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Effect of speech therapy intervention program for non-fluent aphasic patients after stroke

Efeito de programa de intervenção fonoaudiológica para pacientes afásicos não fluentes após acidente vascular cerebral

ABSTRACT

Purpose: the objective of this paper is to verify the effect of speech therapy intervention program in patients with non-fluent aphasia due to stroke in language tasks related to verbal fluency in semantic and phonological categories. **Methods:** Patients with aphasia due to stroke were selected to take part in this study. Two groups were formed: diagnosed patients with Broca/transcortical motor aphasia (GA), and a control group (healthy individuals). GA took a fluency verbal task (FAS, other complementary categories: phonological /p/ /l/ and semantic: "fruits" and "names"). These patients were all engaged in a language intervention program developed by the authors of this study. GA received speech therapy sessions (ten sessions lasting for an hour once a week), following a specific language program. After the sessions, the patients were re-evaluated. **Results:** GA had statistical significant improvement in the verbal fluency task after the speech therapy program (p-value < 0,001). **Conclusion:** The speech language therapy program we proposed was efficient enough to show improvement in the results for GA in the verbal fluency task.

RESUMO

Objetivo: verificar o efeito do programa de intervenção fonoaudiológica em pacientes com afasia não fluente após AVC na tarefa de fluência verbal em categorias semânticas e fonológicas. **Método:** Foram analisados casos de pacientes com diagnóstico de afasia de Broca e transcortical motora, secundárias ao AVC. Os pacientes realizaram o teste de fluência verbal (FAS, categorias fonológicas /p/ /l/, e semânticas "frutas" e "nomes") e foram submetidos à intervenção fonoaudiológica, que foi constituída por 10 sessões de terapia realizadas de forma individual, semanalmente, com duração de uma hora. O programa de intervenção fonoaudiológica foi desenvolvido pelos autores deste estudo, contou com a realização de atividades de linguagem visando estimular e desenvolver estratégias para melhorar o acesso da linguagem expressiva do paciente afásico. Após o término do período de intervenção, os pacientes foram reavaliados, tendo sido realizada novamente a prova de fluência verbal. **Resultados:** GA contou com dez participantes (nove com afasia de Broca e um com afasia transcortical motora). Foi observada melhora estatisticamente significante na tarefa de fluência verbal pós-intervenção fonoaudiológica (p < 0,001). **Conclusão:** Observamos que a intervenção fonoaudiológica de linguagem proposta foi eficiente para apresentar melhora, com resultado estatisticamente significante na prova de fluência verbal para GA.

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INTRODUCTION

Stroke (cerebrovascular accident - CVA) is the second leading cause of death in the world, also a major cause of disability and hospitalizations around the globe[1-2]. Stroke can cause several sequelae, among which the individual's language and communicative capacity can be frequently affected, characterizing aphasia[3-4]. It can damage the quality of life of the affected individuals, since language - which is a brain function characterized by arbitrary symbols that, when combined systematically, provide communication[3-4-5] - is what allows us living in society, expressing emotions, reporting facts and expressing opinions through oral and gestural elements[5-6].

Aphasia is an acquired disorder that impairs communication, caused by a brain injury characterized by impaired language skills in speech, comprehension, reading and writing, and is not the result of a sensorimotor or intellectual deficit, mental confusion or any psychiatric disorder. Aphasias can affect understanding, expression or both[3-4].

One of the ways to verify changes in language in aphasia is the verbal fluency test. Verbal fluency is the ability to produce spontaneously fluid speech, without excessive pauses when searching for words[7]. The verbal fluency test is widely used to assess language changes in aphasias, as it verifies the linguistic production that needs a start up of several cognitive mechanisms, such as processing speed and attention, and is also widely used to verify the semantic memory[8-9]. This test also proved to be sensitive to check for language changes in several pathologies, including lesions in the frontal and temporal lobe [8-9-10-11].

When performing the verbal fluency test, the subject is asked to, within a limited time (usually one minute), generate the largest amount of words belonging to a restricted category, which can be semantic or phonological. Thus, it represents an important tool in the diagnostic aid and also treatment of expression aphasias, since it is capable of bringing information about the storage of lexical inventory and semantic fields and also provides evidence of the strategies used to access them[9-10-11-12].

