Revista Chilena de Fonoaudiología 22(1), 1-13
https://revfono.uchile.cl/
ISSN 0719-4692

Original Article

Evolution of Post-Stroke Aphasia in Adolescents: A Case Series Study

Jimena Gabilondo [a, *], Agustina Pereyra [a], Mauro Andreu [b] and María Candelaria Saravia [a]

[a] *Servicio de Fonoaudiología, CETNA, Instituto Fleni, Escobar, Argentina.*
[b] *Departamento de Ciencias de la Salud, Universidad Nacional de la Matanza (UNLaM), Argentina.*

ABSTRACT

Post-stroke aphasia is a language disorder that has been scarcely studied in adolescents, both in Latin America and worldwide. Although a significant number of cases of aphasia improve spontaneously, it is crucial to start treatment as soon as possible. This case series study describes the clinical presentation and evolution of aphasia in 3 adolescents with post-stroke sequelae, who were admitted to a neurorehabilitation facility. Two females and one male, aged between 15 and 17 years, underwent intensive and comprehensive rehabilitation in the areas of physiotherapy, occupational therapy, neuropsychology, psychopedagogy, music therapy, and speech-language therapy. They were assessed using the Chilean version of the Western Aphasia Battery (WAB). After 3 months, all of them improved and evolved to a milder type of aphasia. This study shows the importance of early, intensive treatment in adolescents who are at the height of their social development, where language disturbances impact their relationships, their group belonging, their mood, and their academic performance. Systematic assessment and follow-up are considered essential for identifying changes and progress achieved during rehabilitation.

Keywords:
Aphasia; Stroke; Adolescent; Speech, Language and Hearing Sciences; Neuropsychological Assessment; Neurological Rehabilitation

Evolución de la afasia en adolescentes con secuela de ACV: Serie de casos

RESUMEN

La afasia como secuela de un accidente cerebrovascular es un trastorno del lenguaje poco estudiado en adolescentes, tanto en Latinoamérica como a nivel mundial. Independientemente del hecho de que un número significativo de afasias mejora espontáneamente, la necesidad del inicio oportuno del tratamiento es imprescindible. En esta serie de casos se describe la presentación clínica y evolución de la afasia en 3 adolescentes con secuelas de accidente cerebrovascular que ingresaron a un instituto de neurorehabilitación. Fueron dos mujeres y un varón, de entre 15 y 17 años, que recibieron rehabilitación integral intensiva desde las áreas de fisioterapia, terapia ocupacional, neuropsicología, psicopedagogía, musicoterapia y fonoaudiología. Fueron evaluados con la versión chilena de la herramienta Western Aphasia Battery (WAB). A los 3 meses todos mejoraron y evolucionaron a un tipo de afasia más leve. Este estudio expone la importancia del tratamiento precoz e intensivo en esta población de adolescentes en plena etapa de construcción social como personas, en donde la alteración del lenguaje impacta en sus vínculos, grupo de pertenencia, estado anímico y a nivel académico. Se considera fundamental la evaluación y seguimiento sistemático con el objetivo de identificar los cambios y avances alcanzados durante la rehabilitación.

Palabras clave:
Afasia; Accidente Cerebrovascular; Adolescente; Fonoaudiología; Evaluación Neuropsicológica; Neurorehabilitación

** Corresponding Author: Jimena Gabilondo*
Email: jime.gabilondo@gmail.com

Received: 02-17-2022
Accepted: 04-10-2023
Published: 05-22-2023

INTRODUCTION

Childhood stroke, just as in adult patients, is a devastating condition that has been increasingly observed in pediatrics. Stroke is one of the 10 most frequent causes of death in childhood, with a mortality rate that ranges from 6 to 40%, depending on the previous case series that have been published and the stroke subtypes (Fullerton et al., 2003; Goldenberg et al., 2009; Jordan & Hillis, 2007).

In developed Western countries, ischemic stroke affects an estimated 1 to 2 per 100,000 children per year (excluding newborns), while hemorrhagic stroke represents approximately half of the cases of stroke in children and young people, with an incidence of approximately 1 to 1.7 per 100,000 children per year (Goldenberg et al., 2009). This incidence varies according to age and sex, being the highest in children under 5 years of age, and higher in men than in women (Goldenberg et al., 2009).

The most common clinical presentation of stroke in pediatrics is hemiparesis, followed by language impairment, visual impairment, and ataxia. Non-specific symptoms such as headache and altered consciousness may also be observed (Christerson & Strömberg, 2010; Mallick et al., 2014; Steinlin et al., 2005). According to the literature, childhood stroke can also cause disturbances in numerous higher brain functions, such as attention, memory, planning, and language (deVeber et al., 2017; Jordan & Hillis, 2007). It should be noted that three-quarters of the children who survive a stroke are left with sequelae, which are often severe (Fullerton et al., 2003; Gottesman & Hillis, 2010).

The most common language disturbance associated with stroke is aphasia. According to the literature, it is the second most frequent post-stroke clinical manifestation in children (20-50%). Aphasia is an acquired neurological disorder that affects an individual's ability to produce and/or understand language. Post-stroke aphasia in children is characterized by difficulties in both expressive and receptive language, which manifest in naming, fluency, repetition, spontaneous speech, and comprehension. The level of compromise may vary according to age and the characteristics of the stroke (deVeber et al., 2017; Lehman et al., 2018; Sinanović et al., 2011).

Childhood aphasia recovery can vary depending on the type of stroke and aphasia. The period during which the most significant recovery occurs is associated mainly with the type of stroke. The greatest improvement from aphasia caused by an ischemic stroke can be observed within the first two weeks, while in the case of aphasia secondary to hemorrhagic stroke, this can be seen between the fourth and eighth weeks after the event. On the other hand, the type of aphasia is a key factor that determines the degree of recovery, with global aphasia being the most disabling and anomic aphasia being the mildest (Basso, 2003; Lehman et al., 2018).

