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Aphasia after stroke: natural history and associated deficits

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SUMMARY Data relating to 976 patients registered as suffering an acute stroke has been analysed to determine the natural history of speech disturbance: these patients came from a community survey of 215,000 people over a 28 month period. Of the 545 patients assessed within 7 days of stroke, 24% were aphasic and 28% unassessable. At 3 weeks, when over 90% of survivors were tested, 20% of those tested had aphasia. At 6 months only 12% of survivors had significant aphasia, but 44% of patients and 57% of carers thought speech was abnormal. Of those aphasic within 7 days, 40% remained so at 6 months; 60% of those aphasic at 3 weeks remained so. There was a high correlation between early and late aphasia scores. Aphasia was associated with more severe disability (degree of limb weakness, loss of function, loss of IQ), and with a less good recovery of social activities, but did not cause any measurable increase in stress upon carers. In a Health District of 250,000 people, about 60 patients each year may be referred for speech therapy after an acute stroke.

Stroke is commonly perceived to be a disease which causes physical disability, and its effect upon communication and language functioning is often overlooked. For example, while stroke is probably the most frequent single cause of impaired communication in adult life,[1] few community based surveys have investigated the size or natural history of the problem. Further, there are often problems in interpreting the terminology used: in one survey[2] "aphasia" was differentiated from "dysphasia", which was considered to include "difficulty in speech, slurred, bulbar or dysarthric speech". In this paper the term "aphasia" includes "dysphasia" and refers to language disturbance of all grades of severity. The term "dysarthria" refers to abnormal function confined to the articulatory muscles and innervation. Apraxia of speech, which may also cause misarticulation, was not specifically studied but if there was any associated language disturbance then this was studied.

Various studies suggest that 21%–24% of patients admitted to hospital with acute stroke are aphasic shortly after their stroke,[3 4] and up to 33% of immediate survivors may have aphasia.[3] In the long-term it is likely that 10% to 18% of survivors are left with significant aphasia.[5 6] Dysarthria may be present in 35% of patients soon after their stroke,[7] with about 15% of long-term survivors having residual dysarthria.[6] Most other studies have simply recorded "speech disturbance", finding this present in 57%–69% of patients soon after their stroke;[2 8 9] this presumably includes dysarthria and aphasia, and possibly even confusion.

These studies give some indication of the frequency of speech disorder after stroke, but they have weaknesses. Some have studied only patients admitted to hospital, which may bias the sample as aphasia probably increases the likelihood of admission.[10] Other studies have not included any formal examination of speech. There is no reported prospective community study which has included any formal assessment of aphasia.

This is the first study of the natural history of aphasia to use patients from a community survey of stroke. This is important both for planning the level of services which may be needed for patients rendered aphasic and also as background information when instituting any research involving stroke patients with aphasia. This paper addresses the following questions: (1) How frequent is aphasia at

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various times after stroke? (2) How many patients recover, and what are the prognostic factors? (3) What stroke-induced disabilities are associated with aphasia? (4) Does the presence of aphasia influence other outcomes?

Patients and methods

Between 1 March 1981 and 30 June 1983, a record was kept of every acute stroke occurring in a population of 215,000 people registered with 96 general practitioners in Frenchay Health District, Bristol, England. The register (described in more detail elsewhere)[11] included all strokes, whether first or recurrent. Patients who had a further stroke in the first 6 months after their index stroke were not re-registered but those 17 patients who had later recurrences were registered again. Nine hundred and seventy-six patients were registered.

Stroke was a clinical diagnosis based upon the WHO definition.[12] It was confirmed by a neurologist's examination (DW) in 713 (73%) of cases; in remaining cases (that is those who died before examination, or who were notified late) the diagnosis was confirmed by personal examination of any hospital notes. Surviving patients were assessed as soon as possible after notification, then at 3 weeks post-stroke and at 6 months.

Physical disability was measured using the Barthel Activity of Daily Living (ADL) scale.[13] This gives a score between 0 and 20 in one point increments, but the top score of 20 only implies functional independence, not necessarily normality. Depression in the carers was assessed using the Wakefield self-assessment depression inventory,[14] a questionnaire with 12 statements giving a score between 0 and 36, any score over 14 indicating depression. Stress upon carers was also assessed using the General Health Questionnaire (GHQ).[15] Social functioning was assessed using the Frenchay Activities Index (FAI)[16] which measures the frequency with which a patient undertakes 15 "social" activities (for example shopping, washing dishes). Motor loss was assessed using the Motricity Index[17] which gives a score from 0 (total paralysis) to 100 (normal). Mental function (IQ) was measured using Raven's coloured progressive matrices,[18] a non-verbal test for which normative data is available for the elderly.

