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A Study on the Combined Effect of Cognitive Therapy and Speech Therapy for Aphasics: Comparison of Follow-up Evaluation After Post-Treatment

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Purpose : The purpose of this study is to investigate the effects of cognitive therapy combined with speech therapy. In particular, this study aims to discover the effect of follow-up within the group six months after the end of treatment.

Methods : This study included a total of 22 patients with non-fluent aphasia between the ages of 50 and 60. Group A performed speech therapy (PACE) only, while Group B performed cognitive therapy (Rehacom) and speech therapy simultaneously. A paired *t*-test and Pearson correlation coefficient were performed.

Results : In Group B, the AQ, LQ, and all subtest scores of PK-WAB-R increased significantly in follow-up evaluation after six months compared to the post-treatment evaluation results. On the other hand, there was a slight decrease in Group B, but it was not statistically significant. Second, in the Cognitive Function Test (CNT) results for Group B, statistically significant improvements were made in five of the six cognitive functions. Group A had poor performance in five cognitive functions and was statistically significant in four areas. Third, there was a significant correlation between the language domain of the aphasia assessment and the subtest of the Cognitive Function Test (CNT).

Conclusions : The results of this study suggest that communication therapy combined with cognitive function training is more effective in maintaining the recovery of speech and cognitive ability even after treatment is terminated. In order to support the validity of the results, a systematic cognitive-based speech therapy program should be developed to comprehensively compare and study the relationship between functional communication ability and cognition.

Keywords : Aphasia, cognitive therapy, PACE, follow-up

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Ⅰ. Introduction

Language and cognition cannot be thought separately, and language is a major component of the cognitive process, such as attention or learning, memory and execution (Helm-Estabrooks, 2002). Communication skills are built in the complex interplay of cognition and language (Coelho et al., 1996). Patients with aphasia caused by stroke and TBI suffer from communication difficulties. Murray (2012) reported that there was significant relations between the apahsics' attention deficits and their language and communication status.

Studies on the cognitive abilities of aphasia patients have shown that patients with aphasia show deficiencies in attention, memory, spatiotemporal orientation, and reasoning (Tatemichi et al., 1994). Marinelli et al. (2017) confirmed the improvement of the cognitive domains attention, executive functions, intelligence, memory, visual-auditory recognition, and visual-spatial abilities through speech therapy in patients with severe aphasia and the necessity was emphasized. There have been various discussions on cognitive impairment in patients with aphasia. Cognitive problems in aphasia are caused by limitations in the ability to understand and use non-verbal language (Laine & Martin, 2012). There are reports of speech-related memory impairments such as short-term memory and phonological memory in people with aphasia (Laine & Martin, 2012).

Cognitive therapeutic approaches in aphasia are an important factor in improving language and communication ability (Helm-Estabrooks, 2002). The language ability of aphasia patients is directly related to

their daily communication function. In other words, the effective communication function is based on concentration and judgement on the conversational situation, understanding and memory of messages.

In Korea, a study that enhanced cognitive stimulation of stroke patients is examined, Chen et al. (1997) is a general stimulus, functional adaptation and behavior correction, computerized cognitive rehabilitation program uses training to improve reasoning, problem solving, etc., by organizing them in a game-like step-by-step format. A cognitive stimulation program for improving cognitive function in adult patients suffering from mental problems is currently applied to adult patients with stroke, and its more computerized-cognitive therapy effects' have been reported (Cho, 2010). The effectiveness of Rehacom (by HAZOMED, 1996) or Cogrehab (by Bracy, 1995) a cognitive rehabilitation program for stroke patients, was reported (Park, 2016; Shin et al., 2008). In this, the advantages of treatment through a computerized program over general cognitive therapy are that it can be learned on its own depending on the patient's condition and can receive immediate feedback on the progress and performance of the program (Glisky et al., 1986).

The importance of cognitive therapy for stroke and traumatic brain damage is already emphasized in the field of communication disorders at home and abroad. As a result, various approaches are constantly being studied today to further increase the effectiveness of treatment within a limited time. The approaches are also aimed to improve and generalize real-life-oriented communication skills (maintenance effects) in aphasia patients. A recent study, CBLT (cognitive behavior language therapy) (Akabogu et al., 2019), have suggested improvements of aphasia symptoms in groups of stroke patients who were treated with CBLT after the previous therapy was completed. The persistence of the therapy effect has also been suggested to be significantly improved compared to the groups mpt exposed to CBLT. This implies that the improvement of cognitive ability is not only effective in increasing communication skills of aphasia patients, but also in maintaining the effects of therapy after the treatment is over. Also, the treatment effects of applying Computer-assisted Cognition Training Program (Rehacom ®)-in Korea- to stroke patients have been reported to have affected the improvement of their daily life functions (Shin et al., 2008).

