

CHINESE MEDICAL SCIENCES JOURNAL

ORIGINAL ARTICLE

Clinical Application of Loewenstein Occupational Therapy Cognitive Assessment Battery-Second Edition in Evaluating of Cognitive Function of Chinese Patients with Post-stroke Aphasia

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Key words: stroke; Chinese; aphasia; cognition; assessment

Objective To investigate the clinical application value of Loewenstein Occupational Therapy Cognitive Assessment (LOTCA) battery in Chinese patients with post-stroke aphasia.

Methods Cognitive functions of 59 Chinese patients with aphasia following a stroke were assessed with the Chinese version of the second edition of LOTCA battery and their linguistic functions were tested with the Western Aphasia Battery (WAB) Scale, respectively. The results of LOTCA were analyzed and compared across different groups, in the light of gender, age, educational background, the length of illness, and the degree of aphasia.

Results Neither the score of subtests of the LOTCA nor the overall scores of LOTCA of aphasia patients with different gender and educational background differed (all $P>0.05$). In different age groups, apart from thinking operation ($F=3.373$, $P=0.016$), visuomotor organization ($F=3.124$, $P=0.022$), attention ($F=3.729$, $P=0.009$) and the total score ($F=2.683$, $P=0.041$), there was no difference in terms of the other subtest scores of LOTCA (all $P>0.05$). In the groups of different length of time with illness, apart from orientation ($F=2.982$, $P=0.039$) and attention ($F=3.485$, $P=0.022$), the score of other subtests and the total score of LOTCA were not different (all $P>0.05$). In the groups of different degree of aphasia, apart from attention ($F=2.061$, $P=0.074$), both the score of other subtests and the total score of LOTCA differed (all $P<0.05$).

Conclusion LOTCA might be suitable to assessing the cognitive ability of post-stroke Chinese patients with aphasia.

Chin Med Sci J 2013; 28(3):167-171

STROKE causes damages to brain tissues responsible for language function and in turn results in cognitive deficits in a patient. Previous research has shown that aphasia is the most important predictor of social outcome in a patient with stroke.¹ Early evaluation of the stroke patients' cognitive status is an important predictor of recovery of comprehensive functions.^{2, 3} However, clinically there is no protocol suitable to assessing cognition of aphasia patients. Loewenstein Occupational Therapy Cognitive Assessment (LOTCA) is mainly used to measure cognitive ability of brain injured patients, but it is extended to assess and evaluate additional patients whose brains are affected by diseases.⁴ The second version of LOTCA has been improved on the first version.⁵ The simplified Chinese version of LOTCA has good validity, reliability, and sensitivity. It can be used clinically to evaluate Chinese subjects with cognitive problems.⁶ Due to the differences in races and cultures, the results from the assessment will be different.^{7, 8} In this study, we assessed and analyzed the cognitive functions of 59 patients with post-stroke aphasia by combining the Chinese version of the second edition of LOTCA with the Western Aphasia Battery (WAB), to explore the clinical value of LOTCA in assessing cognition in aphasic patients after stroke in the light of different factors, in order to provide objective theoretical evidence for clinically cognitive assessment and the linguistic rehabilitation of stroke patients.

PATIENTS AND METHODS

Patients

Fifty-nine inpatients and outpatients with aphasia following a stroke who were admitted to the Rehabilitation Medicine Center of Chinese People's Liberation Army General Hospital between January 2005 and January 2012 were participating in the study. Of the 59 patients, 50 were male and 9 were female. Their age ranged from 24 to 87 years (56 ± 13 years) and the average years of schooling were 11 ± 3 years. Fifty-nine patients were divided into 5 age groups (≤ 40 years, 41-50 years, 51-60 years, 61-70 years, ≥ 71 years) and 3 groups of different educational background (≤ 10 years, 11-13 years, ≥ 14 years). And the interval between onset and admission was between 2 and 181 weeks. All enrolled patients were divided into 4 groups according to the length of time of illness (≤ 12 weeks, 13-26 weeks, 27-52 weeks, ≥ 53 weeks). Except 1 left-handed patient, 58 patients were right-handed. Twenty patients were diagnosed as intracerebral hemorrhage, thirty-eight patients as cerebral infarction, and one patient as glioma. Of them, 13 patients had Broca's aphasia, 9 patients had Wernicke's aphasia, 2 patients had conduction aphasia, 5 patients had transcortical motor aphasia, 8 patients had transcortical

