

## PHYSICAL THERAPY AND REHABILITATION FOR ATAXIC PATIENTS

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### Abstract

The goal of the study was to review the definition of ataxia, a movement disorder in which there is incoordination of movements and postural control, its subtypes, causes, to analyze the assessment methods in rehabilitation and the treatment modalities from the point of view of the rehabilitation team.

We observed that after a long term rehabilitation treatment, the patients with ataxia improved their balance and postural reactions, increased postural stabilization, developed new upper extremity functions and independent, functional gait.

Physical therapy applications play a crucial part in the rehabilitation treatment of ataxia. Of major importance are the evaluation of the patient and the establishment of the treatment methods keeping in mind that every patient has a particular form of evolution of the disease.

**KEY WORDS:** Ataxia, assessment, rehabilitation treatment.

### Introduction

Ataxia is a movement disorder resulting from the incoordination of movements and inadequate postural control, which results in balance and walking disturbances, without muscle weakness. (1)

In normal population, the process of motor development is completed when normal postural mechanisms are localized, followed by the ability to maintain balance in different positions and formation of muscular coordination.

Normal postural tonus means standing erect against gravity, adaptation to changes on different surfaces and proximal stabilization. Balance is a postural adaptation to changes in gravitational center with the contribution of normal postural tonus. Muscular coordination is the functioning of all muscle active during the voluntary motor movement.

Nervous system diseases and injuries of the nervous system frequently affect the mechanisms of postural control. For example, diseases as stroke, cranio-cerebral traumas, multiple sclerosis, Parkinson disease and sensory neuropathies produce balance and coordination problems.

### 2. OBJECTIVES

Ataxia can result from damage to several different motor or sensory regions of the central nervous system, but as well as peripheral nerve pathology. Problems that can induce ataxia are arising from the proprioceptive system, visual

system and vestibular system, the cerebellum and also from the interconnections of these systems.

There are 4 types of ataxia: sensory, cerebellar, vestibular and frontal. In some cases, the symptoms of two or three ataxia types can be observed together, in which case is referred to as mixed ataxia.(2)

### SENSORY ATAXIA

The term is used to indicate ataxia due to loss of proprioception (sensitivity of joint and body position), which is usually caused by dysfunction of the dorsal columns of the spinal cord, because they carry proprioceptive information to the brain. In some cases, the dysfunction is in the various brain parts which receive the information (thalamus and parietal lobes).

The patient with sensory ataxia has an unsteady gait and postural instability, characteristically worsened when the visual input is dysfunctional, as in poorly illuminated environments. If the patient stands with the feet in touch and the eyes shut, the instability is worsened and he can fall, so the Romberg test is positive, which is the most significant sign that differentiates sensory ataxia from other types of ataxia. An important characteristic of sensory ataxia is losses of vibration sense in the extremities and deep tendon reflexes, and also, worsening of the finger-pointing test with the eyes closed.

The diseases that produce sensory ataxia are represented by hereditary ataxia (Friedreich's ataxia),

spinocerebellar ataxia, diabetic or alcoholic neuropathy, vitamin B12 deficit neuropathy, tabes dorsalis, tumoral masses in the posterior cord of the medular spine and multiple sclerosis.

#### VESTIBULAR ATAXIA

This type develops as a result of peripheral or central diseases that affects the vestibular nuclei and/or the afferent and efferent connections of the nuclei. The patient has disturbances of balance in standing and sitting, tends to stagger when walking, has a broad base support and the balance is usually disrupted when performing a head or eye movement. Ataxia may be accompanied by vertigo, nausea, vomiting, blurred vision and nystagmus. Extremity ataxia is absent and deep tendon reflexes are normal. (3)

#### CEREBELLAR ATAXIA

This form of ataxia is caused by lesions of the cerebellum and/or the afferent and efferent connections of the cerebellum. The patient has postural instability, tends to separate the feet when standing to gain a wider base of support, and the instability is worsened when standing with the feet together, irrespective of whether the eyes are opened or closed, which indicates a negative Romberg test.

There are some symptoms associated with cerebellar ataxia:

Dysmetria is the inaccuracy in achieving a final end position, demonstrated by the finger-nose test.

Tremor, which can be kinetic (oscillation that occurs during the course of movement), intentional (the increase in tremor towards the end of the movement), or postural (when holding a limb in a given position).

Hypotonia occurs only in acute cerebellar lesions, being rarely seen in chronic cases. It affects particularly the proximal and antigravity muscles.

Weakness and fatigue occurs more often in extensive and deep lesions, being most apparent in proximal muscles.

