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RECOVERY PATTERN OF APHASIA IN STROKE PATIENTS

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Abstract

Introduction: Stroke is defined as a focal or at times global neurological impairment of sudden onset, lasting more than 24 hrs and of vascular origin. Cerebrovascular accidents rank among the leading causes of death and physical disability in general population. Of the stroke population 20-30 % suffer from communication deficits and aphasia due to brain tissue damage. This interferes adversely with the patient's physical, mental and occupational rehabilitation. So, thorough knowledge of aphasia is essential for stroke rehabilitation.

Materials and methods: Patients who developed aphasia with or without other neurologic deficits due to acute stroke admitted in Department of General Medicine Government Medical College, Ananthapur during the period September 2020 to October 2021 were taken up for study after getting informed consent. This study was approved by the Ethics Committee of our College. Consent form enclosed. A detailed history was taken and a complete clinical examination was done. Blood biochemical analysis, hemogram, ECG, Echocardiogram were done. CT scan brain was taken.

Results: Of the 90 stroke patients admitted to our ward during the study period 30 cases were selected in accordance with inclusion criteria based on language, education etc. Of the 90 stroke patients, 18 lost to follow up, 19 died and 23 were strokes due to other causes (trauma, tumor).Two cases of embolic stroke due to preexisting rheumatic heart disease also died within 2 weeks of admission and could not be followed up for aphasia recovery pattern. Out of this global aphasics were 11(n=11). Broca's aphasics were 9(n=9), Wernicke's aphasics were 5(n=5), conduction aphasics were 3(n=3) and transcortical motor aphasics were 2(n=2).

Conclusion: Patients with transcortical motor aphasia became normal. Patients with broca's aphasia showed fair recovery. Two patients out of nine evolved into transcortical motor aphasia. Even though, global aphasia showed poor recovery, auditory word recognition was noted to improve. Three evolved into broca's aphasia. Among the recovery groups, significant improvement was noted from 8th week of stroke. Initial severity and final outcome correlated significantly. Patients with initial high scores indicating mild involvement improved better. There was good correlation with the clinical anatomical location of lesion and CT scan brain.

Key Words: Stroke, Cerebrovascular accidents, Echocardiogram, motor aphasia.

INTRODUCTION

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Stroke is defined as a focal or at times global neurological impairment of sudden onset, lasting more than 24 hrs and of vascular origin[1]. Cerebrovascular accidents rank among the leading causes of death and physical disability in general population. Of the stroke population 20-30 % suffer from communication deficits and aphasia[2,3] due to brain tissue damage. This interferes adversely with the patient's physical, mental and occupational rehabilitation. So, thorough knowledge of aphasia is essential for stroke rehabilitation.

Aphasia is defined as a disorder of language that is acquired secondary to brain damage (Alexander and Benson -1997)[4]. Many studies have shown favorable outcome in aphasic patients of post traumatic etiology[5]. Few aphasia recovery studies have been done with stroke patients also[6,7].

A preliminary study was done regarding the recovery of aphasia by Vijayaraghavan et al in 1989 on 16 cases. Based on that study, a modified protocol suiting the needs of GGH patients with the concurrence of specialists was designed and this study was conducted to analyse the recovery pattern of aphasia in acute stroke patients.

AIMS AND OBJECTIVES

The objectives of this study are: To study the time course of spontaneous recovery of aphasia in stroke patients, to compare the recovery patterns between different types of aphasia, to evaluate the factors influencing the recovery of aphasia, to correlate the clinical syndrome of aphasia with the anatomical substrate in the CT scan.

MATERIALS AND METHODS

Study Design: Cross sectional prospective study.

Study Population: Patients who developed aphasia with or without other neurologic deficits due to acute stroke admitted in Department of General Medicine Government Medical College, Ananthapur during the period September 2020 to October 2021 were taken up for study after getting informed consent. This study was approved by the Ethics Committee of our College.

Inclusion Criteria: The patients taken up for the study were:

1. Right handed persons fulfilling the criteria for handedness.
2. Patients with lesion in left hemisphere as confirmed by CT scan.
3. Patients with normal hearing threshold
4. Patients coming for regular follow up

Exclusion Criteria: Patients were excluded from the study if they had:

1. Pre-existing language or speech disorder.
2. Psychiatric disease or previous stroke.
3. Aphasia secondary to head trauma, tumor.
4. Evidence of right hemisphere lesion.

