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Exploring predictors of aphasia recovery: A 6-month follow-up study in Bengali-speaking stroke patients using the Western Aphasia Battery

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Abstract

This study investigated the recovery of language dysfunction in 50 consecutive stroke patients over a 6-month period, employing the Bengali adaptation of the Western Aphasia Battery (B-WAB) for language assessment. The cohort, with a mean age of 58.16 year, predominantly presented with Broca's aphasia (36%) at the initial evaluation, and moderate aphasia was prevalent (56%). Aphasia severity was quantified using Aphasia Quotient (AQ) scores, with a mean AQ of 52.16 at the first assessment. Notably, 80% of participants exhibited ischemic strokes, and cortical stroke was the most common type (44%). Follow-up assessments revealed a statistically significant improvement in mean AQ at 6 months (63.17), with 64% demonstrating 'some recovery,' 8% achieving 'complete recovery,' and 28% exhibiting 'no recovery.' Improvement was most notable in single-word comprehension and repetition. Factors influencing recovery were examined, revealing that male patients experienced better recovery, and the interval between the index event and the first assessment significantly impacted outcomes. Logistic regression analysis identified AQ at first assessment and the site of stroke (cortical vs. cortico-subcortical vs. pure subcortical) as significant predictors of aphasia recovery. The study contributes valuable insights into the dynamics of aphasia recovery post-stroke, emphasizing the importance of early assessment and highlighting specific factors influencing the rehabilitation process.

Keywords: Aphasia recovery, Stroke patients, Aphasia quotient, Cortical stroke

INTRODUCTION

Stroke is one of the leading causes of morbidity and aphasia is one of the most common and devastating cognitive impairment that stroke incurs.[1,2] Aphasia is a common consequence of left hemispheric lesion and most common neuropsychological consequence of stroke, with a prevalence of one third of all stroke patients in acute phase, although there are reports on even higher figures.[1,3,4] There are various published studies which has tried to examine different variables influencing language recovery but with conflicting results. Some studies concluded that initial aphasia and stroke severity negatively impacts language recovery[5,6,7,8], whereas some studies found contradictory evidence.[9] Also, there is scarcity of studies examining predictors of language recovery in Indian population particularly from eastern India. Our aim was to study different variables impacting language recovery among stroke patients with aphasia either admitted in neurology ward or attending cognitive clinic of our hospital in eastern India.

METHODS

Fifty consecutive stroke patients having language dysfunction were recruited from January 2022 to July 2023. Patients with mother language other than Bengali were excluded. Patients with acute stroke with GCS scores <12, patients with acute stroke in delirium, patients with pre-morbid language dysfunction due to any etiology were also excluded.

Data of language examination in our study is taken according to B-WAB (adaptation of the western aphasia battery in Bangla). Its standardization in Bengali speaking population is previously published (Keshree NK *et al* 2013).[10]

Aphasia was categorised qualitatively into following standard syndromes: 1. Broca's aphasia, 2. Wernicke's aphasia, 3. Global aphasia, 4. Transcortical motor aphasia, 5. Transcortical

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sensory aphasia, 6. Transcortical mixed aphasia. Apart from these syndromes we had two patients of 'alexia without agraphia'.

Aphasia severity was categorised quantitatively by Aphasia quotient (AQ) scores which was calculated for every participating patient using B-WAB. AQ is a composite score based on fluency, comprehension, repetition, and naming according to B-WAB. The sub scores (spontaneous speech is scored out of 20; comprehension is scored out of 10; repetition is scored out of 10; naming is also scored out of 10. Spontaneous speech has two sub-headings: information content and fluency; each is scored out of 10) are added and then multiplied by 2. This provides the Aphasia Quotient (AQ). Score ranges from 0-100.

Aphasia is diagnosed when AQ score was below cut-off value of 93.8. Severity of aphasia in the present study was determined by AQ scores. Magnitude of severity was semi-quantified as follows- mild (AQ = 76–93.8); moderate (AQ = 51–75); severe (AQ = 26–50); and very severe (AQ = 25 or less).[11]

Initial neurological stroke severity was assessed with the Scandinavian Stroke Scale (SSS).[12,13] The SSS evaluates level of consciousness; eye movement; motor strength in the arms, hands, and legs; orientation; speech; facial paresis and gait. The total score ranges from 0 to 58 (normal) points. In this study, the speech (language dependent) sub-score was omitted from total SSS score to overcome the confounding effect of language in the analyses of determinants of aphasia recovery.[5] This revised SSS score ranged from 0 to 48 points.

