Ann. Bull. RILP (1982) No. 16, 219-227

PROGNOSIS FOR ACQUIRED APHASIA AND SIGNIFICANCE OF AGE AT ONSET: THE LONG-TERM OUTCOME OF LINGUISTIC AND NONLINGUISTIC FUNCTIONS

*Toshiko S. Watamori**

Introduction

The prognosis for recovery in aphasia depends on various factors and the importance of the age variable has been emphasized.[5 7 12 14] However, no detailed investigation designed specifically to explore this variable has been reported. Although the prognosis for acquired aphasia in children has generally been reported to be excellent,[3 4 9] there has been no report on the ultimate outcome of linguistic and nonlinguistic functions in children with aphasia.

The purpose of the present study was to look specifically for the presence of subtle linguistic and nonlinguistic deficits that persist after left hemisphere lesions incurred during infancy or childhood, and to compare them with the ultimate outcome for the late onset aphasics (adult and geriatric aphasics).

Method

Subjects

The subjects were 17 CVA patients with left hemisphere lesions confirmed by CT scan (Table 1). The subjects consisted of three different age-at-onset groups; i.e., 5 child aphasics (less than 15 years old at the time of onset); 6 adult aphasics (20 to 59 years old at the time of onset); and 6 geriatric aphasics (more than 60 years old at the time of onset). Language development was normal in all of the subjects before the onset, and a marked disturbance in language functions was noted after the onset. All the subjects were right-handed or (in the cases of the children) came from exclusively right-handed families. Six normal elementary school children (mean age: 11.5) served as controls.

Procedures

1. Linguistic Examinations

A battery of linguistic examinations was constructed which was sufficiently sensitive to detect the subtle and specific deficits of children with acquired aphasia as inferred from the study of early hemispherectomy cases.[6] These incorporated recent findings in neurolinguistic research on aphasia and the use of kanji that are within the repertoire of elementary to junior high school age children.

* Tokyo Metropolitan Institute of Gerontology

Table 1 *Summary of Subject Characteristics*

Patient No. and Sex	Handedness Before Lesion	Handedness After Lesion	Age at Lesion	Age at Testing	Cause of Lesion	CT Findings	Type of Aphasia	Characteristics of Spontaneous Speech: Word Finding Difficulty	Paraphasia	Agrammatism	Articulation Disorder	PIQ/VIQ	Overall Score of Linguistic Examination
C-1 M	R	L	6:04	19	CVA	Lt.F, T, P	-	+	±	±	±	83/69	82.7
C-2 M	R	L	7:03	20	CVA	Lt.T, Cerebral Hemiatrophy	-	-	-	-	±	56/75	83.9
C-3 F	?	L	0:11	13	CVA	Lt. widened Sylvian F.	-	-	-	-	±	54/64	82.4
C-4 F	R	L	2:07	11	CVA	Lt.T-P	-	-	-	-	±	48/52	83.3
C-5 F	R	L	11:01	13	CVA	Lt.F-P,T	-	-	-	-	±	95/80	81.1
A-1 F	R	L	49	52	CVA	Lt. F-T-P	B	+	+	+	+	98/S.O.	46.9
A-2 M	R	R	54	56	CVA	Lt.F, Capsulo-putaminal region	W	+	+	-	-	80/78	70.1
A-3 M	R	L	35	38	CVA	Lt. F-T	B	+	+	+	+	74/S.O.	39.8
A-4 M	R	L	37	40	CVA	Lt.F-T-P	B	+	+	+	+	86/S.O.	34.6
A-5 M	R	R	51	54	CVA	Lt.T-P	W	+	+	-	-	81/79	69.7
A-6 F	R	R	46	49	CVA	Lt.T-P	W	+	+	-	-	102/76	75.1
G-1 M	R	R	73	76	CVA	Lt.F	U	+	+	-	+	62/S.O.	57.7
G-2 M	R	R	63	66	CVA	Lt.T-P	U	+	+	-	-	72/S.O.	42.3
G-3 M	R	R	66	72	CVA	Lt.F-P	B	+	-	-	+	74/78	64.8
G-4 F	R	R	67	72	CVA	Lt.F-T-P	B	+	+	-	+	104/68	67.3
G-5 M	R	L	68	72	CVA	Lt.F	B	+	-	-	+	90/82	74.8
G-6 M	R	R	62	67	CVA	Lt.Internal Capsule	U	+	+	+	-	96/62	38.0