Methods of Study: A detailed history was taken and a complete clinical examination was done. Blood biochemical analysis, hemogram, ECG, Echocardiogram were done. CT scan brain was taken.

The bedside analysis[4] of aphasic disorders entails the systematic testing of six aspects of language function:

1. Conversational speech (fluency), 2. Comprehension, 3. Repetition, 4. Reading, 5. Writing, 6. Naming.
Language function was assessed by telugu version of modified western aphasia battery system at the end of Admission (T1) and repeated at 1 week (T2) 1 month (T3) and at 3 months (T4) with a variation of plus or minus one week.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

Test battery and scoring system: The assessment of aphasia is done by various techniques. Specific assessment instruments will show a good deal of variability. Matching the assessment to any given patient requires that the clinician maintain a flexible and knowledgeable manner of dealing with the task examining aphasia. This manner of examination is core to what it means work as a clinician, rather than testing patients as a technician or as a gatherer of research data (e.g., Matarazzo, 1990).The test battery used to assess the language function is western aphasia battery (Kertesz and Poole 1974). In this four language parameters namely spontaneous speech, auditory comprehension, repetition and naming were tested and scored and final aphasia quotient arrived.

RESULTS

Of the 90 stroke patients admitted to our ward during the study period 30 cases were selected in accordance with inclusion criteria based on language, education etc. Of the 90 stroke patients, 18 lost to follow up, 19 died and 23 were strokes due to other causes (trauma, tumor).Two cases of embolic stroke due to preexisting rheumatic heart disease also died within 2 weeks of admission and could not be followed up for aphasia recovery pattern.

Out of this global aphasics were 11(n=11). Broca's aphasics were 9(n=9), Wernicke's aphasics were 5(n=5), conduction aphasics were 3(n=3) and transcortical motor aphasics were 2(n=2).

AGE: The age of the patients ranged from 30 years to 70 years and mean age was 50 years. Correlation between the recovery pattern could not be done due to the limited number of cases in each type of aphasia.

Age	N	N
30-40	7 (23%)	5
41-50	11(36%)	2
51-60	7 (23%)	3
61-70	5 (16%)	1

Table 1: Age and types of aphasia

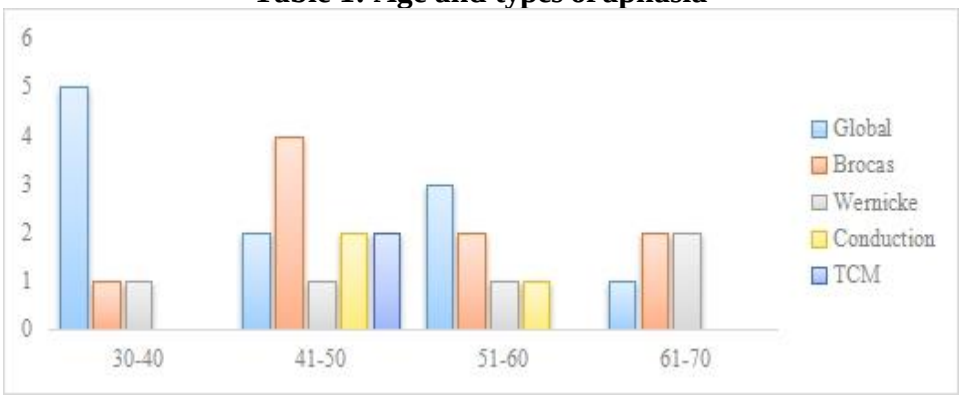

Figure 1: Age wise distribution of aphasis

SEX: 25 males and 5 females were included in the study. Out of 25 males, 9 suffered from global aphasia,9 from Broca's aphasia, 3 from Wernicke's aphasia,2 from conduction aphasia and 2 from transcortical aphasia. Out of 5 females, 2 suffered from global aphasia, 2 had Wernicke's aphasia and 1 had conduction aphasia. Because of limited cases, sex and recovery pattern could not be compared.