The length of the spontaneous recovery phase for aphasia in the adult population is widely discussed in the literature, with some authors stating that it is limited to the first month (Basso, 2003; Gottesman & Hillis, 2010; Lehman et al., 2018; Sinanović et al., 2011), while others report that it can extend for up to six months (Winhuisen et al., 2007). However, there is a consensus that the most significant recovery occurs within the first three months post-stroke; after this, the recovery rate gradually decreases and eventually gives way to the chronic stage. Although a significant number of aphasias improve spontaneously, it is recommended to start treatment as soon as possible to optimize recovery (Bakheit et al., 2007; Breier et al., 2009; Fridriksson et al., 2007; Lee et al., 2017). In this regard, the literature indicates that starting language therapy early is a crucial factor for aphasia recovery. This is because the rate of function improvement is higher during the first months, and it slows down as time passes (Fama & Turkeltaub, 2014).

On the other hand, the existing evidence on adults with aphasia suggests that intensive treatment has a positive effect on the evolution of linguistic symptomatology. In this regard, a meta-analysis conducted by Bhogal et al. (2003) showed that lower-intensity therapy provided over an extended period does not significantly change the outcomes, while intensive treatment over a shorter period could improve language skills considerably. The authors conclude that intensive language therapy over the course of 2 to 3 months is essential to maximize recovery from aphasia. Otherwise, the results could be compromised.

Furthermore, studies also show that comprehensive rehabilitation that includes both language therapy and activity/participation intervention is a key factor for aphasia recovery. In this context, it is recommended to establish personal goals, interact with other people with aphasia, train in multiple modalities for functional communication, and educate the patient and their family (Babbitt et al., 2015). If intensive and comprehensive treatment is carried out the results will be optimized, which is why this is a fundamental aspect when providing care to these patients.

There are additional individual factors that may impact recovery, such as genetics, comorbidities, baseline deficit, age, stroke mechanisms, and neuroanatomical characteristics (size and location of the lesion and healthy areas) (Cassidy & Cramer, 2017). Different types of aphasia can improve at different rates and change over time (Lendrem & Lincoln, 1985). Moreover, the initial severity of aphasia usually predicts the outcomes (Allen et al., 2012). In this regard, Peña-Casanova & Pérez Pamies (1995) describe the following recovery patterns in the adult population: global aphasia usually evolves into Broca's aphasia, and Wernicke's aphasia into conduction aphasia. In turn, conduction and transcortical aphasias ideally evolve into anomic aphasia. It should be noted that anomia represents the most frequent residual symptom in most aphasic disorders.

An essential aspect of language and cognitive rehabilitation after brain injury is neuroplasticity; that is, the adaptive capacity of the central nervous system to modify its own structural and functional organization (O'Leary et al., 1994). There are different types of neuroplasticity, which are influenced by factors such as age, the nature of the disease, and affected systems (Finger & Wolf, 1988). Although children have higher levels of neuroplasticity than adults, they usually do not achieve full language recovery when the lesion occurs at school age or in adolescence. Children and adolescents may recover grammar and phonological skills more easily than lexical access, with anomia frequently persisting (Gárriz-Luis et al., 2021).

There is currently little evidence of the effect of therapy on the evolution of aphasia in children, even less so in adolescents. Only two studies were found on this topic after performing an extensive bibliographic search. The first is a study carried out on children with functional hemispherectomy, which shows post-intervention improvement of language skills mostly linked to the left hemisphere (Curtiss & Schaeffer, 2005). The second is a pilot study in adolescents with aphasia, in which a follow-up was carried out on language and hemispheric dominance five years after the stroke. This study found similarities with both the child population (under 5 years of age) and the adult population (Gárriz-Luis et al., 2021). Developing more research on aphasia recovery in childhood and adolescence is crucial since adolescents are at a stage of social development where language disturbances impact their relationships, the groups to which they belong, their mood, and their academic level.

There are no data in Argentina that indicate the proportion of stroke in children and adolescents compared to the general population, which creates gaps in the understanding of this condition. For this reason, and because more than 40% of patients suffering from this pathology show a significant degree of disability (Jordan & Hillis, 2007), this study aims to describe the changes observed in the clinical presentation of aphasia in 3 adolescents with post-stroke sequelae, who were hospitalized at *Centro de Rehabilitación Neurológica* FLENI *Escobar* in Argentina.

METHOD

Design

This is an empirical study that uses descriptive analysis. This research was evaluated and approved by the Ethics and Research Committee of the Institution (Protocol 002/22 Date 03/15/2022).

Participants

Between 2019 and 2021, a total of 20 adolescents required hospitalization at *Centro de Rehabilitación Neurológica* FLENI *Escobar* in Argentina, due to presenting consequences from stroke. In this study, we analyzed the evolution of 3 of those adolescents, who met the following eligibility criteria: being aged between 15 and 18 years, with a compromise of the left hemisphere post-stroke, and having been evaluated twice using the Chilean version of the WAB (Western Aphasia Battery) (González, 2008; Kertesz, 2012) within a period of approximately 3 months (Figure 1). These patients were monolingual and had no neuropsychological, learning, or cognitive development problems prior to the event, as reported by their parents. The participants' parents signed an informed consent before their participation. The sample consisted of two women and one man between the ages of 15 and 17 years. Table 1 describes the characteristics of the participants.

Table 1. Characteristics of the participants.

Variables	Case 1	Case 2	Case 3
Sex	Female	Female	Male
Age in Years	15	17	17
Type of Stroke	Ischemic	Hemorrhagic	Hemorrhagic
Compromised Hemisphere	Left	Left	Left
Hydrocephalus	No	Yes	Yes
Etiology	Purpura	Factor XIII deficiency	AVM

Notes: AVM (Arteriovenous Malformation).

Instrument

The main variable was the presence and type of aphasia, which was quantified using the Western Aphasia Battery. This instrument assesses content, spontaneous speech, fluency, auditory verbal comprehension, sequential commands, repetition, and naming, as well as reading, writing, and calculation. The oral language section of the test can be completed in one hour in most patients and is independent of the other sections (reading, writing, and calculation). The scoring system provides the following general measures of impairment: the aphasia quotient, which is based on the oral language portion of the test, and the cortical quotient, which includes all the optional verbal tests. The aphasia quotient is a functional measure of the severity of oral language deficit in aphasia. The maximum score is 100, which is easily achievable by adults with typical language skills. This test establishes a classification system that includes eight types of aphasia, based on both the fluency score and the comprehension, repetition, and naming scores. The patients were evaluated by different professionals with wide experience in the application of this tool.

