Aphasia in Acute Stroke: Incidence, Determinants, and Recovery

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Knowledge of the frequency and remission of aphasia is essential for the rehabilitation of stroke patients and provides insight into the brain organization of language. We studied prospectively and consecutively an unselected and community-based sample of 881 patients with acute stroke. Assessment of aphasia was done at admission, weekly during the hospital stay, and at a 6-month follow-up using the aphasia score of the Scandinavian Stroke Scale. Thirty-eight percent had aphasia at the time of admission; at discharge 18% had aphasia. Sex was not a determinant of aphasia in stroke, and no sex difference in the anterior-posterior distribution of lesions was found. The remission curve was steep: Stationary language function in 95% was reached within 2 weeks in those with initial mild aphasia, within 6 weeks in those with moderate, and within 10 weeks in those with severe aphasia. A valid prognosis of aphasia could be made within 1 to 4 weeks after the stroke depending on the initial severity of aphasia. Initial severity of aphasia was the only clinically relevant predictor of aphasia outcome. Sex, handedness, and side of stroke lesion were not independent outcome predictors, and the influence of age was minimal.

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Aphasia is a common symptom in stroke. It is considered a major disability by sufferers and relatives, and knowledge of prognosis and the time course of remission is important for the planning of rehabilitation and for informing patient and family. The remission of aphasia is known to take place mainly within the first 3 months, but little is known about the time course of recovery within these 3 months [1–4]. The relationship between aphasia and lesion localization has a theoretical interest concerning the functional organization of the brain. Based on claims of a higher incidence of aphasia in women as compared to men, it has been suggested that language function is less lateralized in women [5] or alternatively that language is more anteriorly located in women [6].

Presented here are data from a large prospective, community-based stroke population on the incidence of aphasia, its determinants, time course of recovery, and predictors of aphasia outcome.

Materials and Methods

Patients

This study is part of the Copenhagen Stroke Study described in detail elsewhere [7]. The setting is community based and includes all hospitalized stroke patients from a well-defined catchment area, regardless of the age of the patient, the severity of the stroke, and the condition of the patient prior to the stroke. Eighty-eight percent of all stroke patients are hospitalized in the Copenhagen area [8]. All patients were transferred on acute admission to the same 60-bed stroke unit, where all stages of acute care, work-up, and rehabilitation took place.

INCLUSION AND EXCLUSION CRITERIA. A total of 1,014 patients with acute stroke were admitted during the study period from January 1, 1992, to September 30, 1993 (mean age, 74.5 years; standard deviation [SD], 10.9; 451 men [44.5%] and 563 women [55.5%]).

Excluded were 133 patients who (1) were admitted late to the hospital (after the first week from stroke onset, n = 76) or (2) were unconscious at admission (n = 57). There was no difference in age between included (mean age, 74.5 years) and excluded (mean age, 74.5 years) patients, but mortality was lower among the included patients (18% compared to 41%, $\chi^2 = 36.88$, $p < 0.00001$). The percentage of males was highest among the included patients (46% compared to 33%, $\chi^2 = 8.05$, $p = 0.005$).

Included were thus 881 patients. Median time from stroke onset to admission was 12 hours. Seventy-three percent were admitted within 24 hours, 83% within 48 hours, and 89% within 72 hours from stroke onset.

Definition of Acute Stroke

Stroke was defined according to World Health Organization criteria [9]: rapidly developed clinical signs of focal disturbance of cerebral function, lasting more than 24 hours or

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leading to death, with no apparent cause other than vascular origin. Subarachnoidal bleeding was not included.

Previous Stroke

A history of previous stroke was obtained on admission. The hospital register containing information on diagnosis from former admissions was also studied.

Medical Condition Before Stroke

Information concerning comorbidity was obtained on admission and included other disabling diseases apart from previous stroke (amputation, multiple sclerosis, severe dementia, heart failure, latent or persistent respiratory insufficiency, parkinsonism, etc).

