foot (7). Khalili and Yadegary described that manual dexterity affected by spasticity and dependent on coordination between the central nervous system, peripheral nerves and the upper limb muscles (8).

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Various stimuli may affect spasticity. Spasticity may be changed by various factors, there may be a fluctuation in the spasticity during the day and this seems more pronounced in persons with spinal cord injury (9) Therefore, to avoid variation of experimental results, the conditions of the patient and the experimental results, the conditions of the patient and the experiment must be the same(10).
Lesion of the corticospinal pathways at different levels of the brain (cerebrum and the spinal cord) cause spasticity, Some important factors and diseases causing spasticity are; multiple sclerosis, head and/or spinal cord injury, cerebral palsy, cerebral vascular accident and other neurological conditions(11).

Assessments

Clinical assessment may affect management programme of spasaticity. During decades many methods for assessment of spastic limbs, have been applied depending on the aims and treatment programme of investigators, to assess the spastic limb recovery. However, there is no total agreement among investigators as to what method of assessment is the most suitable for evaluation of spasticity.
Ashworth scale and modified Ashwoth scale are the most common scales for assessment of spasticity. However, those are not suitable methods of spasticity assessment(12). A number of the other tools have been proposed for measurement of tone, these tools are motor assessment scale, Oswestry scale of spasticity. Some of investigators employed electrodignostic technique for meaurement of spasticity, but this technique can be used only for individual muscle or local measurements (13). Also an assessment method has been suggested for disabled people with spastic limbs(14), this method is used for sport and functional classification. The mejority of the spasticity scales are based on assessment of resistance during passive movement(11).
Investigators widely employed this assessment methods for spastic limbs, eg; Nuyens and colleages used the Ashworth Scale for measurement of spasticity (15) and Khalili and Hajhassanie employed Modified Ashworth Scale for evaluation of spastic limbs in children with cerebral palsy(10). However, in a study Fleuren and co-workers proposed that the validity and reliability of the Ashworth scale is insufficient to be used as a measure of spasticity(12). The other assessment methods have been used for evaluation of spastic limbs. Josien and co-workers in 2009 used goniometry in estimating the joint angle of the catch in spasticity assessment of the medial hamstrings, soleus and gastroenemius in twenty children with Cerebral palsy(16). Also they used modified Ashworth scale for assessment of children with spasticity on their lower limbs.
Deglado and colleages in 2010 proposed a number of tools for assessment of spasticity including Tardieu scale and recommended that Tardieu scale is a proper tool for evaluation of spasticity(3).
Some of investigators assessed reliability and validity of the measurements and they reported a variety of the results, modified ashworth scale(15), pendulum test(17), range of motion (18). Khalili assessed goniometric measurement on 16 healthy subjects and reported that it is necessary to standardize the method of goniometric measurement in different parts of the body (18).
Isokinetic dynamometers have frequently been used for evaluation of spasticity. Biering and co-workers (9) stated the great advantage of Isokinetic dynamometers is standardization of the applied stretch velocity-dependent and amplitude possible, and thereby can measure the velocity-dependent resistance in the muscle to passive movement. Biering and co-workers suggested that, a combination of electrophysiological and biomechanical techniques shows some promise for a full chartacterization of spastic syndrome, there is a need of simple, standardized instrument, which provide a reliable quantitative measure with a low interrater variability.

Treatment

There is no model based evidence agreed and available for the management of spasticity and much of what is done is based on a logical and pragmatic approach(19).
The key to succeed the management of spasticity is education of the patient and carers with both verbal and written information. This allows them to understand, appreciate and be fully involved in the management plan(20). Doctors, physiotherapists, occupational therapists, and nurses across primary and secondary care can play key roles in working with the individual and their carers to assess the degree and impact of spasticity, identify the treatment goals, initiate referring to the specialist, implement management programmes, and monitor the effects of all the mentioned interventions. Effective spasticity management requires clear communication and

documentation between the individual and all the services involved in their care (19) .

"Theorically, the best chance for full functional recovery would be total anatomical restoration of the lost neurons and axonal corrections. This would require replacement of the lost neurons, regeneration of injured axons and restoration of synaptic contacts that were lost(20).

Current clinical management of spasticity involves a wide variety of therapies ranging from noninvasive (eg, oral administration of antispastic drugs, physiotherapy) to invasive procedures (eg, surgical rhizotomy). The type and rate of treatment depend on the levels of spread (diffuse versus focal) and disability caused by spasticity.

Bavikatte and Gabe in 2009 proposed the following aims for management of spasticity(20);

1. Improve function- mobility , dexterity
2. Symptom relief (Ease pain- muscle shortening, tendon pain, postural effects, decrease spasms, orthotic wearing)
3. Postural- Body image
4. Decrease carer burden- care and hygiene, changing position, dressing
5. Optimise service responses- to avoid unnecessary treatments, facilitate other therapy, delay/ prevent surgery

Shaw and Rodgers(22) described that pharmacological, Physical and surgical treatments are currently employed in spasticity management.

Pharmacological: The most commonly used antispastic drugs are Baclofen, Benzodiazepine, Clonidine, and Ttizanidine. Each of these drugs could be used alone or in combination with the others to obtain a desired effect and are administered orally or intrathecally(4) .

Physical modalities: Simple physical treatments such as correct positioning, stretching and exercise therapy are recommended for use in the first stage of treatment (22). Collin and Daly stated that rehabilitation techniques, positioning, splinting, and stretching have a large part to play(5). DeSouza and colleages proposed that an approach to rehabilitation that views the in the individual in his or her social, family, work and cultural roles, informs the therapist about the impact of disability on the individual lifestyle(23).

