Research Article
http://dx.doi.org/10.17784/mtprehabjournal.2014.12.159

Effects of cryotherapy on tonic adequacy upper limb hemiparesis after stroke.

Efeitos da crioterapia na adequação tônica do membro superior hemiparético pós acidente vascular encefálico.

Stéfanie Saccomam Freitas Guimarães[1], Carly de Faria Coelho[2], Luciana Barcala Carruba[3].

Abstract
Introduction: After stroke more than 80% of survivors have hemiparesis associated with muscle weakness. It is cited as a major deficiency, responsible for reducing the functional use of the paretic upper limb. Spasticity, altered muscle tone caused by injury to the upper neuron bike, is present in most patients who suffer strokes, causes resistance to speed-dependent mobilization, the individual providing significant motor changes, which lead to the difficulty of movement, limiting activities of daily living, especially in manual tasks. **Objective:** This study aims to analyze the effect of cryotherapy before carrying out exercises cinesioterapêuticos in hemiparetic patients. **Methods:** Among the existing resources on physical therapy the adequacy of as spasticity, cryotherapy is the use of cold to promote relaxation of the site to be treated allowing active progressive exercise becomes pain free and with good range of motion. In the case of patients suffering from stroke, cryotherapy may reduce muscle atrophy, because it can tailor the tone for the move takes place. **Results:** After assessment all patients increased their level of functional independence, both the Fugl-Meyer assessement and Functional Independence Measure, with physical therapy associated with the use of ice. **Conclusion:** New research may prove the efficacy of ice in reducing spasticity in post-stroke patients.
Keywords: stroke, hemiparesis, active exercise, cryotherapy, spasticity.

Resumo
Introdução: Após o acidente vascular encefálico, mais de 80% dos sobreviventes apresentam hemiparesia associada à fraqueza muscular. É citada como uma importante deficiência, responsável pela redução do uso funcional do membro superior parético. A espasticidade, alteração do tônus muscular causada por lesão no moto neurônio superior, está presente em grande parte dos pacientes que sofrem AVE, causa resistência à mobilização dependente da velocidade, proporcionando ao indivíduo alterações motoras significativas, que acarretam a dificuldade da movimentação, limitando as atividades de vida diária, principalmente nas tarefas manuais. **Objetivo:** O presente trabalho tem como objetivo analisar o efeito da crioterapia antes da realização dos exercícios cinesioterapêuticos em pacientes hemiparéticos. **Método:** Dentre os recursos existentes na fisioterapia como adequação da espasticidade, a crioterapia consiste no uso do frio para promover o relaxamento do local a ser tratado permitindo que o exercício ativo progressivo fique sem dor e com boa amplitude de movimento. No caso de pacientes acometidos por AVE, a crioterapia poderá diminuir a atrofia muscular, pois pode adequar o tônus para a realização do movimento. **Resultados:** Após avaliações todos os pacientes aumentaram o seu nível de independência funcional, tanto pela escala de Fugl-Meyer e pela Medida da Independência Funcional, com o tratamento fisioterapêutico associado ao uso do gelo. **Conclusão:** Novas pesquisas poderão comprovar a eficácia do gelo na redução da espasticidade em pacientes pós-AVE.
Palavras chave: acidente vascular encefálico, hemiparético, exercício ativo, crioterapia, espasticidade

Received: 27 November 2013. Accepted: 12 March 2014. Published: 27 March 2014.

1. Post-graduate, Sociedade Brasileira de Terapia Intensiva (SOBRATI), São Paulo (SP), Brazil.
2. Doctor in Ciências Biomédicas, Institute of Ciências Biomédicas of Universidade de São Paulo (USP), São Paulo (SP), Brazil.
3. Professor of physical therapy school, Universidade Nove de Julho (UNINOVE), São Paulo (SP), Brazil.

Corresponding Author:
Stéfanie Saccomam Freitas Guimarães – e-mail: stefaniesaccomam@yahoo.com.br - Rua Jorge Amado, 170 – Parque Piratininga – Itaquaquecetuba – SP.

INTRODUCTION

Stroke can be defined as a sudden focal neurologic deficiency not seizure resulting from restriction or leakage of blood supply to the brain, which can cause cell damage and changes in neurological functions. The extent and severity of the injury depend on the areas. The most common causes for interruption of blood flow in the central nervous system are embolism, aneurysms and thrombi. Hemorrhages can also be derived factors for neurological injury.[1]

One of the most important sequelae of stroke is the difficulty in performing the movements, which is related to spasticity or increased muscle tone. Depending on the severity of sequelae presented, these individuals have committed their level of functional independence in daily activities such as eating, bathing, using the toilet, dressing, walking, lying down and getting up, needing help another person for performing the activities of daily living (ADL's).[2]

According to studies, hemiparesis is a sequela resulting from an injury to the upper motor neurons, with the consequence inadequate recruitment of lower motor neurons. The movement deficits are evident in the contralateral limb to the side of hemispheric lesion and are characterized by specific muscle weakness, abnormal muscle tone, postural adjustment and loss of intra articular coordination.[3]

Spasticity is one of the most frequent and disabling motor disturbances observed in individuals with damages in central nervous system, affecting millions of people worldwide. This is defined by an increase with speed dependent, muscle tone associated with exacerbation of deep reflexes caused by hyperexcitability of the stretch reflex and that it fell within the upper motor neuron syndrome.[4]

The pathophysiology of spasticity is not yet fully elucidated. It was assumed for a long time that the increase in stretch reflexes in spasticity was a result of hyperactivity of gamma motoneurons. However, recent experiments cast doubt on this explanation. Although the gamma hyperactivity is present in some cases, changes on the basis of the alpha motor neurons and interneurons are probably more important.[6,10]