Stroke Severity

Initial neurological stroke severity was assessed with the Scandinavian Stroke Scale (SSS) [10, 11] on admission. Recovery was measured by weekly assessments throughout the hospital stay. The SSS evaluates level of consciousness; eye movement; motor strength in the arms, hands, and legs; orientation; aphasia; facial paresis; and gait. The total score ranges from 0 to 58 (normal) points. In the SSS score used as a parameter of stroke severity in the analyses of determinants of aphasia and of aphasia recovery, the aphasia score and the language-dependent orientation score were omitted. This revised SSS score ranged from 0 to 42 points.

Aphasia was assessed with the aphasia scale of the SSS [10, 11]. This scale divides aphasia into severe (the patient can say only "yes" and "no," or less), moderate (the patient can say more than "yes" and "no," but not longer sentences), mild (the patient has limited vocabulary or incoherent speech), and no aphasia. The four speech levels were assigned the scores 0 (severe) to 3 (no aphasia). Patients who were judged to have pure dysarthria were assigned a score of 3.

Type, size, and localization of the stroke lesion were determined by visual inspection of the computed tomography (CT) scan. Lesion size was measured as the largest diameter. All scans were evaluated by the same radiologist, who was blinded to patient data. CT scans were done with a Siemens Somatom DR scanner.

Rehabilitation based on the Bobath technique was given daily to all patients by nursing staff, physiotherapists, and occupational therapists within the neurological wards. Rehabilitation was completed within the department. Patients were discharged when no further in-hospital improvement in function was expected.

Speech Therapy

All patients in need of speech therapy were referred to a speech therapist unless their physical or cognitive condition hindered participation. Individually adapted therapy was offered one to three times a week in 45-minute sessions and continued until no further improvement was expected. A large percentage of patients with severe aphasia died early (81 patients, 47%) and a large percentage of patients with mild aphasia had early complete spontaneous recovery; 50 (49%) of 101 had complete recovery within the first week. Thus, 92 (28%) of the 330 patients with aphasia on admission were referred to speech therapy.

Statistics

Comparisons for continuous data were carried out with Students's nonpaired and paired t test for single comparisons and for multiple interdependent comparisons by one-way analysis of variance followed by post hoc analysis using Duncan's method. Categorical tables were analyzed with the χ^2 test. Univariate correlations were carried out with the Pearson correlation coefficient, r. The required two-tailed significance level for all tests was set to 0.05, except for univariate correlations, where the one-tailed significance level was set to $p < 0.001$, to correct for multiple tests.

Multiple linear regression models were constructed to evaluate the relative importance of multiple variables when needed. Forward stepwise linear regression followed backward stepwise regression for all covariates with a probability less than 0.2. The choice of multiple regression methods was made in advance. The decision for entering and removal of variables was determined by their standardized regression coefficient (β). A variable was removed if the probability of F was less than 0.10 and entered when the probability of F was less than 0.05. The amount of variance explained from the resulting regression equation was determined by the adjusted R^2 statistic.

All analyses were performed with the SPSS for Windows 6.0 statistical package [12].

Ethics

The study was approved by the Ethics Committee of Copenhagen (approval number V. 100.2263/91).

Results

Incidence and Patient Characteristics

Patient characteristics are provided in Table 1. The incidence of aphasia on admission was 38%; 12% had mild aphasia, 6% moderate, and 20% had severe aphasia. A further 6% had speech disturbances that were judged to be dysarthric. Aphasia was highly correlated to left-hemisphere lesions and stroke severity, but not to handedness or comorbidity. Including patients with hemisphere lesions only, the incidence of aphasia rose to 40%; 12% had mild aphasia, 7% moderate, and 21% had severe aphasia.

Computed Tomography

CT was performed in 84% of the patients. Median duration from stroke onset to the time of CT was 10 days. For patients without visible focal lesions the median duration from stroke onset to CT was also 10 days. CT scans were without visible focal lesions in 38% of the patients without aphasia, 30% of the patients with mild aphasia, 26% with moderate, and 20% of those with severe aphasia. Hemorrhage was found on CT scans in 6%, 3%, 11%, and 15%, respectively.