At the beginning of the speech-language therapy intervention, a language screening was carried out using the Bedside Assessment of Language tool (Sabe et al., 2008).

Neuropsychology specialists were in charge of evaluating intellectual functioning, using the Wechsler Intelligence Scale for Children-V (WISC-V) (Wechsler, 2014).

Figure 1. Timeline.

Intervention

The patients received intensive and comprehensive rehabilitation for 4 to 7 months (Figure 1) in the areas of physiotherapy, occupational therapy, neuropsychology, psychopedagogy, music therapy, and speech-language therapy. These consisted of daily in-person therapy (two half-hour sessions Monday to Friday, one in the morning and one in the afternoon, and one half-hour session on Saturday mornings).

RESULTS

Case 1 Pre-Intervention

Relevant Background Information

Female patient, 15 years old, with a history of splenectomy in February 2021. At the beginning of July 2021, she was admitted to a health facility in the province of Buenos Aires due to an ischemic stroke secondary to a thrombus in the left middle cerebral artery (Figure 2).

During hospitalization, she presented arterial hypertension and microalbuminuria, for which she required treatment with blood thinners. Two weeks after the injury, she was transferred to our institution for rehabilitation.

Characteristics of the clinical picture and Diagnosis

Upon admission, she was evaluated using the Bedside Assessment of Language (Sabe et al., 2008), where difficulties were found in receptive and expressive language, the latter being the most affected. The patient communicated mostly by answering yes/no using head gestures or pointing. Seven days after beginning rehabilitation, she started to produce words spontaneously, at which point the WAB test was administered, obtaining characteristics comparable to Broca's Aphasia (Table 2).

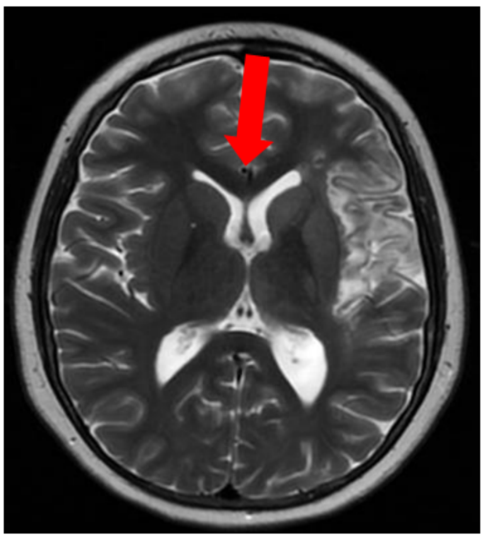

Figure 2. Magnetic Resonance Imaging (MRI) of the brain, with angiography. The red arrow indicates the subacute ischemic lesion in the territory of the left middle cerebral artery, as well as multiple supra- and infratentorial micro-bleeds.

Case 2 Pre-Intervention

Relevant Background Information

Seventeen-year-old female patient, with no previous relevant medical history, who required admission to the PICU of a facility in the city of Buenos Aires, Argentina, in December 2019. She was admitted due to sensory impairment secondary to a spontaneous acute frontotemporoparietal subdural hematoma. A brain CAT scan was carried out, confirming the presence of a hyper-acute hemorrhagic collection (Figure 3).

Emergency neurosurgery was performed. She presented refractory intracranial hypertension in the immediate postoperative period due to rebleeding, requiring urgent re-operative surgery to evacuate the intraparenchymal hematoma. After surgery, invasive mechanical ventilation was necessary for 20 days. Thirty-five days after hospitalization, she was referred to our institution for intensive rehabilitation.

Figure 3. Brain CAT scan at the beginning of intensive pediatric therapy. The red arrow indicates the hyperacute hemorrhagic lesion. A midline displacement can be observed, as well as a reduction in the volume of the left frontotemporoparietal subdural collection.

Characteristics of the clinical picture and Diagnosis

On admission, the patient had a tracheostomy and was being fed through a nasogastric tube. Due to her marked emotional lability, her communication and language were evaluated through clinical observation, and treatment started until a structured test could be applied. During the first weeks, based on the clinical evaluation, severe global aphasia was detected. Regarding comprehension, the patient could follow very simple instructions, in context and with assistance (such as pointing). Additionally, she managed to make functional use of objects, mostly those related to her body such as glasses and spoons. Concerning expression, she was non-verbal, and communicated through non-symbolic strategies, smiling to express contentment and moaning or crying when displeased. With respect to respiratory and swallowing aspects, a month after admission the nasogastric tube was removed and decannulation was performed. Two months after the beginning of treatment, the patient was emotionally regulated, complying with different activities proposed by the therapist. However, she continued to show significant difficulties in decoding and verbal expression. Three months after starting rehabilitation, she began to produce some sounds and repeat words, which allowed formal evaluation to be carried out using the WAB test, thus confirming the diagnosis of global aphasia (Table 2).

The patient showed below-average intellectual functioning in the neuropsychological evaluation, compared to the performance of a population of the same age. She had a strong performance in the domain of attention and in tasks that assess visual memory. She also performed well in tasks that evaluate impulse control and inhibition, as well as in one of the tests that assess categorization and cognitive flexibility.

Case 3 Pre-Intervention

Relevant Background Information

Male patient, 17 years old, who experienced intense headaches every two weeks, with a maternal family history of arterial hypertension. At the beginning of June 2021, he presented acute right hemiplegia associated with aphasia, without loss of consciousness. He was transferred to a medical center in the province of Santiago del Estero, Argentina, where a brain CAT scan and angiography were carried out, revealing a fistulous left parietal arteriovenous malformation (Figure 4).

Figure 4. CAT scan of the brain. The red arrow indicates an extensive hematoma in the left frontoparietal area.

After this procedure, he showed significant perilesional edema with an increase in the size of the hematoma and midline displacement, for which emergency surgery was performed. In it, the patient underwent a decompressive craniectomy, dural enlargement, and evacuation of the intracerebral hematoma. He required invasive mechanical ventilation for 2 days and remained in the PICU for 4 days.

