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Cognitive Impairments in Aphasic Stroke Patients: Clinical Implications for Diagnosis and Rehabilitation: A Review Study

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Abstract

Objectives: The primary objective of this study was to undertake a narrative review of qualitative studies on the operational mechanism of non-linguistic modalities connected to language.

Introduction: Post-stroke aphasia has received much attention lately due to the debilitating effects it has on patient's communication skills. Research has shown that language plays a centralized role in human cognition and therefore, cognitive impairments usually co-occur with language disturbances due to the interrelatory and complementary function of higher cognitive skills.

Methods: Keyword searches of Pubmed, manual searches of other relevant journals and reference lists of related articles.

Results: Data gathered revealed that language is a complex cognitive skill which plays a central role in human cognition. Therefore, it is directly connected to other higher cognitive skills and as such should not be assessed in isolation. Deficits in cognitive skills like attention, memory and executive functions may impair language functions and if left untreated can hinder and slow down language recovery despite aphasia therapy.

Conclusions: A cognitive-linguistic method of assessment for evaluating language abilities in post-stroke survivors with aphasia should be utilised. Also, emphasis should be laid on redeveloping the non-linguistic skill affected while aphasia therapy is been provided in other to achieve optimum restoration of linguistic skills.

Keywords: Aphasia; Cognition; Stroke; Language

Public Significance Statement

This article reveals that a cognitive-linguistic method of assessment should be used when evaluating language abilities in aphasic stroke patients as this helps to identify the specific area of cognitive deficit that impacts language functions adversely.

Understanding Stroke

While a stroke has been perceived to be a common health problem in recent times, it becomes imperative to know that it can have the greatest disabling impact than any chronic disease [1]. However, the disabling effects that follow the event will be dependent on what area of the brain the stroke has occurred and the size of the lesion. Medically, it is termed a cerebrovascular accident and can be further described as a form of brain attack that occurs when blood flow to an area of the brain is cut-off either by a blockage or rupture of a blood vessel which leads to bleeding in the brain. On the norm, a continuous supply of oxygen, blood and glucose to the brain is required for nerve cells within the brain to function properly and an impairment in this supply may stop parts of the brain from functioning temporarily. If the impairment is severe, or lasts long enough, brain cells die and permanent damage follows. Because the movement and functioning of various parts of the body are controlled by these cells, they are also affected. Generally, a stroke causes various disabilities depending on the hemisphere involved and it is beginning to receive much attention lately from medical practitioners and rehabilitation specialists due to the incapacitating impact it has on survivors. A recent report by the World Heart Federation [2] revealed that stroke is a major health problem which affects 15 million people worldwide each year, part of which nearly six million die and five million become permanently disabled. It is a leading cause of long-term disability and the leading preventable cause of disability [3]. Therefore, regardless of the nature of the eventual disability that comes with a stroke, there always remain a lasting impact on survivors and their families.

Stroke-Induced Aphasia

Aphasia is a common impairment that is often experienced amongst stroke survivors. Aphasia is defined as an impairment of language, affecting the production or comprehension of speech and the ability to read or write [4]. It is described as a disturbance in language which is characterised by impaired comprehension, expression of words caused by a brain lesion [5]. Aphasia is a very common consequence of stroke and is found to occur in 34 to 38% of patients [6] which is significantly high when compared to other post-stroke conditions such as seizures and spasticity which have recorded incidences of 10.5% and 20% respectively [7,8]. A report by the National Aphasia Association [4] provided an estimate of new cases of aphasia to be about 225,000 per year as a result of stroke. In terms of lesions, aphasia occurs after a neurological insult to the perisylvian area of the left hemisphere of the cerebral cortex. This part of the brain houses the Wernicke's area and Broca's area which are responsible for language comprehension and production respectively [9] . In recent times, some more thorough research into this distressing disorder has revealed that Aphasia goes

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beyond just a breakdown in production and comprehension of spoken language [10,11]. Parrish said "Asides its direct influence on language, it also affects the ability to reason, make decisions and be creative depending on the area damaged and severity" [10]. Some previous studies have revealed that language disorders do not usually occur in isolation has there have been evidences that they co-occur with other cognitive impairments [11-13]. Aphasic disturbances have been found to rarely occur in the absence of other cognitive impairments such as memory impairment, attention and executive problems, even in milder cases of aphasia and related disorders [11]. This finding was corroborated by another study which revealed that non-linguistic cognitive impairments are common and associated with poor functional outcome and depression, especially in patients with persisting aphasia [12]. The aim of this article is to therefore review related literature and identify the key and most important higher cognitive skills that impact language abilities in post stroke survivors with aphasia and to bring forth, a unique way of evaluating aphasias and the effect on recovery.

Cognitive Deficits in Aphasic Stroke Patients

Language is a centralized function in human cognition, and therefore it is closely in sync with other cognitive functions due to the complementary nature of higher human cognitive functions [11]. Attempts have been made to establish associations between language processing, attention, memory, and executive functions. Several authors have attempted to define the link between each of these cognitive functions and the individual role they play in language processing. A study by Korda and Douglas [13] compared aphasics' and normal subjects' performance in a sustained attention task and reported only an increase in reaction time for both groups. A follow-up study conducted by Kalbe et al. [14] have however been able to report a remarkable association between attention deficits and language abilities and reported that aphasic patients performed poorly in at least one of the three cognitive functions assessed in their study (memory, attention and reasoning). Murray [15] also in a study seeking to establish a significant relationship between participant's attention deficits and their language and communication status divided her participants into two groups. One group comprised of individuals with varying types and severity of aphasia while the other group comprised of age- and education-matched adults with no brain damage. Both groups completed tests of attention, short-term and working memory, and executive functioning. The data obtained revealed that overall, the group with aphasia performed significantly more poorly than the control group on cognitive measures but displayed variability in the presence, types, and severity of their attention and other cognitive deficits. Similarly, Cahana-Amity and Albert [16] revealed that attentional deficits among persons with aphasia impair multiple language functions and lead to increased error rates and prolonged reaction times that further worsen language performance. Many of the previous studies on attention and aphasia have focused on a specific attention ability, therefore results obtained vary. However, a large percentage of the existing evidence still points to the fact that aphasia occurs in unison with at least one form of attention deficit. Language comprehension requires the person involved to maintain concentration on the speaker. Thus, attention is an important complex skill that is required for language comprehension and deficits in attention may affect language outcome [14,15].

