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Post-stroke recovery updates

Actualităţi în recuperarea accidentului vascular

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Abstract

We aim to highlight the stages of cerebrovascular accident recovery. Stroke is defined as a circulatory disorder of ischemic or hemorrhagic type with the persistence of symptoms for more than 24 hours. It has a clinical expression of hemiplegia which in the first stage (day-weeks) is flaccid, followed by the spasticity phase that may last for weeks or months, and the last phase, the chronic one, during which reducing motor deficit and recovering abilities can be continued.

Motor recovery recognizes these stages of cerebrovascular accident and applies different techniques depending on the presence of spasticity and its degree. If in the flaccid phase, passive kinetic elements and the restoration of kinesthetic memory are predominant, in the spastic stage and the chronic stage, the techniques of initiating the active movement predominate.

Recovery of a stroke patient is difficult and goes through several stages. These involve a longer or shorter period of time, depending on when the recovery starts. The sooner the recovery program starts, the higher the benefits, and the less the functional deficit.

Keywords: stroke, neurological rehabilitation, kinetotherapy

Rezumat

Ne propunem punerea în evidenţă a etapelor de recuperare a accidentului vascular. Accidentul vascular cerebral (stroke) se defineşte ca o afectare circulatorie de tip ischemic sau hemoragic, cu persistenţa simptomatologiei mai mult de 24 de ore. Are ca expresie clinică hemiplegia, care în prima etapă (zile-săptămâni) este flască, urmată de etapa de instalare a spasticităţii, care poate dura săptămâni, luni, iar ultima etapă, cea cronică, de continuare a reducerii deficitului motor şi refacerea abilităţilor.

Recuperarea motorie recunoaşte aceste etape ale accidentului vascular şi aplică tehnici diferite în funcţie de prezenţa spasticităţii şi gradul acesteia. Dacă în etapa flască predomină elementele kinetice pasive şi de refacere a memoriei kinestezice, în etapa spastică şi etapa cronică, predomină tehnicile de iniţiere a mişcării active.

Recuperarea unui pacient cu accident vascular cerebral este anevoioasă şi parcurge mai multe etape. Acestea presupun o perioadă mai mare sau mai scurtă de timp, în funcție de momentul începerii recuperării. Cu cât programul de recuperare debutează precoce, cu atât beneficiile sunt mai mari, iar deficitul funcțional restant este mai mic.

Cuvinte cheie: accident vascular, recuperare neuromotorie, kinetoterapie

Introduction

Stroke may be ischemic or hemorrhagic. In the case of ischemic stroke, there is a decrease in blood flow in a brain territory with the sudden onset of a neurological deficit. This decrease may be transient (transient ischemic attack), when the duration of the motor deficit does not exceed 24 hours. It may last up to 24 hours to induce brain tissue necrosis (cerebral infarction) (Popescu & Băjenaru, 2009). Etiology: Most ischemic strokes are caused by thromboembolic mechanisms through the separation of thrombi formed at carotid level or in large cerebral vessels with atheromatous lesions, or by cardiac/paracardiac embolism (atrial fibrillation, atrial myxoma, valvular heart disease).

The term hemorrhagic stroke includes intraparenchymal, intraventricular and subarachnoid spontaneous cerebral hemorrhages (Popescu & Băjenaru, 2009).

Risk factors: interaction between environmental/ modifiable factors (arterial hypertension, diabetes mellitus, atrial fibrillation, carotid atheromatosis, hypercholesterolemia, ischemic heart disease) and genetic/

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unmodifiable factors: predisposition (age, family history, race, gender). In terms of frequency, ischemic stroke ranks first in Europe and the US, accounting for 80%, while bleeding stroke represents about 10-15%, but in Romania this proportion is significantly changed in favor of hemorrhagic stroke (35-40%), probably due to less effective primary prevention (Kiss, 2012).

Morbidity and mortality of hemorrhagic stroke are higher than for ischemic stroke within the first 3 months of onset. The risk of mortality is 4-fold initially, reaching 1.5 after 3 weeks for hemorrhagic stroke compared to ischemic stroke. It was found that after 3 months, mortality is random among subjects with hemorrhagic or ischemic lesions (Andersen et al., 2009).