Once the language changes are verified, the relevance of the rehabilitation process must be taken into account, which is possible thanks to the great capacity that the brain has to adapt through neuroplasticity.[3-4-13]. Studies show that patients with aphasia secondary to stroke and who underwent a rehabilitation process, receiving speech therapy intervention focused on therapy aimed at improving language functions, showed improved performance in language tests[8-14].

Thus, this study aims to verify the effectiveness of the speech therapy intervention program in patients with non-fluent aphasia after a stroke and to compare the pre and post speech therapy performance based on the task of semantic and phonological verbal fluency.

METHOD

This study was approved by the Ethics and Research Committee of Irmandade da Santa Casa de Misericórdia de São Paulo (ISCMSP). It is a prospective, descriptive, qualitative and quantitative research.

Participants were presented with an informed consent form (ICF).

Cases of aphasic patients (aphasia secondary to stroke) treated in the subject of Neurology of Irmandade da Santa Casa de Misericórdia de São Paulo and in patients of Hospital Geriátrico e de Convalescentes Dom Pedro II (HGCDPII), from May 2015 to October 2016, were analyzed. A speech therapy intervention program developed by the authors of this study was also applied. These patients were called a group of aphasics, called GA.

Inclusion criteria: For the group of aphasic patients (GA), 16 individuals of both genders were included in the study, with minimum age of 18 years, minimum education of elementary school (complete or incomplete), submitted to neurological clinical assessment, with medical diagnosis of stroke confirmed by clinical neurological assessment and/or image examination (computed tomography or magnetic resonance imaging) and speech-language diagnosis of aphasia of expression (non-fluent aphasia) confirmed after performing the speech-language assessment, who had not been previously submitted to speech-language intervention. Taking into account the results of a previous study[15], or participation in this research, the main inclusion criterion was the speech-language diagnosis of aphasia of expression, and data such as location and time of injury were not decisive for the inclusion of individuals.

Exclusion criteria: Patients with the following comorbidities were excluded: dementia, psychiatric conditions, seizures, epilepsy and uncontrolled clinical comorbidities and illiterate patients.

All patients underwent an initial speech-language assessment, which aimed to classify the type of aphasia using the Montreal-Toulouse Protocol version Alpha (MTL)[16]. To complement the language assessment of the MTL, patients with aphasia of expression underwent the verbal fluency test. For this study, the phonological categories /f/ and /s/ and the semantic category "animals" (FAS) were considered [7].

Although the FAS verbal fluency test[7] was not developed primarily to be applied in Portuguese, despite being widely used because it is an important validated test, it has characteristics which should be considered, especially with regard to phonological categories and their applicability in different languages, since performance in these categories also derives from cultural issues[20]. Therefore, it was decided to complement the FAS verbal fluency test with the semantic (names and fruits) and phonological (/p/ and /l/) categories. The choice of phonological categories occurred because they had already been addressed in a previous study[17] as categories with more appropriate applicability to the Portuguese language. The semantic categories "fruits"[18] and "names" were also included, the latter for having been observed in a therapeutic environment as a facilitator for the lexical access process of patients.

Thus, the patient was asked to speak as many words as he could access in each of the semantic or phonological categories in one minute. For the verbal fluency test (FAS), use used the normality parameter that has already been established in the specific literature[7]. Considering the phonological categories /p/ and /l/ and the semantic category "fruits"[18], we can say that despite having been used in previous studies, they do not have

validated parameters. The semantic category "names", in turn, has not been observed in previous studies. For this reason, it was decided to create a control group (CG). The CG performed the verbal fluency test and its results served as a parameter for these complementary semantic and phonological categories /p/, /l/ and "fruits" and also for the category "names", when analyzing the performance of GA.

The control group (CG) was composed of 60 individuals, randomly and voluntarily selected, with no history of neurological diseases, who were not using drugs that act on the central nervous system, without language complaints, with minimum education of complete elementary school.

Language intervention program

After the application of the MTL protocol (16) and also the verbal fluency test, the period of speech therapy started. The specific language therapeutic program for Broca's aphasia/motor transcortical, created by the authors of this study, was applied.

The language intervention program was developed with the purpose of fostering the patient's linguistic and communicative improvement, as well as improving the performance of tasks in the verbal fluency test, when performed in a testing parameter.

In order to implement the therapeutic program, the language strategies used were inspired by the specific literature of the area[19]. This program aims to contemplate the stimulation of comprehensive and expressive aspects of the Portuguese language, with activities aimed at stimulating semantic and phonological categorization, lexical access, naming, reading stimulation, written stimulation, stimulation for the formation and identification of syntactic and morphosyntactic language structures of portuguese and stimulus for the formation of a semantic and phonological network (Chart 1).