F = frontal lobe, T = temporal lobe, P = parietal lobe, Sylvian F. = Sylvian fissure, U = unclassifiable,
B = Broca's Aphasia, W = Wernicke's Aphasia

Table 2 *Test Battery*

I Linguistic Examinations

(1) Repetition of Sentences
(2) Picture Naming
(3) Picture Description(oral)
(4) Word Fluency
(5) Comprehension of Sentences (Modified Token Test)
(6) Comprehension of Active, Passive and Causative Sentences
(7) Comprehension of Locative Prepositions
(8) Production of Locative Prepositions (Modified Reporter Test)
(9) Writing to Dictated Sentences
(10) Picture Description(written)
(11) Comprehension of a Paragraph
(12) Reading Aloud-Paragraph
(13) Reading Aloud-Kana Words
(14) Reading Aloud-Kana Words Embedded in Phrases
(15) Judgment of Semantic Category
(16) Judgment of Phonological Identity

II Communication Effectiveness

(1) Speaking Rate
(2) Richness of Information
(3) Mean Length of Utterance
(4) Mean of the Three Longest Utterances

III Test of Right Hemisphere Functions

(1) Facial Recognition Test
(2) Line Orientation Test

IV Standard Intelligence Test

(1) Wechsler Intelligence Scale for Children-Revised (WISC-R)
(2) Wechsler Intelligence Scale for Adults (WAIS)

2. Communication Effectiveness

Although the battery of linguistic examinations was designed to disclose subtle and specific deficits in certain linguistic functions, a deficient performance in the linguistic test battery may not correspond to the patient's functional ability to communicate verbally. Therefore, four measures of spontaneous speech (speaking rate, richness of information, mean length of utterance, and the mean of the three longest utterrances) were compiled using a tape recorded sample of subjects' speech.

3. Tests of Right Hemisphere Functions

Two visual-spatial tasks which have been found to be sensitive to right hemisphere damage (The Facial Recognition Test[7,11] and the Line Orientation Test[2]) were used.

4. Standard Intelligence Test

The Wechsler Intelligence Scale for Children-Revised (WISC-R)-was used for the child aphasics. The Wechsler Adult Intelligence Scale (WAIS) was used for the adult and geriatric aphasics.

Results

1. Linguistic Examinations

The child aphasics as a group exhibited higher scores on most of the subtests in the linguistic examination battery than the two other subject groups. Statistically significant differences were found between the child aphasics and the other subject groups on subtests such as repetition of sentences, word fluency, comprehension of active, passive, and causative sentences, writing to dictation of sentences and judgment of semantic category (Table 3). No statistically significant differences were found between the adult and geriatric aphasics.

Table 3 *ANOVA Results for Linguistic Examinations in Three Aphasia Groups*

Subtest items on which statistically significant differences were found	Subtest items on which no statistically significant difference was found
(1) Repetition of Sentences ($p<0.05$)	(2) Picture Naming
(4) Word Fluency ($p<0.01$)	(3) Picture Description
(6) Comprehension of Active, Passive and Causative Sentences ($p<0.05$)	(5) Comprehension of Sentences (Modified Token Test)
(7) Comprehension of Locative Prepositions ($p<0.01$)	(8) Production of Locative Prepositions
(9) Writing to Dictated Sentences ($p<0.01$)	(10) Picture Description
(15) Judgment of Semantic Category ($p<0.05$)	(11) Comprehension of a Paragraph
Overall Score ($p<0.05$)	(12) Reading Aloud - Paragraph
	(13) Reading Aloud - Kana Words
	(14) Reading Aloud - Kana Words in Phrases
	(16) Judgment of Phonological Identity

The overall score on the linguistic examination battery, which was an average of all the subtest means, was calculated for each subject. The child aphasics showed strikingly little variance on their overall scores, while the other two groups exhibited great variability (Table 1). The difference between the child aphasics and the other two aphasia groups on the overall score was statistically significant (Table 3).