The fundamental pathological basis of spasticity is sustained by the loss or disruption of the spinal mechanisms of supraspinal control, regulating mechanisms and their corresponding reflex arcs. All these elements intervening arches receive a dual descending supraspinal influences, activating or inhibitory, primary sensory neurons, excitatory or inhibitory interneurons, Renshaw cells and motoneurons. As a result, an exaggeration of polysynaptic reflexes appears or a reduction in the activity of pathways postsynaptic inhibition and mechanisms of presynaptic inhibition, as important to keep the processes of reciprocal inhibition and recurrent autogenous. It is a factor that brings serious consequences to the patient, such as contractures and deformities, which will affect the development of functional skills. May manifest clinically by hypertonicity, exaggerated osteotendinous reflexes, pocketknife sign and clonus sometimes predominating in some agonist muscle groups, especially in antigravitários, resulting in changes in the mechanical and functional characteristics of muscles.[7,13]

The upper limb spasticity in flexor muscles predominates, with attitude in adduction and internal rotation of the shoulder, elbow flexion, pronation of the wrist and finger flexion.[8,19,20]

The commitment of the reach and gripping is considered the largest and most compromising motor deficits found in hemiplegic patients, considering their importance for virtually all activities of daily living.[9,3]

Typically, the angles of the shoulder and elbow joints are altered in a subtle rhythm and synchronized manner, seeking to produce a smooth movement range, with a pretty straight path. The trajectories of movements observed in patients with neurological sequelae are often characterized by the loss of the coordinated coupling between synergistic muscles and joints.[10,13]

In physical therapy evaluation of patients with sequelae of stroke, instruments that are able to check the performance on ADLs should be included. Of the various ways to assess the upper limb Fugl-Meyer Assessement (FMA) and functional independence measure (FIM) can be used to assess the functionality of the upper limb hemiparesis. The FMA is a system of cumulative numerical score which assesses six aspects of the patient: range of motion, pain, tenderness, motor function of upper and lower extremity and balance, in addition to coordination and speed, totaling 226 points. A three-point ordinal scale is applied to each item: 0 - cannot be accomplished, 1 - partially done and 2 - done completely. This scale has a total of 100 points for normal motor function, wherein the maximum score towards the upper limb is 66. The motor assessment includes measurement of motion, coordination and reflex activity of shoulder, elbow, wrist, hand, hip, knee and ankle. Fugl-Meyer *et al* determined a score according to the level of motor impairment, in which less than 50 points indicate severe motor impairment; 50-84 remarkable; 85-95 moderate, and 96-99 mild.[17]

The Functional Independence Measure (FIM) is a tool for evaluating the disability of patients with functional restrictions diverse origin, having been developed in North America in the 1980s. Its primary objective is to evaluate quantitatively the burden of care demanded by a person to perform a range of motor and cognitive tasks of daily living. Among the activities are evaluated self-care, transfers, locomotion, sphincter control, communication and social cognition, including memory, social interaction and problem solving. Each of these activ-

ities is evaluated and receives a score of 1 (total dependence) to 7 (complete independence), so the total score ranges from 18 to 126. Two domains are described in FIM, motor and cognitive.[19]

Why not a permanent cure treatment exists, physical therapy in individuals with spastic musculature must be inserted into a rehabilitation program based on their functional evolution with multifactorial approach aiming at reducing disability.[5]

The first reports on the local use of ice and its therapeutic effects are Schaubel (1946) in the United States, where it is said the monograph Fay and Henny, cited by Schaubel (1946), in which the ice is used in the treatment of pain in metastatic tumors and Krieg, quoted by Schaubel (1946), who observed reduced use of analgesics in surgical patients, as well as less discomfort with topical ice. Describes quote from Allen, quoted by Schaubel (1946), who conducted the first experimental study to investigate the effects of ice in metabolism, reducing the local temperature, the reimplantation of injured paw animal, reducing the risk of gangrene and shock. Hippocrates used ice or snow before starting surgery Dominique Jean Larrey and (doctor of Napoleon Bonaparte) took on soldiers, less painful amputations at temperatures below zero degrees.[6]

Cryotherapy in the treatment of spasticity has as primarily objective to reduce visco-elastic mioarticular tension and facilitate neuromuscular function. The physiological effect of ice is reduction of muscle spindle, neuromuscular junction and peripheral nerve activity. The ice reduces the activity of the muscle spindle rises because its tripping threshold, causing a decrease afferent stimulation. This is a valuable feature, if previously applied to kinesitherapy, since the relaxation effect which is achieved with the cooling lasts for approximately 30 minutes to 2 hours. Meanwhile, the physical therapist can perform cinesioterapêuticos exercises, providing patients with greater amplitude to move free of the spastic pattern.[7]

The application of cold tissue involves the transfer of thermal energy out of the tissues, thus being part of the therapy. The most common indications are the treatment of muscle spasm, pain from the injury, reducing bleeding and swelling. Often it is used in the cold reduction in muscle spasticity. The ice initially increases and decreases spindle discharge then so should not be used briefly. The ice lowers the tone and therefore the abnormal patterns, which is one of the important factors affecting the prognosis of treatment.[5]

The aim of the study was to evaluate the effect of cryotherapy on muscle tone adequacy to provide functional mobility of the upper limb of patients recovering after stroke. Demonstrating the effect of physical therapy with the use of cryotherapy, which could provide positive results in fitting the tone and conduct of functional activities.