Through the above, we reconfirmed the necessity of cognitive therapy for patients with aphasia in Korea. Accordingly, this study attempts to investigate the effect of combined speech therapy with a computerized cognitive rehabilitation program (Rehacom®) reported in Korea. In particular, in order to clearly confirm the value of speech therapy (PACE) combined with cognitive therapy, we would like to investigate whether the effect is well maintained until post-evaluation without intervention after treatment is completed. This paper will aim to answer following questions. Is there any difference in language ability and cognitive function within each group when comparing the follow-up evaluation results after the end of treatment? And in the post-evaluation results, is there a correlation between the language ability and cognitive function of all subjects?

II. Methods

1. Participants

Participants who enrolled in this study were selected so that there was no statistical difference between group A (PACE only) and group B (PACE + cognitive therapy) in sex, age, education, time of injury, type of aphasia, and type of brain injury. In addition, the treatment period was limited from 1 year and 3 months to a maximum of 2 years and 3 months. The average age of the subjects in the experimental group was 61.09 years, and the average age of the control group was 57.81 years. For the educational background of the subjects, 13 subjects with a high school diploma (12 years) and 9 subjects with university degree (16 years) were selected. The type of brain injury was subarachnoid hemorrhage SAH (subarachnoid hemorrhage) in 12 subjects, intracranial hemorrhage intracerebral hemorrhage (ICH) in 7 subjects, and traumatic brain damage TBI (traumatic brain damage) in 3 subjects. By this, the type of aphasia was transcortical motor aphasia in 17, and Broca Aphasia in 5 from the results of PK-WAB-R. Two types of aphasia subjects were included in group A (12 people) and group B (12 people). There was no significant difference in AQ (aphasia quotient) and LQ (language quotient) of aphasia between groups (Table 1).

Table 1. Participants' information

	Group A (n=11)	Group B (n=11)	t	p
	M (SD)	M (SD)		
Age	61.09 (5.26)	57.81 (5.63)	1.408	.175
Education periods (years)	13.27 (1.84)	13.64 (1.93)	- .447	.660
AQ	16.8 (9.98)	22.7 (17.37)	- .93	.338
LQ	15.7 (10.81)	20.3 (14.16)	- .85	.401

Note. Group A=PACE only; Group B=PACE + CT (cognitive therapy by Rehacom®); AQ=aphasia quotient; LQ=language quotient.

2. Assessment and Intervention

1) Language and Cognitive Ability Tests

The evaluation tools used in the post-evaluation at the end of treatment and after 6 months are as follows.

The Paradise-Korean version of the Western Aphasia Battery Revised (PK-WAB-R, Kim & Na, 2012) was used for language abilities.

CNT (cognitive function test, Glisky et al., 1986) was developed based on starting memory training. The evaluation in this study area includes such as auditory CPT (continuous performance test), visual CPT, trail making test A and B, verbal learning test, and visual learning test.

2) Treatments

This study was to compare the results of follow-up evaluation after 6 months after completion of treatment. For reference, speech therapy and cognitive therapy are as follows. Promoting Aphasic Communicative Effectiveness (PACE) used for language and speech therapy. The time taken for PACE treatment is about 40 minutes per session. A computerized cognitive rehabilitation program (Rehacom) (Chen et al., 1997) was conducted on enhancing cognitive abilities. The combined time of cognitive therapy and PACE therapy was about 40 to 45 minutes per session. The computerized cognitive training program took about 15 minutes per session.

3. Data Analysis

Paired t-test was performed to evaluate the sub-test scores of PK-WAB-R and CNT within the two groups, and window SPSS 23.0 was used for analysis. Pearson correlation was used for the performance scores of language and cognitive abilities derived from the tests.

Ⅲ. Results

1. Comparison of the Results of Follow-up Evaluation for Language Ability Within the Group

1) AQ and LQ

In the follow-up evaluation, AQ and LQ of PK-WAB-R were significantly increased in group B. However, in group A, AQ and LQ decreased slightly, but not statistically significant (Table 2).

Table 2. AQ and LQ from PK-WAB-R (Paired t-test results)

Group		Post-treatment		Follow-up		t	p
		M	SD	M	SD		
AQ	A	23.25	12.06	22.95	11.02	.358	.728
	B	40.18	19.67	50.35	18.24	-5.339***	.000
LQ	A	22.16	14.18	21.16	11.73	.692	.505
	B	33.11	17.18	44.03	18.24	-5.795***	.000

Note. AQ=aphasia quotient; LQ=language quotient.
***p<.001

2) Scores of Subtests

In all subtests of PK-WAB-R, post and follow scores paired t-test results showed significantly in group B. An increase trend was found in group A, but it was not statistically significant (Table 3).