We repeated language examination 6 months after index event. An important factor in recovery of aphasia is the time elapsed since injury. There seems to be general agreement that greatest improvement occurs in the first six months.[14,15]

Aphasia recovery following stroke was categorised into three varieties as follows[11]:

1. no recovery: no qualitative or quantitative changes in aphasia severity.
2. 'some' recovery: it is defined as follows:
   - Qualitative: change to a milder type (e.g., evolution from Broca's aphasia to transcortical motor aphasia)
   - quantitative: lower severity type across severity scales (e.g., change from severe to moderate aphasia), but not amounting to complete recovery.
3. complete recovery: Complete recovery is defined as AQ > 93.8 as B-WAB considers this value as cut off to diagnose aphasia.

MRI/CT scan of Brain was done to look for both nature and site of stroke. MRI brain was done in GE 1.5T SIGNA VOYAGER machine and CT brain was done in GE BRIVO CT 385 machine. In MRI brain, T1; T2; Diffusion weighted imaging (DWI); Gradient recalled Echo (GRE), Fluid Attenuated Inversion Recovery (FLAIR) sequences were studied to evaluate site of infarct and presence of hemorrhage. A stroke is considered 'cortical' when it involves cerebral cortex and adjacent subcortical white matter; it is considered 'cortico-subcortical' when it involves both cerebral cortex and subcortical nuclei (e.g., caudate nucleus or thalamus) and considered 'subcortical' when stroke is confined to subcortical nuclei. Apart from these three groups, we had 2 patients of 'alexia without agraphia' who had stroke in medial occipital cortex plus corpus callosum (cortical plus callosal stroke).

The statistical software SPSS version 20 has been used for the analysis. An alpha level of 5% has been taken i.e., if any p value is less than 0.05 it has been considered as significant.

RESULTS

Total 50 patients (38 males and 12 females) were enrolled with mean age of 58.16 years (58.16±8.95 years) and with mean education of 8.6 years. First language assessment was done within a median interval of 30 days from onset of stroke. Broca's aphasia was the commonest aphasia syndrome in our study (36%) at first assessment followed by Wernicke's aphasia (28%), global aphasia (12%), transcortical sensory aphasia (8%), mixed transcortical, conduction aphasia and anomic aphasia (4% each). In our study mean AQ at first assessment was 52.16 (52.16±22.32). Majority of our study population (56%) had moderate aphasia at initial evaluation. 16% had very severe aphasia and 12% had mild aphasia and severe aphasia each. Eighty percent of the study population had ischemic stroke with the other 20% population had intracranial hematoma. Cortical stroke was the predominant stroke type in our study comprising 44% of the study subjects followed by cortico-subcortical and pure subcortical stroke (28% each). Only 8% (total=4) of patients had right hemispheric stroke.

All the patients were re-evaluated 6 months after index event using B-WAB. Mean AQ at 6 months was 63.17 (63.17±24.92). Improvement in mean AQ after 6 months was found to be statistically significant (Table 1).

Table 1: comparison of Aphasia Quotient (AQ) at first assessment with AQ at 6 months.
(Test applied: Paired t-test)

Time of determination	Aphasia Quotient		P value	Significance
	Mean	SD		
At first assessment	52.16	22.32	**<0.05**	Significant
At 6 months	63.17	24.92		

Majority of the study population (64%=32) showed 'some recovery' in language function while another 8% (=4) achieved 'complete recovery'. Rest 28% (=14) did not show any recovery in language function. In the subgroup of patients with 'some recovery, there is variable improvement in different language domains with maximum number of patients showing improvement in single word comprehension and repetition (Table-2).

At 6 months 12% patients had Broca's aphasia, 16% had Wernicke's aphasia while almost half (48%) of the study subjects evolved to transcortical aphasias. Accordingly transcortical aphasias were most common (48%) aphasia syndrome at 6 months post-stroke. Pattern of evolution is summarized as in Figure 1.

We divided our study population into two groups based on recovery status at 6 months: 1. Improvement (comprises patients with some recovery and complete recovery) and 2. No improvement. Now we compared different variables between these two groups.

We found that age and educational status did not differ significantly between two groups. Male patients showed significantly better language recovery compared to female patients. Interval between index event and first assessment significantly influenced aphasia recovery. (Table 3, 4, 5)

Stroke severity at first assessment was significantly higher in 'No improvement' group. Difference of AQ score (at first assessment) between two groups reached near-significance

Table 2: Distribution of study subjects with some recovery in language function, according to the domain specific improvement

Domain specific improvement in language function (N=32)	Number
Single word comprehension	20
Fluency	4
Naming	12
Repetition	22
Sentence Comprehension	2