Further analysis of the performance by the child aphasia group was carried out comparing their scores with those of normal control children (Table 4). Although the child aphasics were identified as the best recovered group among three aphasic groups, they were nonetheless inferior to the normal control children on several measures. The comparison of the overall scores yielded a statistically significant difference ($p < 0.01$). The difference between the child aphasics and the normal controls indicated that the child aphasics were inferior to the normal controls on the syntactic and written language processing tasks in the linguistic examination battery. Furthermore, all the child aphasics demonstrated an articulation difficulty. On the other hand, no child aphasics showed a deficient performance on the subtests related to semantic functions, i.e., picture naming, word fluency, and judgment of semantic category.

Table 4 *t-Test Results for Linguistic Examinations in Child Aphasics and Normal Controls*

Subtest items on which statistically significant differences were found	Subtest items on which no statistically significant difference was found
(5) Comprehension of Sentences ($p<0.05$) (Modified Token Test)	(1) Repetition of Sentences
(6) Comprehension of Active, Passive and Causative Sentences ($p<0.05$)	(2) Picture Naming
(11) Comprehension of a Paragraph ($p<0.05$)	(3) Picture Description
(14) Reading Aloud - Kana Words in Phrases ($p<0.05$)	(4) Word Fluency
Overall Score ($p<0.01$)	(7) Comprehension of Locative Prepositions
	(8) Production of Locative Prepositions
	(9) Writing to Dictated Sentences
	(10) Picture Description
	(12) Reading Aloud - Paragraph
	(13) Reading Aloud - Kana Words
	(15) Judgment of Semantic Category
	(16) Judgment of Phonological Identity

2. Communication Effectiveness

The child aphasics showed a superior performance on all the measures of communication effectiveness compared to the two other aphasic groups. However, a statistically significant difference was found only for richness of information. The relationship between speaking rate and richness of information is considered to be the best measure for communication effectiveness.[12 13] Fig. 1 shows this relationship for the three aphasia groups and two normal control groups (the performance of normal adults was added as a reference). The aphasics differed clearly from the normal control groups—except for one Wernicke's patient in the adult aphasia group. The child aphasics as a group exhibited the highest performance among the three aphasia groups when one subject (C-4) who developed stuttering after the onset of aphasia was excluded.

3. Tests of Right Hemisphere Functions

No statistically significant difference was present among the three aphasia groups on the performance of the two right hemisphere function tests. However, while most of the adult aphasics showed a normal performance, more than half of the child and geriatric aphasics showed a defective performance compared to the corresponding age level norms (Table 5).

4. Standard Intelligence Test

No statistically significant difference was present in the performance IQ for the three aphasia groups. However, while no subject demonstrated a PIQ lower than 70 in the adult aphasia group, three subjects in the child aphasia group and one subject in the geriatric aphasia group demonstrated a PIQ lower than 70 (Table 1).