Four aspects of language function were assessed: comprehension, expression, spelling and reading, using three tests from the shortened version of the Minnesota Test for the Differential Diagnosis of Aphasia (the "Schuell")[19] and one from the Boston assessment for aphasia.[20]

Comprehension was tested using a picture: the patient was given five instructions of graded severity and scored one for each correct response.

Expression was tested by asking the patient to describe a second picture from the "Schuell", and he was scored from 0 to 5 depending upon his use of words, phrases and sentences.

Spelling was tested by asking the patient to write five words (girl, went, watch, window, letter), also from the "Schuell": for those who could not write due to paralysis, oral spelling was used.

Reading was tested using five sentences of graded severity: each sentence had one missing word and the patient had to select the missing word from four shown.

Those who were comatose, too confused to test, had such visual neglect that they could not see the stimulus cards, or could not be assessed for other reasons were classified as "unassessable". The few illiterate patients had scores pro-rated from their performance on comprehension and expression. These four tests gave a score ranging from 0 to 20 (each was scored from 0–5, with 5 representing normal performance). There is no normative data for this arbitrary scale. However many of these patients were also seen by a speech therapist and our clinical experience was that all those scoring less than 15 had definite aphasia. Some patients who scored 15–19 had mild aphasia, judged clinically, and a few scoring 20 still had clinical evidence of high level language disturbance. As many patients scored less than 20 simply because their premorbid spelling or reading was not good, we have used a cut off score of 14 or less to indicate definite aphasia. Thus the results will tend to underestimate the prevalence of aphasia, omitting those with minimal disturbances. Every patient was assessed once, but if no aphasia was detected (clinically), then the tests were not repeated (they were classified as "normal").

At six months, "speech" was also assessed by asking patients and carers to rate its recovery on a line scale 150 mm long where one end represented the patient's worst state after stroke, and the other end his pre-stroke state; those who felt speech had not been affected were classified separately. In this context, the term "speech" was used to include both language and articulation.

Results

Frequency of aphasia

When first seen, 24% were aphasic, with a further 28% being unassessable; 12% of survivors had aphasia at six months post-stroke. Table 1 gives details, showing the numbers of patients seen, the frequency of comprehension and expression difficulties, and of aphasia at various times after stroke. The first column refers only to those patients initially seen within 7 days of their stroke: 18% were first seen later. It can be seen that over 85% of all surviving patients were seen at the second and third assessments when one fifth and one eighth of patients respectively were aphasic. Although the findings suggest that communicative difficulties were relatively infrequent at 6 months, patients and carers had a different opinion. At six months after stroke, 338 patients were able to rate their "recovery of speech"; any aphasic patients who could not understand the test was excluded. One hundred and nine patients (32%) felt speech had never been affected, 80 (24%) thought it had returned to normal, 103 (30%) thought it was over half way better and 46 (14%) thought recovery was less than half way back to normal. Two hundred and fourteen carers were asked about the patient's "recovery of speech": 57 (27%) felt it had never been affected,

Table 1 *Aphasia after stroke*

Time seen	*First 7 days*	*2–4 weeks*	*6–7 months*
Number alive	976	626	544
Number seen:	545	568	470
Comprehension score:			
Unassessable	174 (32%)	57 (10%)	16 (3%)
0 (no comp.)	76 (14%)	53 (9%)	21 (5%)
1–3 (poor)	33 (6%)	42 (7%)	30 (6%)
4 (fair)	27 (5%)	26 (5%)	20 (4%)
5 (normal)	235 (43%)	390 (69%)	383 (82%)
Expression score:			
Unassessable	176 (32%)	58 (11%)	16 (3%)
0 (no exp.)	93 (17%)	63 (11%)	29 (6%)
1–3 (poor)	31 (6%)	39 (7%)	27 (6%)
4 (fair)	24 (4%)	25 (4%)	15 (3%)
5 (normal)	221 (41%)	383 (67%)	383 (82%)
Total aphasia score:			
Unassessable	152 (28%)	50 (9%)	13 (3%)
0–14 (poor)	133 (24%)	121 (20%)	62 (12%)
15–19 (fair)	121 (22%)	98 (17%)	44 (9%)
20 (normal)	139 (26%)	309 (54%)	351 (76%)

34 (16%) felt it was normal, 87 (40%) felt it was over half way back towards normal, leaving 36 (17%) feeling it was less than half way better. These figures show that minor speech disturbance after stroke was quite common in these patients. As many of these patients had no evidence of aphasia, much of this presumably reflects minor dysarthria.

