

The rehabilitation of post stroke cognitive changes

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ABSTRACT

The Stroke has a strong impact on the country's global health context, being considered one of the major causes of disability in the world, as it generates motor, sensory, language, cognitive, emotional and behavioral sequelae. The person with stroke needs integration, and this article aims to demonstrate how the Psychology Service at the Institute of Rehabilitation Medicine, Hospital das Clinicas, Faculty of Medicine, University of São Paulo (IMREA HC FM USP) uses state of the art of neuropsychological / cognitive rehabilitation, in which it is necessary to conceptualize Neuropsychology and its interface with the differential diagnosis, with an understanding of the functioning of mental activities towards normality and its alterations, to finally discuss the structuring of the program of neuropsychological / cognitive in the process of Integral Rehabilitation of the person victim of AVE in IMREA FMUSP.

Keywords: Stroke, Neuropsychology, Cognitive Dysfunction

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INTRODUCTION

It is considered of paramount importance to systematize the knowledge and care practices for people with stroke, as it is one of the diseases that kills Brazilians the most, being the main cause of disability worldwide. Approximately 70% of people do not return to work after a stroke due to sequelae and 50% become dependent on other people on a day-to-day basis. Although it occurs more frequently in individuals over 60 years of age, stroke can occur at any age, including in children. Stroke events are growing more and more among young people, occurring in 10% of patients under 55 years, and the World Stroke Organization predicts that one in six people in the world will have a stroke throughout their lives.¹

According to the World Health Organization (WHO),² Stroke is defined as a clinical sign of rapid development of focal disturbance of brain function, of possible vascular origin that lasts more than 24 hours. The World Health Organization (WHO), in 2002, has published the annual incidence of 20.5 million cases of stroke worldwide, 5.5 million fatal cases, with two-thirds of the events occurring in developing countries.²

Cerebrovascular diseases have a strong impact on health, as they are more incapacitating than fatal.^{4,3,5} According to the WHO, the greatest cause of disability in the world is correlated to cerebral functioning diseases.²

Acquired brain lesions can generate several sequelae, such as motor changes (monoplegia, hemiplegia, hemiparesis, double hemiplegia), which changes body movements and can lead to functional limitations and disabilities.⁶ Among the motor alterations, stroke victims may also present ataxias, imbalances, incoordination, and sensitive impairments such as pain and tactile, vision, hearing, taste, smell disturbances, as well as language disabilities, such as aphasia, dysarthria, amusia, and agraphia.

According to Battistella⁷ the reason for the existence of the Institute of Physical Medicine and Rehabilitation of the *Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo* (IMREA-HCFMUSP) is the patients and their families. Therefore, to meet their needs and expectations, everything that is offered must respect their individualities for excellence in results. Caregivers are the keys for the success of rehabilitation, so it is essential to ensure the formation, preparing them to continue the efforts undergone during and after the therapeutic process.

Therefore, the person who has acquired transient or permanent deficiencies due to

stroke needs comprehensive care in several areas and require multiprofessional care. The Psychology Service is part of the process of rehabilitation which emphasizes emotion related aspects, such as fear, anger, sadness, disgust, joy and surprise,⁸ i.e. the way the patient reacts to the emotions and feelings aroused by the new condition, that not uncommonly are feelings of revolt, nonconformity, lack of value, guilt, incapacity and insufficiency.

It is important to verify the humor state. It can be euthymic, constant or oscillatory and, due to neurological injury, may present dysphoric, expansive, irritable, exalted, labile or euphoric behaviors.⁹ The possible destabilization of the emotional affective dynamics damages the manner the person relates to others and to the world, and may also interfere with his/her actions and behaviors.

It is up to the Psychology Service to evaluate the cognitive status of the patient and to verify the presence of impairments of orientation, attention, memory, executive functions, course of thought, criticism, social cognition and consciousness.¹⁰

Changes in the emotional, behavioral, and cognitive aspects of stroke can be dramatic for both the affected person, their family, and society. In this context of search for the best overall recovery of stroke, there is the state of the art of Neuropsychological / Cognitive Rehabilitation.

To better understand the work performed at IMREA-HCFMUSP, it is essential to conceptualize Neuropsychology, to set the importance of Neuropsychological Evaluation with the understanding of the development of mental activities, its alterations, to finally discuss Neuropsychological/Cognitive Rehabilitation, management and treatment strategies.