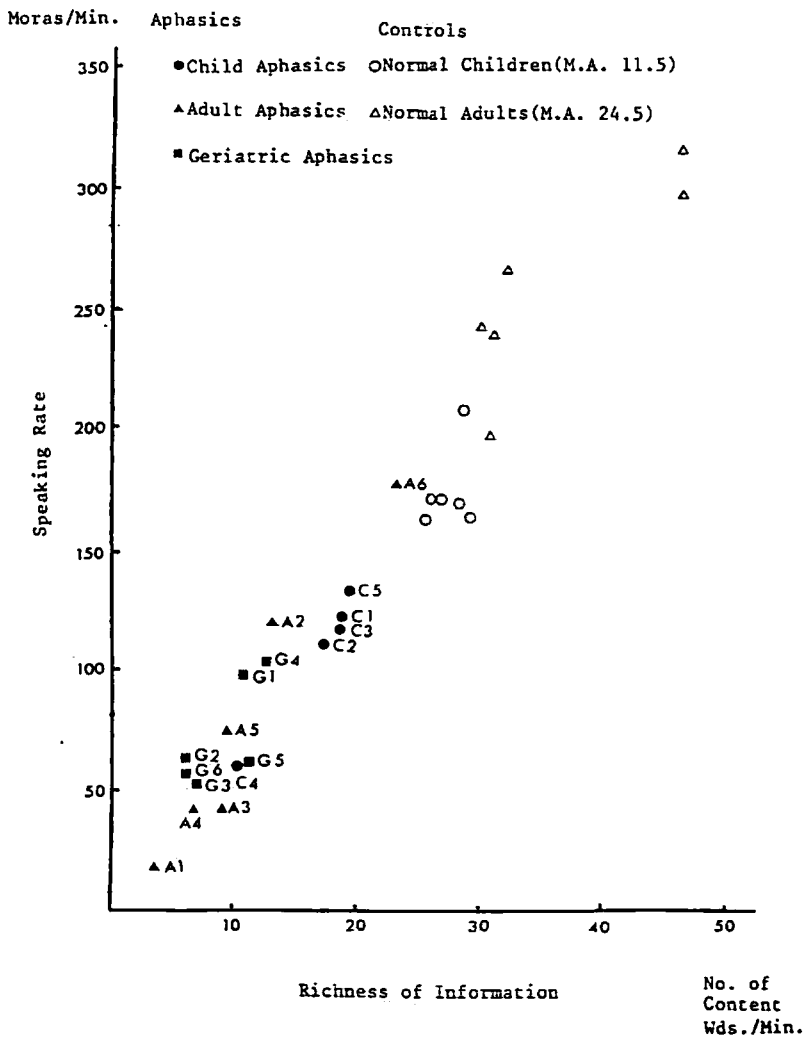

Fig. 1 Communication Effectiveness

Table 5 *Number of Subjects Showing Defective Scores on Right Hemisphere Function Tests*

Test	Child Aphasics N=5	Adult Aphasics N=6	Geriatric Aphasics N=6
Facial Recognition	3	1	3
Line Orientation	3	0	2

$X^2=3.49$ NS

Discussion

1. Linguistic Functions and Communication Ability

The comparison of the performance on the linguistic examination battery and on the measures of communication effectiveness among the three subject groups showed a superior performance for the child aphasia group. Thus, the clinical impression of a good prognosis for child aphasics was confirmed. However, when their performance was analyzed in relation to that of normal control children residual deficits were found in specific areas of linguistic functions. The child aphasics showed disorders in syntactic functions as well as difficulty with phonological functions and written language processing. On the other hand, no subjects in this group showed a disorder in the subtests related to the semantic aspects of language. That is to say, although the child aphasics showed good overall recovery in linguistic functions, they nevertheless showed various discrepancies among the different areas of linguistic functions.

No statistically significant difference was found in performance between the geriatric and adult aphasics. In the adult aphasics, however, the disturbance in linguistic functions was found to be relatively independent of the disturbance in nonlinguistic functions. Furthermore, their pattern of linguistic impairment fit well into the classical aphasia classifications. In the geriatric aphasics, on the other hand, the type of aphasia did not fit well into the classical aphasia classifications. Communication effectiveness was generally low in the adult and geriatric aphasics and aphasic symptoms—such as word finding difficulty, paraphasia, articulation difficulty, etc.—were still apparently present in all of them.

2. Nonlinguistic Functions

It has been pointed out that cases with brain lesions incurred before birth or in early infancy show nonlinguistic disturbances while their language abilities recover fairly well when tested later their life.[8] [10] In this study, two cases with an onset of brain lesions before age three manifested a pattern in accord with the above findings, i.e., a defective performance on the two right hemisphere tests and a PIQ lower than VIQ. On the other hand, subjects with an older age-at-onset showed an adult-type pattern (disturbance in linguistic functions in the face of relatively preserved nonlinguistic functions), except for one subject whose CT revealed extensive left hemisphere atrophy.

The adult aphasics as a group demonstrated the best score on the two right hemisphere function tests, and no subject showed a lower PIQ than 70 on the WAIS. More than half of the geriatric aphasics showed poorer than age-norm scores on the two right hemisphere function test.

3. Lesion Site in the Left Hemisphere and Linguistic and Nonlinguistic Functions

No attempt has been made in the literature to associate the results of detailed examinations on linguistic and nonlinguistic functions with confirmed brain lesions in acquired aphasia in children.[13] Two early onset aphasics (less than 3 years old) in this study demonstrated a poorer than normal performance on linguistic functions

in general without a clear differentiation of symptoms. Although both of these subjects had lesions in the language area, the site of their lesions were not identical. The subjects with an older onset (more than 6 years old) demonstrated symptoms which bear some correspondence to lesions in the left hemisphere, although a difference from adult patterns was also noted. For example, the verbal output of one subject whose lesion included Broca's area was sparse, consisted of short phrases, and an occasional agrammatism was still present, thus showing features similar to those of adult Broca's patient. However, little difficulty was noted in the sphere of articulation and prosody for this patient, and no problem was found in kana processing, which is almost always affected in adult Broca's patients.