Determinants of Aphasia

Aphasia score was univariately correlated to age ($r = -0.14$, $p < 0.001$), prior stroke ($r = -0.18$, $p < 0.001$), right-sided stroke lesion ($r = 0.43$, $p < 0.001$),

Table 1. Basic Patient Characteristics in Relation to Aphasia Severity

	No Aphasia	Mild Aphasia	Moderate Aphasia	Severe Aphasia	p Value
N (incidence)	551 (62.5%)	101 (11.5%)	56 (6.4%)	173 (19.6%)	
Age (yr) (SD)	73.1 (11.5)	76.5 (9.5)	75.8 (9.5)	77.1 (9.4)	<0.0001
Sex, male (%)	48%	48%	29%	45%	0.04
Handedness, right (%)	93%	92%	98%	94%	NS
Side of stroke lesion, left (%)	37%	93%	89%	87%	<0.00001
Mortality (%)	10%	10%	18%	47%	<0.00001
Prior stroke (%)	20%	26%	26%	36%	0.0004
Comorbidity (%)	21%	14%	25%	27%	NS
SSS on admission (SD)	43.9 (12.1)	41.8 (9.7)	33.5 (11.6)	15.5 (11.2)	<0.0001
SSS excluding language (SD)	29.2 (10.4)	31.2 (9.5)	28.0 (10.6)	15.0 (10.7)	<0.0001
BI on admission (SD)	61.6 (38.9)	63.6 (37.0)	44.3 (38.4)	16.1 (30.3)	<0.0001

SSS = Scandinavian Stroke Scale; SSS excluding language = SSS on admission excluding aphasia and orientation scores; BI = Barthel index; SD = standard deviation; NS = not significant.

and neurological severity (SSS excluding aphasia and orientation score, $r = 0.35$, $p < 0.001$), but not to sex, comorbidity, or handedness. The same relations were found when these variables were analyzed with multiple linear regression. Side of stroke lesion, neurological severity, prior stroke, and age explained 37% of the total variance in the aphasia score on admission.

The patients in whom the CT scan was without visible lesions were excluded from the analyses substituting neurological severity with CT variables. In these analyses aphasia score was univariately correlated with prior stroke ($r = -0.17$, $p < 0.001$), right-sided stroke lesion ($r = 0.47$, $p < 0.001$), size of stroke lesion ($r = -0.28$, $p < 0.0001$), and cortical involvement ($r = -0.27$, $p < 0.001$), but not with age, sex, comorbidity, handedness, or lesion type. In a multiple linear regression analysis, three of these variables had a significant independent influence on the aphasia score. Side of stroke lesion, size of lesion, and cortical involvement explained 35% of the total variance.

Among patients with visible cortical lesions, there was no difference in aphasia score between 66 patients with purely frontal lobe localization (mean, 2.0; SD, 1.2) and 139 with purely posterior localization (temporal, parietal, and/or occipital localization) (mean, 2.1; SD, 1.2; $t = -0.43$, $p = 0.67$), and the same was true for the aphasia score at discharge.

Sex and Hemispheric Localization of the Stroke Lesion

Table 2 shows the distribution of frontal lobe lesions versus posterior (temporal, parietal, and occipital lobe) lesions in relation to sex and presence of aphasia. No significant difference was found between men and women in the distribution of aphasia and anterior-posterior lesion localization. The mean aphasia score for men with frontal lesions was 1.75 (SD, 1.24) and for those with posterior lesions it was 1.16 (SD, 1.19).

Table 2. Presence of Aphasia in Relation to Sex and Intrahemispheric Lesion Localization in Patients with Visible Lesions on CT Scans[a]

	Patients with Frontal Lesions	Patients with Posterior Lesions	p Value
All patients			
Male	16 (34%)	31 (66%)	
Female	26 (38%)	42 (62%)	NS
Patients with aphasia			
Male	10 (28%)	26 (72%)	
Female	19 (36%)	34 (64%)	NS
Percentage with aphasia			
Male	63%	87%	
Female	77%	86%	NS

[a]Frontal lesions involve only the frontal lobe. Posterior lesions involve the temporal, occipital, and/or parietal lobes, but exclude lesions also involving the frontal lobe on CT scans.

CT = computed tomography; NS = not significant.

For women the corresponding mean scores were 1.46 (SD, 1.21) and 1.50 (SD, 1.09). The differences between these scores were not significant ($F = 1.0$, $p = 0.39$).