Many attempts have been made to also look into the relationship between aphasia and memory and there have been evidences suggesting that a possible association exists between working memory capacity and comprehension in individuals with aphasia. Ronnberg et al. [17] studied memory ability in adults with mild aphasia. They measured short-term memory function by performance on digit and word span tasks. The results of the study reported that verbal short-term memory was impaired in the participants with mild aphasia. These findings have also been supported by other researchers [18-20]. Working memory is necessary for a wide range of complex activities [20]. Language comprehension requires an individual to recall previous words in a sentence [21]. Therefore, deficits in the area of working memory impacts language outcome [17,20].

Executive functions are responsible for the step by step process of planning and coordinating an idea or action. In language Studies have attempted to look at how the cognitive skill complements language function in humans by looking at how executive dysfunctions influence language abilities. Ramsberger [22] suggested that communicative success of clients with aphasia might depend on the integrity of executive function skills. Also, similar studies [23,24] have also demonstrated that persons with aphasia have difficulty in various aspects of cognition that fall under the umbrella of executive functioning. It provides storage and workspace for information, thus, permitting interactions between attention, perception, and memory [25]. The executive controller performs operations on information held in working memory so that this information may be used effectively. Therefore, limited executive functioning may lead to deficits in word comprehension and production in patients with aphasia [26].

Clinical Implications for Diagnosis and Rehabilitation

Review of existing literature has led to the conclusion that language is a complex cognitive skill which plays a central role in human cognition and as such cannot be assessed in isolation [11,27]. A deficit in language abilities occur with other cognitive impairments and this interrelationship between language and other higher cognitive functions have to be put into consideration during language tasks assessment procedures [11]. Further review of literature on the higher cognitive functions that are primarily connected to language revealed that attention, memory and executive functions play a huge role in language processing and can impact language abilities if their integrity is to be questioned [16,18,23]. Therefore, assessments and treatment of language deficit should take to account comorbid cognitive deficits, for example deficits in attention, working memory and executive functions. It is possible for a language disorder to occur indirectly as a result of an insult to a primary source external to languagee. So, aphasia cannot be said to be a definite linguistic disorder. It may arise as a result of a dysfunction in the non-linguistic modalities connected to language. The role the dysfunctional cognitive skill plays in language processing then determines the presentation of the aphasia.

Methods

A narrative review was undertaken which focused on the period 1998-2015. The studies included in the review were identified by keyword searches of the PubMed database. Keywords searched included "Attention deficits", "Working memory", "Executive functions", "Cognitive deficits", "Post-Stroke" in combination with aphasia and qualitative study. Cognitive deficits in aphasia yielded the most relevant material. Manual search of reference lists of primary articles found from initial searches were also conducted. These searches revealed ten qualitative studies on the different cognitive impairments that accompany post-stroke aphasia.

Results

The review led to the conclusion that language disturbance always co-occur with cognitive impairments (Table 1). In addition, the review

Authors	Paper title	No of Participants	Results
Seniow et al. [21]	The relationship between non-linguistic cognitive deficits and language recovery in patients with aphasia.	78	Working memory was associated with degree of improvement in two functions crucial to language
Bonini and Radanovich [25]	Cognitive deficits in Post-Stroke Aphasia	47	All aphasics performed significantly poorer that all non-aphasics
Korda and Douglas [13]	Attention deficits in stroke patients with aphasia	42	All aphasics demonstrated impaired attentional capacity shown by slower processing speed
Kalbe et al. [14]	A new test battery to assess aphasic disturbances and associated cognitive dysfunctions.	154	Aphasics performed poorly in at least one of the three cognitive domains (memory, attention and executive functions)
Murray [15]	Attention and other cognitive deficits in aphasia.		Group with aphasia performed significantly poorly than control group on cognitive measures but displayed variability in the presence, types and severity of their attention and other cognitive deficits
Ronnberg et al. [17]	Memory dysfunction in mild aphasics	2	Verbal short-term may is impaired participants with mild aphasia
Caspari et al. [20]	Working memory and Aphasia.	22	They had mild aphasia with impaired verbal short-term memory and their comprehension is predictable from it.
Purdy	Executive function ability in persons with aphasia	27	Results suggested a decreased executive functions skills in the group with aphasia.
Jefferies and Ralph [27]	Semantic impairment in stroke aphasia versus semantic dementia	20	Limited executive functions may lead to deficits in word comprehension and production in patients with aphasia.
Hachioui et al.	Non-linguistic cognitive impairment in post-stroke aphasia	147	88% had impairments in at least one cognitive domain.

Table 1: The review suggesting that language disturbance always co-occur with cognitive impairments.

identified attention deficits, working memory deficits and executive function deficits to be the most common cognitive functions affected following aphasia.

Conclusion

This article advocates for a cognitive-linguistic method of assessing language deficits and comorbid cognitive deficits in aphasic stroke patients. Aphasia therapy must address comorbid cognitive deficit for aphasia recovery to be more effective. Further research is necessary to investigate the interactive effect of cognitive deficits and aphasia therapy on language recovery in post stroke patients with aphasic.

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