sensory aphasia, 15 patients had anomic aphasia, 3 patients had basal ganglion aphasia, 1 patient had thalamic aphasia, 2 patients had mixed transcortical aphasia, and 1 patient had global aphasia. All participants met the criteria stipulated by the Forth Chinese Conference on Stroke. All participants who were first-time stroke sufferers, voluntarily participated. The criteria of inclusion: (1) all patients who underwent cerebral CT and MRI scanning; (2) lately in stable condition and mood and with clear consciousness; (3) willingly receiving the conditional visits; and (4) the presence and type of aphasia was identified according to WAB and Benson. Exclusion criteria: (1) patients in coma, in unconscious state, and in persistent vegetative state; (2) patients' condition was too serious to finish assessments or patients who were unwilling to participate; (3) patients' condition developed rapidly and acutely, deteriorated with signs of latest cerebral infarction or intracerebral hemorrhage, or patients with internal organ dysfunction and failure; and (4) patients with subarachnoid hemorrhage, transient ischemic attack, or reversible ischemic neurological deficit.

Procedures

All the 59 patients were assessed with WAB and LOTCA for three to five days upon admission.

WAB Their language ability was assessed with WAB. The language and cultural background have little influence on the evaluating results of WAB. A full battery of subtests is used to evaluate both the linguistic and nonverbal skills. Linguistic skills include spontaneous speech, auditory comprehension, and repetition and naming. Nonverbal skills include reading, writing, operation, and structures. The scoring yields three scores termed aphasia quotient, performance quotient, and cortical quotient. Aphasia quotient demonstrates the degree of severity of language impairment; performance quotient is regarded as a measure of the nonlinguistic function of the brain; and cortical quotient shows the overall profile of the cognitive status. Patients were divided into 7 groups in terms of different degrees of aphasia (≤ 30 scores, 31-40 scores, 41-50 scores, 51-60 scores, 61-70 scores, 71-80 scores, ≥ 80 scores).

LOTCA Cognitive status was assessed using the second edition of LOTCA battery, which was based on Luria's neuropsychology and Piaget's theory of cognitive development. The LOTCA consists of 27 subtests in 7 areas: orientation, visual perception, spatial perception, praxis, visuomotor organization, thinking operations, and attention. The first two subtests are designed to assess orientation, subtests 3-6 to determine visual perception, subtests 7-9 to identify spatial perception, subtests 10-12 to examine praxis, subtests 13-19 to analyze visuomotor

organization, subtests 20-26 to assess thinking operations, and subtest 27 to determine attention, respectively. LOTCA subtests scores are as follows: subtests 1-2 score ranges from 1 to 8, subtests 20-22 score is 1-5, the rest subtests score is 1-4; and the total score is 119.

Statistical analysis

Statistical analysis was performed using SPSS 13.0 software. To compare the scoring results of LOTCA across different groups, 59 patients were divided into 2 gender groups, 5 age groups, 3 groups of different educational background, 4 groups according to the length of time of illness, and 7 groups in terms of different degrees of aphasia. For normal distributed data, the scoring results of LOTCA between the two gender groups were compared by using independent-sample *T* test, and the other data were analyzed by analysis of variance. The nonnormal distributed data were analyzed by nonparametric tests. $P < 0.05$ was considered to indicate a significant difference.

RESULTS

The subtest and total scores of LOTCA showed no significant difference among 2 gender as well as 3 educational background groups (all $P > 0.05$, Table 1). In 5 age groups, apart from thinking operations ($F = 3.373$, $P = 0.016$), visuomotor organization ($F = 3.124$, $P = 0.022$), attention ($F = 3.729$, $P = 0.009$) and the total score ($F = 2.683$, $P = 0.041$), there was no significant difference in terms of the other subtests of LOTCA (all $P > 0.05$, Table 1). In the groups of different length of time with illness, apart from orientation ($F = 2.982$, $P = 0.039$) and attention ($F = 3.485$, $P = 0.022$), the score of other subtests and the total score of the LOTCA were not significantly different (all $P > 0.05$, Table 1). In the groups of different degree of aphasia, apart from attention ($F = 2.061$, $P = 0.074$), both the other subtests scores and the total score of LOTCA differed (all $P < 0.05$), and there was significant correlation between all subtests of LOTCA and different degree of aphasia quotient of WAB (Table 1).

