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# Aphasia after Stroke: Type, Severity and Prognosis

## The Copenhagen Aphasia Study

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**Key Words**
Aphasia · Stroke · Prognosis · Time-course

**Abstract**
***Aim:*** To determine the types, severity and evolution of aphasia in unselected, acute stroke patients and evaluate potential predictors for language outcome 1 year after stroke. ***Methods:*** 270 acute stroke patients with aphasia (203 with first-ever strokes) were included consecutively and prospectively from three hospitals in Copenhagen, Denmark, and assessed with the Western Aphasia Battery. The assessment was repeated 1 year after stroke. ***Results:*** The frequencies of the different types of aphasia in acute first-ever stroke were: global 32%, Broca's 12%, isolation 2%, transcortical motor 2%, Wernicke's 16%, transcortical sensory 7%, conduction 5% and anomic 25%. These figures are not substantially different from what has been found in previous studies of more or less selected populations. The type of aphasia always changed to a less severe form during the first year. Nonfluent aphasia could evolve into fluent aphasia (e.g., global to Wernicke's and Broca's to anomic), whereas a fluent aphasia never evolved into a nonfluent aphasia. One year after stroke, the following frequencies were found: global 7%, Broca's 13%, isolation 0%, transcortical motor 1%, Wernicke's 5%, transcortical sensory 0%, conduction 6% and anomic 29%. The distribution of aphasia types in acute and chronic aphasia is, thus, quite different. The outcome for language function was predicted by initial severity of the aphasia and by the initial stroke severity (assessed by the Scandinavian Stroke Scale), but not by age, sex or type of aphasia. Thus, a scoring of general stroke severity helps to improve the accuracy of the prognosis for the language function. One year after stroke, fluent aphasics were older than nonfluent aphasics, whereas such a difference was not found in the acute phase.



## Introduction

Aphasia is one of the most common symptoms in acute and chronic stroke patients [1]. We have previously reported on the frequency, initial severity and 6-month prognosis of aphasia in general in a community-based study of acute stroke patients [2]. However, the frequencies of the different types of aphasia in acute stroke and possible differences in prognosis are also of theoretical interest as well as of practical importance for the planning of rehabilitation. Related interesting questions are whether age and sex influence severity, type and remission of aphasia. The literature on these subjects is growing, but

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the studies are mostly limited to more or less selected patients, most often those patients selected for rehabilitation departments.

Regarding type of aphasia in acute stroke, Brust et al. [3] reported on type of aphasia in a large population, but the study was not prospective, the type of assessment was not described, and the selection of patients was probably socioeconomically biased as only African Americans were included. Type of aphasia in acute or subacute stroke has been described in selected populations in a few other studies [4–6]. Finally, a recent French study reported on the incidence and type of aphasia within 1 month of stroke in 308 patients consecutively admitted to a stroke unit, but not all included were from a well-defined catchment area [7].

A number of studies have reported on the evolution in type of aphasia during recovery [4, 8–10] and on the influence of age and sex on type of aphasia and recovery [5, 6, 11–17]. However, most of these studies have been performed with selected populations, which in some cases has led to conflicting results.

## Methods

*Patients*

All stroke patients with suspected aphasia, Danish as their first language, and without a previous dementia were included from three Copenhagen hospitals. Patients were included from Bispebjerg Hospital from December 1, 1996, from Hvidovre Hospital from April 1, 1997, and from Frederiksberg Hospital from May 1, 1997. Inclusion from all three hospitals ended on May 15, 1999. Bispebjerg Hospital admitted all stroke patients to stroke units during the entire period, whereas such units were first opened at Frederiksberg and Hvidovre Hospitals during the study period, i.e., January 1, 1998. Thus, some stroke patients were admitted to internal medicine wards. These patients were seen by a neurologist from the Department of Neurology and – if aphasia was suspected – referred to our project. Speech therapy was freely available for all patients considered in need and who were able to participate. This was usually begun within the first 3 weeks. The aphasic patients usually started speech therapy while still in hospital, but continued as outpatients after discharge from hospital.

*Assessments*

The patients were assessed with the first part of the Western Aphasia Battery (WAB) [18], which was translated and adapted to Danish for the present study by two of the authors [19]. This part of WAB assesses fluency and information content of speech, naming, comprehension and repetition. It is sufficient to determine the type of aphasia according to the Boston classification, and it yields a measure of severity of aphasia, the Aphasia Quotient (AQ), ranging from 0 to 100, with scores above 93.8 being considered normal (nonaphasic). The original cut-off score was retained after a study of 21 normal elderly individuals (mean age 73 years), all of whom scored above the cut-off [19].