Aphasia in Patients with Right-Sided Stroke Lesions

Thirty-four patients (10%) with right-hemisphere lesions had aphasia. Three of the right-hemisphere aphasia patients had previously had a left-hemisphere stroke; 1 had previously had bilateral strokes. Aphasia was severe in 21 (62%), moderate in 6 (18%), and mild in 7 (21%). This distribution was not significantly different from the distribution of patients with left-hemisphere lesions (50%, 17%, and 33%). The percentage of left-handedness in patients with aphasia and right-hemisphere lesions (19%) was higher than that

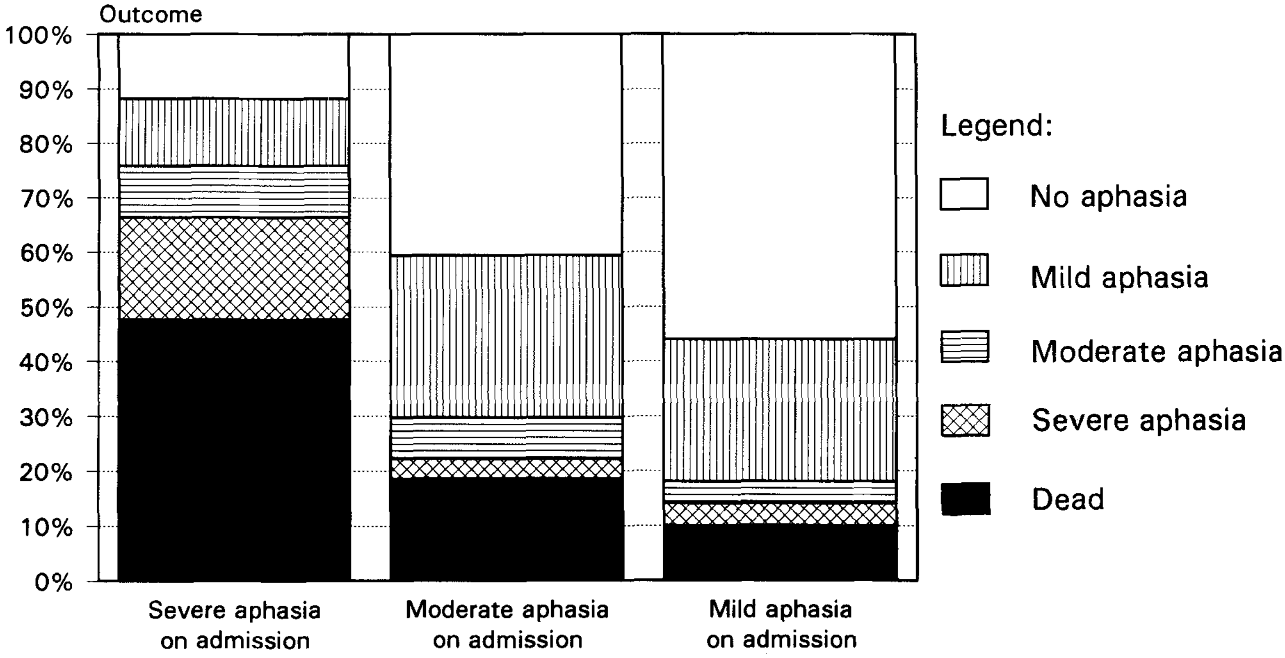

Fig 1. The relation of aphasia on admission to aphasia outcome at discharge.

in aphasic patients with left-hemisphere lesions (3% left-handed, 2% ambidexter, χ^2 = 11.78, p = 0.003).

Of the total sample, 11% of the patients with aphasia on admission had signs of a right-sided stroke lesion, corresponding to an incidence of crossed aphasia of 4% in all patients and 9% of the patients with right-sided stroke. At discharge 6% of the aphasic patients had crossed aphasia, corresponding to 1% of all patients and 3% of the right-sided stroke patients.

Sex and Side of Stroke Lesion in Aphasia

Of the 333 patients with right-hemisphere lesions (148 men and 185 women), 8 men (5% of the men) and 26 women (14% of the women, χ^2 = 6.7, p = 0.0096) had aphasia. A right-hemisphere lesion was found in 14% of the women with aphasia, but in only 6% of the men (χ^2 = 5.73, p = 0.017). A multiple linear regression analysis of patients with right-hemisphere lesions was performed, with aphasia on admission as the dependent variable and sex, age, handedness, comorbidity, prior stroke, and neurological severity on admission as the independent variables. Sex was significant in this analysis (b = 0.18, SE(b) = 0.08, p = 0.023). Neurological severity on admission, prior stroke, and sex explained 11% of the total variance in aphasia score on admission.