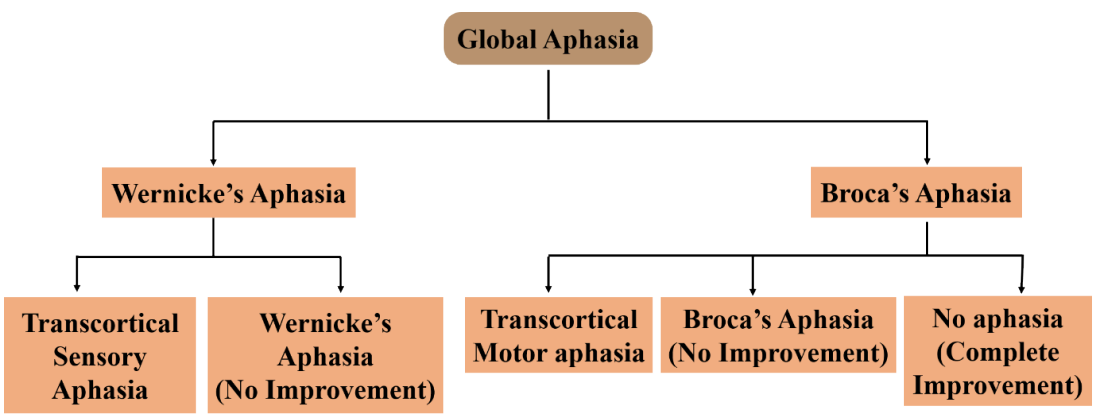

Figure 1. Pattern of aphasia syndromic evolution in our study

Table 3: Comparison of age, stroke severity and aphasia quotient at first assessment between two groups (Mann Whitney test)

Status of improvement		Age	Stroke severity at first assessment (Scandinavian Stroke Scale)	Aphasia Quotient (At first assessment)
No Improvement	Mean	60.57	46.00	45.67
	Median	60.00	48.00	50.50
	Std. Deviation	6.81	5.08	18.41
Improvement	Mean	57.22	43.78	57.22
	Median	56.00	45.50	61.50
	Std. Deviation	9.58	5.19	19.87
	p Value	0.208	**0.008**	0.057
	Significance	Not Significant	**Significant**	Not Significant

level (p=0.057) with 'NO improvement' group having lower mean AQ score at first presentation. (Table 3) Nature of stroke (infarct vs haemorrhage) was significantly different between two groups. All patients with intracranial haemorrhage in our study showed some language recovery over 6 months and contrarily all patients in 'No improvement' group had infarct. (Table 6) Site of stroke was noted to have significant impact on language recovery. All patients with 'pure subcortical' stroke showed some language recovery whereas all patients in 'No improvement' group had either cortical or cortico-subcortical stroke. (Table 7)

We then performed 'binary logistic regression' analysis using stroke severity at first presentation, AQ score at first presentation, nature of stroke, site of stroke as independent variable and aphasia recovery as dependent variable (recovery: 1 and no recovery: 0). In this analysis we noted that AQ score at first presentation and site of stroke (cortical vs cortico-subcortical vs pure subcortical) are the two variables that significantly impacts aphasia recovery over 6 months. (Table 8)

If AQ at first assessment increases by one unit the odds of improvement in AQ increases by 1.044 times.

People with subcortical stroke have higher odds of improvement in AQ.

DISCUSSION

In our study Broca's aphasia is the commonest aphasia syndrome at first evaluation, found in 36% of subjects. It is followed by Wernicke's aphasia found in 28% of the subjects. Global aphasia is the third most common syndrome, found in 12% of the cases. Our finding contrasts with what have been found by Pederson *et al*. (2004) and Scarpa *et al*. (1987).[16,17] They found global aphasia to be the commonest aphasia type at first presentation. But they incorporated only those patients who present within 7 days after stroke. Whereas in our study we incorporated patients within a median interval of 30 days after stroke. This can explain the differences.

Majority of the study subjects showed improvement in aphasia severity over 6 months. Sixty four percent patients showed 'some improvement' with another 8% showing complete recovery. Twenty eight percent patients did not show any recovery.

Table 4: Comparison of sex between two groups (Pearson's Chi Square test)

		Sex		Total		
		MALE	FEMALE		p Value	Significance
Status of Improvement	No improvement	6(15.79)	8(66.67)	14(28)	**0.001**	**Significant**
	Improvement	32(84.21)	4(33.33)	36(72)		
Total		38(100)	12(100)	50(100)		

Table 5: Comparison of educational status between two groups (Fisher's exact test)

		Education						Total	p Value	Significance
		Illiterate	**Primary**	**Secondary**	**Higher Secondary**	**Graduate**	**Masters**			
Status of improvement	No improvement	2(20)	0(0)	10(41.67)	0(0)	2(25)	0(0)	14(28)	0.338	Not Significant
	Improvement	8(80)	2(100)	14(58.33)	2(100)	6(75)	4(100)	36(72)		
Total		10(100)	2(100)	24(100)	2(100)	8(100)	4(100)	50(100)		

Table 6: Comparison of nature of stroke between two groups (Fisher's exact test)

		Nature of stroke		Total	p Value	Significance
		Infarct	Haemorrhage			
Status of improvement	No improvement	14(35)	0(0)	14(28)	**0.027**	**Significant**
	Improvement	26(65)	10(100)	36(72)		
Total		40(100)	10(100)	50(100)		

