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# Alterations in Neuropsychological Functions after the Right Hemisphere Stroke: a Literature Review

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### ABSTRACT

**INTRODUCTION:** Neuropsychological functions can suffer damage after a le-sion in the right hemisphere of the brain. **OBJECTIVE:** To present an overview of existing publications concerning the study of changes in associated neuropsychological functions after right hemisphere vascular lesion. **METHODOLOGY:** Electronic databases of scientific articles were searched for in the internet databases, such as Latin American and Caribbean Literature in Health Sciences (LILACS) and Scientific Electronic Library Online (SCIELO). **RESULTS:** The studies that evaluate neuropsychological functions and alterations in the Right Hemisphere after a Stroke vary from one to the other, showing convergences and divergences between authors in this relation of injured area and impaired function. However, in general, the authors agree that patients injured in the right hemisphere after a stroke present homogeneously in several neuropsychological functions. **CONCLUSION:** In the course of the study, it was noticed that some of these functions such as attention, perception, visual perception, memory, language and executive functions are highlighted more often and by more than one author, which are then considered the most associated functions with HD after a stroke. More studies on changes in neuropsychological functions following the right hemisphere stroke are needed to identify different clinical profiles and contribute to the increased effectiveness of assessment and re-habilitation procedures.

**Keywords:** Stroke, Neuropsychology, Alterations.

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## INTRODUCTION

Neuropsychology is a scientific discipline that deals with relating the brain and cognitive functions, encompassing knowledge of sciences such as Psychology and Neuroscience. A science developed initially from the meeting of Neurology with Psychology, aiming to understand the changes in behavior resulting from a brain injury. Currently, it is an area of interaction between Neurosciences and Behavioral Sciences, acting in the diagnosis, follow-up treatment and research of cognition, emotions, personality and behavior, focusing on the relationship between these aspects and brain functioning<sup>1</sup>.

The evaluation of the neuropsychological functions of patients after brain injury is important to complement the studies of the cerebral hemispheres and the impacts on these functions when one of them is injured. Despite many studies and international instruments of neurocognitive evaluation, it is still difficult to find in Brazil specific literature studies about the impacts on the right hemisphere after brain injury.

The stroke refers to a complex set of symptoms of neurological deficiency lasting at least twenty-four hours, resulting from brain injuries caused by changes in cerebral blood flow.

In the case of damage to neurological functions, impairments in motor, sensory, behavioral functions and in the areas of perception and language are possible<sup>2</sup>.

Stroke is considered one of the most prevalent diseases worldwide, with 15 million victims each year<sup>3</sup>. It is also considered one of the most important causes of disability in developed and developing countries<sup>3</sup>.

Neuropsychological assessment seeks to identify the cognitive functions that have been preserved and those that have been impaired after brain injury and thus aid in the diagnosis, prognosis and rehabilitation of the patient. Evaluating the deficit functions after a stroke makes possible to understand the cerebral

hemisphere that suffered the injury since each hemisphere is responsible for specific functions and they need different strategies in the recovery process.

It is very common to have cognitive impairments after an injury or brain trauma, among those that may be affected are the areas of attention, memory and the association of these abilities. Consequently, it reduces the thought's organization and the process of language becomes disorganized, causing problems related to the way of speaking and in the sequential way of producing words, which compromises the individual's ability to understand information, whether written or spoken<sup>4</sup>.

A stroke can lead to irreversible sequelae. which depending on the degree of event may cause mild or severe deficits and different combinations of cognitive impairments that depends on several factors, like the area that suffers the injury and extension of itself, the time interval between the episode and the first aid/ time period after injury, among others personal factors such as age and degree of education. The neuropsychological losses that are most associated with stroke are found as aphasia, such as agnosia, such as dysmeniasis, dyspraxia, and a dissociative syndrome. In addition to neuropsychiatric disorders, such as depression and anxiety<sup>5</sup>.

Long time the neurologists discovery as the mind is segment in two diferents regions and separate by a line that demarked that division. For a long time science has considered one area superior to the other, the left hemisphere being the most important, seen as the rational, logic and analytical, a summary of what it expected from the brain to be. The right hemisphere was experienced as secondary, not considered important for humans<sup>6</sup>.

The Right Hemisphere and Left Hemisphere dichotomy has been evidenced in the current literature and refers to the notion of dominating a mind in a hemisphere, a concept that existed for a long time. This justifies a disparity between

the broad field of knowledge about the left hemisphere in cognition and the restrict knowledge about the cognitive abilities of the right hemisphere.

Roger W. Sperry, a professor at the California Institute of Technology, began reforming the way our brain was seen. In the 1950s, with his studies it was noticed that the right hemisphere was not inferior to the left, it was different, coming to the conclusion that there were two forms of reasoning. For him, the left hemisphere thought sequentially, controlled the language, and had good analytical results. On the other hand, the right hemisphere reasoned holistically, recognized patterns and was responsible for emotions, the way it was interpreted, and nonverbal expressions. He concluded, then, that human beings possessed two intelligences.<sup>6</sup>

The research presented below aims to provide more theoretical support to health professionals and students who work with patients with a diagnosis of stroke, more specifically those with damage to the right hemisphere of the brain. And with the literature review in this area, the main objective of this study is to verify in the literature the present alterations of the neuropsychological functions in individuals after a stroke in the right hemisphere.