Dysarthria occurs due to incoordination between tongue and lip muscles.

Nystagmus is an abnormal eye movement that develops in horizontal and vertical directions.

Deep tendon reflexes are maintained in cerebellar lesions, being characteristically pendular.

Cerebellar ataxia is present in diseases such as spino-cerebellar ataxia, chronic alcoholism, paraneoplastic cerebellar degeneration, ponto-cerebellar tumors and multiple sclerosis.

#### FRONTAL ATAXIA

This type is also known as gait apraxia and occurs when tumors, abscesses, cerebro-vascular accidents affect the frontal area. In this cases, the patient has difficulties in standing erect, tends to lean towards hyperextension, there is incoordination between the legs and trunk during walking, and the ataxia is accompanied by frontal dementia and urinary incontinence.

#### MIXED ATAXIA

Mixed ataxia refers to the type of ataxia when symptoms of two or more types of ataxia are observed together, such as sensory and cerebellar ataxia symptoms. For example, in multiple sclerosis, cerebellar, vestibular and sensory ataxia symptoms may be observed together, or in spino-cerebellar ataxia, cerebellar and sensory ataxia may be present.

### 3. METHODS AND MATERIAL

The goal of the rehabilitation treatment in ataxia resulting from defects in neurological structures and affecting the functions of the patient, is to improve the functional level through restorative techniques. When this is not possible, the therapist tries compensatory strategies to make the patient perform as independent as possible within the present functional level. (4)

The main goals of restorative rehabilitation treatment are the following:

1. Improving balance and postural reactions against the external stimuli and gravitational forces.
2. Improving and increasing postural stabilization after the development of joint stabilization.
3. Developing upper extremity functions.
4. Developing independent and functional gait, improving the quality of life of the patient and increasing the patient's independence in performing daily life activities.

#### PRINCIPLES OF REHABILITATION PROGRAMME

1. During the training program, the exercises will be practiced consciously at first, and in later stages should be followed by automatic exercise activities.
2. Exercises will progress from simple to complex.
3. Activities should be practiced first with the eyes opened and then with the eyes closed.
4. After achieving proximal tonus and stabilization, the coordinated movement of the distal segments will be integrated in the program.
5. Compensation methods and supportive aids and equipment will be used when it is necessary.
6. Treatment should be completed by an appropriate home exercise program and sport activities.

### 4. ASSESMENT

Evaluation of a patient with ataxia should include determination of basic functional capabilities such as:

- bed mobility and posture
- ability to sit up from a reclining position
- maintenance of sitting posture on surfaces normally used
- ability to stand up from a sitting position and transfer within the home environment
- maintenance of standing posture
- ambulation

-ability to dress, groom and eat as normal daily living activities.

The International Cooperative Ataxia Rating Scale (ICARS) may be useful in the evaluation of the patient with ataxia. This scale provides a consistent, organized way to demonstrate changes in patient function and motor control. The scale measures ataxia in four categories of movement: posture and gait, limb kinetics, speech and eye movements. There are 100 points on an ordinal scale and the higher the score, the greater the impairment or limitation in functional status. (5)

#### REHABILITATION APPROACHES

A rehabilitation treatment program results from the interpretation of the measurement and assessment conclusions. The content of the treatment program will vary depending on the type and characteristics of ataxia. For example, while approaches which improve proprioception and incorporate visual aids are used more frequently in patients with sensory ataxia, stabilization techniques are more important to reduce truncal and extremity ataxia in patients with cerebellar ataxia. The patient with vestibular ataxia should be given habitation exercises to reduce vertigo, and also vestibulo-ocular, vestibulo-spinal reflexes should be stimulated to improve balance. Mixed ataxia is a problematic condition, which requires the use of many approaches and in such cases, the experience of the rehabilitation team plays an important role in determining the program. (6)

When prescribing the rehabilitation program we must keep in mind that the proprioceptive, vestibular and visual systems and the cerebellum are in close relation, and the balance and coordination result from this relation. Therefore, it is not possible to classify the methods used in the rehabilitation of ataxia as approaches directed merely towards proprioception or balance, since all of these interact with each other.

#### APPROACHES FOR IMPROVING PROPRIOCEPTION

The aim in these cases is to increase proprioceptive input by mechanically stimulating the joint surfaces, the muscles and tendons, and decreasing postural instability by improving body awareness. The approaches used are: techniques of proprioceptive neuro-muscular facilitation (PNF) as rhythmic stabilization, slow reversal techniques, resistive exercises, pressure splints, gait exercises on different surfaces (hard, soft, inclined surfaces), with eyes first opened and then closed, plyometric exercises, balance board-ball exercises. (1)

Recently, vibration has been a frequently used application, because it can be directly applied to the muscles and tendons and also can be applied by exposing the whole body to vibration (whole-body vibration therapy).