Recovery from aphasia

One quarter of the patients who were initially aphasic remined so at 6 months. Table 2 gives details, showing the fate of those who were aphasic (that is scored 14 or less) at initial (that is within 1 week) and at 3 week assessments. It can be seen that many initially aphasic patients made a good recovery, but that only 18% of patients still aphasic at 3 weeks recovered to "normal" by 6 months. Considering only the 93 initially "aphasic" patients (that is scoring 0–14) who survived to 6 months, the correlation coefficient (r) between the scores at these two points was +0·746 ($p < 0·01$). The equation generated was:

Table 2 *Recovery of aphasia*

Outcome measured at	*2–4 weeks*	*6–7 months*
Group:		
Aphasic first 7 days	133	133
Died	22 (17%)	38 (28%)
Unassessable	5 (4%)	2 (1%)
"Aphasia score":		
0–14	72 (53%)	37 (28%)
15–19	22 (17%)	26 (20%)
Normal	12 (9%)	30 (23%)
Aphasic at 3 weeks		111
Died	*	20 (18%)
Unassessable	*	2 (2%)
"Aphasia score":		
0–14	*	54 (49%)
15–19	*	28 (25%)
Normal	*	7 (6%)

Score at 6 months = 0·73 × initial score + 7·07.

For the 89 patients scoring 0–14 at 3 weeks and who survived, the coefficient was 0·711 ($p < 0·01$), and the equation:

Score at 6 months = 1·04 × 3 week score + 5·4.

Disabilities associated with aphasia

One surprising observation was that patients with aphasia generally had more severely disabling strokes. Patients with significant aphasia (score 0–14) were compared with those who scored 15–20 (that is non-aphasic or only having a mild deficit), excluding all comatose and otherwise unassessable patients. Table 3 compares the Motricity index, Barthel ADL and IQ scores for patients first assessed within 7 days of their stroke. Some aphasic patients did not have complete motor or IQ testing as the aphasia precluded formal testing. It can be

Table 3 *Aphasia and severity of initial losses*

	Aphasic	*Not aphasic*	
Number	133	260	
Total "Motricity score"			
Not known	37 (28%)	38 (15%)	
0–32 (severe)	29 (22%)	27 (10%)	
33–65 (moderate)	13 (10%)	35 (14%)	
66–99 (mild)	26 (19%)	118 (45%)	
100 (no weakness)	28 (21%)	42 (16%)	Chi = 25·8
Average (SD)	59·7 (38·6)	72·4 (23·7)	t = 3·67
Barthel ADL score			
Not known	6 (5%)	4 (2%)	
0–4 (v severe)	52 (39%)	21 (8%)	
5–9 (severe)	25 (19%)	66 (25%)	
10–14 (moderate)	21 (16%)	54 (21%)	
15–19 (mild)	14 (10%)	66 (25%)	
20 (normal)	15 (11%)	49 (19%)	Chi = 61·55
Average (SD)	8·4 (6·9)	12·8 (5·8)	t = 6·16
IQ: Raven's matrices			
Unassessable	94 (71%)	62 (24%)	
Average (SD)	85 (14)	96 (15)	t = 4·5

All statistically significant $p < 0·01$

seen that at least 21% of aphasic patients had no limb weakness, and 11% no ADL loss. Nevertheless, the group of aphasic patients contained significantly more patients in the more disabled categories, and comparison of the average scores showed significant differences. This applied at all three assessment points for all the modalities, and also to motor assessment of both the arm and the leg. Aphasic patients had a significantly reduced average IQ at all points, but the large number of unassessable aphasic patients must be noted.

While the majority of aphasic patients had right sided weakness, not all did. Information concerning the numbers of patients with left or right sided symptoms/signs, and their handedness, is shown in table 4. Realising that the site of any lesion can only be presumed as most patients did not have a CT scan, two facts are of interest. First, 10% of right handed aphasic patients had presumed non-dominant hemisphere lesions while, second, most left handed patients with aphasia had left hemisphere lesions.