## METHODOLOGY

Fourteen (14) articles published between 2006 and 2016 were used in the Portuguese and English languages and aimed to characterize the impact on the neuropsychological functions of post-stroke patients with right hemisphere injury. We used studies published in the internet databases, such as Latin American and Caribbean Literature in Health Sciences (LILACS) and Scientific Electronic Library Online (SCIELO). Using the following terms descriptors: Stroke, Neuropsychology, Alterations We found 47 articles for reading, including repeated references in more than one database, 44 (forty-four) in Portuguese and 03 (three) in English. From the reading of the titles, 32 (thirty-two) articles were pre-selected for further reading. After the careful reading of these studies, 18

(eighteen) were excluded because they were not directly related to the subject of this study, so 14 (fourteen) articles were included for the study, 13 (thirteen) in Portuguese and 1 (one) in English.

The final selection criteria of these articles for inclusion in the review were as follows: 1) they should approach studies with injured individuals in the right hemisphere; 2) correspond to at least one of the neuropsychological functions under study; and 3) the right unilateral lesion should be of origin after ischemic or hemorrhagic cerebrovascular accident. References comparing the right hemisphere lesion with other pathologies, duplicity of articles, along with letters or editorials were excluded.

This study involved the collection of data from different sources, according to a rigorous method, from careful and interpretative reading, collecting recent and verified data, to a thorough reading and analysis of the abstracts of the articles, leading to a final selection.

## RESULTS

Regarding the studies found, we can see that despite an intense search on the subject, little material was found. Only 29.78% of the total number of publications of researched articles and summaries found involved the relation of the neuropsychological functions and the stroke of right hemisphere performed in the period of 10 years were included in the present study.

Some neuropsychological functions were categorized to describe the association between the frequency of complications of these functions with the right hemisphere stroke, such as: attention, memory, perception, executive functions, language and communication.

Among the categorized functions it is possible to verify that in 03 (21.42%) studies were found the relation between attention and stroke in the right hemisphere; 04 (28.57%) articles had studies focused on perception. Memory function was studied in 03 (21.42%) articles; 05 (35.71%) had a higher prevalence of executive functions related to right hemisphere stroke; 06 (42.85%) evaluated the language and communication

associated with the right hemisphere stroke; and, lastly, 04 (28.57%) studies analyzed visuoperception in this link.

In the present study was noticed that some authors<sup>7</sup>, have been conducting studies on the right hemisphere and its functions for the past years, because the left hemisphere was the area of greater interest until a while ago, this interest in right hemisphere has been redirecting the focus of the work, and there has been a growing interest in the functions of this hemisphere.

According to the studies<sup>7</sup>, some of the neuropsychological functions that can be altered after a right hemisphere lesion are: attention, perception, memory, language, arithmetic, praxis, spatial functions, executive functions and emotions.

There are studies that group the alterations of the cognitive, behavioral and emotional functions of the right hemispheric lesion by the name of Right Hemisphere Syndrome. This syndrome is highlighted in the studies<sup>7</sup> who state that the changes caused by this neurological impairment still require more research with high methodological rigor by clinicians and researchers in Neuropsychology, so that they can improve their description. Despite this, they

cite some dysfunctions resulting from this type of injury, such as visuo-spatial orientation, attention, perception, memory, praxis, emotion and communication.

Regarding the attention, 7 and 8 point that the individuals with right hemisphere brain damage (RHD) shows attention disorders. The damages that can be emphasized can base a severity of the others on the cognition and the behavior, since they are a fundamental characteristic for the other processes. Individuals with RHD manifest themselves in activities of daily living that are maintained attention.

7 and 8 point out that many individuals with RHD have difficulty in daily tasks that demand concentrated attention (concentration of the brain in only one activity and excluding all

stimuli), sustained (focus of attention on a stimulus for a given period of time) and divided (attention distributed between two or more concomitant stimuli). In this way, they are not completely successful in grasping the general meaning of events and in maintaining appropriate patterns of interaction with interlocutors.

With regards to perception, 7; 8; 9 and 10 highlight in their studies the perception deficits in patients affected after a RHD. In these studies they were able to identify that people with right hemisphere lesion shows anosognia, which is characterized by the absence of a full awareness of these sequelae, or even the size of the impact on the individual's life. In addition to the presence of left sensory or spatial heminelect, it is a disorder in which the injured person may not perceive important sensory stimuli, such as tactile, auditory and / or visual stimuli, from the left space field. Some of these patients may present with frequent symptoms such as absence of reaction to people, sounds and objects located to the left of the body midline; performing personal care only on the right side of the body; flaps in the movements of the upper and lower left limbs; collision on walls and doors on the left; reading and writing restricted to the right half of the page; and, disinterest in participating in rehabilitation programs. This disturbance may be caused by impairment in the mental representation of visuospatial relations and / or by impairment in attentional and perceptual processing.