Table 3. Results of sub-tests from PK-WAB-R

Group		Post-treatment		Follow-up		t	p
		M	SD	M	SD		
S.S	A	5.09	2.07	5.64	2.54	-1.49	.167
	B	9.09	3.08	12.18	2.22	-4.73**	.001
A.C	A	81.36	50.28	82.36	50.21	- .36	.724
	B	1.23	33.90	144.54	35.03	-4.44**	.001
Re	A	20.64	18.39	22.09	15.82	-1.13	.283
	B	29.73	23.89	40.55	23.03	-4.92**	.001
C.N	A	15.09	13.20	15.64	13.61	- .35	.727
	B	30.36	24.22	40.00	25.27	-5.28***	.000

Note. S.S=spontaneous speech; A.C=auditory comprehension; Re=repetition; C.N=confrontation naming.
**p<.01, ***p<.001

2. Comparison of the Results of Follow-up Evaluation for Cognitive Function Within the Group

1) Auditory CPT and Visual CPT

The paired t-test results in group B, the scores both Auditory CPT and visual CPT were shown significantly increased in follow-up. However, the both scores was

significantly decreased in group A (Table 4).

Table 4. Auditory CPT and visual CPT

Group		Post-treatment		Follow-up		*t*	*p*
		M	*SD*	*M*	*SD*		
ACPT	A	65.27	34.78	61.18	32.37	2.824*	.018
	B	73.82	28.35	93.55	22.69	-5.027**	.001
VCPT	A	84.82	37.65	78.73	35.12	2.688*	.023
	B	94.91	25.50	105.60	19.22	-3.245**	.009

Note. ACPT=auditory CPT; VCPT=visual CPT.
*p<.05, **p<.01

2) Verbal Learning Test and Visual Learning Test

Scores of verbal learning test in both group A and group B was significantly improved in follow-up (Table 5).

Table 5. Verbal learning test and visual learning test

Group		Post-treatment		Follow-up		*t*	*p*
		M	*SD*	*M*	*SD*		
VbL	A	20.45	12.930	18.82	11.42	2.243*	.049
	B	27.91	8.080	105.64	19.22	-3.245**	.009
ViL	A	33.82	13.159	31.00	10.57	1.749	.111
	B	42.55	4.480	43.91	5.82	-.893	.393

Note. VbL=verbal learning; ViL=visual learning.
*p<.05, **p<.01

3) Scores of Trail Making A and B Test

After post-treatment, the scores of both Trail making A and B task in Group B was significantly improved. In Group A, the scores of trail making A task was slightly improved (Table 6).

Table 6. Results of Trail Making A and B tasks

Group		Post-treatment		Follow-up		*t*	*p*
		M	*SD*	*M*	*SD*		
TmA	A	70.91	36.13	75.55	40.11	-2.322*	.043
	B	43.55	28.75	33.00	19.31	3.127*	.011
TmB	A	149.18	70.09	149.82	68.03	-.071	.945
	B	89.82	53.20	69.27	35.20	2.823*	.018

Note. TmA=trail making A; TmB=trail making B.
*p<.05

3. Correlation Between Cognitive Ability and Language Ability in Follow-up Evaluation

The correlation between the results of language tests and cognitive tests in post-treatment showed a strong correlations (r=.000~.031, p=.460~.750). Auditory CPT test of CNT was a significant correlation with spontaneous speech (r=.004, p=.591) and auditory comprehension (r=.001, p=.645). In addition, the visual CPT of CNT is also spontaneous speech task (r=.005, p=.578) and the auditory comprehension task (r=.001, p=.676) was highly correlated. Visual learning test showed a significant correlation with spontaneous speech tasks (r=.005, p=.576) and auditory comprehension (r=.004, p=.594). The trail making-B task correlates with all language abilities in PK-WAB-R; with AQ scores (r=.003, p=-.600), LQ (r=.002, p=-.615), spontaneous speech (r=.001, p=-.665), auditory comprehension (r=.000, p=-.725), confrontation naming (r=.002, p=-.625) (Table 7).