Neuropsychology

Neuropsychology is an area of science that consistently gains respectability it translates cognitive, emotional and behavioral phenomena into the interface between Neurology and Psychology.¹¹

It arises from the perspective that Man that in its ontogenesis is a social being. It follows the materialistic epistemology and dialectical method in which it is understood that there are no dualistic or dichotomous oppositions between the instances of the social and individual, objectivity and subjectivity, internal and external; the paradigm becomes monistic in which the Man is a complete being without biological, mental, emotional and social divisions.^{11,12,13}

Man develops and individualizes himself through the mediations of language, through his relationship to the other and his activities. Its development is a long process marked by qualitative leaps that occur in three moments: from phylogenesis (origin of the species) to sociogenesis (origin of society); from sociogenesis to ontogenesis (the origin of man) and from ontogenesis to microgenesis (the origin of the single individual). Thus, with the perspective of man as an active and integral being that neuropsychological care is ruled.¹⁴

Differential diagnosis

The structuring of a neuropsychological / cognitive rehabilitation program should be based on the results collected during the neuropsychological evaluation that contributes to the diagnosis, prognosis and rehabilitation of cognitive functions, fundamental for differential diagnosis. Many modifications can occur for the person who with stroke, which makes it important to check for changes in their psychological dynamics. Through evaluation it is possible to understand certain reactions and behaviors, which can be distinguished if they arise from their personality structure, in which the resilience capacity is part, or if the emotional changes are part of the neurological injury.^{15,16,17}

Namely, the differentiation of the reactive behavioral aspects of social cognition is qualified as reactive depression versus secondary depression, emotional lability, and other behavioral changes.^{17,18} It makes it possible to verify the preserved and deficient mental activities in their functionalities and in what way the qualification of the symptomatology has repercussions in the life of the person and in his / her family dynamics.

It is important to know the development and alterations of mental activities for the correct evaluation and structuring of neuropsychological / cognitive rehabilitation.

Mental Activities

Initially every baby's psychic apparatus revolves in relation to the internal and external stimuli that act in the receiving organs is Sensation, whereas Perception is the awareness of the sensorial stimulus.¹⁹ Sensation is an elementary phenomenon generated by varied physical, chemical or biological stimuli, from outside or within the organism and that produces changes in the recipient organs.

The perceptual process is complex, structurally similar to the processes underlying the higher cognitive activities, it is active

and involves the search for corresponding information, the distinction of the essential aspects of the object, the comparison of the aspects among themselves, the formulation of appropriate hypotheses and the comparison with the original data. From all this path, perception gives attribution of sense, meaning and category of the object.^{19,20,21}

People with stroke can have quantitative changes in the sense of perception, in which perceptual images have an abnormal intensity, for more or less. For example: Hyperesthesia: it is the condition in which perceptions are increased. Sounds are heard in a very amplified way, a noise sounds like a crash, colors and visual images become more vivid and intense. This can generate irritation and the patient may desire to be isolated. In Hypoesthesia the surrounding world is perceived as darker, colors become paler, food has no flavor, odors lose their intensity. Analgesia of parts of the body may also occur.^{19,20}

Among the qualitative alterations of sense-perception, there is the *Illusion* which is the deformed perception of a real and present object, whereas *Hallucination* is the clear and definite perception of an object (voice, noise, image) without the presence of the real stimulating object. *Agnosia* loss or deterioration of the ability to recognize or identify objects despite maintaining sensory function intact (sight, hearing and touch), neglects disorders in which the injured individual may not perceive sensory stimuli, such as tactile, auditory and / or visual, generally coming from the left field. *Astereognosias* is characterized by the inability to recognize the objects by the palpation and without the aid of another sensorial channel. Depending on the intensity of the injury, the level of the elemental sensations (cold, heat, smooth, soft), the level of perceptions (of shape – sphere or cube; or of material – metal or plastic), which is where the object is recognized and named.^{22,23,24}

The selection of relevant information, selective programs of action and their control are called Attention, that is, direction of consciousness. If there were no attentional process, it would be impossible to develop other mental activities. The attentional process can be divided into:^{20,21,24}

- Voluntary attention: which expresses the active and intentional concentration of consciousness on the object;
- Spontaneous attention: awakened by the momentary, incidental interest that emanates from an object. It is usually increased in states where the

individual has little voluntary control over their mental activity;

- External attention: projected out of the subjective world of the individual, to the external world or his body, is of a more sensorial nature;
- Internal attention: focused on the internal processes of the individual, more reflective;
- Focal attention: it remains concentrated on a determined and relatively limited and restricted field of consciousness;
- Dispersed attention: it does not concentrate under a given field, losing focus;
- Selective attention: it depends on a state of concentration so that the individual can establish priorities of the conscious activity, before a wide set of environmental stimuli.
- Sustained attention: maintenance of selective attention, which allows the execution of tasks;
- Tenacity: is the ability of the individual to focus on an area or object;
- Surveillance: quality of attention that allows the individual to change his focus from one object to another.