The main objective of medical rehabilitation is to gain functional independence and improve quality of life. Even if rehabilitation does not "heal" the effects of a stroke, it can substantially help achieve the best long-term outcome (1). At any time after stroke, cognitive functions, language and motor skills can be altered through the brain processes involved in ordinary learning. This exercise-induced neuroplasticity includes an excitability and a higher recruitment of neurons in both brain hemispheres that contribute to the strengthening of synaptic connections and, implicitly, motor performance. Patients who survive a stroke always recover some of the motor deficit by the end of the first three months (Dobkin & Dorsch, 2013). Functional evaluation systems, such as the Barthel Index and the National Institutes of Health Stroke Scale, the modified Rankin Scale (which measures physical care or supervision for self-care, including toilet use, personal hygiene, nutrition and mobility), tend to show a plateau of gains for the first three to four months after stroke (Harrison et al., 2013).

Flaccid stage

In the case of hemiplegia (clinical expression of stroke), there is initially a slight control of voluntary movement associated with low resting muscle tone. Voluntary active movement is absent, normal reflexes disappear and pathological reflexes appear. Rehabilitation therapy begins after the general condition of the patient has stabilized, often within 24 to 48 hours after stroke. Motor gain, especially in the first few weeks after a stroke, reflects the recovery of neurotransmission in spared tissue near and remote from infarction or hemorrhage (Andersen et al., 2009).

The objectives of this stage are:

- Preventing eschars, mobilizing the patient at a pre-established pace, and using the anti-eschar mattress.

- Corrective post-treatment of the patient in order to prevent vicious postures.

- The paretic side must be positioned at the edge of the bed; the patient will become aware of the motor deficit, losing the memory of the movement.

Passive mobilization and massotherapy are the only techniques used in the first stage to maintain joint and muscle integrity (Kiss, 2012).

Stroke recovery depends on the integrity of ipsilateral motor circuits and interactions between the ipsilesional and contralateral brain hemispheres (Liu et al., 2015).

Spastic stage

Three weeks after the onset of stroke, an increase in muscle tone occurs. There are also situations in which it does not occur or situations where it occurs early or only partially in the lower limb. Osteotendinous reflexes are enhanced and resistance to muscle stretch occurs across the range of motion so that spasticity is increased and the patient has tonic flexion postures of the upper limb and extension of the lower limb with the development of equinus foot. As voluntary motor control is restored, a reduction in tone and reflex response can be observed. At this stage, muscle spasticity is used to initiate kinetic rehabilitation programs. Therapeutic strategies used to induce cortical reorganization and promote the recovery of motor function are needed to acquire new skills or to regain lost skills. The traditional treatment methods still used, with no convincing evidence, are sensory motor techniques, namely exercises for muscle growth, increased range of motion, balance training, and postural control (de Man-van Ginkel et al., 2010). As voluntary motor control is recovered, a reduction in tone and reflex response can be observed.

Kinetic techniques and conventional electrotherapy are used (Kiss, 2012; Sbenghe, 1987):

- Bobath's technique inhibits abnormal movements and postures, facilitating motor control.

- Kabat technique maximizes proprioceptive information input through rapid stretches and diagonal and spiral motion patterns.

- Rood technique promotes skin stimulation to facilitate motor recovery.

- The Brunnstrom technique encourages movement initiated as early as possible based on predefined patterns.

- Mirror therapy, whereby the movement of the affected limb is superimposed on the affected limb (Yavuzer et al., 2008), creating the illusion of movement in the affected limb, or virtual reality which offers a massive practice of skills through many repetitions. Therapy involves the use of computer-based programs designed to simulate objects and events in real life. Virtual reality and interactive video games can have some advantages over traditional therapy approaches as they can offer people the ability to practice day-to-day activities that cannot be used in the hospital environment. In addition, patients spend more time in therapy and their activity becomes more motivating (Laver et al., 2017). Evidence has been found that using virtual reality and interactive video games has not benefited from conventional therapeutic approaches in improving upper limb function, which is why they are only used as an adjunct to therapy (to increase overall therapy time). There was not enough evidence to come to conclusions about the effect of virtual reality and interactive video games on speed, balance, participation, or quality of life (Laver et al., 2017).