In patients with left-sided lesions there was no significant difference in the incidence of aphasia between men (59.3%) and women (64.7%, χ^2 = 1.45, p = 0.23) in the univariate analysis, and in a multiple linear regression analysis of aphasia score similar to the above described, sex had no significant influence (b = −0.07, SE(b) = 0.12, p = 0.53).

The severity of aphasia was not different between women with left-sided lesions (mean aphasia score, 0.8; SD, 0.9) versus those with right-sided lesions (mean aphasia score, 0.5; SD, 0.8; t = 1.61, p = 0.11), and the gain in aphasia score from admission to discharge was similar (left-sided lesions: mean gain, 0.9 [SD, 1.1]; right-sided lesions: mean gain, 1.3 [SD, 0.9]; t = −1.48, p = 0.14).

Outcome of Aphasia

Thirty-one percent of the patients with aphasia died during the hospital stay. Full recovery from aphasia was reached in 30%. Forty-four percent of the patients with aphasia who survived had completely recovered at the time of discharge. Figure 1 shows the outcome of aphasia at the time of discharge in relation to the initial severity of aphasia. Twelve percent of the patients with severe aphasia, 41% of the patients with moderate aphasia, and 56% of the patients with mild aphasia had completely recovered at the time of discharge. Eighteen percent of the survivors still had aphasia at the time of discharge.

Forty-one percent of the patients with aphasia on admission died before the 6-month follow-up, and 17% were noncompliant. Figure 2 shows the aphasia status at the 6-month follow-up. Fifty percent of the patients with initial aphasia had aphasia at the follow-up. Complete recovery had occurred in 8% of the patients with severe aphasia, 32% of the patients

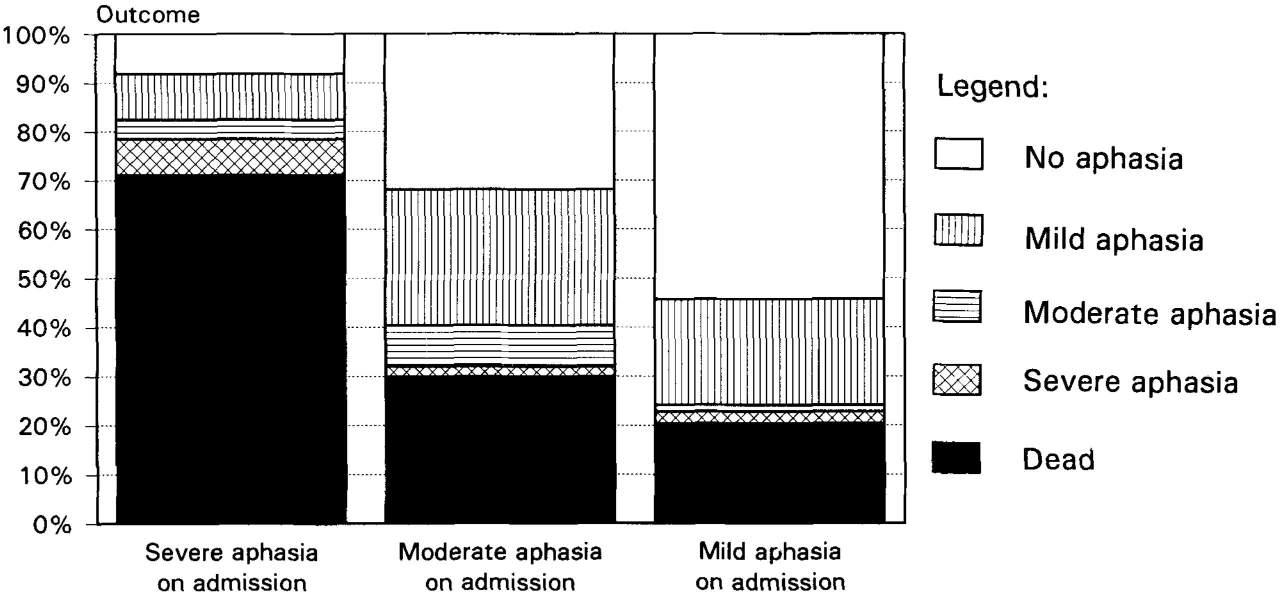

Fig 2. The relation of aphasia on admission to aphasia outcome at 6-month follow-up.

with moderate, and 54% of the patients with mild aphasia.