METHODS

This was an observational study of qualitative and quantitative type, conducted at the Clinical School of Physical Therapy, Universidade Nove de Julho, São Paulo, after approval by the Research Ethics Committee cm humans, protocol number FR. 420165. The inclusion criterion for the study of individuals who have suffered stroke, patients with spasticity in the upper limbs (UL) and were recommended physical therapy treatment. The affected upper limb could be whether or not the dominant upper limb.

Ice bags, towels and review records containing personal data was used, of which was not levied any charge participants. All funds required for the development of the research was the responsibility of researchers.

After screening and selection of patients were chosen to study 10 patients, and all were in agreement with the informed consent, they underwent 10 sessions of cryotherapy associated with conventional physiotherapy.

At baseline, patients underwent two separate ratings: Fugl-Meyer Assessement (FMA) and Functional Independence Measure (FIM) in order to evaluate the functionality of the upper limb hemiparesis.

The analysis of the results was through *Grap PadInstat* software, comparing pre and post intervention proposal.

RESULTS

Ten patients were also subjected to evaluations by means of validated functional scales, with the FIM and Fugl Meyer. The initial assessments were followed by sessions of physical therapy associated with cryotherapy. Patients received compresses with ice packs for 20 minutes in the joints of the shoulders, elbows and wrists hemiparesis; kinesiotherapeutic in sequence performed the exercises in flexion and extension of shoulder, elbow, wrist, and fingers training ADLs. All exercises stimulated ADLs and gain ROM affected by upper limb spasticity.

During the visits may perceive the increased ease in performing active movements of the upper limbs, it can be viewed in comparison of the two scales assessed (Figure 1 and 2). All patients had higher scores scales Fugl-Meyer and Functional Independence Measure.

At the end of 10 sessions of physiotherapy patients underwent to a further evaluation aimed to compare the results of both the clinical evolution by combining the use of cryotherapy to conventional therapy. The results obtained pre and post-intervention can be seen in Figures 1 and 2.

The statistical analysis shows a significant result in both scales: MIF ($p < 0.01$) and Fugl-Meyer ($p < 0.05$).

According to the results presented, cryotherapy may be helpful in kinesiotherapeutic treatment, as sta-

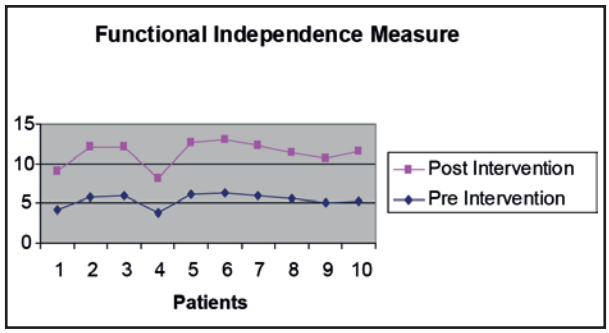

Figure 1. Comparison of Functional Independence Measure (FIM) pre and post physiotherapy intervention.

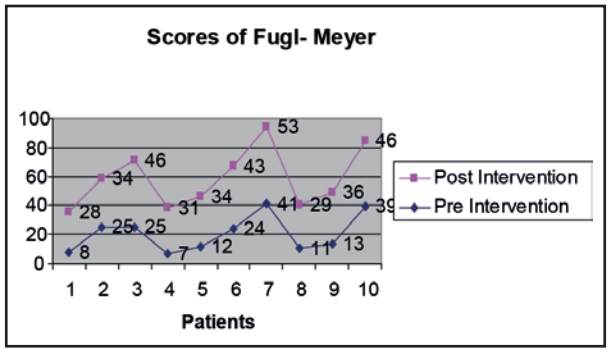

Figura 2. Comparison of Fugl-Meyer Scale pre and post physiotherapy intervention.

tistical data resource. Ideally, new research proving the efficacy of cryotherapy as an aid in physical therapy for spasticity feature.

DISCUSSION

Among the complications caused by stroke spasticity stands out, an imbalance of muscle activity due to the release of intact reflex arcs of the control of the central nervous system, causing hypertonicity, hyperactive stretch reflexes and clonus, interferes with quality of life of the patient. Cryotherapy is the use of the cold for therapeutic purposes. With extended cooling, there is decreased muscle spindle activity by increasing its firing threshold, the pulse neurotransmission, both afferent and efferent is decreased.[21]

The normal upper limb function includes the ability to reach targeted, gripping and manipulating objects. These components form the basis of the motor skills required for carrying out activities of daily living (ADLs) efficiently.[22]

The upper limb spasticity in flexor muscles predominates, with attitude in adduction and internal rotation of the shoulder, elbow flexion, pronation of the wrist and finger flexion.[20]

The impairment of reach is considered one of the leading and most compromising motor deficits found in hemiplegic patients, it is of utmost importance for virtually all activities of daily living.[20,22]

The angles of the shoulder and elbow joints are altered in a very subtle rhythm and synchronized manner, seeking to produce a smooth movement range, with a pretty straight path. The trajectories of movements observed in patients with sequelae of stroke are often characterized by the loss of the coordinated between synergistic muscles and joints coupling. According McCREA *et al* (2002) once a target is set, it generates a muscle activation pattern which is used to drive the agonist muscle.[21,22]

The central nervous system adapts the feedback control of the paralyzed limb with the aim of promoting a correction of deviations from the desired trajectory, however, the movement's reach still more targeted and less symmetrical than in a healthy limb.[22]