Some people may have difficulty concentrating on internal or external distractors such as: talking in a noisy place, sharing attention in two or more simultaneous activities. For these, the processing of new information is usually slower than that of a normal person.^{20,21,24,25}

Memory is the way in which man knows of his existence and can mentally recover experiences in the brain. The process of memorization begins with the reception, selection, and treatment of information received by sense organs; then encoding and storing this information in the form of “engrams” which would be, within the set of neurons, the networks that represent the support of the stored information; and, at last, the ability to access this information.^{10,25,26}

All the information we use in our day-to-day life is memory-related, it's new data that needs to be stored and retrieved. This process is done in a simultaneous and crossed way, in which multiple memories are involved.^{21,28}

Distinctions between memory types can be related to time (long or short term), to repetition, to stimulus relevance, and to individual consciousness (explicit and implicit). Different types of memory can have their forms and characteristics and contain different types of information, such as:^{10,27,28}

a) short-term memory or immediate memory: it has a limited capacity, which

includes the analysis of sensory information in specific brain areas (visual, auditory etc.) and its immediate reproduction, in a very short time, one to two minutes. To reach the long-term memory the information must necessarily pass through the short term. The short-term model is not a single system, but can be divided into specific and independent subsystems such as short-term memory for verbal events and short-term memory for visuo-spatial events. Operational memory is in short-term memory.²⁸

b) operational memory: “this is a hypothetical concept that refers to the temporary filing of information for the performance of a variety of cognitive tasks, such as keeping a conversation, shopping, etc.” Your injury can bring great difficulties to a person's life, because “it is necessary for learning, for recovering old material and for performing many other tasks”. Short-term memory can not be reduced to a passive storage system. In fact, it serves as an operational memory that is a system of limited capacity, capable of storing and manipulating information, thus allowing the performance of cognitive tasks such as reasoning, understanding and problem solving.^{25,27,29,30}

c) recent memory: this refers to the temporal dimension of memory, so that a person has access to information such as: his/her address; his/her last breakfast; his/her last night activities so on. It is fundamental to the process of learning and continuity of the construction of personal history, since it refers to the capacity of the nervous system to retain information and form new memories.³⁰

d) reference memory: it is independent on the specific temporal context of the information, it is a system that stores information relevant to one's life, a fact that explains the need for repetition, since the critical stimulus is cataloged for storage in the long term memory. It is an “inactive” or “latent” memory until it is activated by the appropriate stimuli, which corresponds to evocation or remembrance.^{26,28}

e) long-term memory: it allows the durable preservation of information, due to a coding followed by organized storage in a multimodal associative frame (semantic, spatial, temporal, affective). It allows learning, and the stored information is the object of a varied consolidation according to emotional importance and repetition. Declarative or explicit memory includes episodic and semantic, non-declarative or implicit memory, it comprises motor, perceptual, and motor skills, all belonging to long-term memory.³⁰

f) declarative memory: it is the ability to store and remember or consciously recognize facts and events. This memory can be stated, that is,

brought to the mind, verbally, as a proposition, or as an image. This type of memory is affected in amnesic patients, and it can be divided into semantic and episodic:³¹

- Semantic memory: this is a factual memory, concepts, facts, rules and mathematical operations. It is a more abstract “mental lexicon” system, storing information without reference to the circumstance in which it was acquired. It is a component of long-lasting memory, socially shared and relearned constantly and not temporally specific.³¹
- episodic memory: it allows the individual to record and recall information referenced in a spatial and temporal context of his personal history.^{27,30,32}
 - g) procedural memory: it is the ability to gradually acquire a percepto-motor or cognitive ability through repeated exposure to a specific activity that follows constant rules.^{27,32}
 - h) prospective memory: it is directed to the facts of the future, how to remember to take the medicine every four hours, go to rehab treatment on a certain day of the week, etc. “It’s a memory focused on what happens in each person’s day-to-day life.” It also requires many attentional mechanisms, and other important cognitive mechanisms such as planning, intention, and motivation.³²

Memory Disturbances

Memory can be impaired after stroke. In some conditions, memory impairment is secondary to attention deficit, confusional states, motivation, or other cognitive impairments.