The aphasia score had not changed since discharge in 74% of the patients, in 12% it had deteriorated, and in 14% it had improved. The mean score was unchanged from 2.17 at discharge to 2.21 at follow-up ($t = 0.85$, $p = 0.40$).

Time Course of Recovery

Stationary language function was reached in 84% of the patients within 2 weeks and in 95% within 6 weeks from stroke onset. Figure 3 shows the time course of recovery of aphasia in relation to the initial degree of severity. Eighty percent of the patients with mild aphasia reached their best level within the first week after stroke onset—95% within 2 weeks; 80% of the patients with moderate aphasia reached their best level within 4 weeks—95% within 6 weeks; and 80% of the patients with severe aphasia reached their best score within 3 weeks—95% within 10 weeks.

Factors Related to Recovery

Univariate analyses showed a correlation between aphasia score at discharge and left-sided stroke lesion ($r = -0.32$, $p < 0.001$), neurological severity on admission ($r = 0.31$, $p < 0.001$), and aphasia score on admission ($r = 0.71$, $p < 0.001$). No correlation was found between aphasia score at discharge and age, sex, prior stroke, comorbidity, or handedness. The mean gain in aphasia score from admission to discharge was comparable between patients with right- and those with left-hemisphere lesions (1.3 points and 1.0 point, $t = -1.3$, $p = 0.19$). A multiple linear regression analysis was performed, with aphasia score at discharge as the dependent variable and aphasia score on admission, neurological severity on admission, age, sex, side of stroke lesion, prior stroke, comorbidity, and handedness as the independent variables. Aphasia score on admission and neurological severity on admission explained 50% of the total variance. Age, sex, side of stroke lesion, comorbidity, prior stroke, and handedness were thus not related to recovery from aphasia.

Eighty-seven aphasia patients who received aphasia therapy had a lower aphasia score on admission (mean, 0.8; SD, 0.8) than did 141 aphasia patients who did not receive therapy (mean, 1.2; SD, 0.9; $t = -3.37$, $p = 0.001$). The same was true for their discharge scores (mean, 1.7 [SD, 1.0], and mean, 2.2 [SD, 1.2]; $t = -3.29$, $p = 0.001$), whereas there was no difference in gain from admission to discharge (mean, 1.0 [SD, 0.9], and mean, 1.0 [SD, 1.1]; $t = -0.28$, $p = 0.78$).

Discussion

The incidence of aphasia in acute stroke patients in this study is larger than that reported in previous studies (ranging from 21 to 33% [13–15]). The high incidence in the present study demonstrates the importance of early assessment. We diagnosed aphasia in a considerable number of patients who subsequently either died or had full recovery during the hospital stay and aphasia was present at discharge in only 18% of the survivors.

A weekly assessment of aphasia in a large-scale study like the present cannot be comprehensive. Thus, minor