- Electrostimulation of flaccid muscles using rectangular currents to restore muscular imbalance between agonists and antagonists. A recent systematic review by Langhammer and Stanghelle has evaluated the efficacy of traditional physiotherapeutic approaches. Although improvements in motor function have been demonstrated, no study has demonstrated that these approaches were

superior to the comparator therapies (Langhammer & Stanghelle, 2011).

In addition, a variety of experimental rehabilitation approaches have been tested against the established means of facilitating stroke recovery, such as physical therapy and kinetotherapy. Recent developments include non-invasive brain stimulation techniques such as repeat transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS). The use of these tools is based on neurophysiological studies demonstrating an imbalance of inter-ischemic interactions that appear to interfere with the recovery process (Lindenberg et al., 2010). Lindenberg et al. studied whether the non-invasive modulation of the bilateral motor cortex in combination with physical and occupational therapy improves motor outcome after stroke. Thus, the combination of bihemispheric tDCS and peripheral sensorimotor activities improved motor functions in patients with chronic stroke who had exceeded the recovery period. This new approach can potentiate adaptive brain processes that facilitate motor recovery (Lindenberg et al., 2010). Functional neuroimaging studies have also highlighted the evolution of brain activity in both hemispheres as patient skills improve (Seitz et al., 2010).

- Neurotrophic stimulation and antiallergic electrotherapy as required using low frequency current and continuous downstream current (Rădulescu, 2016).

Sometimes, at this stage, spasticity can be severe, difficult to treat and generating disability; the methods used will be based on clinical needs and the likelihood of achieving functional goals. Stretch techniques are used to reduce resting and dynamic muscular tone, hand and ankle-foot orthoses are aimed at preventing muscle contraction and soft tissue retrieval, or local botulinum toxin injection with a dose-proportional effect can be used (Braddom, 2015).

Chronic stage

The last stage is the stage in which spasticity no longer evolves, the residual motor deficit is already stabilized and difficult to recover. Facilitation techniques are used to track the progress of motor skills, balance and walking, social and family integration. It is the stage in which occupational therapy programs are the most important and can be applied individually or in groups, accompanied by specific adaptations at home. Thus, the last two stages are superposable in terms of physical-kinetic and occupational therapy, to which the benefits of current robotic-assisted and electronic technology, functional electrical stimulation (FES) therapy can be added.

At present, robotic-assisted therapy is no longer in the testing stage, with many centers using it for regaining both gait and balance. A walking training system intended for neuromotor recovery is the body weight-supported treadmill training (BWSTT) system. Robotic therapy promotes movement while the patient acquires a skill by repeating movements without the need for the therapist's continued involvement (Mayr et al., 2007). One study shows that in the case of chronic survivors of cerebrovascular accidents, kinetotherapy by a therapist is superior to robotic-assisted therapy. Given the cost and continuous development of rehabilitation devices, it is imperative to identify patients who can benefit from robotic-assisted rehabilitation. In view of the present results, patients with chronic hemiparesis that can move independently, even at a very slow pace, can be better served by kinetic therapy. As such, larger clinical trials evaluating the effects of robotic-assisted therapy may be justified in this patient population. In conclusion, robotic-assisted therapy may be indicated for non-ambulatory or subacute disease patients (Mayr et al., 2007; Husemann et al., 2007). Kinetics therapy facilitates and increases ambulation capacity in stroke patients compared to a similar dose of robotic-assisted therapy. Robotic devices only provide assistance for locomotor therapy, and their effectiveness in improving ambulation capacity is not well established (Hornby et al., 2008).