The relationship between aphasia and stroke severity has also been investigated using correlation coefficients. Considering all patients with information on both scales, the correlation coefficient between the aphasia score and the Barthel ADL score on 392 patients seen within 7 days was 0·363 ($p < 0·01$) and for 457 patients seen at 6 months it was 0·270 ($p < 0·01$). For IQ measured using non-verbal means (Raven's matrices), the correlation coefficient was 0·311 at initial assessment (237 patients; $p < 0·01$), dropping to 0·250 at 3 weeks (382 patients; $p < 0·01$) and to 0·181 at 6 months (376 patients; $p < 0·01$).

Outcome and aphasia

The effect of aphasia upon social outcome (as measured by the FAI) is complicated by the association between aphasia and more severe ADL loss: two-way analysis of variance has been used to control for this. Patients were divided first into an aphasic group and a non-aphasic group, and then into those with no functional disability (Barthel score = 20) and those with some functional disability. The numbers of patients and average FAI scores are shown in table 5. Functional (ADL) disability and aphasia both had a major effect on social activities (FAI scores) at 6 months: (ADL, $F = 102·56$; $p < 0·01$: aphasia, $F = 12·35$; $p < 0·01$). There was no interaction between the two variables ($F = 1·41$; NS).

Eight (27%) of 30 carers of aphasic patients were depressed compared with 37 (19%) of 193 carers of non-aphasic patients (Chi square = 0·43, NS). There was no difference in the average GHQ scores of carers ($t = 1·76$; NS). Only 33 aphasic patients at home at 6 months had a carer, and so subdivision according to the patient's disability was not possible.

Table 5 *Effect of aphasia upon social outcome at 6 months; average (SD) FAI scores in four groups*

Barthel Score	20 (normal)	0–19 (disabled)
Aphasic (0–14)	n = 14	n = 47
FAI score: av (SD)	15·4 (9·2)	3·4 (4·6)
Not aphasic (15–20)	n = 200	n = 192
FAI score: av (SD)	21·6 (9·9)	6·5 (7·1)

Discussion

The strength of this study lies in the unselected nature of the sample, the routine formal assessment made of aphasia and the wide range of additional information available on each patient. The most notable finding is the strong relationship between the presence of aphasia and the severity of the stroke as assessed by other measures such as loss of functional independence. Other interesting findings include the relative infrequency of severe aphasia at 6 months post-stroke and the strong correlation between initial and 6 month aphasia scores. Before discussing the interpretation of the findings, some discussion of the assessments used and population studied is needed.

Table 4 *Handedness and side of limb abnormality in aphasic patients*

	All patients	*Aphasic patients*	
		Initial	*2–4 weeks*
Number	976	133	110
Side weak Right	451 (46%)	103 (78%)	86 (78%)
Left	391 (40%)	15 (11%)	11 (10%)
Neither	119 (12%)	15 (11%)	13 (12%)
Not known	15 (2%)		
Handedness Right	647 (66%)	114 (86%)	93 (85%)
Left	42 (4%)	9 (7%)	8 (7%)
Not known	287 (30%)	10 (7%)	9 (8%)
Right handed, left side impaired		13 (10%)	10 (9%)
Left handed, right side impaired		7 (5%)	6 (5%)

The assessment used was not a complete formal test of aphasia, but it did specifically test the four major aspects of language function. Its advantage was its brevity and simplicity which enabled many patients to be tested who could or would not have tolerated a longer, more complete test. No formal validation was conducted against a speech therapist's diagnosis, but each individual test was taken from a well standardised measure of aphasia. Clinically there was little doubt that, provided clinical judgement was used to exclude patients who clearly could not perform for other reasons (for example confusion, hemianopia), these tests assessed aphasia. In other words, patients who scored badly did so because of aphasia and not because of other problems.

One quarter of patients were never seen. Most of these died rapidly and may never have been conscious, but some did survive 6 months and it is apparent from their hospital notes that some of these patients suffered aphasia. We do not know if the unassessed survivors differ significantly from the assessed survivors. Other patients could not be assessed for aphasia, usually through stroke-induced problems (for example coma, hemianopia) but sometimes because of pre-existing disease (for example blindness). A few of these had obvious language disturbance, but again it is not known whether any systematic bias is present. Nevertheless, the results cover over 85% of those surviving 3 weeks or longer, and are probably as complete as is possible in any study which attempts to investigate every stroke occurring in a defined population.