Two weeks after the event, he was admitted to our institution for rehabilitation.

Characteristics of the clinical picture and Diagnosis

On admission, the patient was conscious and presented central right facial palsy. He was able to understand simple commands after several repetitions and to make some gestures with his left hand. He was non-verbal.

A Bedside Assessment of Language was carried out, as well as clinical observation. Based on this, a therapy plan was structured which included recognition of concrete objects and their functional use, categorization of concrete objects and graphics according to perceptual similarities, and execution of instructions. A month after starting rehabilitation, he was able to produce isolated words and presented apraxia, which significantly impacted his fluency. Consequently, the WAB test was applied, obtaining characteristics corresponding to global aphasia (Table 2).

It was not possible to evaluate the patient's verbal IQ during the neuropsychological assessment, due to his linguistic difficulties. In addition, his Performance IQ was at the lower end of the low average range. As for the remaining cognitive functions that could be evaluated, the greatest challenges were found in his working memory and his processing and response speed, while his strongest performance was at the level of visual memory skills.

Case 1 Intervention

The objectives of therapy changed throughout the process according to the patient's progress and the results of evaluations.

Regarding expressive language, the first aspect to be addressed was naming objects in pictures. Simultaneously, the patient's communication functions were approached using stories and questions with the support of pictographic symbols due to her decreased communicative intention. When these objectives were reached, the work moved towards reading words and sentences aloud. At the same time, she began working on writing words that were familiar and interesting to her.

Concerning comprehension, once the patient managed to follow increasingly complex orders without visual support, she moved towards the comprehension of short texts delivered orally, using open questions. Initially, simple questions were asked (what, where, who), moving on to more complex ones (why) once her responses were consistent.

In addition, there was joint work with neuropsychology and psychopedagogy to help her carry out simple tasks of her interest, such as following a recipe (understanding written instructions in successive steps, time prioritization, planning, and organization). The use of a journal was also implemented, to enhance organization and to remember activities and commitments, in order for her to anticipate changes, organize her activities, avoid forgetfulness, manage her time, and consequently achieve greater independence. At the same time, self-monitoring strategies were incorporated, such as reviewing her work once it was finished and asking questions when she did not understand an instruction.

Case 2 Intervention

Language comprehension was addressed by working on the identification of concrete familiar objects from three possible options. One month later, when the patient was able to recognize concrete objects, she moved to identifying objects from pictures. Comprehension of simple instructions was also worked on. After one month and a half, and after the patient was able to execute simple, one-step commands (for example: "close your eyes", "open your mouth"), she progressed to two-step commands ("close your eyes and open your mouth”).

At the expressive level, the patient worked on producing everyday vocabulary (parts of the body, furniture, everyday objects), with the therapist assisting her through semantic and phonological cues. It was observed that sometimes associating the word with a song helped recall it. Due to this, in collaboration with the music therapy service, MIT (Melodic Intonation Therapy) was incorporated. MIT has been proposed primarily for patients with significant defects in language production, poor verbal agility, deficient sentence repetition, exaggerated sentence prosody, and relatively preserved listening comprehension (i.e., mainly patients with nonfluent aphasia). In this approach, patients are taught to follow the rhythm of the sentences initially sung by the therapist; the patient then attempts to repeat these sentences while maintaining the prosodic pattern, intonation, and rhythm. As therapy progresses, the therapist provides less support and the patient gradually drops rhythm and intonation until the utterances are produced independently and with their usual prosody. The ultimate goal of MIT is to restore propositional speech. One of the advantages of this approach compared with other tools is that it contains a structured program that has been translated into several languages (Van der Meulen et al., 2012). Once the patient was able to identify initial sounds in familiar words, she was provided with visual aid in the form of an alphabet, so that she could recall words in different contexts. After two months, when she achieved spontaneous production of words, she started working on uttering simple sentences.

In addition to the above, the different attention types (selective, sustained, alternating, divided) were addressed with the areas of psychopedagogy and neuropsychology. Scanning and visual selective attention tasks were also carried out. Furthermore, strategies to achieve efficient and organized picture search tasks were incorporated. At the same time, we sought to improve working memory, both visual and verbal.

Case 3 Intervention

This patient’s receptive language was first approached through activities to recognize objects by their name using gestural support, simple command execution (for example “close your eyes”, “open your mouth”), and closed questions (“Are you in your house?”, “Is your name x?”). In parallel, there was work on vocabulary comprehension, requesting him to recognize a familiar object (e.g. a pen) among three options. His ability to follow instructions gradually became more complex, being able to follow two-step related commands. As the patient progressed, he worked on semantic association activities (for example, associating an object with its respective profession).

Expressive language was first addressed through imitation. When the patient was able to produce spontaneous speech, signs of apraxia were found. Due to this, he started working on general vocabulary such as nouns and family names, using visual support. At the same time, there was collaboration with the music therapy service using MIT, in order to contribute to word retrieval. An alphabet was also included, which helped achieve consistency in word retrieval by localizing the initial letter of each word. When better consistency was achieved in lexical retrieval, the rehabilitation moved towards activities to improve fluency, using simple sentences. Additionally, reading and writing were incorporated into activities with high-frequency words.

In addition to the above, the different forms of attention (selective, sustained, alternating, divided) were addressed together with psychopedagogy and neuropsychology. Scanning and visual selective attention tasks were also carried out. Furthermore, strategies to achieve efficient and organized picture search tasks were incorporated. On the other hand, the different disciplines attempted to increase his communicative intention, by encouraging conversations in different contexts and with different people, and by using recreational activities or interesting topics.

Table 2. Results obtained from the Western Aphasia Battery.