#### APPROACHES FOR IMPROVING BALANCE

In the first part of the program, the proximal muscles and stabilization muscles of the trunk will be improved. For this stage, the therapist will use

activities of the PNF techniques, the patient will be trained to come to the bridge position from lying on the back, onto the forearms from lying face down, to crawl and to come onto the knees, half knees and into a sitting position and to establish static and dynamic stability in these positions. (1)

Initially, the patient should be maintained in the required position and then static stabilization should be strengthened through external perturbation (pushing and pulling in different directions). Afterwards, the patient should be trained in these positions for weight transferring so as to be prepared for dynamic stabilization. Then, the patient will be trained in positions in which the support surface is narrowed or the centre of gravity is changed in order to make the balance activities difficult (establishing balance on two or three extremities in the crawling position or shifting the center of gravity by the elevation of the arms in the sitting-on-knees position). (6)

In the standing position, following the transferring of weight onto the front, back and sides, narrowing the support surface and balance training in tandem position, balance training on one leg should be performed, because this is a position in which ataxic patients have great difficulty. (5)

The best indicator of dynamic stabilization and balance is gait. Gait training should be performed in the following applications: walking on two narrow lines, tandem gait, backward gait, slowed down gait (soldier's gait), stopping and turning in response to sudden directions, flexion, extension and rotations of the head. (3)

#### VESTIBULAR EXERCISES

Because dizziness accompanies balance dysfunction in vestibular pathology, repetitive head movements exercises are very important. The vestibular exercise program consists of repetitive, progressively more difficult eye, head and body movements designed to encourage movement and facilitate sensory substitution.

#### APPROACHES TO EXTREMITY ATAXIA

Exercises designed for the treatment of extremity ataxia are realized to provide fixation by establishing balance between the eccentric and concentric contractions in the multi-joint movements of the lower extremities and the upper extremities in particular. During the performance of these exercises, it is important to establish slow, controlled and reciprocal multi-joint movement and stabilization. (4)

Frenkel's coordination exercises were developed for this purpose. Active repeated contractions similar to proprioceptive neuro-muscular facilitation exercises can be utilized on their own or by combining them with Frenkel's coordination exercises. (6)

While these two types of exercises are effective in cases with mild extremity ataxia, they can be insufficient in severe cases. In such cases, rhythmic

stabilization and combination of isotonic techniques are more effective than PNF techniques.

#### EXAMPLES OF FRENKEL EXERCISES

##### SUPINE POSITION

1. Flex and extend one leg, heel sliding down a straight line on table.
2. Abduct and adduct leg with knee and hip extended, leg sliding on table.
3. The same exercise with hip extended.
4. Flex and extend hip and knee with heel off table.
5. Place heel on knee of opposite leg and slide heel smoothly down toward ankle and back.
6. Flex and extend both legs together, heels sliding on table.
7. Flex one leg while extending the other.
8. Flex and extend one leg while abducting and adducting the other leg.

##### SITTING POSITION

1. Place foot on therapist's hand, which will change position.
2. Raise leg and put foot on traced footprint on the wall.
3. Rise and sit with knees together.

##### STANDING POSITION

1. Place foot forward and backward on a straight line.
2. Walk along a winding strip.
3. Walk between two parallel lines.
4. Walk, placing each foot in a tracing on floor.

##### USE OF SUPPORTIVE AIDS

In severe cases in which the rehabilitation treatment applications are insufficient, use of supportive devices enables the patient to function more easily within the present functional level. In severe cases of ataxia, suspending weights from the extremities and the use of weighted walkers can be preferred.

##### SPORT ACTIVITIES

Horse riding, swimming, golf, walking are suitable for this type of patients, because they improve balance and postural control, in addition with the rehabilitation program used daily.

## 5. RESULTS

According to the rehabilitation team, mobility and upper extremity functions are the most important functions of the patient. Ataxia is a neurological problem with major effect on both functions and, when compared to other symptoms of neurological diseases (muscle weakness, spasticity) is sometimes more persistent and difficult to cope with.

After a long term rehabilitation treatment, the patients with ataxia improved their balance and postural reactions, increased postural stabilization, developed new upper extremity functions and independent and functional gait.

## 6. CONCLUSION

Physical therapy applications play a crucial part in the treatment of ataxia. Of major importance are the evaluation of the patient and the establishment of the suitable treatment methods, as well as performing the rehabilitation program regularly.

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