Anterograde Amnesia refers to the inability to learn new material while Retrograde Amnesia indicates the inability to recall events that occurred in the premorbid period, which affects a limited period of the individual’s life that may decline as the condition evolves. Retrograde memory can be accessed through questioning of public events, or autobiographical facts narrated by relatives.^{31,33,34}

Semantic memory and episodic memory are sometimes impaired in amnesic patients, in whom frontal injuries may present deficits to temporarily order judgments. These memories exhibit poor recent recalls, while injured in temporal regions of the brain do not present damage to recent memory, but to the item of recognition memory or memory consolidation, i.e. whether a stimulus has or has not been previously presented.^{12,14,21,33}

The capacity and knowledge of the strategies used for the memorization process is called metamemory, in which the poor planning and organization of strategies contribute to its relegation.

Consciousness is a property of certain states of the functioning of our organism. The degrees of consciousness correspond to the clarity with which we can take cognizance of our experiences. We are aware of something, for example, of what goes on around us, or the nature of our thoughts and our emotions.^{36,37,38}

Executive Functions

These are specialized cognitive processes, that is, a set of cognitive skills of principles and organization necessary to suitably deal with fluctuating and ambiguous situations of social relationship and for an appropriate, responsible and effective conduct. Thus, executive functions help to achieve future goals, since they involve planning, initiation, follow-up and monitoring of complex behaviors directed to an end. In the neuropsychological evaluation, the term Executive Functions is used to designate a wide variety of cognitive functions which imply attention, concentration, selectivity of stimuli, capacity of abstraction, planning, flexibility, mental control, self-control and operational memory.³⁹

It is divided into Cold Executive Functions⁴⁰ which includes cognitive control and includes functions such as working memory, attention control, planning, monitoring, abstract reasoning, and problem solving, and Hot Executive Functions,⁴⁰ which refers to behavior control that includes initiative of movements or behaviors, impulse control, anticipation of consequences, among other functions, and emotional control that encompasses modulation of emotional arousal, mood modulation, self-reassuring strategies.

Linked to this form of functioning we also have Social Cognition, which is the process that guides behaviors among individuals of the same species, such as decision making, social reasoning, emotional work memory. It is responsible for the social judgment of faces, fear and anxiety, empathy, simulation, and theory of mind.^{40,41}

Neuropsychological / Cognitive Rehabilitation

The structuring of the neuropsychological / cognitive rehabilitation program demands the knowledge for the development of mental

activities, the neuropsychological assessment and the verification of important aspects regarding the person with stroke, namely, their conscience, expectations and their own desires which implies issues of grief-making capacity and family support. Determining factors for adherence to treatment are based on the following principles:

Neuroplasticity: the brain’s ability to reshape itself according to the individual’s experiences, to reformulate its connections according to the needs and aspects of the environment. The relationship that the human being establishes with the environment produces modifications in his brain, allows a constant adaptation and learning throughout life, thus the cerebral plasticity makes the human being more effective.^{41,42} Neuroplasticity explains the fact that certain brain regions take over injured and inactive areas, however, this recovery depends on factors such as age, area of the brain affected, time of exposure to injury, nature of the injury, amount of damaged tissue, mechanisms of cerebral reorganization, environmental, cultural, psychosocial and emotional factors.^{41,42}

- Positive Neuroplasticity: Morphological and functional changes in the brain increase the cognitive reserve.⁴²
- Negative Neuroplasticity: Morphological and functional changes in the brain decrease the cognitive reserve.⁴²
- Cognitive reserve: a set of resources of cognitive processes and neural networks underlying performance in tasks that allow better adaptation. Factors: schooling, habits, activities, culture.⁴²
- Transference: an untrained cognitive domain, task, or skill improves as a result of training in another domain.⁴³
- Cognitive domain: with skill calculated by tasks or tests, where the transfer is characterized by secondary improvement, not predicted, for example, improvement in constructive tests after training in operational memory.^{42,43}
- Functional Behaviors: Measures of functional cognition, scales, inventories or behavioral questionnaires, such as professional inclusion, generate effects on tasks of daily living for which the individual was not specifically trained.^{44,45}
- Learning: The human being has a brain capable and eager for learning, which gains even greater complexity of

functioning with the advent of symbolic language, and which biologically and culturally has the tools to overcome adversities and to transform course accidents into qualitatively different forms of being and dwelling in the world.²⁰