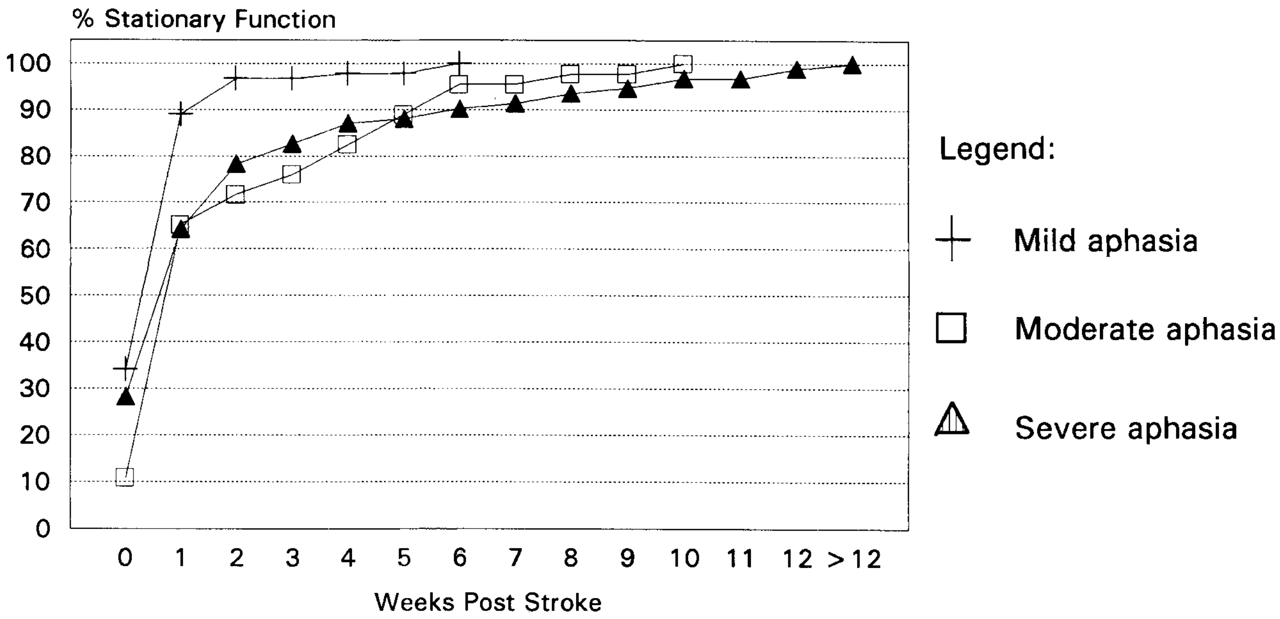

Fig 3. Time course of aphasia. Cumulated percentage of patients having reached stationary language function in relation to initial severity of aphasia.

improvement in function could have been overlooked and some of the patients we classified as having no aphasia or fully recovered could have undetected, very mild aphasic symptoms. In contrast, a change in the aphasia level recorded is likely to be of clinical relevance. The aphasia assessment employed in this study rates spoken language, but does not assess auditory impressive function. This is not an important problem in a large-scale study, as all major types of aphasia affect spoken language [16], a contention that is supported by the finding that there was no difference in aphasia score between patients with purely anterior and those with purely posterior lesion localizations.

The value of assessment of speech would be limited if the recovery for speech and auditory function was markedly different, but that is probably not the case. Of five studies, two found a better remission of auditory function [17, 18], whereas three studies found no difference in the remission of speech and auditory function [4, 19, 20].

Aphasia was related to side and size of the stroke lesion and to stroke severity. Age was significant in one analysis, but of a minimal size: 10 years more of age reduced the aphasia score by less than one tenth of a point. We found a minor relation between aphasia and prior stroke: The presence of prior stroke reduced the aphasia score by one fifth of a point. Finally, there was no influence of handedness on aphasia score. Prior studies noted the relation of aphasia to stroke severity [13] and reported mixed results concerning age [14, 21]. The weight of these factors has not been studied before.

The incidence of crossed aphasia (i.e., aphasia with a right-sided stroke lesion) was comparable to what was reported by Wade and colleagues, who found crossed aphasia in 3% of all patients, corresponding to 13% of the aphasic patients and 4% of the right-sided stroke patients [13]. A markedly smaller incidence at discharge suggests that part of the crossed aphasia is caused by diaschisis or other temporary influences on the left-hemisphere language areas.

Small, but statistically significant differences in cognitive and language abilities between the sexes are well documented, and differences in cerebral localization and degree of lateralization of function have been suggested as possible explanations [22]. Recently, a brain imaging activation study found that a phonological task showed left-sided activation in men, but bilateral activation in women [23]. It is thus of interest whether the incidence of aphasia differs between male and female stroke patients, because this could imply a difference in lateralization of language function between the sexes. Based on studies of selected samples [5, 6], it has been claimed that the incidence of aphasia is higher in men than in women [24]. In the present study, a difference between sexes for aphasia score (in the opposite direction: more women having aphasia) just reached significance in the univariate analysis, but this difference disappeared in the multiple regression analysis. A number of previous studies found no relation between sex and aphasia [1, 21, 25, 26], but did not control for covariates. A case-based stroke data bank study [27] had a result similar to ours; it found univariately a higher rate of aphasia in women, a difference that disappeared when analyses included covariates. We found no influence of sex on aphasia outcome. This confirms the findings of previous studies in selected samples [1, 28–33].