Table 2: Sex and Types of Aphasia

Sex	N	Global	Borca	Wernicke	Conduction	TCM
Male	25(83%)	9 (36%)	9 (36%)	3 (12%)	2 (8%)	2 (8%)

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

Female	5 (16%)	2 (40%)	0	2 (40%)	1 (20%)	0

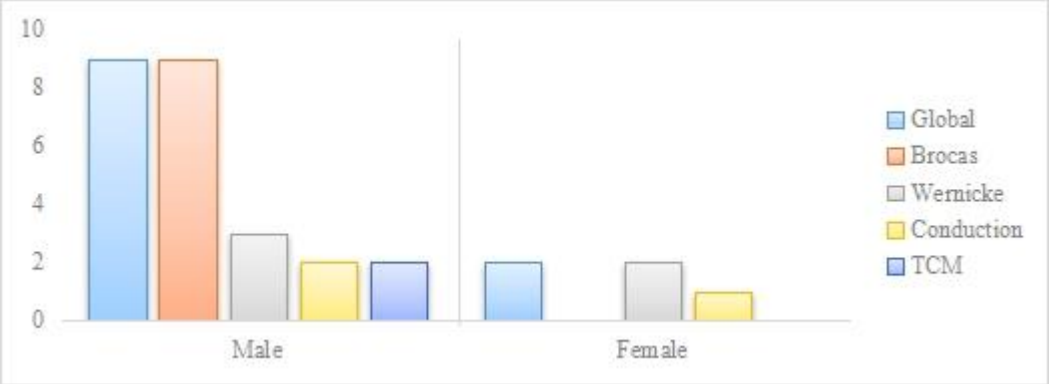

Figure 2: Sex and Distribution of Aphasia

Education: Out of 30 patients,1 patient studied upto 10th std,3 upto 8th std,2 upto 6th std,5 upto 5th std,7 patients upto 4th std,2 upto 3rd std and 10 patients were illiterate. There was no significant difference in recovery among literate and illiterate patients**.**

Risk Factors for Stroke: Several risk factors have been identified to influence the recovery from aphasia. M. T. Sarno and Levita(1971) reported that aphasic individuals who were employed at the time of stroke recovered more than those who were unemployed. The presence of depression, anxiety, and paranoia have been cited as negative factors in recovery (Benson, 1979a, 1979b, 1980; Damasio, 1992;Lebrun, 1980; M.T. Sarno, 1993). Premorbid traits have been identified as important prognostic factors (Eisenson, 1973; Herrmann, Britz, Bartels, &Wallesch, 1995;Wepman, 1951). Eisenson (1949, 1964, 1973) felt that patients with outgoing personalities had a better prognosis than those with introverted, dependent, or rigid personalities.

Diabetes: Out of 30 patients, 10 had diabetes. Out of 10, 3 developed global aphasia, 2 Broca, 3 Wernicke which showed poor recovery and 2 patients developed conduction aphasia and showed good recovery.

Hypertension: Out of 30 patients, 14 patients had high blood pressure as a risk factor. Out of 14,5 patients developed global aphasia,3 patient developed Broca,3 patients developed Wernicke, 2 had conduction aphasia and 1 patient developed trans cortical motor aphasia.

Smoking: Out of 30 patients, 22 patients were smokers. 8 developed global aphasia, 9 developed broca's aphasia, 2 developed wernicke's aphasia, 2 had conduction aphasia and 1 developed transcortical motor aphasia.

Alcoholism: Out of 30 patients, 6 patients were alcoholics.4 patients developed broca's aphasia,1 patient developed wernicke's aphasia and 1 patient developed global aphasia.

Table 3: Risk Factors of Stroke and Types of Aphasia

Risk Factor	N	Global	Borca	Wernicke	Conduction	TCM
HT	14	5	3	3	2	1
DM	10	3	2	3	2	0
Smoking	22	8	9	2	1	2
Alchoholic	6	1	4	1	0	0

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

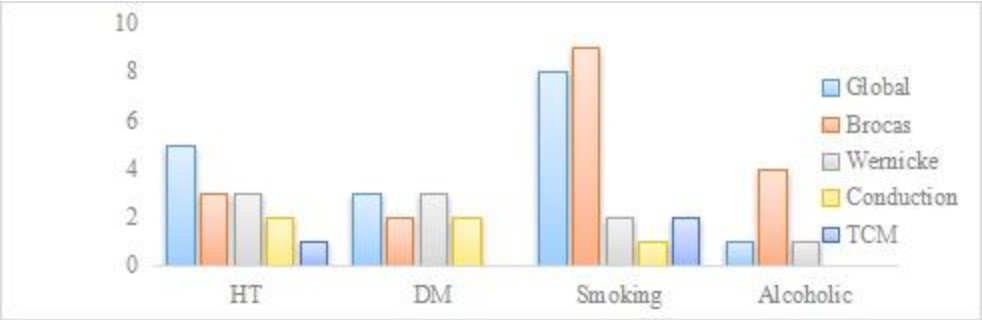

Figure 3: Risk Factors among Alphasic Patients

Types of Aphasia and Recovery Rates

Global aphasia (n=11), These patients showed limited recovery in 3 months period. However, three of them showed good improvement and evolved in to broca's aphasia