In terms of cognitive, language and communication disorders, the most important strategy applied in our country remains encouragement in any form of vocalization. These communication disorders after a stroke include aphasia, dysarthria, apraxia of speech and cognitive impairment. They can affect speech, listening, reading, writing, gestures and pragmatism. Dysarthria is a collective term for a group of speech disorders resulting from paralysis, weakness or non-coordination of speech muscles after neurological injury. Dysarthria may affect, individually or in combination, any of the subsystems underlying speech production: respiratory, laryngeal, velopharyngeal and oral subsystems (1).

Assisted communication media may range from low-tech strategies: paper and pencil, books to advanced smart-phone technologies or language-generating devices. Studies show that therapy initiated immediately (3 days after stroke) for aphasia improves the communication of patients with moderate/ severe aphasia (Godecke et al., 2012). Another study shows that treatment of patients with aphasia continues to be effective 6 months after stroke (Allen et al., 2012), pointing out that there is insufficient evidence to know exactly when to initiate treatment and for how long this should last (2). Dysphagia is common after stroke, affecting between 42% and 67% of patients within 3 days of stroke. Of these, a third develop aspiration pneumonia, dysphagia, malnutrition, dehydration, weight loss, and decreased quality of life. Early identification through screening can reduce the risk of developing the above mentioned disorders. Once the risk of dysphagia or aspiration pneumonia has been identified, bedside clinical assessment can provide information about the swallow mechanism and patient management (2). The compensatory treatments for swallowing dysfunction include changing posture and positioning for swallowing, learning new swallowing maneuvers, changing the amount and texture of foods (Geeganage et al., 2012; Ashford et al., 2009).

The frequency of micturition and defecation disorders in patients with hemiplegia is known. In a positive note, the recovery of a neurogenic bladder is possible in stroke, but insufficient awareness, the need for medical care for at least 3 months after stroke (Dorsher & McIntosh, 2012), the difficulty in communicating due to aphasia or the difficulty or impossibility of going to the bathroom are factors with a negative impact on the patient and his/her family.

In the case of patients with neurogenic bladder, the first strategy is timed evacuation which, depending on the residual volume, requires the administration of pharmacological substances for complete evacuation (α-blockers) or anticholinergic substances which allow an increase in the bladder volume. Other strategies include ensuring a correct water intake, using specific techniques according to a well-established timetable, medical assistance, possibly intermittent catheterization, condom catheters, only in the case of non-responders, permanent intravesical Foley catheters (Dorsher & McIntosh, 2012). Fecal incontinence can be prevented by using standard fixed-hour planning techniques for early gastric emptying, rectal stimulation with the fingers and suppositories (Mayr et al., 2007). Depression and anxiety are common after stroke and are associated with poor functional outcomes and increased mortality (Wulsin et al., 2011). Signs of clinical depression include sleep disturbances, a radical change in dietary patterns, which can lead to sudden weight loss or gain, lethargy, social withdrawal, irritability, fatigue, self-rejection, and suicidal thoughts. There is evidence that the severity of depression increases after stroke (de Man-van Ginkel et al., 2010). Anxiety, in particular, is found to coexist with depression in patients with cerebrovascular accidents, but is frequently undiagnosed (Vuletić et al., 2012). Unfortunately, little has been done to address the treatment and recovery of post-stroke generalized anxiety disorder (Campbell Burton et al., 2011). There is no evidence of the benefits of treating depression through psychotherapy, but additional practices such as motivational interviews, programs and exercises as well as health care have a positive impact on the reduction of depression symptoms (Hackett & Pickles, 2014).

Rehabilitation services are the primary mechanism by which functional recovery and independence are promoted in stroke patients. The current trend in stroke units to start recovery from the first day of stroke is the chance for an independent life offered to these patients. The main goal underlying all rehabilitation interventions is to maximize the quality of life of patients with cerebrovascular accidents, and not only to improve motor control, functional independence and social reintegration (Braddom, 2015). In well-designed rehabilitation studies, the magnitude of improvement by physical or occupational therapy tends to be modest but clinically useful, such as an increase in the Barthel Index score by about 20 points (range 0-20) in 6 months compared to the first few weeks (a score below 40), with a larger number indicating greater independence (Nakao et al., 2010). Rehabilitation after stroke undergoes constant change, and work over the last decades has shown it. The current effort is to develop new research methods and to use emerging technologies to study the physiology of the brain, with emphasis on recovery and response to recovery methods (Carter et al., 2016).