A number of investigators studied to determine a suitable method for the treatment of patients with neurological conditions, ie; stretching, cooling muscle and heat, Bobath technique, Brunnstrome technique, proprioceeptive neuromuscular facilitation, and nerve block The aim of such techniques would be to help patients to obtain as much normal active movements as much as possible, but the therapist must be trained in each method(20, 24). Stretching in spasticity can improve muscle flexibility, reduce muscle stiffness, and improve function. Clinically, a number of stretching techniques is used including static, dynamic, Proprioceptive Neuromuscular Facilitation (PNF) for improvement of spastic limbs (25).

Electrical stimulation of muscles and nerves has been used in the rehabilitation of patients with neurological problem to reduce spasticity and improve limb functions, this method can be applied for children and adults with spasticity(10), Vodvonik and co-workers suggested that about one-half of randomly selected spinal cord injury patients with knee joint spasticity might benefit electrical stimulation(26). Khalili and Hajhassanie applied electrical stimulation on spastic limb of children with cerebral palsy and reported that electrical stimulation may contributing improvement of spasticity in children(10). Various electrical stimulation modalities have been used to reduce the level of spasticity. These conditions vary from surface electrical stimulation of muscles to electrical stimulation of the peripheral and central nerves. Electrical stimulation of peripheral nerves would block sensory and motor muscle activity and may prevent the transmission of residual voluntary activation of muscles that might remain after incomplete spinal cord injury(4). It has been reported that the load that is applied to paralyzed muscle during an electrical stimulation training program is an important factor in determining the amount of muscle adaptation that can be achieved(27).

Davis and co-workers (28) explained some of the advantages of electrical stimulation leg exercise include augmented “cardiorespiratory fitness, promotion of blood circulation in the leg, increased activity of specific metabolic enzymes or hormones, greater muscle volume and fiber size, enhanced functional exercise capacity like strength and endurance, and altered bone mineral density.” Positive psychosocial adaptations have also been reported among SCI individuals who undergo FES exercise.

Peripheral nerve block in control of spasticity: Nerve block can be used in the treatment of spasticity. Nerve block refers to the application of a chemical agent to a nerve to either temporarily or permanently

impair the function of the nerve. The agents most frequently used are phenol, alchol and local anesthethetics(29). Khalili and co-workers used the technique by the application of phenol for peripheral nerve to block electrical stimulation of the motor nerve innervate to the related (spastic) muscles(30). Since then the technique has been widely developed (24, 30). Rekand proposed that Botulinum toxin combined with physiotherapy and orthopedic surgery is effective treatment of localized spasticity(11). Viel and colleages proposed that regional blocks have a threefold use in patients with painful spasticity including diagnostioc, prognostic, and therapeutic, peripheral neurotic blocks are easy to perform, effective, and inexpensive(30).

Spasticity in agonist (spastic) muscles resists antagonist movements and prevents limb function. If spasticity in agonists can be relieved by using nerve block, strengthening of antagonist muscles will be possible and limb function will improve (29).

It has been claimed that phenol nerve block can prevent surgery(30). Petrillo and Knoploch(31) employed nerve block on the tibial nerve on 92 patients with severe spasticity of plantar flexors and ankle invertors. Nineteen of patients had had indication for surgery. The authors reported that after nerve block, the range of movements improved in all of them and surgery was prevented. However, this study did not accurately investigate nerve block effects in preventingsurgery, and further research required. Sciatic nerve block: Injection to the sciatic nerve can reduce spasticity in the hamstring muscles. Injection facilitates it, positioning and standing transfer, also range of motion of the knee is improved and contracture and pressure sores are prevented. Injection facilitates heel strike during walking(30).

Musculocutaneous nerve block: Injection of the musculocutaneous nerve may reduce spasticity in the biceps and improve flexion contracture of the elbow(30). If there is a severe hypertone in the brachioradialis muscle and elbow movement is limited, motor point block of the brachioradialis muscle is useful to reduce spasticity of the brachioradialis muscle(31). Advantages of nerve block: Nerve block may be a useful technique to reduce spasticity and obtain hand function and gait improvement.

Range of motion and activities of daily living are improved by using nerve block(24). Further more, it has been suggested that application of nerve block is a valuable treatment between the period of short term and long term rehabilitation programmes by reduction of spasticity in a particular muscle group(32). Side effects and complications: A number of investigators reported that following nerve block tenderness and swelling occurred in the injection area(32). Some other investigators have reported that more complications occur using nerve block, they reported development of paresthesia in a number of patients (31). Choi and co-workers pointed out that it is possible to cause allergic reaction, hematoma, pain, burning sensation, paresthesia, trismus, infection, and edema in the injection site of the limb(33).

Glenn stated that a burning sensation may be felt by the patient, following motor point nerve block but no serious side effects occur particularly if injection is carried out by an experienced person who is aware of the nerve block complications(29).

Contracture and surgery: One of the most common complications of spasticity is contracture, When there is imbalance between agonist and antagonist muscles, and if the limb is kept in a static position, spasticity may start during a short time (31) proposed that for treatment of the flexion contracture using surgery, 50% of recovery can be expected without a major complication. However, after surgery serial casting is recommended for further correction.

Occasionally orthopaedic or neurosurgical procedures may be recommended. These can include myelotomy (severing of tracts in the spinal cord) and rhizotomy (resection of posterior roots)(34).

Conclusion

A number of methods for assessment and treatment of spasticity are reviewed, some of the common methods of spasticity assessment or management, depend on the patient's condition and the therapist's goal of treatment, in prefering a method. So developing, standardizing, and validating clinically relevant spasticity scales is necessary. Also it is noted that studies to establish efficacy of the current therapies and to find effective treatments to help people with spasticity.

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