Table 4: Global Aphasia and Test Scores

Case No.	T1 (Admission)%	T2 (1 Week))%	T3 (1 month)%	T4 (3 months)) %	Initial Type of Aphasia	Final Evolution
1	2.8	3.6	4.2	4.2	Global	Global
2	2.2	2.4	2.6	2.6	Global	Global
3	2.2	3.6	4.0	4.0	Global	Global
4	3.0	8.0	16.0	18.0	Global	Global
5	4.8	5.6	8.6	10.0	Global	Global
6	2.6	3.8	6.2	9.8	Global	Global
7	8.8	36.4	48.0	62.0	Global	Broca
8	13.4	38.6	54.0	60.0	Global	Broca
9	13.6	38.8	56.0	64.0	Global	Broca
10	4.8	5.8	8.8	12.0	Global	Global
11	4.8	5.6	8.6	12.0	Global	Global

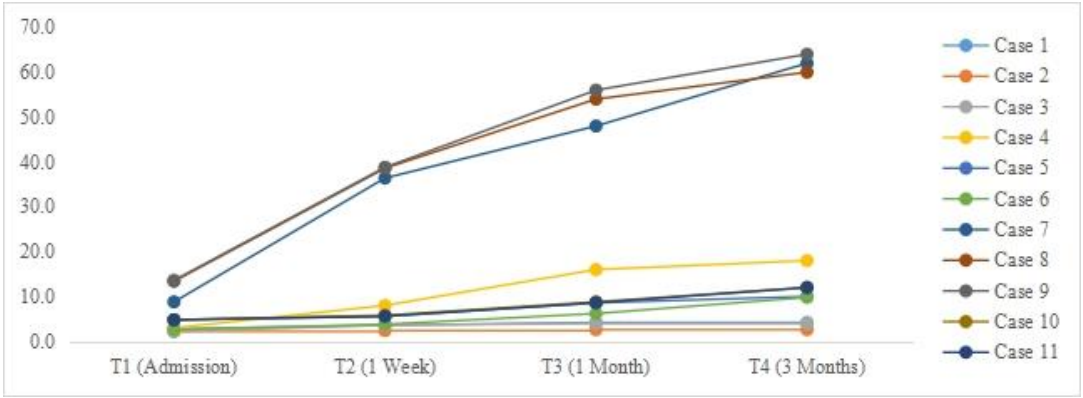

Figure 4: Evolution of Global Aphasia

Broca's aphasia (n=9): These patients showed overall recovery in all test period. 2 of them evolved in to transcortical motor aphasia. 2 did not show significant improvements.

Table 5: Broca's Aphasia and Test Scores

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

Case No.	T1 (Admission) %	T2 (1 Week)) %	T3 (1 month) %	T4 (3 months)) %	Initial Type of Aphasia	Final Evolution
12	60.2	70.4	70.8	95.2	Broca	TCM
13	36.0	48.0	49.0	52.0	Broca	Broca
14	26.0	33.2	42.2	50.0	Broca	Broca
15	21.0	23.0	25.0	28.0	Broca	Broca
16	56.4	65.2	70.0	90.4	Broca	TCM
17	22.0	31.0	40.0	50.0	Broca	Broca
18	21.0	23.0	25.0	28.0	Broca	Broca
19	22.0	31.0	42.0	52.2	Broca	Broca
20	22.0	33.0	46.0	54.0	Broca	Broca