Spasticity is evidenced by the degree of excitability of the muscle spindle which fundamentally depends on the speed with which movements are made. Therefore, the slow movements are less likely to induce spastic hypertonia. Likewise, stretches the muscle-tendon slow and must be carried out daily to keep the amplitude of motion and decrease muscle tone. Exercise against great resistance may be useful to strengthen weak muscles, but should be avoided in cases of patients with central lesions, since these will strengthen the existing abnormal tonic responses and consequently increase spasticity.[20]

In physical therapy evaluation of patients with sequelae of stroke, instruments that are able to check the performance on ADLs should be included. There are various methods of measurement for the assessment of independence of these patients. The instruments that assess functional capacity are those that measure individual items of assistance in the quantitative aspect, providing information about the quality or improved function of the individual. The Functional Independence Measure (FIM) is probably the most comprehensive tool for measuring functional capacity. It is a recent, accurate and universal tool to evaluate the higher functions, one basic indicator of the importance of disability, which may be modified during the rehabilitation / upgrading; therefore, modifications of MIF demonstrate the effects or results of the rehabilitation program.[2]

Another measurement of motor and sensory impairment followed by stroke, known as Fugl-Meyer Assessment (FMA) was developed and introduced in 1975 by Fugl-Meyer. This scale was the first quantitative tool for measuring sensorimotor stroke recovery and is probably the most known and used for research and / or clinical practice scale.[19]

The FSA was essentially developed based on methods described previously by Twitchell and Brunnstrom which described the specific sequences of motor recovery in post-stroke patients, featuring the performance and changes in motor impairment.[19]

The measures proposed in the FSA are based on

neurological examination and sensory-motor activity of the upper and lower limbs, seeking to identify selective and synergistic activity patterns of stroke patients. This scale was constructed following the hypothesis that restorations of motor function in hemiplegic patients follow a defined course. Thus, for a patient with hemiparesis, the return of reflexes precedes voluntary motor action, followed by complete dependence on synergies, and active movement appear successively less dependent on primitive reflexes and reactions.[19]

Finally the complete voluntary motor function with normal reflexes engines can be achieved. The FMA is a numerical scoring system for assessing cumulative six aspects of the patient: Range of motion, pain, tenderness, motor function of the lower and upper end and balance, in addition to the coordination speed and totaling 226 points.[19]

The physical therapy has as goals, in short, prepare for a function, maintain or enhance their existing quality through suitability of spasticity.[20]

Among the different existing physical therapy methods for the treatment of spasticity protrudes neuroevolutive method (Bobath). Other alternatives that can be used to reduce spasticity would be the application of heat and cold for long periods and deep rhythmic massage, applying pressure on the muscle insertions. (20)

Cryotherapy in the treatment of spasticity has the main objective to reduce the visco-elastic tension mioarticular and facilitate neuromuscular function.[4]

Cryotherapy is the term used to describe procedures for the application of cold to have a temperature range of 0 ° C to 18.3 ° C. It is applied in three ways. The connective involves the movement of cooling air on the skin and their therapeutic use is rare. Evaporative cooling results when a substance applied to the skin using thermal energy to evaporate, thereby lower the surface temperature. The conductive cooling using the local application of cold, as heat from the highest object (body) is transferred to the colder object, there is a decrease in the temperature scale. Thus, local and systemic responses are generated.[4]

The physiological effects of cold make it superior to heat the acute pain of inflammatory conditions in the period immediately after tissue trauma and for treating muscle spasm and abnormal tone. The conduction velocity of peripheral nerve myelinated fibers both large and small in demyelinated fibers decreases 2.4m per °C of cooling. As a result, the perception of pain and decrease muscle contractility. Peripheral receptors become less excitable. The response of the muscle spindle elongation decreases and as a result, also decreases muscle spasm.[4,5]

The local blood flow is initially reduced, as well as local edema, hemorrhage and inflammatory response. However, the application of cold for periods greater than 15 minutes results in increased blood flow. This protection mechanism brings blood temperature at the surface and prevent tissue damage resulting from prolonged cooling. Cellular metabolic activity slows. The oxygen needs of the cell decreases. [4,6,7]

In cellular metabolism, cryotherapy acts slowing the pace of chemical reactions that occur as part of the tissue metabolism. The cold also act by inhibiting the release of histamine, thereby preventing the formation of large swelling at the site of injury.[4,8,9]

In inflammation, cryotherapy acts by preventing blood leakage, leading to a smaller amount of fibrin and collagen synthesis less minimizing adhesion. Since immobilization following trauma contributes to the increase of collagen synthesis, the ice can act reducing downtime.[4,12,14]

Once muscles, tendons and joints respond differently, the preferred method of application depends on the treated fabric. Acute injuries are best treated with cryotherapy along with rest, compression and elevation. The muscle spasm decreases with cold bags and stretching.[4]

The physiological effect of freezing is reduction of muscle spindle, neuromuscular junction and peripheral nerve activity. The ice reduces the activity of the muscle spindle rises because its tripping threshold, causing a decrease afferent stimulation. When ice is used, thermal stimulation of receptors that use the lateral spinothalamic pathway, one of which transmits painful stimuli occurs. The cooling occurs causes an increase in the duration of the action potential of sensory nerves and, consequently, an increase in the refractory period, causing a decrease in the amount of fiber that will depolarize the same period of time. Thus a reduction in the frequency of the transmission pulse occurs and an increase in the threshold of excitation of nerve cells as a function of application time, that is, the longer the lower the transmission of impulses is related to temperature.[4,5]

No one knows for sure if it is the motor neuron excitability or hyperactivity of the gamma system, changed the muscle spindle or spinal cord level, which is responsible for the reduction of spasticity. However, it is certain that the cold is effective in reducing spasticity by reduction or modification of the stretch reflex mechanism highly sensitive muscle.[4,6]