Table 7. Correlation with language and cognitive performance

	AQ	LQ	S.S	A.C	R	CN	Au	Vi	VbL	ViL	TmA
LQ	.982**										
S.S	.824**	.778**									
A.C	.667**	.672**	.752**								
R	.820**	.824**	.704**	.471*							
CN	.833**	.821**	.686**	.549**	.756**						
Au	.464*	.444*	.591**	.649**	.330	.451*					
Vi	.491*	.528*	.578**	.676**	.404	.379	.836**				
VbL	.692**	.705**	.617**	.460*	.498*	.521*	.479*	.708**			
ViL	.493*	.461*	.576**	.594**	.297	.406	.708**	.723**	.698**		
TmA	-.476*	-.508*	-.560**	-.552**	-.252	-.463*	-.622**	-.618**	-.711**	-.665**	
TmB	-.600**	-.615**	-.665**	-.724**	-.402	-.625**	-.732**	-.678**	-.646**	-.604**	.891**

Note. AQ=aphasia quotient; LQ=language quotient; S.S=spontaneous speech; A.C=auditory comprehension; R=repetition; CN=confrontation naming in PK-WAB-R; Au=auditory CPT; Vi=visual CPT; VbL=verbal learning test; ViL=visual learnig test; TmA=trail making A; TmB=trail making B in CNT.
*p<.05, **p<.01

Ⅳ. Discussion

This study was conducted to find a treatment method for improving communication function in daily life for patients with aphasia in Korea. At the same time, the effect was investigated in terms of the degree of maintenance after treatment.

The results of follow-up evaluation after 6 months after the end of treatment in the group are as follows.

First, the results of aphasia assessment (by PK-WAB-R) shows that groups with both CT (Rehacom®) and PACE therapy have higher scores than those with only PACE exposure. In the sub-tests of PK-WAB-R, spontaneous speech, auditory comprehension, repetition, and confrontation naming waiting, high scores were all significant. Comprehensively, these results showed that language ability after treatment was well maintained, and more improved.

Second, the scores of CNT for cognitive function in the group B with both CT (Rehacom®) and PACE showed significantly improved. Also improved in all subtests of CNT. Compared to group B, the improvement in group A, exposed only to PACE, is not clear. However, it was found that the treatment effect was maintained.

Third, there was a significant correlation between the cognitive function of CNT and the language ability of PK-WAB-R in all subjects in follow-up.

Taking the above results together, it is confirmed that the group that combined cognitive therapy and communication therapy maintained the effect well after treatment.

This conclusion is mutually supported within the results of this study. Results of all subtests of PK-WAB-R and CNT showed significant improvement and correlation in group B. Therefore, based on the results of this study, it may be necessary to carry out rehabilitation with speech therapy and cognitive therapy. Group A, exposed only to PACE in follow-up, showed only a reduced score on cognitive tests (by CNT). Scores decreased significantly in 4 of the 6 cognitive functions. This result is very contrary to the performance of group B. In addition to this, these results support the inseparable relationship between cognition and communication skills (Lee, 2020; Line & Martin, 2012). And these results support studies presented by Shin et al. (2008) and Akabogu et al. (2019), namely cognitive therapy, which has a generalization effect on the daily lives of stroke patients. It also supports several other previous studies that have highlighted the importance of cognitive therapy in stroke patients (Akabogu et al., 2019; Chen et al., 1997; de Jong-Hagelstein et al., 2011; Kim, 2010; Salis et al., 2018; Tippet et al., 2018).

As mentioned above, the study of CBLT (Akabogu et al., 2019) reported that aphasia was significantly reduced in stroke patients exposed to CBLT intervention. CBLT includes a variety of maps (e.g. gestures, use of pictures, use of devices, etc.) that allow stroke patients to use their language skills to the fullest. Interestingly, PACE for communication therapy, which is a multimodal treatment approach that allows aphasia to communicate messages in any way. In this respect, it is in common with CBLT. Therefore, it is predicted that the effect would have been greater because treatment focused on cognitive stimulation was combined. However, in a comparative study of the effects between the cognitive-linguistic treatment group and the communication-oriented treatment group in aphasia patients with stroke (de Jong-Hagelstein et al., 2011), in the test of the Amsterdam-Nijmegen Everyday Language, there was no significant difference in the average score of the test. Since this study is different from the task of cognitive therapy, so more in-depth literature study is needed on the effects of both cognitive therapy and speech therapy in patients with postmortem aphasia.

Continuing, the findings in this study support the study of Choi (2014) that the parallel guidance of cognitive and speech therapy will certainly be effective to restore aphasia and cognitive abilities in stroke patients. In addition, it supports the results of study by Kim (2010). It is reported that computerized cognitive training through Rehacom for patients with traumatic brain injury improved cognitive abilities and activities of daily living compared to the group that received traditional cognitive therapy. There was a study reported the effect of improving memory and attention by using a computerized cognitive rehabilitation program (Comcog) for stroke patients. Here, the digit span forward/reverse direction, spatio-temporal memory, and auditory/visual continuous performance items were compared with the control group. It supports previous studies that reported that there were significant differences in comparison (Sim et al., 2007). In the study of Salis et al. (2018), memory span, which is a component of cognition, was related to speech timing, and speech timing was related to aphasia severity (WAB evaluation results), spontaneous speech and auditory comprehension. This is in line with the results of this

study.