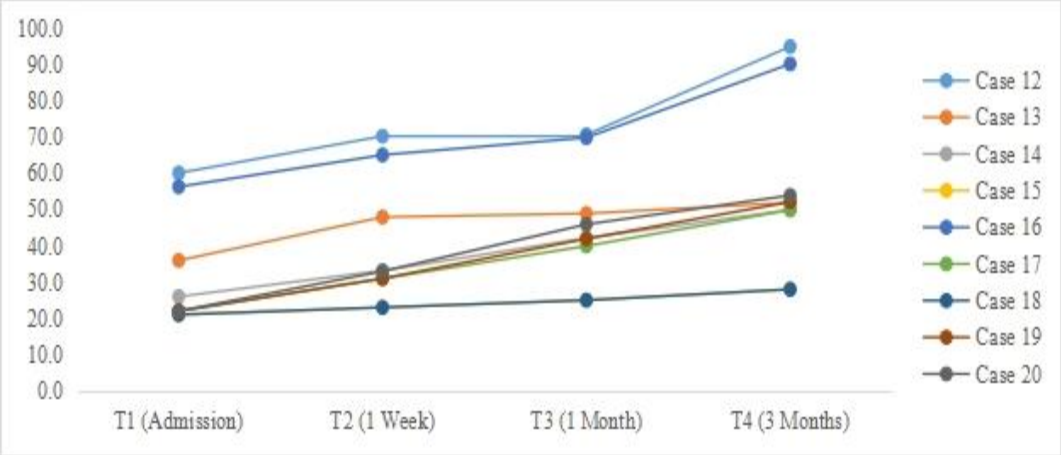

Figure 5: Evolution of Broca's Aphasia

Wernicke's aphasia (n=5), These patients did not show much improvement throughout the test period and remained as wernicke's aphasia at the end of 6 months period.

Table 6: Wericker's Aphasia and Test Scores

Case No.	T1 (Admission) %	T2 (1 Week)) %	T3 (1 month) %	T4 (3 months)) %	Initial Type of Aphasia	Final Evolution
24	24.6	35.0	36.0	36.0	Wernicke	Wernicke
25	20.0	26.0	26.8	34.0	Wernicke	Wernicke
26	20.0	26.2	26.8	36.0	Wernicke	Wernicke
27	22.0	26.0	26.0	28.0	Wernicke	Wernicke
28	20.0	28.0	32.0	36.0	Wernicke	Wernicke

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

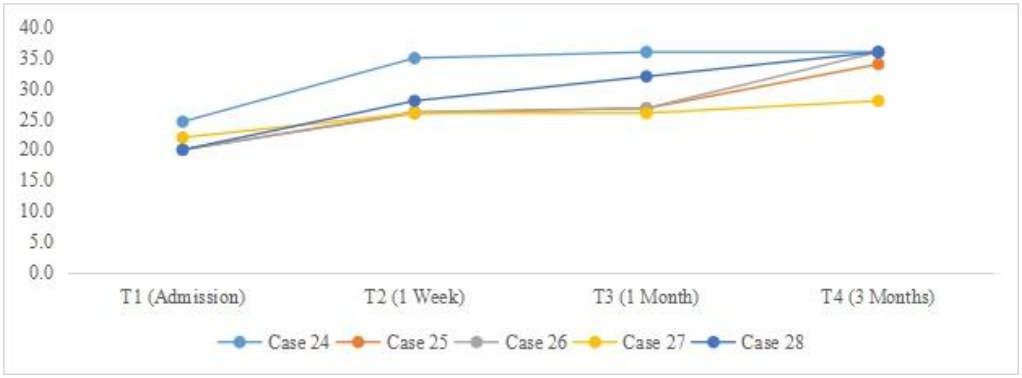

Figure 6: Evoluation of Wernicke's Aphasia

Conduction aphasia (n=3), These patients showed favorable spontaneous recovery pattern. 2 patients became anomic aphasia and another remained as conduction aphasia.

Table 7: Conduction Aphasia and Test Scores

Case No.	T1 (Admission) %	T2 (1 Week)) %	T3 (1 month) %	T4 (3 months)) %	Initial Type of Aphasia	Final Evolution
21	81.7	88.0	92.8	94.0	Conduction	Conduction
22	58.4	72.0	92.0	92.0	Conduction	Anomic
23	53.4	68.0	86.0	92.0	Conduction	Anomic