DISCUSSION

Post-stroke aphasia is mostly accompanied by cognitive deficits. There has been a long-standing debate among scholars surrounding the relationship of language to cognition, but the exact nature of this relationship is still unclear.⁹ The worldwide study of aphasia is actively exploring the function of language from cognitive point of view. Clinical application of LOTCA sufficiently reflects the patient's cognition, helps to predict the changes and progress of the damage to the brain and successful rehabilitation,

lends insight into cognition in general and the research into it, provides guidance for future treatment, and helps further clinical evaluation and research into brain's cognition.¹⁰ According to earlier study, the performance on 2nd edition of LOTCA ought to be interpreted in the context of total score,¹¹ and may have a beneficial effect on cognition, as assessed by general cognitive measures.¹² Therefore, this study explores the language function from cognition point of view.

The comparison of LOTCA of groups with different factors of the 59 post-stroke patients with aphasia, showed that their subtest score and overall score in the groups of different gender and educational background were not different and therefore their cognitive functions were not affected by gender and educational background. In the different age groups, apart from thinking operation, visuomotor organization, attention and the total score, the rest of the LOTCA scores were the same. It showed that thinking operation, visuomotor organization and attention were affected by age, but the rest cognitive functions were not affected. Careful observation of the analysis of statistics of different age groups, there was no difference among those older than forty but there were differences between the group of younger than forty and those older than forty. It indicates that as people age, their thinking patterns change from specific images to relative and abstract until after forty year of age, hence people's thinking patterns strengthen until they are fixed. The study showed the scores of LOTCA of the patients with various length of time were not different except orientation and attention, so to speak, only orientation and attention were affected by the time of their illness, but their other cognitive functions and general cognitions were not affected. It may because the post-stroke patients' brain have been damaged and the activity of the brain have declined and lost organizing power, resulting in the difficulty in distributing energy and in turn, causes to impair the orientation and attention of the patients. The extent of the impairment increases with the length of the illness.¹³ Nevertheless, the other cognitive functions are not related to the length of illness.¹⁴ Besides, in the groups of different degree of aphasia, apart from attention, the difference in the score of other subtests and the total scores of LOTCA across the groups, shows that cognitive function is affected by aphasia, and there is a close relationship between cognition and language.

Our another research showed that there was significant correlation between all subtests of LOTCA and the subtests of WAB, aphasia quotient, performance quotient and cortical quotient.¹⁵ Linguistic function and cognitive function are closely related, interrelated and promoting mutually. The

Table 1. Comparisons of subtest and total scores of LOTCA across groups of different factors of 59 post-stroke patients with aphasia[§]