Chart 1. Speech Therapy Intervention Protocol - Broca/transcortical motor aphasia

General Purpose: Improve performance in language skills verified by the verbal fluency test.
Therapy 1 **Purpose – Stimulate lexical access by semantic categories + naming + reading stimulus + semantic categorization** Strategies: 1. Through figures, identify which elements belong to certain semantic categories (animals, fruits, transportation, furniture and household items). 2. After this step, elect more elements from each category from the patients. Use facilitation strategies whenever necessary (What are they for? Where do we find them? Is it to eat? What color is it? What is the size?). 3. On a piece of paper, indicate a written word and ask the patient to identify the picture corresponding to the word. After that, he must also classify the semantic category. After this step, patients can also complement the semantic categories with new elements. 4. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy.
Therapy 2 **Purpose – Stimulate lexical access via phonological + semantic/phonological categorization + naming + written stimulus with figure association** Strategies: 1. Categorization: Identification of elements belonging to the phonological categories (Ex: strawberry – phonological category M). 2. Perform the quick naming of figures (figures that start with a target phoneme). 3. On a piece, indicate a written word and ask the patient to identify which figure it belongs to. After this step, elicit more lexical items from the target phonological category (more words that start with the sound of P, for example). 4. Task: suggest a related task for home, for example, cut/write words that start with the "F" sound).
Therapy 3 **Purpose – Stimulate naming + lexical access via semantics + semantic categorization** Strategies: 1. Present figures and ask the patient to name them. Give clues when necessary (the initial phonemes of the word, for example). 2. Request that the figures be classified into semantic categories. 3. Elect more elements from each category from the patient. Use facilitation strategies whenever necessary (What are they for? Where do we find them? Is it to eat? What color is it? What is the size?). 3. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy.
Therapy 4 **Purpose – Written stimulus with association with the figure + lexical access by semantic and phonological means** Strategies: 1. On a piece of paper, indicate a written word and ask the patient to identify which figure it belongs to. 2. Elicit from the patient more elements of a certain semantic category (example: this is the monkey, what are other animals you remember?) Or phonological (example: monkey starts with M. What are other words you remember that starts with M?). 3. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy.
Therapy 5 **Purpose – Reading stimulus with figure association + semantic categorization + lexical access** Strategies: 1. On a piece of paper, indicate a written word and ask the patient to identify the picture corresponding to the word. 2. After that, the patient must also classify the semantic category (fruit, animals, transport, food,). 3. After this step, the patient can also complement the semantic categories with new elements. 4. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy.

Chart 1 - Continuation...

General Purpose: Improve performance in language skills verified by the verbal fluency test.
Therapy 6 **Purpose – Stimulate naming and lexical access (through phonological means)** Strategies: 1. Present figures to the patient. Request that the figures be named. For this task, choose a target phoneme (example: L, P, F). 2. After the picture naming step, elicit more words from patients that start with the same sound/phoneme. 3. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy
Therapy 7 **Purpose – Stimulate naming and lexical access (through semantic means)** Strategies: 1. Present pictures to the patient of a certain semantic category (fruits, animals). Ask the patient to perform naming. Figures can be quickly named after this step, depending on performance. 2. After the step of naming the figures, elicit more words from the patient belonging to the semantic category in question. 3. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy.
Therapy 8 **Purpose – Stimulate naming + lexical access (via semantics) + reading stimulus with association with spelling** Strategies: 1. Present figures of a certain semantic category. Ask the patient to perform naming. Figures can be quickly named after this step, depending on performance. 2. After the step of naming the figures, elicit more words from the patient belonging to the semantic category in question. Use more than one semantic category per therapy session (when possible). 3. On a piece of paper, indicate a written word and ask the patient to identify the picture corresponding to the word. 4. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy.
Therapy 9 **Purpose – Stimulate the naming of action verbs + lexical access (phonological path) and reading stimulus with association with the figure** Strategies: 1. Present figures with actions. Ask the patient to perform naming. Figures can be quickly named after this step, depending on performance. 2. After the step of naming the figures, elicit words from the patient that begin with the same sound. Use clues to help you in this process (the initial phonemes of the words/beginning of the word for example). 3. On a piece of paper, indicate a written word and ask the patient to identify the picture corresponding to the word. 4. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy.
Therapy 10 **Purpose – Stimulate the naming of action verbs + lexical access (phonological and semantic means) + reading stimulus with association with the figure** Strategies: 1. Present figures with actions. Ask the patient to perform naming. Figures can be quickly named after this step, depending on performance. 2. After the step of naming the figures, elicit more words belonging to the semantic/phonological category in question. Use more than one semantic/phonological category per therapy session (when possible). 3. On a piece of paper, indicate a written word and ask the patient to identify the picture corresponding to the word. 4. Task: suggest a related home task, for example, remember/write/cut out elements from the categories worked on during therapy.
Note: Strategy for all therapies: Suggest a task related to the subject worked in therapy to be performed at home, for example: remember/write/cut out 5 (or more) elements of the categories worked during the therapy.