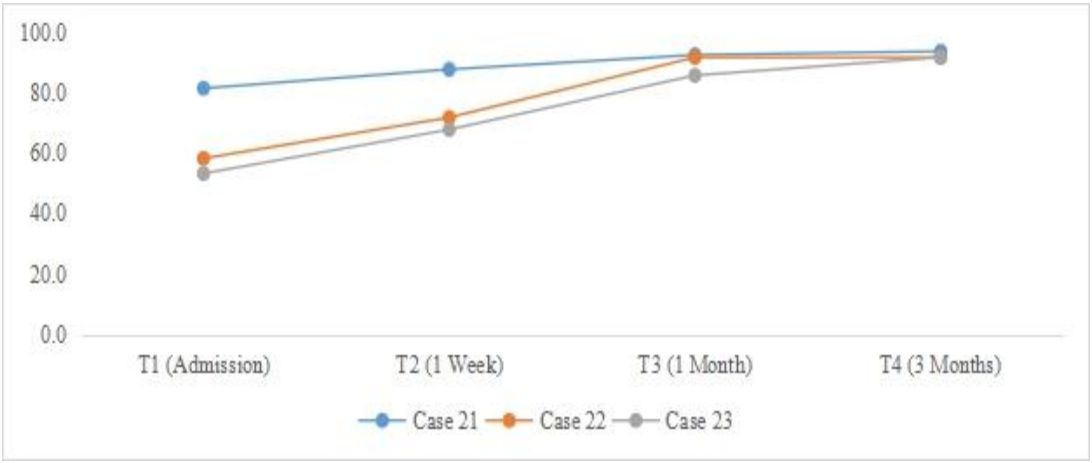

Figure 7: Evolution of Conduction Aphasia

Transcortical aphasia (n=2), These patients showed good improvements in test period and became normal.

Table 8: Transcortical Motor Aphasia and Test Scores

Case No.	T1 (Admission) %	T2 (1 Week)) %	T3 (1 month) %	T4 (3 months)) %	Initial Type of Aphasia	Final Evolution
29	50.0	64.0	78.0	92.0	TCM	Normal
30	50.0	66.0	80.0	94.0	TCM	Normal

Comparision of various aphasias shows the least improvement as shown in previous studies. This is probably due to the more extensive involvement of cerebrum particularly the frontal operculum in global aphasias. Compared to wernicke's and broca's , broca's aphasia recovers much better than wernicke's, also is to note

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

from the graph that lower the score at presentation lower is the extent of recovery as shown in previous studies.

T1-(Admission), T2-(1 Week), T3-(1 Month), T4-(3 Months)

Prognosis of Various Aphasias: These 30 patients were followed for 6 months and outcome was evaluated. The aphasia quotient values of the last test were used to correlate the language performance at the end of follow up as poor, fair, good and excellent (Andrew Kertez and McCabe study - 1977).

Table 9: Pronosis of Various Aphasias

Aphasia type initially	N	Poor 0-25	Fair 26-50	Good 51-75	Excellent 76-100
Global	11	8	0	3	0
Broca	9	2	0	5	2
Wernicke	5	1	4	0	0
Conduction	3	1	0	0	2
Transcortical Motor	2	0	0	0	2

Outcome and Initial Severity: Those patients who had low scores during initial examination recovered to lesser extent and who had high scores show good improvement. So the initial severity of aphasia and final outcome in 6 months was found to be significantly correlated.

Table 10: Initial Scores and Outcome of Various Aphasias

Type of Aphasia	N	Initial AQ (%) T1 (Admission)		Final AQ (%) T4 (3 months)		Outcome
		Range	Mean	Range	Mean	
Global	11	2.2-13.6	5.72	2.6-64.0	23.5	Poor
Broca	9	21.0-60.2	31.0	25.0-95.2	58.0	Good
Wernicke	5	26-24.2	21.0	28.0-36.0	33.0	Fair
Conduction	3	58.4-81.7	70.0	92.0-94.0	93.0	Excellent
TCM	2	50.0-52.0	51.0	92.0-94.0	93.0	Excellent

Evolution of Aphasia: Three of the global aphasics became broca's aphasia. 2 of broca's aphasics became transcortical motor aphasia. In conduction aphasics 2 became anomic aphasia and one remained the same.Transcortical motor aphasics became normal.

Table 11: Evolution of Aphasias

Initial Aphasia	N	End stage	N
Global	11	Global Broca	8 3
Broca	9	Broca TCM	7 2
Wernicke	5	Wernicke	5
Conduction	3	Conduction Anomic	1 2
TCM	2	Normal	2

Correlation with CT scan

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

Global Aphasia: All patients showed large infarct involving the broca's , wernicke's and adjacent areas. Large portions of left frontal, parietal and temporal lobes involved both cortically and subcortically.

Figure 8. Dense MCA sign in a patient with global aphasia

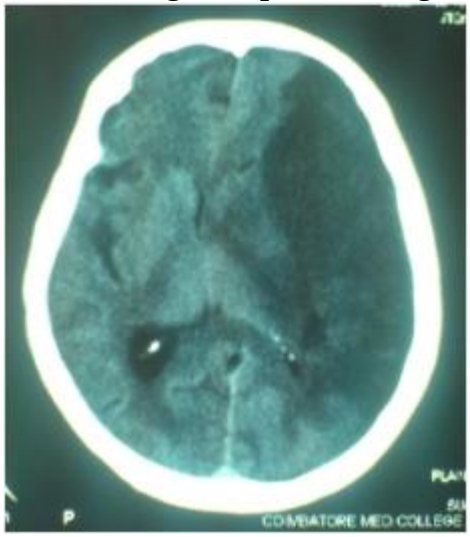

Figure 9. Large left MCA territory infarct with global aphasia.