The initial assessment was carried out on the ward as soon as possible after admission, in most cases within the first week after stroke onset (median 4 days, mean 7.3 days, SD 11.2). Those patients who had aphasia on admission were contacted about 1 year later if they were still alive and residing in the vicinity of Copenhagen. This assessment was carried out after a median interval of 385 days after stroke onset (mean 406.8 days, SD 76.1).

One year after stroke, most patients were additionally assessed with the second part of the WAB comprising reading and writing and the third part comprising nonverbal tests (Apraxia; Drawing; Block design; Calculation; and Ravens Coloured Matrices).

Assessment of neurological severity was not routinely done in all visited departments, but an acute Scandinavian Stroke Scale score (SSS ranging from 0 to 58 points [20, 21]) was available for a subset of the patients. In order to look at the neurological severity of the stroke without the influence of language impairment, we made a modified total score for the SSS excluding the speech and orientation items (ranging from 0 to 42 points).

*Statistics*

All statistical analyses were carried out with the SPSS for Windows version 10 computer program. The relationships of categorical variables were analyzed with the $\chi^2$ test and for continuous variables with Pearson's r. Differences in means for two independent groups were analyzed with Student's t test, and for more than two groups with the one-way ANOVA. The relative importance of potential predictors of aphasia outcome was analysed with multiple linear and logistic regression analysis with backward removal of insignificant variables. The level for statistical significance was set to 0.05 for all tests. NS designates nonsignificant differences.

## Results

*Aphasia on Admission*

Case notes for 488 patients fulfilling the inclusion criteria were reviewed. Aphasia was found for 270 on the WAB. Ninety-two had full remission before the test was carried out. Additionally, 126 patients had to be excluded for the following reasons: 40 had impaired consciousness, 27 showed to have pure dysarthria, 4 died, 2 were discharged before the assessment could be carried out, 27 could not cooperate for various reasons including severe hearing impairment, 10 were in a severe somatic condition precluding assessment, 5 refused to participate, and 11 could not be assessed for other reasons (e.g., transfer to other hospital).

There was no difference in initial mean AQ for aphasic stroke patients included from the three hospitals (Bispebjerg n = 178, mean AQ 42.6, SD 33.9; Hvidovre n = 50, mean AQ 42.7, SD 33.5; Frederiksberg n = 42, mean AQ 43.4, SD 31.8; F = 0.008, NS). 37 of the patients from Frederiksberg Hospital and Hvidovre Hospital were included before the opening of their stroke units. Mean age, mean AQ and male-female ratio of these 37 patients were

**Table 1.** Type and severity of aphasia on admission

| | All patients[1] | | | | | | Patients with first-ever strokes[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | AQ | | males % | age | | n | AQ | | males % | age | |
| | | mean | SD | | mean | SD | | mean | SD | | mean | SD |
| All aphasic patients | 270 | 42.8 | 33.4 | 42 | 75.8 | 10.4 | 203 | 42.0 | 32.8 | 41 | 75.4 | 11.0 |
| Global | 86 (32%) | 4.8 | 7.1 | 34 | 76.6 | 10.0 | 65 (32%) | 5.3 | 7.4 | 32 | 75.9 | 10.1 |
| Broca's | 33 (12%) | 30.7 | 17.8 | 42 | 74.6 | 9.5 | 25 (12%) | 29.1 | 15.1 | 40 | 74.7 | 9.1 |
| Isolation | 4 (1%) | 40.0 | 5.9 | 25 | 85.8 | 5.9 | 3 (2%) | 39.9 | 7.2 | 33 | 87.3 | 6.1 |
| Transcortical motor | 5 (2%) | 57.5 | 11.6 | 0 | 75.6 | 12.7 | 4 (2%) | 56.7 | 13.3 | 0 | 80.3 | 8.4 |
| Wernicke's | 41 (15%) | 42.0 | 17.4 | 46 | 75.3 | 12.0 | 32 (16%) | 41.4 | 17.8 | 44 | 75.6 | 13.3 |
| Transcortical sensory | 16 (6%) | 69.8 | 8.0 | 63 | 75.0 | 8.3 | 14 (7%) | 69.9 | 8.3 | 57 | 74.9 | 8.5 |
| Conduction | 13 (5%) | 65.2 | 65.2 | 31 | 71.2 | 17.0 | 10 (5%) | 63.8 | 9.3 | 40 | 69.9 | 19.3 |
| Anomic | 72 (27%) | 83.1 | 83.1 | 49 | 76.1 | 9.3 | 50 (25%) | 83.3 | 7.9 | 50 | 75.1 | 9.8 |

not significantly different from the 233 stroke unit patients.