The hemineglect appears with some regularity in the literature, in which 8 come to believe that this symptom can be considered as an independent syndrome. The great constancy of research associating hemineglect to the impacts of right hemisphere is due to the fact that this syndrome is quite prevalent after an RHD. 8 found that, compared to the number of patients with RHD and left hemisphere lesion, 66% of individuals with RHD had hemineglect, whereas only 31% of patients with left hemisphere presented this condition. As for the authors 8 hemiagnosia also

appears much more frequently in patients with right hemisphere lesion than in individuals with left hemisphere lesion.

However, there are contradictions in the literature for the neuropsychological function being impaired in these cases. Authors 7 believe that hemiagnosia and hemineglect are attention disorders rather than disorder of spatial attention, disagreeing with some authors who agree with the idea.

Besides all this, we have prosopagnosia, which is also a perceptual alteration of right hemisphere lesion. 7 point out that prosopagnosia consists of the lack of ability to recognize faces. In this way, patients would have little ability to recognize faces previously presented, as well as recognize famous people through photographs.

Authors 7; 8 and 11 emphasize that in addition to sequelae in attention and perception functions, individuals with RHD may also present alterations in some domains of memory. Thus, they note that the greatest obstacle of individuals with RHD is to store and evoke nonverbal stimuli, presented visually or audiotively, with visual stimuli being more problematic. The authors also report that people with RHD may present deficits in working and long-term memory

(episodic and semantic) and losses in the storage and retrieval of spatial information, intensified by hemineglect. In addition to presenting a disturbance of spatial working memory.

The executive functions (EF) are commented on in the studies of the authors 12; 7; 8; 13 and 11 in which they point out that they can be characterized as a process set with the basic objective of simplifying the adaptation of the individual to new situations and which may be impaired after a right hemisphere brain damage, altering these processes.

In their studies, 12 report that executive functions are related to the cognitive processes of controlling, integrating, directing and

managing cognitive, emotional and behavioral abilities, such as the ability to take initiative, select relevant targets and inhibit actions or competitive stimuli, to plan and predict problem-solving strategies, to change them flexibly in the face of environmental changes (cognitive flexibility), to reason abstractly and to conduct self-monitoring.

12 complement affirmed that it is possible to change some of the elements of executive functions manifested after a RHD, having the potential to transform into a severe dysfunctional syndrome. 12 report that individuals with RHD have a tendency to respond to stimuli quickly and impulsively, making their highest percentage of errors in neuropsychological activities such as impulsivity and inhibition deficit.

12 and 7, 9 agree that, when analyzing the elements that make up executive functions in patients after a RHD, changes in verbal fluency, problem solving skills and mind theory. Oliveira8 agrees with these authors and also adds the failure in processing speed.

Language is another neuropsychological function that may be compromised in patients with RHD. In this function we can find contribution in the studies of the authors.13; 8; 7; 11;9 and 10. The authors report that patients with may have implications for language expression and comprehension. Knowing that although the left hemisphere represents a great predominance in language, research indicates that the right hemisphere also plays an important role in several communicative aspects. 13 complement, stating that some patients after stroke in the right hemisphere may experience interference in the receptive and expressive language competence necessary for social discourse.

13 emphasizes more specifically that functional linguistic aspects such as pragmatics (related to the communicative context), semantics more related to the connotative meaning (meaning of non-literal content) and prosody (associated with the suitability of the different vocal intonations)

are more associated with RHD. In this case, the patient can express difficulty in the communicative rules during the conversation (exchange of the dialogic shift), to communicate the communicative intentions based on the emotions that modulate the prosodic parameters of his speech and to understand the use of the indirect or figurative sense of the language of the other individual.

In agreement with the above author, 9 and 7 point out that patients with RHD may present deficits in four communicative processes: discursive, pragmatic-inferential, lexical-semantic and prosodic.

## CONCLUSION

We know that each stroke is different and consequently the people who suffer it are also affected differently and the possible sequelae depend on some factors to happen, such as the area of the brain that has been injured, the severity of the injury and the general state of health when the stroke happens.

With the data found we can observe that despite an increase in the number of publications in recent years, studies on right hemisphere and the implications in neuropsychological functions after a stroke still have a very much reduced number. However,

this increase has already been able to bring more studies about this area of the brain and it is possible to realize that there is a consensus regarding the functions evidenced in each hemisphere, being the HD associated with the cognitive functions and of important weight for the neurological study.

By analyzing the results, there was a consensus among the authors regarding patients with RHD after a stroke and considered that they may present changes in one or more functions. In the course of the study we could see that some of these functions such as attention, perception, visual perception, memory, language and executive functions are highlighted more often and by more than one author, which are then

considered the functions most associated with the injury of the right hemisphere after a stroke.

The present study evidences the need for new research on the evaluation of neuropsychological functions after a right hemisphere lesion and about the role of right hemisphere in human behavior, investigating both patients with right hemisphere brain damage and individuals with preserved right hemisphere, so the data of this neurological field which still underexplored can contribute to the growth of the underlying Neuropsychology.

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