Broca's Aphasia: Here CT scan showed infarct in the left frontal lobe involving broca's area and sub cortical areas. Temporal lobe and wernicke's area were spared. Both cortical and subcortical structures were involved.

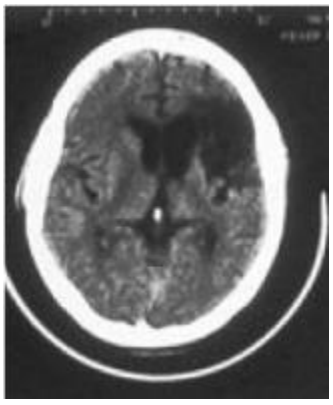

Figure 10: Infarct left frontal lobe – Broca's aphasia

Wernicke's Aphasia: Infarct was noted in left lower temporal lobe and involved wernicke's area. The supramarginal gyrus of the parietal lobe was involved. Broca's area not involved. Deeper structures were also involved.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

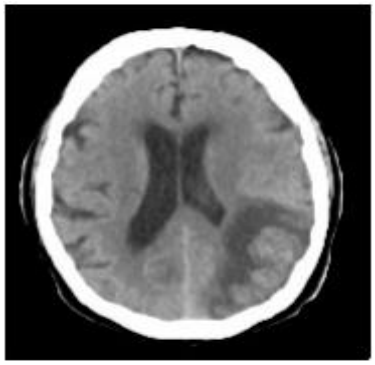

Figure 11: Infarct left frontal lobe – Wernicke's aphasia

Conduction Aphasia: Infarct was seen laterer to the posterior portion of the body of left lateral ventricle consistent with location of the posterior portion of the arcuate fasciculus. Wernicke's area spared.The lesion continued superiorly into upper parietal lobes. Both cortical and subcortical structures were involved.

Transcortical motor aphasia: Infarct was noted in left frontal lobe anterior and superior to broca's area.

DISCUSSION

Many studies have focused on recovery pattern of aphasia in stroke patients but there is no uniformity. The patients were not segregated on the basis of etiology of stroke. In our study we have focused only on ischemic and hemorrhagic stroke, excluding trauma, infections, degeneration, tumors and vasculitis. This study focused on the recovery pattern of aphasias in 30 stroke patients with western aphasia battery system.[10]

The present study showed that among patients with broca's aphasia 2 out of 9 had excellent recovery, 5 had good recovery and 2 had poor recovery. Andrew Kertesz and McCabe (1977), Weisenberg and McBrides (1935) showed good recovery in broca's aphasia as in our study.

As shown in Table 11, Three patients with global aphasia transformed into broca's aphasia, 2 patients of broca's aphasia turned into transcortical motor aphasia, 2 patients with conduction aphasia turned into anomic aphasia and 2 with transcortical motor transformed into nonaphasics. This observation was already noted by Andrew and McCabe in their study.[14]

Lendren W, Lincoln (1985) studied spontaneous recovery of language in aphasic patients between 4 and 34 weeks which revealed age, sex and aphasia type were not related to amount of improvement. No significant sex difference in recovery was found in our study. It was observed that hypertensive and diabetics developed larger infarcts (global aphasia) and showed poor recovery.

Within the groups showing recovery, significant improvement was noted within eighth week of onset of stroke in our study. Sarno and Levita also noted the improvement in first three months after stroke. In1979 they used a subjective, functional assessment of language at two days, three months and six months after stroke. They concluded that greatest change occurred in the first 3 months. Age and education failed to correlate the changes. Culton's studies (1971) also supported this view.