Conclusions

1. Stroke is one of the most common causes of disability, which requires sustained medical rehabilitation programs.

2. The new technological advancements have led to various methods and techniques based on robotics and virtual reality, which can be used in neurological rehabilitation. Using these methods, stroke recovery can be spectacular, minimizing motor deficit and greatly improving quality of life.

3. In order to limit disability after stroke, rehabilitation should be started from the outset, with objectives specific to the patient's stage of evolution.

Conflicts of interest

There are no conflicts of interest.

References

Allen L, Mehta S, McClure JA, Teasell R. Therapeutic interventions for aphasia initiated more than six months post stroke: a review of the evidence. Top Stroke Rehabil 2012; 19(6):523-535. doi: 10.1310/tsr1906-523.

Andersen KK, Olsen TS, Dehlendorff C, Kammersgaard LP. Hemorrhagic and ischemic strokes. Stroke, 2009;40(6):2068-2072. doi: 10.1161/STROKEAHA.108.540112.

Ashford J, McCabe D, Wheeler-Hegland K, Frymark T, Mullen R, Musson N, Schooling T, Hammond CS. Evidence-based systematic review: oropharyngeal dysphagia behavioral treatments, part III: impact of dysphagia treatments on populations with neurological disorders. J Rehabil Res Dev. 2009;46(2):195-204.

Braddom RL. Medicină fizică şi reabilitare. Ed. RAMO, Bucureşti, 2015, 1245-1290.

Campbell Burton AC, Holmes J, Murray J, Gillespie D, Lightbody EC, Watkins CL, Knapp P, Interventions for treating anxiety after stroke. Cochrane Database Syst Rev. 2011: CD008860. 2011 Dec 7;(12):CD008860. doi: 10.1002/14651858. CD008860.

Carter AR, Connor LT, Dromerick AW. Rehabilitation after stroke: Current State of the Science. Curr Neurol Neurosci Rep. 2010;10(3):158-166. doi: 10.1007/s11910-010-0091-9.

Dobkin BH, Dorsch A. New evidence for therapies in stroke rehabilitation. Curr Atheroscler Rep. 2013;15(6):331. doi:10.1007/s11883-013-0331-y.

Dorsher PT, McIntosh PM. Neurogenic Bladder. Adv Urol. 2012;2012:816274. doi: 10.1155/2012/816274.

Geeganage C, Beavan J, Ellender S, Bath PM. Interventions for dysphagia and nutritional support in acute and subacute stroke. Cochrane Database Syst Rev. 2012;10:CD000323. doi: 10.1002/14651858.

Godecke E, Hird K, Lalor EE, Rai T, Phillips MR. Very early poststroke aphasia therapy: a pilot randomized controlled efficacy trial. Int J Stroke, 2012;7(8):635-644. doi: 10.1111/j.1747-4949.2011.00631.x.

Hackett ML, Pickles K. Part I: frequency of depression after stroke: an updated systematic review and meta-analysis of observational studies. Int J Stroke. 2014;9(8):1017-1025. doi: 10.1111/ijs.12357.

Harrison JK, McArthur KS, Quinn TJ. Assessment scales in stroke: clinimetric and clinical considerations. Clin Interv Aging. 2013;8:201-211. doi: 10.2147/CIA.S32405.

Hornby GT, Campbell DD, Kahn JH, Demott T, Moore JL, Roth HR. Enhanced gait-related improvements after therapist- versus robotic-assisted locomotor training in subjects with chronic stroke: a randomized controlled study. Stroke. 2008;39(6):1786-1792. doi: 10.1161/STROKEAHA.107.504779.

Husemann B, Muller F, Krewer C, Heller S, Koenig E. Effects of locomotion training with assistance of a robot-driven gait orthosis in hemiparetic patients after stroke: A randomized controlled pilot study. Stroke. 2007;38(2):349-354.

