

COGNITIVE AND LANGUAGE IMPAIRMENTS IN STROKE AS LESION ASSOCIATED TO VARIATIONS OF THE CIRCLE OF WILLIS

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Abstract: : The present descriptive review aims to highlight the interconnection between stroke, as a main lesion associated to variations of the circle of Willis (CW) and the development of certain clinical dysfunctions such as cognitive and behavioral, verbal, visual and motor impairments, with a focus on the posterior cerebral (PCA) stroke. Material and Method: As a research method, there were used several international data bases: “PubMed” Central, “Research Gate”, “AHA Journals” and “Cambridge Core”, with the selection of 5 up-dated articles from the recent specialty literature and two chapters from online books of Neurology and Behavioral Neurology. Thus, the premises for a descriptive review were provided. Results: Besides the sensorial and motor deficits that are determined by PCA stroke, there are also some important clinical dysfunctions that refer to cognitive behavior, language and vision recognized as higher cortical functions. The characteristic type of aphasia in the case of PCA strokes is represented by the anomic aphasia, which is seen as a mild form with a relative speech preservation. Conclusions: As final remarks, it is indicated to refer to a global framework of patterns that appear in post stroke patients regarding both their cognitive and language dysfunctionalities.

Keywords: circle of Willis, cognitive, language, impairment, PCA stroke

D)Background and Aim: The arterial circle of Willis (CW) also known as the arterial system of Willis or “circulus arteriosus cerebri” represents the most important arterial anastomosis at the basis of the brain, extremely important for the communication it provides between the arterial blood supply of the forebrain and the one of the hindbrain. The development of the arterial circle provides best collateral source of blood flow in the case of occlusive arterial diseases. The identification of abnormalities and anatomical variants present at this level is essential in the planning of surgery for cerebral aneurysms and endovascular recanalisation for the cases of posterior cerebral artery (PCA) stroke, for example. Several studies have revealed, as well, that these variations play an important role in the development of cerebral-vascular diseases (cerebral infarctions, brain hemorrhages, stroke) and even of some psychiatric disorders. The frequency of these anatomical variations has been mainly investigated in countries like England, Holland, Poland, Italy, China, and, even in an extensive manner, in India and Pakistan, whereas in Romania there is still a demand for such anatomical studies. The present descriptive review aims to highlight the interconnection between stroke, as a main lesion associated to variations of the circle of Willis and the development of certain clinical dysfunctions such as cognitive and behavioral, verbal, visual, motor impairments, with a focus on the PCA stroke, for its important connection to the

circle of Willis. Both anterior and posterior circulations of the brain circulations are connected by the posterior communicating arteries (PCOM), which make up the circle of Willis. In the cases of cerebral vascular occlusions, it is the circle of Willis and the collateral circulations that supply blood to the occluded areas. Symptoms associated with PCA strokes are mainly represented anomic aphasia, cognitive and behavioral dysfunctions, diplopia, visual field defects, dysphagia, vertigo, alteration in consciousness, memory impairment, or difficulty in reading and help at a better clinical differentiation from other types of strokes (1), (2).

II) Material and method: As a research method, there were used several international data bases: “PubMed” Central, “Research Gate”, “AHA Journals” and “Cambridge Core” using the following search term combinations:” ischemic stroke, circle of Willis, variations” for PubMed Central, “ stroke, language disorder” for Research Gate, “stroke, language disorder, circle Willis” for the AHA Journals and “variations, circle of Willis, stroke” for Cambridge Core, with the selection of 5 up-dated articles from the recent specialty literature, combining this research with several relevant chapters from two online books of Neurology and Behavioral Neurology. Through this specific literature investigation, there were, thus, provided the premises for a descriptive review.

III) Results:

1. The Interrelation between the Variations of the Circle of Willis and Anatomical Lesions

The circle of Willis, the arterial anastomotic polygon located at the base of the skull, has an important role in the maintenance of cerebral perfusion (1). The anatomic variants of the circle of Willis can be commonly noticed and investigated in healthy individuals, the genetical and environmental components’ roles in influencing these variants remaining unclarified (2). The main anatomical lesions that accompany the variations of the circle of Willis are represented, in general, by strokes and cerebral aneurysms. In the present study there is a focus on the interrelation between PCA stroke, as part of the posterior circulation of the brain and of the circle of Willis, and the development of clinical cognitive, behavioral, language and speech impairments in patients and their assessment and eventual management, according to clinical outcomes (3), (4). Representing approximately 20 % of all ischemic strokes, posterior circulation strokes come in contrast with the anterior circulation one, presenting certain several differences in presenting symptoms, clinical approach and management strategies for the medical specialist. (5).

Rare variations of the circle of Willis were revealed by Klimek-Piotrowska et al. (2015) consisting of atypical findings related to PCOM, anterior communicating artery (AcomA), anterior cerebral artery (ACA), posterior cerebral artery (PCA) and interrelating with the common findings of their study, such as: “bilateral hypoplasia of PcomAs” (27 % of cases) and “unilateral hypoplastic PcomAs” (19 % of cases) (5).

Jin et al. (2016) investigated the presence of incomplete posterior circulation as being present in subjects without hypertension at a higher rate than in those with hypertension (6).

Studies conducted by Eftekhar et al. (2006) examined only male cases, whereas in other studies by Lazorthes et al. 1979; Riggs and Rupp 1963; Fisher 1965, the gender ratio was not noted. Additionally, De Silva et al. (2011) through a global chi-square test revealed that there were significant variations in the CW among intra and inter-ethnic groups such as Caucasian, African and Asian (1),(5).