Eslinger PJ, Damasio AR (1981) studied the age and gender of aphasic patients. Regardless of gender, patients with broca's and conduction aphasia were significantly younger than those patients with wernicke and global aphasia. In our study, no distinction between aphasia type in different ages was made because too few were in each group for meaningful correlation. When the mean ages of various types were compared no significant differences were apparent.[15]

Comprehension tends to recover to a greater degree than expression (Basso, Capitani, Zonobio et al., 1982; Kenin & Swisher, 1972; Lebrun, 1976). In our study also patients with global and wernicke aphasia showed overall poor prognosis but considerable recovery was noticed in auditory verbal comprehension. Vijayaragavan and Natarajan et al in their study also noted this observation.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

Patients whose computerized tomography scans show large dominant hemisphere lesions, many small lesions, or bilateral lesions are less likely to recover than those with smaller or fewer lesions (Kertesz, 1979; Yarnell et al., 1976). Lesions in Wernickes area or those that extend more posteriorly tend to lead to severe and persistent aphasia (Ludlow et al., 1986;Mohr et al., 1978)

It was interesting to note that three patients with global aphasia which was due to hemorrhagic lesions recovered and turned into broca's aphasia and this could possibly be explained by the following fact.

Meinzer et al found Intensive language training enhances brain plasticity in chronic aphasia and the significance of perilesional areas in the rehabilitation of aphasia even years after the stroke.

CONCLUSION

Maximum recovery was noted in patients with transcortical motor aphasia and conduction aphasia. Out of three patients with conduction aphasia, two transformed into anomia. Patients with transcortical motor aphasia became normal. Patients with broca's aphasia showed fair recovery. Two patients out of nine evolved into transcortical motor aphasia. Even though, global aphasia showed poor recovery, auditory word recognition was noted to improve. Three evolved into broca's aphasia. Among showing recovery groups, significant improvement was noted from 8th week of stroke. Initial severity and final outcome correlated significantly. Patients with initial high scores indicating mild involvement improved better. There was good correlation with the clinical –anatomical location of lesion and CT scan brain.

REFERENCES

1. World health organization, The WHO stepwise approach to stroke surveillance. Geneva : WHO, 2005.
2. Howard S Kirshner, Aphasia and Aphasia syndromes, Neurology in clinical practice fifth edition vol 1 Bradley, Daroff. 2008 pp 141 to159, 1028 to 1030.
3. Catani M, ffychte H: The rises and falls of disconnection syndromes.Brain 128: 2224, 2005.
4. Hillis AE : Aphasia; progress in the last quarter of a century. Neurology 69:200, 2007.
5. Robey RR 1998. Analysis of clinical outcome in the treatment of aphasia, speech language Hearing vol 41, pp 172-187.
6. Kertesz A, Poole E., 1974. The aphasia quotient. The taxonomic approach to measurement of aphasic disability. Canadian Journal of Neurological Sciences, 1, 7- 16.
7. Obler LK, Albert M, Goodglass H, Benson F: Aphasia type and aging. Brain Lang 1978;6:318-322.
8. Laska AC, Hellblom A, Murray V, Kahan T, Von Arbin M (2001) Aphasia in acute stroke and relation to outcome. J Intern Med 249:413–422.
9. El Hachioui H, van de Sandt-Koenderman MW, Dippel DW, Koudstaal PJ, Visch-Brink EG (2011) A 3-year evolution of linguistic disorders in aphasia after stroke. Int J Rehabil Res 34:215–221.
10. Thompson CK, den Ouden DB (2008) Neuroimaging and recovery of language in aphasia. Curr Neurol Neurosci Rep 8:475–483.
11. de Jong-Hagelstein M, van de Sandt-Koenderman WM, Prins ND, Dippel DW, Koudstaal PJ, Visch-Brink EG (2011) Efficacy of early cognitive-linguistic treatment and communicative treatment in aphasia after stroke: a randomised controlled trial (RATS-2). J Neurol Neurosurg Psychiatry 82:399–404.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 04, 2022

12. Smania N, Gandolfi M, Aglioti SM, Girardi P, Fiaschi A, Girardi F (2010) How long is the recovery of global aphasia? Twenty-five years of follow-up in a patient with left hemisphere stroke. Neurorehabil Neural Repair 24:871–875.
13. Lazar RM, Minzer B, Antoniello D, Festa JR, Krakauer JW, Marshall RS (2010) Improvement in aphasia scores after stroke is well predicted by initial severity. Stroke 41:1485–1488.
14. Maas MB, Lev MH, Ay H, Singhal AB, Greer DM, Smith WS, Harris GJ, Halpern EF, Koroshetz WJ, Furie KL (2010) The prognosis for aphasia in stroke. J Stroke Cerebrovasc Disord 21(5):350–357.
15. Bakheit AM, Shaw S, Carrington S, Griffiths S (2007) The rate and extent of improvement with therapy from the different types of aphasia in the first year after stroke. Clin Rehabil 21:941–949