Domains	Case 1			Case 2			Case 3		
	Baseline	Month 3	Dif. %	Baseline	Month 3	Dif. %	Baseline	Month 3	Dif. %
Spontaneous Speech	5/20	11/20	30	3/20	8/20	25	1/20	7/20	30
Informative Content	3/10	6/10	30	1/10	4/10	30	1/10	5/10	40
Fluency	2/10	5/10	30	2/10	4/10	20	0/10	2/10	20
Comprehension	151/200	198/200	23.5	0/200	98/200	49	54/200	86/200	16
Yes/No Questions	45/60	60/60	25	0/60	45/60	75	33/60	42/60	15
Auditory Word Recognition	50/60	58/60	13.3	0/60	47/60	78.3	13/60	32/60	32
Sequential Commands	56/80	80/80	30	0/80	6/80	7.5	8/80	12/80	5
Repetition	54/100	95/100	41	48/100	58/100	10	10/100	62/100	52
Naming	53/100	92/100	39	0/100	38/100	38	5/100	34/100	29
Object Naming	37/60	60/60	38.3	0/60	27/60	45	2/60	23/60	35
Word Fluency	4/20	16/20	60	0/20	5/20	25	0/20	3/20	15
Sentence Completion	6/10	6/10	0	0/10	2/10	20	3/10	2/10	-10
Response to Questions	6/10	10/10	40	0/10	4/10	40	0/10	6/10	60
Aphasia Quotient	37	55.1	18.1	4.9	22.5	17.5	8.5	14.2	5.7
Aphasia Profile	Broca’s	Anomic		Global	Broca’s		Global	Broca’s	

Case 1 Post-Intervention

The patient was reassessed after three months with the WAB, which revealed improvements in all the subtests and confirmed that her clinical picture had evolved from Broca’s aphasia to anomic aphasia. (Table 2). The most significant progress compared with the first assessment was in the naming domain (39 points higher), where the patient was able to recall the name of 23 more daily objects than in the previous evaluation. Similarly, she scored 41 points higher in the sentence repetition subtests, compared to the baseline results.

Concerning spontaneous speech, she was able to describe a picture using coordinated sentences, showing improvement in her verbal fluency and a 6-point increase in spontaneous speech, compared to the first evaluation. Her aphasia quotient increased by 18.1%.

Case 2 Post-Intervention

In the 3-month reassessment, improvements were observed in the different subtests and a transition from global aphasia to Broca's aphasia was confirmed (Table 2). The greatest progress was observed in the comprehension domain.

The patient scored 10 points higher on the sentence repetition subtest, compared to the evaluation carried out three months earlier. A variation of 5 points was observed in the domain of spontaneous speech, remaining non-fluent. Her aphasia quotient increased by 17.55%.

Case 3 Post-Intervention

The improvements observed in the different subtests of the WAB on reassessment confirm the evolution from global aphasia to Broca’s aphasia (Table 2).

The greatest variations were observed in the repetition domain, obtaining 52 points more than in the first evaluation.

In the comprehension subtest, he scored 32 points higher compared to the baseline evaluation, being able to answer 15 more closed questions and recognize 19 images delivered orally.

Regarding the naming section, he was able to recall 29 more everyday objects compared to his first evaluation. On the other hand, a variation of 6 points was registered in the spontaneous speech domain, observing a persistence of non-fluent speech. His aphasia quotient increased by 5.75%.

DISCUSSION

In this study, we have reported the evolution of aphasia in three adolescents who were admitted to our institution with stroke sequelae and received intensive comprehensive therapy. It can be observed that all the patients showed improvement and their clinical picture evolved to a milder type of aphasia after three months of treatment. However, while cases 1 and 2 achieved nearly a 20% increase in their aphasia quotient according to the WAB assessment, case 3 only improved by 5% with regards to the baseline evaluation.

All three patients had different aphasia quotients in the first evaluation. This quotient represents the combined score of several subtests (spontaneous speech, auditory word comprehension, repetition, and naming), and it reflects the severity of the linguistic symptoms. An aphasia quotient equal to or lower than 31.4 is considered very severe (Kertesz, 2012). Two of the cases presented in this study obtained values lower than 10 and symptomatology compatible with global aphasia. This could be linked to the type of stroke, which in both cases was hemorrhagic. On the other hand, the patient with ischemic stroke had a baseline aphasia quotient higher than 35 and characteristics corresponding to Broca's aphasia. Along these lines, evidence indicates that the type of aphasia is a crucial factor to determine the degree of recovery, where global aphasia is the most disabling type, and anomic aphasia the mildest (Basso, 2003).

It can be observed that the three cases evolved as the literature describes (Peña-Casanova & Pérez Pamies, 1995), since the patients diagnosed with global aphasia transitioned to Broca's aphasia, and the case diagnosed with Broca's aphasia evolved to anomic aphasia. In cases 1 and 3, progress was made during the first three months of therapy, while in case 2, we observed improvements in a period of six months since the start of rehabilitation. This coincides with what some authors propose, which is that the stage of spontaneous recovery can extend up to six months (Winhuisen et al., 2007).

Evidence suggests that the majority of patients experience some degree of spontaneous recovery. However, this recovery is often not complete, and there is variation among the recovery rates for neurological functions. In this regard, it is proposed that the time of treatment initiation is an important factor for evolution and that, while a significant number of aphasia cases evolve spontaneously, it is fundamental to start rehabilitation as soon as possible (Breier et al., 2009; Lee et al., 2017). This is because, during the first months, the recovery of functions happens quicker (Fama & Turkeltaub, 2014). In line with this, a study reports that intensive speech and language therapy is effective when started within the first six months after a stroke, regardless of whether it starts in the acute or subacute period (Wertz et al., 1986). Furthermore, it has been observed that improvements in language may continue to happen months or even years after a stroke (Cassidy & Cramer, 2017). All of the cases in our study started intensive speech and language therapy within the first month after the stroke happened, between 15 and 35 days after the lesion. However, it should be noted that, due to clinical instability, the time between beginning rehabilitation and the first assessment differed among the three cases. Therefore, we consider that the improvements in linguistic symptoms could also be attributed to intensive therapy.

In case 1 we observe that, although the patient showed significant progress in different linguistic skills (fluency, repetition, auditory association), certain difficulties in semantic fluency persisted, which impacted her spontaneous speech. Cases 2 and 3 improved in the receptive domain, evolving from global to Broca's aphasia. Concerning the results of this study, it is suggested to incorporate Melodic Intonation Therapy for patients with subacute stroke who present difficulties at the level of fluency and verbal expression, since it was possible to deliver this intervention in two of the cases, witnessing positive changes in patient collaboration. This confirms what has been found in previous studies, where encouraging results have been found in patient mood and collaboration after starting this type of therapy (Street et al., 2020).