Neuropsychological rehabilitation encompasses cognition, which aims to advance symbolic processes for the recovery of autonomy, with dynamic models of tasks and stimulation of function. Neuropsychological rehabilitation, such as that practiced in the IMREA, conceives the human brain as a dynamic and adaptive organ, capable of being restructured due to new environmental requirements or limitations imposed by brain lesions, in which aspects related to dynamics of emotional affection permeate the whole process.^{10,46}

Therefore, neuropsychological rehabilitation aims to remake the path of development, in which the patient being part of the interactive process and rehabilitation goals are discussed between him, the family, the therapist and the multidisciplinary team. It focuses on the improvement of aspects of daily life, with realistic objectives and themes, activities, contexts and personally significant interactions for each patient, to favor the outcome of new neural networks, compensatory strategies and functional improvements.⁴⁷

Treatment is based on the uniqueness of each patient and focus to the most proximal zone of development, which is the distance between the actual level and the level of potential development.¹⁴

Considering what has been exposed above, some forms of stimulation of neuropsychological functions are as follows, and the materials are used according to the moment and pertinence of the case, for example, academic, ecological and technological, including the *neuro games*.⁴⁸

Stimulation of sensory perception⁹

Desensitization of pain, protection of irritating agents, awareness of changes and activation of the senses: hearing, vision, taste, smell and touch.

Attention Direction²⁰

- Environmental and psychosocial strategies and supports. Attention kept: listening and repeating sequence of numbers and stories, mental

activities of math. Alternate attention: alternating numbers and letters, add or subtract numbers. Selective attention: presence of distracting elements. Divided Attention: search for target word in text, time control, self monitoring.

Attention and Memorization Driven Activities

- Write about the difficulties: check the deficits, level of awareness, quality of the course of thoughts. Take note of programs: attention, memory and interest. Autobiography: to present declarative memory data, reflection on the current situation and future projections. Retention of reading and rewriting: Understanding, remembrance, articulation and logical chaining of the elements. Metacognition, mental models, operational memory, recent memory, semantic-associative operations to process new information.^{10,47}
- Memory: visual recognition, mental classification strategies, lexical function. Save paths: attention, long-term memory and spatial navigation, associate sensory information and process it in relation to space, for future recall. Find words: the ability to visually sweep the image and combine it with semantic memory.
- Even numbers: executive control skills, visual exploration strategies, working memory and concentration, numerical processing skills and processing speed.^{10,47}

Shared Activities that Involve Motivation

- Mime: think of significant gesture, recruit old records of images and words, imagination, speed of processing, planning, execution and goals. Recognize the action of others and respond to it. Brain Storm: creative imagination, problem solving, anticipating solutions, updating of knowledge, semantic memory, conceptual and metaphorical thinking, associative and abstract. Learning (activation, direction of intensity

and persistence of the conduct). Goals (relation with objects, interest, curiosity, affective and propulsive force). Situational Phenomenon (involves the person, the activity, the environment and the resources. It is the person in action in a specific context). Reasons related to the world, future occupation and life prospects.^{10,47}

Academic and Social Activities

- Initiative and direction: response, intention, motivation and interest. Inhibitory response: inhibit automatic response, recruit criticism and mental flexibility.
- Task Persistence: keep attention, operational memory and finalize the task. Organization: operational memory, process required to remember and sequence information, goal identification, planning and awareness of time.^{10,48}

Activities for Self-Awareness and Recognition of emotions

- Instruments: tests, performances in activities, comparisons of productions, academic activities. Language: overcomes immediate limitations, planning, ordering and controlling behavior, internalizing production, learning and problem solving.^{10,47}
- The Other: mediator of the process of awareness, interaction and internalization; Empathic resonance: "mirroring" the other.^{10,47}
- Systems of beliefs: false or overvalued; Control of the environment; Communication with caregivers or caregiver-like people. Reflexive experiences: of oneself, of the reaction of the other, of the control of behavior. Emotion management; Consciousness of feelings.^{10,47}

The Neuropsychological / Cognitive Rehabilitation delivered in IMREA is based on bond, motivation for activities, learning, capacity for action, personal and social significance. For, one knows the emotional chain in which emotion affects attention and memory, imagination and reasoning. Therefore, rehabilitation means much more than just recovering deficit functions, in fact it is to seek fulfillment as a human being in

his capacity to share experiences, which is only possible through the existence of AFFECTION!⁴⁸

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