The verbal output of the two patients who had lesions including the temporal and parietal lobes was fluent, consisted of long sentences, and no grammatical abnormality was noted. However, there was a marked difficulty in the sphere of written language processing, especially in reading kana words.

The adult aphasics demonstrated a fairly good correspondence between their aphasic symptoms and the site of their lesions in the left hemisphere. On the other hand, the pattern of the linguistic impairments in the geriatric aphasics did not always correspond to their lesion sites as obtained by CT scan.

The neurophysiological mechanisms underlying the differential recovery among the different age groups discussed above might be due to a differential degree of compensation by the intact hemisphere, as well as to the development of compensatory functions in the damaged hemisphere. Further study is necessary in order to determine the relative importance of these factors in terms of age at onset.

The importance of identifying residual impairment in seemingly well recovered child aphasics cannot be overemphasized. These children have to use their linguistic ability as a tool to learn. They are often regarded as "recovered", and their difficulty in learning situations is not taken seriously in the clinical setting. The identification of subtle but specific difficulty in linguistic and nonlinguistic functions will enable the clinician to work on the problem areas and may be able to ameliorate the handicap such children are otherwise destined to have.

Acknowledgments

The author is grateful to Prof. Sumiko Sasanuma of Yokohama National University, Dr. Motonobu Itoh of the Tokyo Metropolitan Institute of Gerontology, and Dr. Yoko Fukusako of the Tokyo Metropolitan Geriatric Hospital for their valuable advice.

References

1. Benton, A.L., M.W. Van Allen (1968): Impairment in facial recognition in patients with cerebral disease. Cortex 4:344-358.

2. Benton, A.L., N.R. Varney and K. deS. Hamsher (1978): Visuospatial judgment: A clinical test. Arch. Neurol. 35:364-367.

3. Brown, J.W. and H. Hécaen (1976): Lateralization and language representation: Observations on aphasia in children, left-handers, and "anomalous" dextrals. Neurology 26:183-189.

4. Byers. R.K. and W.T. McLean (1962); Etiology and course of certain hemisplegias with aphasia in childhood. Pediatrics 29:376-383.

5. Darley, F.L. (1972); The efficacy of language rehabilitation in aphasia. J. Speech Hear Dis. 37:3-22.

6. Dennis. M. and H.A. Whitaker (1976); Language acquisition following hemidecortication: Linguistic superiority of the left over the right hemisphere. Brain Lang. 3:404-433.

7. Kertesz, A. and P. McCabe (1977); Recovery patterns and prognosis in aphasia. Brain 100: 1-18.

8. Lansdell, H. (1969); Verbal and nonverbal factors in right-hemisphere speech: Relation to early neurological history. J. Comparative and Physiological Psychol. 69:734-738.

9. Lenneberg, E.H. (1967); Biological Foundations of Language. New York, Wiley.

10. Milner, B. (1974); Hemispheric specialization: Scope and limits. In Schmitt, F.O., Worden, F.G. (Eds.): The Neurosciences, Third Study Program. Cambridge, MA, The MIT Press.

11. Mori, K., S. Sasanuma and T.S. Watamori (1975); Effects of aging on the performance of two types of nonlinguistic tests, paper presented at the 17th annual meeting of the Japan Geriatrics Society, Tokyo.

12. Vignolo, L.A. (1964); Evolution of aphasia and language rehabilitation: A retrospective exploratory study. Cortex 1:344-367.

13. Watamori, T.S. (1981); Prognosis of acquired aphasia in children: A longitudinal study of four cases, The Japanese J. of Rehabilitation Medicine, 18, 347-356.

14. Wepman, J.M. (1951); Recovery from Aphasia. New York, Ronald.

15. Yorkston, K.M. and D.R. Beukelman (1978); A system for assessing grammaticality in connected speech of mildly aphasic individuals. In Brookshire, R.H. (Ed.): Clinical Aphasiology: Conference Proceedings 1978. Minneapolis, BRK Publishers.

16. Yorkston, K.M. and D.R. Beukelman (1980); An analysis of connected speech samples of aphasic and normal speakers. J. Speech Hear. Dis. 45:27-36.