Additional factors that may influence aphasia recovery are the location and size of the lesion, as well as a previous history of stroke (Lazar et al., 2008). Individual factors could also be influential, such as genetics, comorbidities, baseline deficits, and age (Cassidy & Cramer, 2017). One study suggests that the cortical representation of language processing may be significantly modified in the days, weeks, and months following left-hemisphere injury (Horn et al., 2005). Moreover, language recovery after such an event has been reported to be considerably dependent on the degree of neuroplasticity of patients after the injury (Cherney & Small, 2006; Musso et al., 1999; Thompson, 2000; Thompson et al., 1997). Our patients did not present comorbidities or genetic anomalies and the size and extension of the lesion were different in every case. Nonetheless, we were able to observe improvements in all cases, which could be attributed both to the neuroplasticity and age of the participants and to the intensive comprehensive rehabilitation that they all received.

It is critical to mention the limitations of this study. First, we used WAB to determine the baseline type and severity of aphasia. It should be noted that the transcultural adaptation and evaluation of the psychometric properties of this instrument have not been carried out on the Argentinian population. However, we believe that using the Chilean version of this battery should not invalidate our results, due to our cultural and linguistic similarities. Similarly, and to our knowledge, the minimal important difference (MID) has not been established for this tool. MID represents the minimal improvement perceived by the patient and it is considered the new standard to determine treatment efficacy, as well as patient satisfaction with regard to that treatment (Copay et al., 2007). However, this area of research is still understudied in the field of aphasia (Breitenstein et al., 2022). Despite the above, we have selected this battery of tests due to the fact that there are no other available instruments that can be applied to our population. This gap invites the development of studies that validate formal and standardized evaluation tools so they can be used with Argentinian children and adolescents, and research that establishes the MID, since this measure links the magnitude of changes with clinical decisions, prioritizing the patient's perception (Salas Apaza et al., 2021).

Another limitation is that the verbal fluency subtest in the Spontaneous Speech domain of WAB depends on the objectivity of the evaluator. In this regard, it should be mentioned that the patients were assessed by different professionals, which could compromise the validity of the results. However, we emphasize that these professionals have extensive experience in the application of this tool.

It is noteworthy that the time between the start of rehabilitation and the first evaluation was different in each case (7, 90, and 30 days). Hence, these results could be explained by the treatment received prior to the first formal assessment. The time of therapy initiation is a crucial factor for evolution; it has been suggested that, although a high number of aphasias evolve spontaneously, it is essential to start rehabilitation as soon as possible (Breier et al., 2009; Lee et al., 2017). It should be noted that intensive speech and language therapy started between 15-35 days after the stroke in all three cases. In this regard, a study reveals that intensive speech and language therapy is effective when initiated within the first six months following a stroke, regardless of starting in the acute or subacute period (Wertz et al., 1986).

Finally, we should highlight certain factors pertaining to our chosen methodological design and the small sample size, which make it impossible to determine a causal relationship between rehabilitation and the observed differences, as well as toneralize these outcomes. The small sample size is explained by the fact that, when carrying out the retrospective collection of variables in our database, out of 20 cases of children and adolescents with post-stroke sequelae, not all met the criteria set for this study (age, assessment within the first three months, and intensive therapy) This has encouraged us to implement an evaluation and systematic data collection protocol in our institution, from admission to the end of the intensive speech therapy treatment.

In summary, this study shows the importance of early and intensive treatment in a population of adolescents with post-stroke aphasia. We consider it fundamental to carry out systematic evaluations and follow-ups, in order to identify changes and progress achieved during rehabilitation.

CONCLUSION

This article presents the clinical characteristics and three-month evolution of post-stroke aphasia in three adolescents who were admitted for intensive comprehensive rehabilitation at our institution. It was observed that all the patients improved and evolved to a milder type of aphasia after three months of intensive therapy. Although the literature indicates the importance of early and intensive intervention to improve aphasia, there are additional aspects that may have influenced the evolution of the participants (genetics, spontaneous recovery, age, and type of stroke). On the other hand, the methodological design of this research makes it impossible to generalize these results and, at the same time, invites further research on this topic, which is of great interest to the field of pediatric speech-language therapy. This work has made it possible to provide an initial characterization of a topic that is highly relevant for a population amid their social development stage, where language disturbances may impact their ties, group belonging, mood, and academic level.

REFERENCES

Allen, L., Mehta, S., Andrew McClure, J., & Teasell, R. (2012). Therapeutic Interventions for Aphasia Initiated More than Six Months Post Stroke: A Review of the Evidence. *Topics in Stroke Rehabilitation*, *19*(6), 523–535. https://doi.org/10.1310/tsr1906-523

Babbitt, E. M., Worrall, L., & Cherney, L. R. (2015). Structure, Processes, and Retrospective Outcomes From an Intensive Comprehensive Aphasia Program. *American Journal of Speech-Language Pathology*, *24*(4), S854–S863. https://doi.org/10.1044/2015_AJSLP-14-0164

Bakheit, A. M. O., Shaw, S., Carrington, S., & Griffiths, S. (2007). The rate and extent of improvement with therapy from the different types of aphasia in the first year after stroke. *Clinical Rehabilitation*, *21*(10), 941–949. https://doi.org/10.1177/0269215507078452

Basso, A. (2003). *Aphasia and Its Therapy*. Oxford University Press.