In summary, it was confirmed that cognitive intervention should be performed concurrently in order to maintain the language ability after treatment of aphasia.

However, in order to support the validity of the results of this study, follow-up studies should be continued based on the following research limitations. First, In this study, we assess the linguistic and cognitive function of aphasia to recognize the effectiveness of follow-up measures. The relevance should be confirmed by evaluating the communication function centered on daily life through future research. Second, the evaluation time in follow-up was different depending on the subjects. So future studies should compare the maintenance of the treatment effect within the same period as much as possible. Hachioui et al. (2013) investigated the resilience of patients with aphasia due to stroke for 1 year after treatment, and found that there was a difference in resilience by language area, and verbal communication ability was related to the stability of recovery of linguistic ability. Third, there are some differences in the content composition of cognitive therapy conducted in previous studies, and a systematic literature survey is needed. The resilience of aphasia's language and communication functions according to cognitive components should be identified. Based on this, it is necessary to analyze which treatment tasks are more effective according to the type and severity of aphasia. Fourth, psycho-emotional anxiety and depression associated with cognitive deficits in aphasia also have a qualitative effect on the life of communication (Doogan et al., 2018; Worrall et al., 2017). To this end, further research will be needed to study the effects of cognitive function in parallel with various speech therapeutic approaches.

The ultimate goal of language rehabilitation for aphasia is to expand and support a healthy life of communication. Aphasia patients' lives are connected not only to individuals but also to their families and communities. Therefore, the evidence based on cognitive linguistic therapy should be continuously studied from various perspectives.

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실어증 환자 인지치료와 언어치료의 병행 효과 연구: 치료종결 이후의 사후평가 비교

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목적: 이 연구는 인지훈련 기반의 언어치료 중요성을 알아보고자 한다. 특히, 치료종결 후에서 6개월 이후의 사후평가에서 인지치료와 언어치료를 병행한 집단과 언어치료만을 실시한 실어증 집단 내에서의 치료효과 정도를 알아보았다.
방법: 연구 대상자는 22명의 비유창성 실어증 환자이며, 연령대는 50~60대이다. 두 그룹으로 구분하여 집단 A는 언어치료(PACE)만 실시되었고, 집단 B는 인지치료(Rehacom)와 언어치료(PACE)가 실시되었다. 언어능력 및 인지능력의 평가는 치료가 종결된 시점에서 6개월 이후에 사후평가를 실시하였다. 집단 내 사후평가와 치료종결 시점의 결과를 비교분석하기 위해 집단 내 대응표본 t-검정을 실시하였다. 사후평가의 언어능력과 인지기능과의 상관성을 알아보기 위해 피어슨상관계수를 구하였다.
결과: 첫째, 인지치료와 언어치료를 병행한 집단 B에서 AQ점수와 LQ점수가 증가되었으며, 통계적으로 유의하였다. 하위 언어영역 평가결과에서도 동일한 결과가 나타났다. 반면 언어치료만 실시한 집단 A에서는 약간의 감소된 경향이 나타났으나 통계적으로 유의한 차이는 나타나지 않았다. 둘째, 인지평가 결과에서는 집단 B의 경우, 6개의 인지기능 중에서 5개 영역에서 통계적으로 유의미하게 향상되었다. 반면 집단 A의 경우 5개의 인지기능에서 수행력이 저조하였고, 4개 영역에서 통계적으로 유의미하였다. 셋째, 실어증 평가(AQ, LQ, 스스로말하기 영역, 청각적 이해력, 따라말하기, 이름대기) 점수와 인지기능 평가의 하위 영역(시각적 연속수행력, 단어학습과 시각적 학습, 기호잇기 A와 B 평가) 간의 통계적으로 유의미한 상관성이 나타났다.
결론: 이 연구결과는 인지기능 훈련을 병행한 의사소통 치료가 치료종결 이후 중재 효과가 비교적 잘 유지되고 있었음을 제시하고 있다. 연구결과의 타당성을 뒷받침하기 위해서는 체계적인 인지 기반 언어치료 프로그램을 개발하여, 실어증자의 언어능력 및 의사소통 기능의 회복력을 종단적으로 비교 연구해야 할 것이다.

검색어: 실어증, 인지치료, PACE, 유지효과

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