Many of our findings confirm previous observations. At least 24% of our patients seen within 7 days were aphasic, comparable to the 21% found in Harlem, New York[4] and the 25% found in Copenhagen.[3] Twelve per cent of our patients had residual aphasia at 6 months, similar to the 10% found in Rochester, Minnesota,[5] 8 less than the 18% recorded in Framingham[6] and considerably less than the 33% recorded in hospitalised patients seen in Copenhagen;[3] our inclusion of patients at home probably reduces the percentages as those with aphasia are more likely to be admitted.[10] In our study, of initially aphasic patients who survived, only 40% were left with significant aphasia, similar to the 74% who showed improvement in the Harlem study. The much greater frequency of general speech disturbance again confirms previous observations; at 6 months post stroke 44% of non-aphasic patients and 57% of all spouses still felt that speech was not as it used to be pre-stroke.

The importance of the severity of initial aphasia in predicting later function is also clear in this study, and confirms earlier observations. One study[21] on 44 patients found a correlation between early (0–14 day) and late (27–30 day) scores of about 0·8; another[22] on 80 men found a Wilks lambda of +0·56 between initial (1–2 month) and final (6 month) scores; a third[23] on 96 patients found that initial language function was the most important predictor of function 28 weeks later.

The association between aphasia and overall stroke severity was more surprising, although it has been hinted at before: fewer Danish patients with aphasia regained independence in walking.[3] The Harlem study[4] noted that patients with non-fluent aphasia had more severe weakness than those with fluent aphasia, but no comparison was made with non-aphasic patients. There is no reason to suspect that sample bias could lead to this association; it is more likely that referral of patients with isolated aphasia would lead to an opposite relationship between aphasia and ADL loss. One possible explanation is that those with aphasia may have large lesions, causing both more severe ADL loss and language disturbance: this has already been suggested as an explanation for the higher long-term mortality seen in aphasic patients.[3] Whatever the explanation, this association has important consequences for any research investigating the relationship between aphasia and other outcomes because ADL ability may influence most other outcomes.

Aphasic patients undertook significantly fewer social activities even after making allowance for their increased disability. This was not surprising, although it has not been shown before. In this study we could not confirm that carers of aphasic patients were under more stress, as has been suggested in a study which also used the GHQ and Wakefield scales.[24] We found that 27% of carers of aphasic patients were depressed, rather less than the 42% found previously.[24]

It is well documented that right handed patients with right hemisphere lesions can suffer aphasia,[25] but the frequency of this occurrence is less well studied. One study suggested that 24% of patients with left hemiplegia had aphasia;[2] this is so high as to make one doubt the accuracy of diagnosis of aphasia. In a second study 2 of 133 patients had left sided weakness, and both were left handed.[3] In our study only 15 (4%) of 391 patients with left-sided symptoms were aphasic, compared with 103 (23%) of 451 patients with right-sided symptoms. It is difficult to know the significance of the small number of patients who appeared to have aphasia in association with non-dominant hemisphere lesions in the absence of more precise confirmation both of the site of the lesion and of cerebral dominance.

It is interesting that 44% of patients and 57% of carers felt that "speech" was still abnormal at 6

months although only 21% had "aphasia". There are several possible explanations for this discrepancy. First, many patients and carers were probably referring to mild dysarthria. Second, a few patients may have had mild aphasia even though they scored 20 out of 20. Third, it is likely that the word "speech" was translated by some patients and carers to include disorders in thinking, for example slowness or confusion. Whatever the explanation, these observations show that perceived speech disturbance after stroke is common, and certainly more common than indicated by formal testing for aphasia.

The results from this survey can be used to estimate the number of patients who might be referred for speech therapy. Assuming that only patients with significant aphasia at 3 weeks post-stroke are referred, table 1 shows that a population of 215,000 people generated 121 such patients over a 28 month period. If one assumes that the average UK Health District contains 250,000 people, then about 60 patients a year may be referred for speech therapy. The association between aphasia and functional disability may limit the number able to tolerate intensive therapy.

We conclude that aphasia occurred in about one quarter of conscious patients soon after stroke. Many of these made an early recovery, leaving 12% of survivors with aphasia at 6 months. The extent of recovery was primarily influenced by the severity of the initial loss. Patients with aphasia tended to have more severe strokes when measured in terms of motor or ADL loss. Even after allowing for this association, long-term aphasia restricted a patient's social recovery but did not seem to lead to any measurable effect upon the carer. The average Health District of 250,000 people can expect to have about 60 patients with aphasia after a stroke referred each year for speech therapy. Any research involving patients with aphasia will need to take into account their increased level of functional disability.

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