Bhogal, S. K., Teasell, R., & Speechley, M. (2003). Intensity of Aphasia Therapy, Impact on Recovery. *Stroke*, *34*(4), 987–993. https://doi.org/10.1161/01.STR.0000062343.64383.D0

Breier, J. I., Juranek, J., Maher, L. M., Schmadeke, S., Men, D., & Papanicolaou, A. C. (2009). Behavioral and Neurophysiologic Response to Therapy for Chronic Aphasia. *Archives of Physical Medicine and Rehabilitation*, *90*(12), 2026–2033. https://doi.org/10.1016/j.apmr.2009.08.144

Breitenstein, C., Hilari, K., Menahemi-Falkov, M., L. Rose, M., Wallace, S. J., Brady, M. C., Hillis, A. E., Kiran, S., Szaflarski, J. P., Tippett, D. C., Visch-Brink, E., & Willmes, K. (2022). Operationalising treatment success in aphasia rehabilitation. *Aphasiology*, *0*(0), 1–40. https://doi.org/10.1080/02687038.2021.2016594

Cassidy, J. M., & Cramer, S. C. (2017). Spontaneous and Therapeutic-Induced Mechanisms of Functional Recovery After Stroke. *Translational Stroke Research*, *8*(1), 33–46. https://doi.org/10.1007/s12975-016-0467-5

Cherney, L. R., & Small, S. L. (2006). Task-dependent changes in brain activation following therapy for nonfluent aphasia: Discussion of two individual cases. *Journal of the International Neuropsychological Society*, *12*(6), 828–842. https://doi.org/10.1017/S1355617706061017

Christerson, S., & Strömberg, B. (2010). Childhood stroke in Sweden I: Incidence, symptoms, risk factors and short-term outcome. *Acta Paediatrica*, *99*(11), 1641–1649. https://doi.org/10.1111/j.1651-2227.2010.01925.x

Copay, A. G., Subach, B. R., Glassman, S. D., Polly, D. W., & Schuler, T. C. (2007). Understanding the minimum clinically important difference: A review of concepts and methods. *The Spine Journal*, *7*(5), 541–546. https://doi.org/10.1016/j.spinee.2007.01.008

Curtiss, S., & Schaeffer, J. (2005). Syntactic development in children with hemispherectomy: The I-, D-, and C-systems. *Brain and Language*, *94*(2), 147–166. https://doi.org/10.1016/j.bandl.2004.12.004

deVeber, G. A., Kirton, A., Booth, F. A., Yager, J. Y., Wirrell, E. C., Wood, E., Shevell, M., Surmava, A.-M., McCusker, P., Massicotte, M. P., MacGregor, D., MacDonald, E. A., Meaney, B., Levin, S., Lemieux, B. G., Jardine, L., Humphreys, P., David, M., Chan, A. K. C., … Bjornson, B. H. (2017). Epidemiology and Outcomes of Arterial Ischemic Stroke in Children: The Canadian Pediatric Ischemic Stroke Registry. *Pediatric Neurology*, *69*, 58–70. https://doi.org/10.1016/j.pediatrneurol.2017.01.016

Fama, M. E., & Turkeltaub, P. E. (2014). Treatment of Poststroke Aphasia: Current Practice and New Directions. *Seminars in Neurology*, *34*(05), 504–513. https://doi.org/10.1055/s-0034-1396004

Finger, S., & Wolf, C. (1988). The “Kennard Effect” Before Kennard: The Early History of Age and Brain Lesions. *Archives of Neurology*, *45*(10), 1136–1142. https://doi.org/10.1001/archneur.1988.00520340090018

Fridriksson, J., Moser, D., Bonilha, L., Morrow-Odom, K. L., Shaw, H., Fridriksson, A., Baylis, G. C., & Rorden, C. (2007). Neural correlates of phonological and semantic-based anomia treatment in aphasia. *Neuropsychologia*, *45*(8), 1812–1822. https://doi.org/10.1016/j.neuropsychologia.2006.12.017

Fullerton, H. J., Wu, Y. W., Zhao, S., & Johnston, S. C. (2003). Risk of stroke in children: Ethnic and gender disparities. *Neurology*, *61*(2), 189–194. https://doi.org/10.1212/01.WNL.0000078894.79866.95

Gárriz-Luis, M., Narbona, J., Sánchez-Carpintero, R., Pastor, M. A., Fernández-Seara, M. A., & Crespo-Eguilaz, N. (2021). Neuroplasticity during the transition period: How the adolescent brain can recover from aphasia. A pilot study. *Brain and Development*, *43*(4), 556–562. https://doi.org/10.1016/j.braindev.2020.12.012

Goldenberg, N. A., Bernard, T. J., Fullerton, H. J., Gordon, A., & deVeber, G. (2009). Antithrombotic treatments, outcomes, and prognostic factors in acute childhood-onset arterial ischaemic stroke: A multicentre, observational, cohort study. *The Lancet Neurology*, *8*(12), 1120–1127. https://doi.org/10.1016/S1474-4422(09)70241-8

González, R. (2008). *Batería de Afasias Western Revisada. Versión traducida y adaptada al español chileno* (1ª ed.). PsychCorp.

Gottesman, R. F., & Hillis, A. E. (2010). Predictors and assessment of cognitive dysfunction resulting from ischaemic stroke. *The Lancet Neurology*, *9*(9), 895–905. https://doi.org/10.1016/S1474-4422(10)70164-2

Horn, S. D., DeJong, G., Smout, R. J., Gassaway, J., James, R., & Conroy, B. (2005). Stroke Rehabilitation Patients, Practice, and Outcomes: Is Earlier and More Aggressive Therapy Better? *Archives of Physical Medicine and Rehabilitation*, *86*(12), 101–114. https://doi.org/10.1016/j.apmr.2005.09.016

Jordan, L. C., & Hillis, A. E. (2007). Hemorrhagic Stroke in Children. *Pediatric Neurology*, *36*(2), 73–80. https://doi.org/10.1016/j.pediatrneurol.2006.09.017

Kertesz, A. (2012). *Western Aphasia Battery-Revised [Data set]*. American Psychological Association (APA). https://psycnet.apa.org/doiLanding?doi=10.1037%2Ft15168-000

Lazar, R. M., Speizer, A. E., Festa, J. R., Krakauer, J. W., & Marshall, R. S. (2008). Variability in language recovery after first-time stroke. *Journal of Neurology, Neurosurgery & Psychiatry*, *79*(5), 530–534. https://doi.org/10.1136/jnnp.2007.122457

Lee, C.-C., Lin, J.-J., Lin, K.-L., Lim, W.-H., Hsu, K.-H., Hsu, J.-F., Fu, R.-H., Chiang, M.-C., Chu, S.-M., & Lien, R. (2017). Clinical Manifestations, Outcomes, and Etiologies of Perinatal Stroke in Taiwan: Comparisons between Ischemic, and Hemorrhagic Stroke Based on 10-year Experience in A Single Institute. *Pediatrics & Neonatology*, *58*(3), 270–277. https://doi.org/10.1016/j.pedneo.2016.07.005