To ensure the effectiveness of cooling as a means to reduce spasticity is recommended to be applied at least cold enough to reduce muscle temperature, ie, for 25-30 minutes, because with this time the temperature decreases excitatory impulses.[6]

Applications with less time may not be effective to achieve deep tissue. The intensity of cryotherapy for reducing pain and muscle spasm is 12 to 15 minutes. Over 30 minutes is deemed the beginning of ulceration and/or nerve palsy.[6]

Although related to reduction of spasticity and clonus after application cryotherapy out in research evidenced from 25% to 35% of patients had no relief, and in some, increased spasticity.[4]

The effects of cryotherapy may last for a relatively long time, and patients experience an increased ability to move, to be released from the limitations of the hypertonic muscles. This effect remains after application for about 30 minutes to 2 hours and may be used as a means of facilitating kinesitherapy, as it reduces the muscular action and promotes relaxation.[4]

The low temperatures used to reduce spasticity does not affect the sensory feedback to the point of causing great influence on skills training. The cooling can affect the fibers range, nerve conduction through the peripheral nerve (sensory and motor) and the transmission of nerve impulses through the myoneural junction.[4]

The feedback and feedforward mechanisms are neural devices that control movement, regulating situations organized as postural control, balance and stability, mobility and spatial orientation, temporal and body schema. This mechanisms are disturbed in the presence of spasticity.[4,9,11]

Cryotherapy is used in the muscular system, particularly in neurological diseases and injuries in sports. According to Swenson *et al*, because the temperature decrease caused by cryotherapy, a decrease of muscle action and a relaxation occurs thereof, facilitating the reduction of spasticity and conducting kinesitherapy exercises.[6]

According Micholovitz (1996) the fact that cryotherapy can change muscle strength may have important explanations when patients are assessed and when effects are treatment plans. Cryotherapy of short duration might perhaps be used for improved muscle performance during the course of therapy, thereby maximizing the initial and subsequent evaluations in patients during therapy program performance. Strength evaluation should be done before application and after a few hours of application.[6,7]

According to Fanning *et al* (1997) after conducting an experimental study in rats was observed the effects of temperature reduction in skeletal muscle response to myotomy inducing agents. The authors concluded that at temperatures between 25 and 15 ° C there was not the development of myotonia, slow contraction followed by a relaxation that occurs in voluntary movement due to normal excitability and muscle contractility induced by anthracene-9-carboxylic acid. The authors correlated the results with myotonia congenita when miotomic contractions of the adductor pollicis disappear when the temperature is decreased to 20 ° C.[6,18]

relata que o efeito inicial de gelo sobre os músculos é aumentada a força máxima de pressão de 8,29%, seguido de uma perda de força de cerca de 14,05% de 30 min após a aplicação de crioterapia.[6,9]

Kottke *et al* (1994), states that clonus disappears only when the temperature of muscle is decreased after the application of cryotherapy, only reduce the temperature of the skin there will be a facilitation of motor neuron alpha-increasing spasticity and is much used by cryotherapy, more focused on the massage ice to reduce muscle.[4]

CONCLUSION

According to the results shown, cryotherapy may be a preparatory feature in kinesiotherapeutic treatment, providing greater functional independence. Future studies can compare cryotherapy with other preparatory techniques of physiotherapy.

REFERÊNCIAS BIBLIOGRÁFICAS

1. Cardozo DC. AVC: A importância da fisioterapia precoce com cinesioterapia e CL-Therapy, [periódico na internet] [acesso em outubro, 2012]; aproximadamente 5. p] Diponínel em: http://artigos.netsaber.com.br/resumo_artigo_sobre_avc_a_importancia_da_fisioterapia_precoce_com_cinesioterapia_e_cl-therapy.
2. Benvegnu AB, Gomes LA, Souza CT, Cuadros TBB, Pavão LW, Ávila SN. Avaliação da medida de independência funcional em indivíduos com seqüelas de acidente vascular encefálico (AVE). Revista Ciência & Saúde, Porto Alegre. 2008; 1(2):71-77 jul/dez.
3. Gaspar Mifaz, Nunes ET, Nascimento APH. Treinamento do alcance com suporte de peso nos membros superiores de pacientes hemiplégicos. Revista Acadêmica Digital do Grupo POLIS Educacional. 2008; 5(4):271-8.
4. Felice TD, Santana LR. Recursos Fisioterapêuticos (Crioterapia e Termoterapia) na espasticidade: revisão de literatura. Revista Neurociências. 2009; 17(1):57-62.
5. Cruz CL, Gotardo CRO, Jorge S. Influência da crioterapia e do calor superficial na espasticidade – relato de caso. Arq. Ciênc. Saúde Unipar. 2003; 7(3):253-257.
6. Barreira VG, Camargo EC. Efeitos fisiológicos e a aplicabilidade da crioterapia: Uma atualização bibliográfica. Fisio Ter. 2003; 7(36):22-8.
7. Cardoso TAC, Oliveira RA, Almeida R. A utilização da crioterapia e do calor superficial na espasticidade [periódi-