We found no evidence of a different hemispheric posterior/anterior language localization between sexes. Previous studies reported mixed results. Kimura [6] reported that aphasia in women usually is caused by frontal lesions and in men by posterior lesions. Kertesz and Benke [34] could not confirm Kimura's finding, whereas a stroke register study noted an anterior/posterior difference but did not report if this finding was significant [27]. All three studies were based on selected samples.

Aphasia with right-sided lesions was more common in women than in men. There was no difference in severity of aphasia between women with left- and those with right-hemisphere lesions and also no difference in the gain in aphasia score. This pattern is more readily explained by a higher frequency of reversed lateralization for language in women than by a higher frequency of bilateral language representation. With bilateral language representation, less severe aphasia and better remission would be expected.

Very different findings regarding the degree of improvement in language function have been reported in previous studies. In this study 44% of the surviving aphasia patients had recovered to normal language function at the time of discharge, and at the 6-month follow-up this percentage was 50%. Marquardsen [15] found that only 16% had complete recovery. Brust and colleagues [14] found full recovery in 25%. Hartman [35] found significant improvement in 93%. Siirtola and Siirtola [36] found full recovery in 46%. Wade and associates [13] found that 40% remained aphasic. Enderby and colleagues [37] found full recovery in only 11%, but good recovery in a further 37%. These studies are, however, not comparable due to differences in sampling, different follow-up periods, and differences in the reporting of patients lost for follow-up.

The present study offers detailed information on the time course of aphasia remission in stroke patients from the time of acute admission to 6 months after the stroke. Eighty percent had reached stationary language function within 2 weeks—95% within 6 weeks. Because no significant change in aphasia score was found between discharge and the 6-month follow-up, it can be assumed that only a few patients will experience clinically significant change in language function later than 1½ months after the stroke. It is remarkable that some patients with severe aphasia on admission had complete recovery of language function (8%), and that complete recovery was found in one third (32%) of the patients with moderate aphasia and more than half (54%) of the patients with mild aphasia. A steep remission curve was assumed before [29], and one study found full recovery 6 months after stroke in only 18% of the patients still aphasic 3 weeks after the stroke [13]. Previous studies did not include early and continuous assessment of aphasia, and most studies included only small and selected samples. These studies generally found that only minimal improvement in language function can be expected after 2 to 4 months [1–4, 13, 14].

It should be noted that a high percentage of the patients with severe aphasia died during the hospital stay, so that the steep remission curve concerns surviving patients. The prognosis of patients with severe aphasia on admission is associated with severe stroke and a high mortality.

We found initial aphasia severity to be the single most important factor for ultimate language function, which is in agreement with previous studies of selected samples [1, 38, 39]. We found no clinically relevant influence of age on aphasia outcome. In this question previous studies have had varying results [1–3, 30, 31, 37–42], presumably primarily due to sampling differences. Finally, aphasia after a right-sided lesion did not have a more favorable prognosis than aphasia after a left-sided lesion. This finding supports results from a multiple regression analysis of a selected sample [31] and from a meta-analysis of single cases of crossed aphasia [43]. We found no difference in recovery of aphasia between patients who did and those who did not receive aphasia therapy. The study was not designed to investigate the effect of aphasia therapy: The group receiving aphasia therapy was certainly selected, as a significant difference in initial severity of aphasia reflects, and the aphasia assessment was not very sensitive, but it could be noted that the result is in line with the majority of previous studies [1, 3, 30, 42, 44–47].

A considerable amount of the variation in degree of aphasia at discharge was left unexplained by our multiple linear regression equation. Although aphasia is the only useful prognostic variable that can be obtained on admission, it is thus not powerful enough to be useful for individual prognostication. However, as discussed here, a repeated aphasia assessment just a few weeks after stroke onset will provide a reliable prognosis.

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