Kiss I. Fiziokinetoterapia şi recuperarea medicală. Ed. Med. Bucureşti, 2012.

Langhammer B, Stanghelle JK. Can physiotherapy after stroke based on the Bobath concept result in improved quality of movement compared to the motor relearning programme. Physiother Res Int. 2011;16(2):69-80. doi: 10.1002/pri.474.

Laver KE, Lange B, George S, Deutsch JE, Saposnik G, Crotty M. Virtual reality for stroke rehabilitation. Cochrane Database Syst Rev. 2017, 11:CD008349. doi: 10.1002/14651858.CD008349.pub4.

Lindenberg R, Renga V, Zhu LL, Nair D, Schlaug G. Bihemispheric brain stimulation facilitates motor recovery in chronic stroke patients. Neurology. 2010;75(24):2176-2184. doi: 10.1212/WNL.0b013e318202013a.

Liu J, Qin W, Zhang J, Zhang X, Yu C. Enhanced Interhemispheric Functional Connectivity Compensates for Anatomical Connection Damages in Subcortical Stroke. Stroke. 2015;46(4):1045-1051. doi: 10.1161/STROKEAHA.114.007044.

de Man-van Ginkel JM, Gooskens F, Schuurmans MJ, Lindeman E, Hafsteinsdottir TB, Rehabilitation Guideline Stroke Working Group. A systematic review of therapeutic interventions for poststroke depression and the role of nurses. J Clin Nurs. 2010;19(23-24):3274-3290. doi: 10.1111/j.1365-2702.2010.03402.x.

Mayr A, Kofler M, Quirbach E, Matzak H, Frohlich K, Saltuari L. Prospective, blinded, randomized crossover study of gait rehabilitation in stroke patients using the lokomat gait orthosis. Neurorehabil Neural Repair. 2007;21(4):307-314.

Nakao S, Takata S, Uemura H, Kashihara M, Osawa T, Komatsu K, Masuda Y, Okahisa T, Nishikawa K., Kondo S, Yamada M, Takahara R, Ogata Y, Nakamura Y, Nagahiro S, Kaji R, Yasui N, Relationship between Barthel Index scores during the acute phase of rehabilitation and subsequent ADL in stroke patients. J Med Invest. 2010;57(1-2):81-88.

Popescu BO, Băjenaru O. Elemente esențiale de neurologie clinică. Ed. Med. AMALTEA, Bucureşti 2009, 170-195.

Rădulescu A. Electroterapie. Ed Med., Bucureşti, 2016.

Sbenghe T. Kinetologie profilactică, terapeutică şi de recuperare. Ed. Med. Bucuresti, 1987.

Seitz RJ, Lindenberg R, Schlaug G. Neuroimaging Advances in Stroke Rehabilitation. Eur Neurol Rev. 2010;5(2):67-72. doi: http://doi.org/10.17925/ENR.2010.05.02.67.

Vuletić V, Sapina L, Lozert M, Lezaić Z, Morović S. Anxiety and depressive symptoms in acute ischemic stroke. Acta Clin Croat. 2012;51(2):243-246.

Wulsin L, Alwell K, Moomaw CJ, Lindsell CJ, Kleindorfer DO, Woo D, Flaherty ML, Khatri P, Adeoye O, Ferioli S, Broderick JP, Kissela BM. Comparison of two depression measures for predicting stroke outcomes. J Psychosom Res. 2012; 72(3):175-179. doi: 10.1016/j.jpsychores. 2011.11.015.

Yavuzer G, Selles R, Sezer N, Sütbeyaz S, Bussmann JB, Köseoğlu F, Atay MB, Stam HJ. Mirror therapy improves hand function in subacute stroke: a randomized controlled trial. Arch Phys Med Rehabil. 2008;89(3):393-398. doi: 10.1016/j.apmr.2007.08.162.

Websites

(1) https://stroke.nih.gov/materials/rehabilitation.htm, Accessed in August 2017

(2) http://stroke.ahajournals.org/content/49/3/e46, Accessed in December 2017