2. Cognitive and Behavioral Impairments in PCA Stroke, the Clinical and Psychotherapeutic Assessments and the Outcome

Besides the sensorial and motor deficits that are determined by stroke, there are also some important clinical dysfunctions that refer to cognitive behavior, language and vision recognized as higher cortical functions. The correct assessment and treatment of these

neurological conditions is important for the prognostic evaluation. Other cerebral lesions like tumors or those caused by infections or by brain injuries are, most of the times, harder to localise than the vascular ones such as stroke, thus, it is visible its great importance for the relationship with behavior mapping. Din carte behavior plus language de laahaj cred..cu lang dis in stroke

Regarding the cognitive and behavioral impairments, these consist mainly of memory loss, reading and concentration issues, the development of aggressive behaviors and sometimes hallucinations and palinopsia. The developed aggressivity may include episodes of obscenities and shouting with a climax that could arrive to physically hitting and injuring others. The aggressivity episodes are usually accompanied by severe states of anxiety, frustration, social isolation and stigma. The hallucinations appear with rare occasions, but there they are possible in PCA strokes, both on the left and the right sides of the brain. Palinopsia, which refers to the remembrance of certain images after their disappearance, usually appears in the context of the affection of the lingual or fusiform gyri (2), (4).

All these neurological disorders can lead to psychological and psychiatric issues such as depression, severe anxiety, panic attacks and anger issues. Therefore, there is introduced the necessity of a behavioral therapist working together with a speech therapist for a better clinical outcome. Therapies such as cognitive behavioral therapy (CBT), CBT play and system desensitization are highly indicated in these cases. Within the wide CBT strategies there are involved the following: an emphasis on the role of thoughts and behaviors in triggering and maintaining psychological distress, a focus on problem solving and conscious intrusion into personal thoughts and beliefs.

3. Language Impairment in PCA Stroke and the Recovery Assessments

Memory and concentration issues which trigger reading issues that are related as well to anomic aphasia usually consist of short-term memory loss. This fact also involves a slower communication, with difficulties (7).

The characteristic type of aphasia in the case of PCA strokes is represented by the anomic aphasia, which is seen as a mild form with a relative speech preservation. The main language and speech issues encountered in these cases consists of “anomia” or the permanent incapacity of finding the right word within the language flow (8). These patients manifest the word retrieval experience and behavior in different daily life contexts, with an incomplete preservation of per-total speech (8). The speech in case of these patients can include certain paraphasic mistakes. The language skills that remain present in the case of anomic aphasia patients consist of: the articulation of speech, the oral reading, dictation writing skills and repetition after someone. According to Sinanovic et al. (2011) an important significance is given to continuous speech treatment regarding the recovery of post stroke aphasias, independently to the type of stroke and sex factors, with better results obtained in younger subjects. As a result, nonfluent aphasia could evolve into fluent aphasia, such as Broca’s aphasia into anomic aphasia. In the case of the inverse transformation, fluent aphasia couldn’t evolve towards nonfluent aphasia. (articol lang stroke). Within the mentioned Croatian study it is highlighted the fact that the treatment of aphasia should be initiated the earliest possible for two important reasons: the recovery of speech, important for the everyday communication and the global rehabilitation of these neurological patients (9).

The study also referred to aphasic speech as “empty” with a patient who would try a replacement of the missing words by circumlocuting them within an oral phrase, with the possibility of an aphasic writing, as well. Referring to the brain area where the lesion causing this syndrome might appear, there are several possibilities indicating the linguistic zone or the right hemisphere. The combination of anomic aphasia with other neurological syndromes and pathologies such as the Gertmann’s syndrome, alexia or agraphia, the dominant angular gyrus is shown as principal location for the lesion (10).

According to Boller (1981, reprinted by *AHAJ*) there has existed a lot of controversy about the efficacy of therapy for patients suffering from aphasia, this consisting mainly of therapist and patient meetings within sessions, instructions within a programme, and the usage of non-verbal signs. The purpose of the therapy is to encourage aphasic patients to try to speak as much as they can, thus, developing more language skills. In the case of more fluent patients, it is demanded a critical view upon what they had verbally produced. Literature studies have shown that aphasic patients who took part in specific language therapy sessions showed a better outcome than controls (10).

IV) Conclusions:

As final remarks, it is indicated to refer to a global framework of patterns that appear in post stroke patients regarding both their cognitive and language dysfunctionalities. It is obvious that in the case of cognitive impairments post PCA stroke, the focal disorders such as aphasia and neglect are most common, whereas in the case of language and speech disorders, there is a highlight on word finding difficulties, circumlocution of the speech and a mild dysfunction in both oral and written comprehensions (11). In what interventions for cognitive impairments post stroke are concerned, it is obvious the necessity of reducing and maintaing within normal limits the hypertension of certain patients, as well as, prescribing the right pharmacological medication that could positively influence cognition such as escitalopram (12) and rivastigmine (13). The two medications have been already included in several trials and studies as beneficial in these cases (11). The psychotherapeutic interventions such as counselling, CBT, meaning-centered therapy could help, as well, in reducing both cognitive and language impairments in post stroke patients. Additionally, such therapies could lead to a higher level of recovery when a speech therapist is involved in the case of language impairments.

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