Lehman, L. L., Khoury, J. C., Taylor, J. M., Yeramaneni, S., Sucharew, H., Alwell, K., Moomaw, C. J., Peariso, K., Flaherty, M., Khatri, P., Broderick, J. P., Kissela, B. M., & Kleindorfer, D. O. (2018). Pediatric Stroke Rates Over 17 Years: Report From a Population-Based Study. *Journal of Child Neurology*, *33*(7), 463–467. https://doi.org/10.1177/0883073818767039

Lendrem, W., & Lincoln, N. B. (1985). Spontaneous recovery of language in patients with aphasia between 4 and 34 weeks after stroke. *Journal of Neurology, Neurosurgery & Psychiatry*, *48*(8), 743–748. https://doi.org/10.1136/jnnp.48.8.743

Mallick, A. A., Ganesan, V., Kirkham, F. J., Fallon, P., Hedderly, T., McShane, T., Parker, A. P., Wassmer, E., Wraige, E., Amin, S., Edwards, H. B., Tilling, K., & O'Callaghan, F. J. (2014). Childhood arterial ischaemic stroke incidence, presenting features, and risk factors: A prospective population-based study. *The Lancet Neurology*, *13*(1), 35–43. https://doi.org/10.1016/S1474-4422(13)70290-4

Musso, M., Weiller, C., Kiebel, S., Müller, S. P., Bülau, P., & Rijntjes, M. (1999). Training-induced brain plasticity in aphasia. *Brain*, *122*(9), 1781–1790. https://doi.org/10.1093/brain/122.9.1781

O'Leary, D. D. M., Ruff, N. L., & Dyck, R. H. (1994). Development, critical period plasticity, and adult reorganizations of mammalian somatosensory systems. *Current Opinion in Neurobiology*, *4*(4), 535–544. https://doi.org/10.1016/0959-4388(94)90054-X

Peña-Casanova, J., & Pérez Pamies, M. (1995). *Rehabilitación de la afasia y trastornos asociados* (2da ed.). Masson. https://dialnet.unirioja.es/servlet/libro?codigo=221487

Sabe, L., Courtis, M. J., Saavedra, M. M., Prodan, V., Luján-Calcagno, M. de, & Melián, S. (2008). Desarrollo y validación de una batería corta de evaluación de la afasia: Bedside de lenguaje. Utilización en un centro de rehabilitación. *Rev. neurol. (Ed. impr.)*, 454–460. https://pesquisa.bvsalud.org/portal/resource/pt/ibc-65458

Salas Apaza, J. A., Franco, J. V. A., Meza, N., Madrid, E., Loézar, C., & Garegnani, L. (2021). Minimal clinically important difference: The basics. *Medwave*, *21*(3), e8149. https://doi.org/10.5867/medwave.2021.03.8149

Sinanović, O., Mrkonjić, Z., Zukić, S., Vidović, M., & Imamović, K. (2011). Post-stroke language disorders. *Acta Clinica Croatica*, *50*(1), 79–94.

Steinlin, M., Pfister, I., Pavlovic, J., Everts, R., Boltshauser, E., Mori, A. C., Mercati, D. G., Hänggeli, C.-A., Keller, E., Luetschg, J., Marcoz, J., Ramelli, G.-P., Perez, E. R., Schmitt-Mechelke, T., Weissert, M., & Neonatology, null T. S. S. of P. N. and. (2005). The First Three Years of the Swiss Neuropaediatric Stroke Registry (SNPSR): A Population-Based Study of Incidence, Symptoms and Risk Factors. *Neuropediatrics*, *36*(02), 90–97. https://doi.org/10.1055/s-2005-837658

Street, A., Zhang, J., Pethers, S., Wiffen, L., Bond, K., & Palmer, H. (2020). Neurologic music therapy in multidisciplinary acute stroke rehabilitation: Could it be feasible and helpful? *Topics in Stroke Rehabilitation*, *27*(7), 541–552. https://doi.org/10.1080/10749357.2020.1729585

Thompson, C. K. (2000). Neuroplasticity: Evidence from aphasia. *Journal of Communication Disorders*, *33*(4), 357–366. https://doi.org/10.1016/S0021-9924(00)00031-9

Thompson, C. K., Shapiro, L. P., Ballard, K. J., Jacobs, B. J., Schneider, S. S., & Tait, M. E. (1997). Training and Generalized Production of wh- and NP-Movement Structures in Agrammatic Aphasia. *Journal of Speech, Language, and Hearing Research*, *40*(2), 228–244. https://doi.org/10.1044/jslhr.4002.228

van der Meulen, I., Sandt-Koenderman, M. E. van de, & Ribbers, G. M. (2012). Melodic Intonation Therapy: Present Controversies and Future Opportunities. *Archives of Physical Medicine and Rehabilitation*, *93*(1), S46–S52. https://doi.org/10.1016/j.apmr.2011.05.029

Wechsler, D. (2014). *Wechsler Intelligence scale for children-fifth edition* (5ta ed.). NCS Pearson. https://www.child-psychologist.com.au/wechsler-intelligence-scale-for-children.html

Wertz, R. T., Weiss, D. G., Aten, J. L., Brookshire, R. H., García-Buñuel, L., Holland, A. L., Kurtzke, J. F., LaPointe, L. L., Milianti, F. J., Brannegan, R., Greenbaum, H., Marshall, R. C., Vogel, D., Carter, J., Barnes, N. S., & Goodman, R. (1986). Comparison of Clinic, Home, and Deferred Language Treatment for Aphasia: A Veterans Administration Cooperative Study. *Archives of Neurology*, *43*(7), 653–658. https://doi.org/10.1001/archneur.1986.00520070011008

Winhuisen, L., Thiel, A., Schumacher, B., Kessler, J., Rudolf, J., Haupt, W. F., & Heiss, W. D. (2007). The Right Inferior Frontal Gyrus and Poststroke Aphasia. *Stroke*, *38*(4), 1286–1292. https://doi.org/10.1161/01.STR.0000259632.04324.6c