Table 7: Comparison of site of stroke between two groups (Fisher's exact test)

		Site of stroke				Total	p Value	Significance
		Cortical stroke	Cortical+ Subcortical stroke	Subcortical stroke	Cortical + Corpus callosum stroke			
Status of improvement	No improvement	8(40)	4(28.57)	0(0)	2(100)	14(28)	**0.007**	**Significant**
	Improvement	12(60)	10(71.43)	14(100)	0(0)	36(72)		
Total		20(100)	14(100)	14(100)	2(100)	50(100)		

Table 8: Binary regression analysis

	Coefficient	p Value	Odds Ratio	95% C.I.for Odds Ratio	
				Lower	Upper
Stroke severity at first assessment Scandinavian stroke scale	0.024	0.809	1.025	0.841	1.249
Aphasia Quotient at first assessment	0.043	0.044	1.044	0.999	1.090
Nature of Stroke	18.731	0.999	136392294.343	0.000	
Site of Stroke	1.582	0.039	4.863	1.082	21.858
Constant	-23.695	0.998	0.000		

Transcortical aphasias become the most common aphasia syndrome at 6 months. Majority of patients showed improvement in single word comprehension and repetition tasks. Pashek *et al*. (1988) have suggested that anomic aphasia is the commonest end-point in language evolution.[18] They studied language evolution beyond 1 year. It is quite possible in our study to have similar finding in further follow up. Lomas *et al*. (1978) conclude that comprehension (receptive language) and repetition (oral imitation) are the two language functions that show greatest improvement across all aphasics.[19] Impairment in single word comprehension in stroke patient is predominantly due to white matter disconnection between anterior temporal lobe structures and posterior temporal lobe structures as involvement of anterior temporal lobe in stroke is very rare.[20] The fact that white matter structures are more likely to recover than cortical gray matter from ischemia explains our finding. On the same note, repetition which is dependent on integrity of arcuate fasciculus (a white matter tract) shows better recovery than other language function.

We divided our study population into two groups based on recovery status at 6 months: 1. Improvement (comprises patients with some recovery and complete recovery) and 2. No improvement. There was no significant difference in age distribution between two groups. One would expect negative correlation between age and language recovery but there is conflicting evidence in literature regarding impact of age on language recovery. Laska *et al*. (2001), Lendrem & Lincoln (1985) have found poor aphasia recovery with advancing age.[7,21] Contrarily there are many studies that have concluded that age does not have a significant impact on language recovery.[9,16,22,23]

We have noted that male patients were significantly more represented in 'Improvement' group compared to females. Majority of the studies in literature have not found sex to significantly influence language recovery.[21,22,24,25] These studies had male: female patients' ratio in the range of 1.5: 1 to 1.7: 1, whereas our study had 3: 1 (male: female) patients' ratio. Slightly skewed male representation in our study might have influenced statistical outcome.

We have not found that educational status to significantly influence language recovery which is concordant with previous study by Lazar *et al*. (2008).[9]

Initial stroke severity and aphasia severity are found to significantly influence language recovery which is concordant with previous studies.[8,16,17,24] Pedersen *et al*. (1995) found that initial aphasia severity is the most important clinical factor impacting aphasia recovery.[24] Laska *et al*. (2001) also noted better recovery in patients with less severe initial language function.[7]

We have noticed that site and nature of stroke (infarct vs haemorrhage) are two important predictors of aphasia recovery. Aphasia due to haemorrhagic stroke is more likely to improve than that due to infarct. Jung *et al*. (2011) and Basso *et al*. (1982) reciprocates similar finding.[26,27] Compared to infarct, haematoma causes neurodeficit more by compression and compartmentalization rather than necrosis of neurons. This probably explains why aphasia due to haematoma is more likely to recover than infarct. Aphasia due to pure subcortical stroke is more likely to recover than cortical/ cortical-subcortical stroke. Kang *et al*. (2010) has previously published same finding.[28] Role of subcortical structures in language processing is still incompletely understood. Diaschisis is one mechanism responsible for aphasia in subcortical stroke (diaschisis induced on cortical language centres which are connected heavily with subcortical structures). Therefore, with time cortical language centres recover from

diaschisis explaining better prognosis with pure subcortical stroke. Also, white matter fibres which connect cortical language centres might remain spared in pure subcortical stroke and that might as well lead to better long-term prognosis.

In conclusion, majority of post-stroke aphasia patients achieve some recovery of language function over time. Repetition and single word comprehension are two language domains which are most likely to improve. Aphasia quotient (AQ score) at first assessment and site of stroke are found to be most significant predictors of aphasia recovery. Sex, stroke severity at first assessment and nature of stroke also influences aphasia recovery.

DISCLOSURE

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