co na internet] [acesso em 11 outubro 2012]; [aproximadamente 3p] - Disponível em: http://www.profala.com/artfisio22.htm
8. Souza SR, Assis PD. Estudo Comparativo da Força de Preensão em Indivíduos Portadores de Hemiparesia. [periódico na internet]; [acesso em 11 outubro, 2012]; [aproximadamente Disponível em: http://artigocientifico.com.br/acervo/4/45/tpl_1317.html. 2005.
9. Cacho EWA, Melo FRLV, Oliveira R. Avaliação da recuperação motora de pacientes hemiplégicos através do protocolo de desempenho físico Fulg-Meyer. Revista Neurociências. 2004; 12(2):94-101.
10. Correia ACS, Silva JDS, Silva LVC, Oliveira DA, Cabral ED. Crioterapia e cinesioterapia no membro superior espástico no acidente vascular cerebral. Fisioterapia e Movimento. 2010; 23(4):555-63.
11. Ruas O, Belmudes CP, Araújo LS, Andrade S, Porto R, Filho BJR. Crioterapia, criocinesioterapia e crioestimulação – spray – [periódico na internet] [acesso em 11, outubro 2012; aproximadamente 3p] Disponível em: http://www.wgate.com.br/conteudo/medicinaesaude/fisioterapia/crioterapia.htm
12. Thamé ACF, Pinho PA, Reys B, Rodrigues AC. A reabilitação funcional do membro superior de pacientes espásticos, pós-acidente vascular cerebral (AVC). Revista Neurociências. 2010; 18(2):179-185.
13. Moraes GFS, Nascimento LR, Glória AE, Salmela LFT, Paiva CMR, Pereira SC, et al. A influência do fortalecimento muscular no desempenho motor do membro superior parético de indivíduos acometidos por acidente vascular cerebral. Acta fisiatr. 2008; 15(4):245-8.
14. Senkiio CH, Souza ED, Negreti MR, Oliveira CA, Aalvez NPF, Souza SRS. A utilização da Escala de Fugl-Meyer no estudo do desempenho funcional do membro superior no tratamento em grupo de pacientes hemiparéticos por AVE. Fisioter. Bras 2005; 6(1):13-18.
15. Fuzaro JVS. O papel do fisioterapeuta nas alterações neurológicas. [Periódico na internet]; [acesso em 2012]; [aproximadamente 4p] Disponível em: http://www.wgate.com.br/conteudo/medicinaesaude/fisioterapia/neuro/neuro_juliana.htm
16. Scalzo PL, Souza ES, Moreira AGO, Vieira DAF. Qualidade de vida em pacientes com acidente vascular cerebral: clínica de fisioterapia PUC Minas Betim. Revista Neurociências. 2010; 18(2):139-144.
17. Ribeiro M, Miyazakimh, Jucá SSH, Sakamoto H, Pinto PPN, Battistella LR. Validação da versão brasileira da Medida de Independência Funcional. Acta fisiatr. 2004; 11(2):72-6.
18. Cancela DMG. O acidente vascular cerebral – classificação, principais conseqüências e reabilitação. [Periódico na internet]; [acesso em 2011]; [aproximadamente 3 p] Disponível em: http://www.psicologia.com.pt/artigos/textos/TL0095.pdf
19. Maki T, Quagliato EMA, Cacho EWA, Paz LP, Nascimento NH, Inoue MMEA, Viana MA. Estudo de confiabilidade da aplicação da escala de Fugl-Meyer no Brasil. Revista Bras. Fisioter. 2006; 10(02):177-183.
20. Teive HAG, Zonta M, Kumagai Y. Tratamento da espasticidade. Uma atualização. Arq neuropsiquiatr. 1998; 56(4):852-8.
21. Camara FC, Lima GM, Fantini G, Macari K, Lucato JRV, Hadad PJ. Efeitos da utilização da crioterapia e do calor superficial na espasticidade de pacientes com lesão medular. Rev. UNORP São José do Rio Preto. 4(12):7-23.
22. Gaspar MFAS, Nunes ET, Nascimento APH, Leite JV. Treinamento do alcance com suporte parcial de peso nos membros superiores de pacientes hemiplégicos. INTELLECTUS – Revista Acadêmica Digital do Grupo POLIS Educacional. 2008; 4(05):371-378.
23. Cavaco NS, Alouch SR. Instrumentos de avaliação da função de membros superiores após acidente vascular encefálico: uma revisão sistemática. Fisioter pesq. 2010; 17(2):178-83.