Groups	<i>n</i>	Total score	Orientation	Visual perception	Spatial perception	Praxis	Visuomotor organization	Thinking operations	Attention
Sex									
Male	50	87.28±16.09	9.68±4.34	13.42±1.44	8.30±3.50	10.88±1.78	21.88±3.83	19.74±4.60	3.38±0.75
Female	9	90.11±9.73	8.44±3.61	13.89±1.36	9.56±3.84	10.78±1.79	22.56±2.13	21.33±2.60	3.56±0.53
<i>t</i>		-0.509	0.805	-0.904	-0.977	0.158	-0.152	-1.006	-0.668
<i>P</i>		0.613	0.424	0.370	0.333	0.875	0.610	0.319	0.507
Age (yr)									
≤40	8	98.63±12.96	11.50±3.89	14.50±1.20	8.00±4.00	11.38±1.77	25.13±2.36	24.38±4.00	3.75±0.46
41-50	10	83.30±17.50	7.60±4.45	13.20±1.55	7.70±3.47	10.60±1.58	21.70±4.30	19.10±4.95	3.40±0.70
51-60	18	82.61±17.25	8.82±4.16	13.17±1.46	7.78±3.62	10.22±2.34	21.50±3.90	18.67±4.20	3.00±0.84
61-70	13	94.00±10.25	11.38±3.36	14.00±1.00	9.69±3.15	11.54±1.13	22.69±2.72	20.85±3.60	3.85±0.38
≥71	10	84.40±10.61	9.50±4.50	12.90±1.52	9.40±3.72	11.00±1.16	19.70±2.67	18.60±3.34	3.30±0.68
<i>F</i>		2.683	2.128	2.372	0.873	1.337	3.124	3.373	3.729
<i>P</i>		0.041	0.090	0.064	0.486	0.268	0.022	0.016	0.009
Educational background (yr)									
≤10	19	88.37±10.78	9.58±3.66	13.63±1.26	9.47±3.41	10.79±1.58	22.00±2.89	19.42±3.75	3.47±0.61
11-13	18	91.06±16.43	9.78±4.25	13.78±1.44	8.61±3.33	11.00±2.00	22.72±3.85	21.61±4.54	3.56±0.62
≥14	22	84.41±17.42	9.18±4.81	13.14±1.55	7.55±3.75	10.82±1.79	21.36±4.02	19.14±4.57	3.23±0.87
<i>F</i>		0.964	0.101	1.134	1.548	0.075	0.691	1.868	1.149
<i>P</i>		0.388	0.904	0.329	0.222	0.928	0.505	0.164	0.324
Course of disease (week)									
≤12	41	89.80±15.45	9.93±4.19	13.56±1.47	8.68±3.42	11.10±1.58	22.49±3.45	20.51±4.59	3.54±0.64
13-26	11	85.73±11.42	9.09±4.06	13.64±1.21	8.00±3.46	10.18±2.04	21.91±3.62	19.55±3.33	3.36±0.81
27-52	4	87.75±17.25	11.00±2.58	13.75±0.96	9.75±4.50	10.50±3.00	20.00±4.16	19.75±3.69	3.00±0.82
≥53	3	66.33±9.07	3.00±1.73	11.67±1.53	6.00±5.20	10.67±1.53	18.00±3.61	14.67±2.89	2.33±0.58
<i>F</i>		2.453	2.982	1.813	0.761	0.848	1.976	1.785	3.485
<i>P</i>		0.073	0.039	0.156	0.521	0.473	0.128	0.161	0.022
Degrees of aphasia (score)									
≤30	8	66.25±12.14	3.88±1.55	11.63±1.77	4.50±2.98	9.88±2.36	18.13±2.95	15.00±3.02	3.25±0.89
31-40	5	75.20±7.09	5.00±1.87	12.60±1.52	6.20±3.49	10.40±1.34	21.60±2.97	16.40±2.41	3.00±1.00
41-50	5	74.60±12.86	8.80±4.76	13.20±0.84	6.00±3.16	8.20±2.28	19.00±4.18	16.80±2.28	2.60±0.89
51-60	7	91.14±12.85	10.00±4.20	13.86±0.69	7.29±3.15	11.29±1.25	23.71±3.40	21.29±4.23	3.71±0.49
61-70	12	92.17±7.85	10.00±2.22	13.75±1.22	9.42±3.50	11.33±1.50	23.08±2.43	21.08±3.15	3.50±0.52
71-80	13	96.92±10.60	11.77±3.17	14.15±1.07	10.77±1.83	11.46±1.05	23.08±3.59	22.08±4.39	3.62±0.51
≥80	9	99.11±9.19	13.00±3.46	14.22±0.97	11.11±1.17	11.67±1.00	22.89±3.18	22.67±3.43	3.56±0.73
<i>F</i>		12.289	9.376	5.197	7.312	4.164	3.600	6.163	2.061
<i>P</i>		0.000	0.000	0.000	0.000	0.002	0.005	0.000	0.074

§ Plus-minus values are means±SD.

LOTCA: Loewenstein Occupational Therapy Cognitive Assessment.

result confirmed that the recovery of language and cognition are related.^{16, 17} At present, it is generally thought that language areas in the brain are situated at the left frontal lobe and the temporal lobe. Previous researches show that lesions occurring in the frontal lobe, temporal lobe, parietal lobe, basal ganglia and thalamus result in cognitive deficits.^{18, 19} It means that there are areas in the brain responsible for language and cognition; language and cognition that share the base-the brain, are closely related. It confirms the relationship between language and cognition, they two coordinate to function depending on the parts of the structure. Clinically LOTCA can be applied to assess the cognition of post-stroke patients with aphasia. Regarding the relation between language ability and cognitive function needs further clinic observation and confirmed further.

To sum up, cognition might be closely related to language function of post-stroke Chinese patients with aphasia; moreover, the cognition might be not affected by gender, age, educational background, and the length of illness, but greatly affected by the degree of aphasia. LOTCA is suitable to assessing the cognitive ability of post-stroke Chinese patients with aphasia.

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