Language therapy was individually performed weekly (once a week) lasting 1 hour. To be considered as a complete speech therapy intervention, the patient should have 80% presence during the intervention period, with the possibility of two replacements, and they could not have two consecutive absences, totaling a maximum of three months of intervention and ten hours of speech therapy.

After the end of the speech therapy intervention period in which the therapeutic language program was applied, a reassessment was carried out with the performance of the verbal fluency test previously applied and comparing the performance before and after speech therapy intervention.

For this study, the complete language assessment with the application of the MTL protocol[16] was initially done to check and classify aphasias. We did not omplete language with a new application of the complete MTL protocol, as our purpose was to verify the effect of applying the therapeutic program measured by the verbal fluency test in the semantic and phonological categories described above.

The responses of all study participants (control group and aphasic group) were recorded on video and archived in MP4 format.

The T test was used to compare patients before and after speech therapy intervention and the analysis of variance table with the F-ANOVA test (analysis of variance) to analyze the data of the control group and compare with the patients.

RESULTS

As the verbal fluency data of the complementary categories are not validated, the CG data will be presented first for better understanding.

Group control

Data were collected for the control group from 60 healthy adult participants, with varying levels of education, minimum education of complete elementary school, 42 women (70%) and 18 men (30%), aged between 18 and 90 years. The average age was 41.2 years.

For the verbal fluency test, statistical analysis was performed and the mean of all semantic and phonological categories was considered. It was observed that men accessed 122.7 words and women 116.6 words. There is no statistical significance regarding the number of words accessed by men and women. On average, 16.9 words per minute were accessed (Table 1).

Table 1. General performance of the control group in the verbal fluency test

Gender	Number of Participants	1st quartile	Average	Average per minute	Median	3rd Quartile	Standard deviation	P-Value Test F
F	42	96.5	116.6	16.7	113.0	130.8	28.0	
M	18	100.0	122.7	17.5	124.0	140.5	34.4	0.48
Total	60	97.5	118.4	16.9	115.5	133.2	29.9	

Regarding education, it was observed that 20% of the participants have completed elementary school and accessed, on average, 96.6 words in the test of total verbal fluency, considering all categories, semantics and phonology. Participants with complete high school corresponded to 36.7% and accessed, on average, 110.4 words. Participants with complete third level education corresponded to 43.3% and accessed, on average, 135.3 words. On average, the control group accessed 118.4 words in the test of total verbal fluency.

Aphasic group

The aphasic group (GA) is the target of this study. It consisted of 16 participants, however only ten completed the speech therapy intervention, and these data were included and considered at the end of this speech therapy intervention program, corresponding to 62.5% of the total. The six patients who dropped out of the procedure claimed personal reasons (lack of time, companion or even unfavorable monetary conditions to move weekly to receive therapy) or did not have an 80% presence during the speech therapy period.

Table 2. Individual performance in the GA verbal fluency task - Broca/Transcortical Motor

Patient	Gender	Age	Pre	Post	Improvement
1	F	27	0	5	100%
2	F	39	22	39	77%
3	M	47	2	22	1000%
4	M	52	24	28	16%
5	M	46	35	52	48%
6	F	37	25	33	32%
7	M	20	17	39	129%
8	F	51	17	21	23%
9	M	53	19	28	47%
10	M	74	28	46	64%
Average		**46.6**	**18.9**	**31.3**	**65%**

* All semantic and phonological categories were considered

From the patients who completed the speech therapy intervention program, nine were previously diagnosed with Broca's Aphasia and one with transcortical motor aphasia (aphasia classified during the speech therapy evaluation period, performed before the speech therapy intervention period), totaling ten patients who made up the group end of aphasics (GA). From the total GA, four were women (40%) and 6 men (60%), aged between 20 and 74 years old, average of 44.6 years.