Anexo I. Escala Fugl-Meyer

Anexo 1

ala de Avaliação de Fugl-Meyer em Português

TESTE	PONTUAÇÃO
I. Movimentação passiva e dor: – ombro: flexão, abdução 90, rot. ext. e int. – cotovelo, punho e dedos: flexão e extensão – antebraço: pronação e supinação – quadril: flexão, abdução, rot. ext. e int. – joelho: flexão e extensão – tornozelo: dorsiflexão e flexão plantar – pé: eversão e inversão *Pont. máx: (44 mobilidade)* *(44 dor)*	**Mobilidade:** **0** – apenas alguns graus de movimento **1** – grau de mobilidade passiva diminuída **2** – grau de movimentação passiva normal **Dor:** **0** – dor pronunciada durante todos os graus de movimento e dor marcante no final da amplitude **1** – alguma dor **2** – nenhuma dor
II. Sensibilidade: – Exterocepção: membro superior, palma da mão, coxa e sola do pé ( ) *Pont. máx: (8)*	**0** – anestesia **1** – hipoestesia/ disestesia **2** – normal
– Propriocepção: ombro, cotovelo, punho, polegar, quadril, joelho, tornozelo e hálux ( ) *Pont. máx: (16)*	**0** – nenhuma resposta correta (ausência de sensação) **1** – ¾ das respostas são corretas, mas há diferença entre o lado não afetado **2** – todas as respostas são corretas
III. Função motora de membro superior 1 – Motricidade reflexa: bíceps/ tríceps ( ) *(2)*	**0** – sem atividade reflexa **2** – atividade reflexa presente
2 – Sinergia flexora: elevação, retração de ombro, abdução + 90, rot. externa, flexão de cotovelo, supinação ( ) *Pont. máx:(12)*	***0 – tarefa não pode ser realizada completamente **** ***1 – tarefa pode ser realizada parcialmente*** ***2 – tarefa é realizada perfeitamente***
3 – Sinergia extensora: adução do ombro, rot. interna, extensão cotovelo, pronação *Pont:(8)*	*
4 – Movimentos com e sem sinergia: **a)** mão a coluna lombar ( ) **b)** flexão de ombro até 90º ( ) **c)** prono-supinação (cotov. 90º e ombro 0º) ( ) **d)** abdução ombro a 90º com cotov. estendido e pronado ( ) **e)** flexão de ombro de 90º a 180º ( ) **f)** prono-supinação (cotov. estendido e ombro fletido de 30 a 90º ( ) *Pont. máx: (12)*	**a)** * **b) 0** – se o início do mov. o braço é abduzido ou o cotovelo é fletido **1** – se na fase final do mov., o ombro abduz e/ou ocorre flexão de cotovelo **2** – a tarefa é realizada perfeitamente **c) 0** – Não ocorre posiciona/o correto do cotovelo e ombro e/ou pronação e supinação não pode ser realizada comp let/e **1** – prono-supino pode ser realizada com ADM limitada e ao mesmo tempo o ombro e o cotovelo estejam corretamente posicionados **2** – a tarefa é realizada completamente **d) 0** – não é tolerado nenhuma flexão de ombro ou desvio da pronação do antebraço no INÍCIO do movimento **1** – realiza parcialmente ou ocorre flexão do cotovelo e o antebraço não se mantêm pronado na fase TARDIA do movimento **2** – a tarefa pode ser realizada sem desvio **e) 0** – o braço é abduzido e cotovelo fletido no início do movimento **1** – o ombro abduz e/ou ocorre flexão de cotovelo na fase final do movimento **2** – a tarefa é realizada perfeitamente **f) 0** – Posição não pode ser obtida pelo paciente e/ou prono-supinação não pode ser realizada perfeitamente **1** – atividade de prono-supinação pode ser realizada mesmo com ADM limitada e ao mesmo tempo o ombro e o cotovelo estejam corretamente posicionados **2** – a tarefa é realizada perfeitamente
5 – Atividade reflexa normal: ( ) bíceps / tríceps/ flexor dedos **(avalia-se o reflexo somente se o paciente atingiu nota 2 para os itens d), e), f) do item anterior)** *Pont. máx: (2)*	**0** – 2 ou 3 reflexos estão hiperativos **1** – 1 reflexo esta marcadamente hiperativo ou 2 estão vivos **2** – não mais que 1 reflexo esta vivo e nenhum esta hiperativo
6 – Controle de punho: **a)** Cotovelo 90º, ombro 0º e pronação, c/ resistência. (assistência, se necessário) ( ) **b)** Máxima flexo-extensão de punho, cotov. 90º, ombro 0º, dedos fletidos e pronação (auxílio se necessário) ( ) **c)** Dorsiflexão com cotovelo a 0º, ombro a 30º e pronação, com resistência (auxílio) ( ) **d)** Máxima flexo-extensão, com cotov. 0º, ombro a 30º e pronação (auxílio) ( ) **e)** Circundução ( ) *Pont. máx:(10)*	**a) 0** – o pcte não pode dorsifletir o punho na posição requerida **1** – a dorsiflexão pode ser realizada, mas sem resistência alguma **2** – a posição pode ser mantida contra alguma resistência **b) 0** – não ocorre mov. voluntário **1** – o pcte não move ativamente o punho em todo grau de movimento **2** – a tarefa pode ser realizada **c)** Idem ao a) **d)** Idem ao b) **e)** Idem ao b)
7 – Mão: **a)** flexão em massa dos dedos ( ) **b)** extensão em massa dos dedos ( ) **c)**Preensão 1: Art. metacarpofalangeanas (II a V) estendidas e interfalangeanas distal e proximal fletidas. Preensão contra resistência ( ) **d)** Preensão 2: O paciente é instruído a aduzir o polegar e segurar um papel interposto entre o polegar e o dedo indicador ( ) **e)** Preensão 3: O paciente opõe a digital do polegar contra a do dedo indicador, com um lápis interposto ( ) **f)** Preensão 4: Segurar com firmeza um objeto cilíndrico, com a superfície volar do primeiro e segundo dedos contra os demais ( ) **g)** Preensão 5: o paciente segura com firmeza uma bola de tênis ( ) *Pont. máx: (14)*	**a)** * **b) 0 -** nenhuma atividade ocorre **1** – ocorre relaxamento (liberação) da flexão em massa **2** – extensão completa (comparado com mão não afetada) **c) 0** – posição requerida não pode ser realizada **1** – a preensão é fraca **2** – a preensão pode ser mantida contra considerável resistência **d) 0** - a função não pode ser realizada **1 –** o papel pode ser mantido no lugar, mas não contra um leve puxão **2** – um pedaço de papel é segurado firmemente contra um puxão **e) 0** – a função não pode ser realizada **1** – o lápis pode ser mantido no lugar, mas não contra um leve puxão **2** – o lápis é segurado firmemente **f) 0** – a função não pode ser realizada **1** – o objeto interposto pode ser mantido no lugar, mas não contra um leve puxão **2** – o objeto é segurado firmemente contra um puxão **g) 0** – a função não pode ser realizada **1** – o objeto pode ser mantido no lugar, mas não contra um leve puxão **2** – o objeto é segurado firmemente contra um puxão
IV. Coordenação/ Velocidade MS: **a)** Tremor ( ) **b)** Dismetria ( ) **c)** Velocidade: Index-nariz 5 vezes, e o mais rápido que conseguir ( ) *Pont. máx: (6)*	**a) 0** – tremor marcante/ **1** – tremor leve/ **2** – sem tremor **b) 0** – dismetria marcante/ **1** – dismetria leve/ **2** – sem dismetria **c) 0** – 6 seg. mais lento que o lado não afetado/ **1** – 2 a 5 seg. mais lento que o lado não afetado/ **2** – menos de 2 segundos de diferença