The results of the statistical analysis carried out show that the GA patients showed an overall improvement of 65% in the performance of the verbal fluency test, considering all categories (semantic and phonological) when comparing the pre and post speech evaluation (Table 2).

Prior to the application of the therapeutic language program, according to the analysis of the results, GA presented, on average, access of 18.9 words per minute. After being submitted to the application of the program, patients obtained an average of accesses in the verbal fluency test, considering the same categories, of 31.3 words per minute.

Statistical significance was observed for the results found, with a confidence level of 5% and with a p-value inferior to 0.01, rejecting the hypothesis of equality between the number of words before and after speech therapy intervention (Table 3).

Table 3. Results observed for GA in the verbal fluency test

Phase	1st quartile	Average	Median	3rd Quartile	Standard deviation	Sample	P-Value Test T
Pre	17.0	18.9	20.5	24.7	10.9		
Post	23.5	31.3	30.5	39.0	13.6	10	< 0.001

The difference in performance before and after speech therapy intervention can also be seen in the graph (Figure 1).

Regarding the injury time, we found that this sample included patients who had a stroke with 1.1 to 9.1 years of injury, with an average of 4.8 years of injury.

Regarding the lesion site, it was found that 100% of the patients had lesions in the left cerebral hemisphere, however it was not possible to determine the extent of the lesion in all patients, as the medical records data were incomplete. It is worth mentioning that, as explained in the methodology, these criteria were not decisive for inclusion in this study specifically, the main criterion for inclusion being the diagnosis of aphasia of expression.
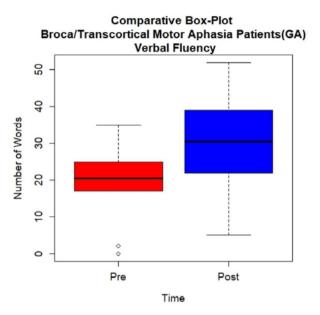
Figure 1. Results observed for GA before and after speech therapy intervention

CG and GA Comparison

CG obtained an average of 118.4 words in the test of total verbal fluency, considering all semantic and phonological categories. After applying the language intervention program, GA obtained an average of 31.3 words accessed per minute, also considering all semantic and phonological categories. We found that, as expected, the GC performed better than the GA.

DISCUSSION

The results obtained show us the benefits of the rehabilitation process and the role of speech therapy intervention.

For GA, there was a statistically significant improvement in the performance of the language task (verbal fluency). This result corroborates aspects verified in previous studies that also found improvement in different language tasks after the speech-language intervention[14-20-21-22-23-24].

Language therapy has been widely applied to patients with communication deficits. Some studies show that patients with aphasia secondary to stroke and who underwent a rehabilitation process, receiving speech therapy intervention focused on therapy aimed at improving language functions, showed an evolution in performance in language tests applied after speech therapy[14-20-25-26-27].

The observed data also verify the importance of therapeutic intervention in the rehabilitation process, which is possible thanks to the great capacity that the brain has to make adaptations through neuroplasticity[3-4-13-28]. Previous studies have found that neuroplasticity plays an important role in the language rehabilitation process[28-29]. However, it is worth noting that this process is facilitated when mediated by strategies that guide the patient to enhance their language skills.

If we consider that stroke is a highly prevalent disease in Brazil and worldwide[1-2] and aphasia being a possible sequel[3-4-5] of the disease, the proposed language therapeutic program can facilitate the speech therapy intervention for aphasic patients. Its application, being of short duration (10 therapy sessions), can be of great value in attendance services with high demand from patients.

Taking into consideration the issues raised in relation to the complexity of the faculty of language and the changes in the linguistic abilities of the aphasic subject is extremely relevant. The discussion about the aspects and parameters of rehabilitation for this group of people should be encouraged so that scientific advances can always assist in the process of language rehabilitation.

Hence, we found that the program proposed in this study proved to be effective for the group of patients evaluated. However, it is suggested to increase the number of cases in order to obtain more information about the effectiveness of this program in a larger population.

CONCLUSION

We found that speech language intervention, according to the protocol proposed in this study, was effective since GA showed improvement with a statistically significant result for the verbal fluency test.

A structured intervention program can be a speech therapy intervention proposal for language therapies, which can be replicated in the speech therapy clinic.

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Authors contributions

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