V. Função motora membro inferior: Motricidade Reflexa A) Aquiles ( )B) Patelar ( ) (4) 1 - Motricidade reflexa: Patelar e aquileu / adutor ( ) (2)	**0** – sem atividade reflexa **2** – atividade reflexa pode ser avaliada **0** – 2 ou 3 reflexos estão marcadamente hiperativos **1** – 1 reflexo esta hiperativo ou 2 estão vivos **2** – não mais que 1 reflexo esta vivo
2 – Sinergia flexora: flexão quadril, joelho e dorsiflexão (dec.dorsal) ( ) *Pont. máx: (6)*	*
3 – Sinergia extensora: extensão de quadril, adução de quadril, extensão de joelho, flexão plantar ( ) *Pont max: (8)*	*
4 – Mov. com e sem sinergias: **a)** a partir de leve extensão de joelho, realizar uma flexão de joelho além de 90°. (sentado) ( ) **b)** Dorsiflexão de tornozelo (sentado)( ) **c)** Quadril a 0°, realizar a flexão de joelho mais que 90° (em pé) ( ) **d)** Dorsiflexão do tornozelo (em pé) ( ) *Pont. máx:(8)*	**a) 0** – sem movimento ativo **1** – o joelho pode ativamente ser fletido até 90° (palpar os tendões dos flexores do joelho) **2** – o joelho pode ser fletido além de 90° **b)** * **c) 0** – o joelho não pode ser fletido se o quadril não é fletido simultaneamente **1** – inicia flexão de joelho sem flexão do quadril, porém não atinge os 90° de flexão de joelho ou flete o quadril durante o término do movimento. **2** – a tarefa é realizada completamente **d)** *
VI. Coordenação./ Velocidade MI: **a)** Tremor ( ) **b)** Dismetria ( ) **c)** Velocidade: calcanhar-joelho 5 vez ( ) (dec. Dorsal) *Pont. máx: (6)*	**a) 0** – tremor marcante/ **1** – tremor leve/ **2** – sem tremor **b) 0** – dismetria marcante/ **1** – dismetria leve/ **2** – sem dismetria **c) 0** – 6 seg. mais lento que o lado não afetado/ **1** – 2 a 5 seg. mais lento que o lado afetado/ **2** – menos de 2 segundos de diferença
VII . Equilíbrio: **a)** Sentado sem apoio e com os pés suspensos ( ) **b)** Reação de pára-quedas no lado não afetado ( ) **c)** Reação de pára-quedas no lado afetado ( ) **d)** Manter-se em pé com apoio ( ) **e)** Manter-se em pé sem apoio ( ) **f)** Apoio único sobre o lado não afetado ( ) **g)** Apoio único sobre o lado afetado ( ) *Pont. máx: (14)*	**a) 0** – não consegue se manter sentado sem apoio/ **1** – permanece sentado sem apoio por pouco tempo/ **2** – permanece sentado sem apoio por pelo menos 5 min. e regula a postura do corpo em relação a gravidade **b) 0** – não ocorre abdução de ombro, extensão de cotovelo para evitar a queda/ **1** – reação de pára-quedas parcial/ **2** – reação de pára-quedas normal **c)** idem ao **b)** **d) 0** – não consegue ficar de pé/ **1** – de pé com apoio máximo de outros/ **2** – de pé com apoio mínimo por 1 min **e) 0** – não consegue ficar de pé sem apoio/ **1** – pode permanecer em pé por 1 min e sem oscilação, ou por mais tempo, porém com alguma oscilação/ **2** – bom equilíbrio, pode manter o equilíbrio por mais que 1 minuto com segurança **f) 0** – a posição não pode ser mantida por mais que 1-2 seg (oscilação)/ **1** – consegue permanecer em pé, com equilíbrio, por 4 a 9 segundos/ **2** – pode manter o equilíbrio nesta posição por mais que 10 segundos **g) 0** – a posição não pode ser mantida por mais que 1-2 segundos (oscilação) **1** – consegue permanecer em pé, com equilíbrio, por 4 a 9 segundos **2** – pode manter o equilíbrio nesta posição por mais que 10 segundos

Anexo II. Medida da Independência Funcional.

Cuidados Pessoais
1. Alimentação
2. Cuidados com a aparência
3. Banho
4. Vestir parte superior do corpo
5. Vestir parte inferior do corpo
6. Asseio
Controle de Esfíncteres
7. Esfíncter Vesical
8. Esfíncter Anal
Mobilidade e Transferência
9. Cama, cadeira, CR
10. Vaso Sanitário
11. Banheira/Chuveiro
Locomoção
12. Caminhar / CR
13. Escadas
Comunicação
14. Compreensão
15. Expressão
Cognição Social
16. Interação Social
17. Solução de Problemas
18. Memória
Total MIF %