112 (42%) of the 270 included patients were male. A CT-verified diagnosis was available for 228 patients: 205 (90%) had infarcts, 21 (9%) had intracerebral hematomas and 2 (1%) had subdural hematomas. 67 (25%) had a previous stroke and 23 (9%) had previous aphasia. We were able to determine handedness for 125 patients without a previous stroke. Crossed aphasia was found in 5 left-handed patients with left-sided stroke lesions and in 2 right-handed patients with right-sided stroke lesions.

Table 1 shows the types and severities of aphasia in the 270 patients with aphasia on admission. Severe aphasia (AQ 0 to 31.2) was found in 119 (44%). Moderate aphasia (AQ 31.3 to 62.5) was found in 52 (19%). Slight aphasia (AQ 62.6 to 93.7) was found in 99 (37%). Table 1 also shows data for patients with first-ever strokes. In these patients, severe aphasia was found in 92 (45%), moderate aphasia was found in 41 (20%), and slight aphasia was found in 70 (35%). The following analyses include only patients with first-ever strokes.

Upon univariate analysis, severity of aphasia (AQ) on admission was not associated with age of the patient ($r = -0.03$, NS), but the aphasia was more severe in women (AQ 37.7 SD 32.3) than in men (AQ 48.2, SD 32.97, $t = 2.3$, $p = 0.02$). Global, Broca's, transcortical motor, and isolation aphasia are non-fluent aphasias, and transcortical sensory, Wernicke's and anomic aphasia are fluent aphasias. There was no significant age difference between patients with nonfluent aphasia (76.1 years, SD 9.9) and patients with fluent aphasia (74.7 years, SD 11.9, $t = 0.9$, NS). Males had a lower frequency of nonfluent aphasia (38.6%) than was the case for women (54.2%, $\chi^2 = 4.8$, $p = 0.03$). Non-fluent aphasia was associated with a much lower AQ (14.6, SD 17.5) than fluent aphasia (AQ 67.0, SD 21.6, $t = -18.8$, $p < 0.001$). In order to leave out patients with very mild or very severe aphasia, we also analyzed a subset of 74 of the patients – those who had either Broca's or Wernicke's aphasia. No significant sex difference was found in that analysis: 41.7% of the males had Broca's aphasia compared to 45.5% of the females ($\chi^2 = 0.1$, NS). There was also no significant difference in age between patients with Broca's (mean age 74.7 years, SD 9.1) and patients with Wernicke's aphasia (mean age 75.6 years, SD 13.3, $t = -0.3$, NS).

The mean SSS score in 84 patients was 30.5 (SD 15.0). The mean neurological severity (total SSS score excluding speech and orientation) in 82 patients was 23.4 (SD 9.3). There was a significant association between neurological severity and AQ ($r = 0.53$, $p < 0.001$). Stroke severity was not significantly different between women (mean 22.8, SD 9.2) and men (mean 24.4, SD 9.6, $t = 0.78$). A multiple linear regression analysis was carried out with AQ as the dependent variable, and sex, age and the neurological severity (modified SSS) as the independent variables. The resulting model explained 27% of the variance in the AQ (adjusted $r^2$) and included neurological severity but neither sex nor age.

*Aphasia 1 Year after Stroke*

73 died within the first year, 13 had a new stroke, 11 moved away from the Copenhagen area and 42 refused to participate. For 11 of these, we were informed that they had full remission of the aphasia; 6 were then clearly demented. Other obstacles precluded the participation of a further 14 patients. Finally, 8 patients were unable to do

**Table 2.** Type and severity of aphasia one year after stroke

| | All patients[1] | | | | | | First-ever strokes[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | AQ | | males % | age | | n | AQ | | males % | age | |
| | | mean | SD | | mean | SD | | mean | SD | | mean | SD |
| No aphasia | 41 (37%) | 96.3 | 1.5 | 51 | 74.0 | 12.6 | 33 (39%) | 96.2 | 1.5 | 52 | 73.5 | 13.5 |
| All aphasic patients | 71 (63%) | 72.4 | 30.8 | 38 | 75.9 | 9.4 | 51 (61%) | 59.4 | 30.9 | 29 | 75.5 | 9.2 |
| Global | 8 (7%) | 10.7 | 8.8 | 50 | 75.9 | 9.2 | 6 (7%) | 11.8 | 9.4 | 50 | 74.2 | 10.1 |
| Broca's | 16 (14%) | 30.9 | 13.5 | 44 | 71.3 | 11.6 | 11 (13%) | 30.0 | 11.8 | 18 | 71.3 | 11.8 |
| Isolation | 0 | – | | – | – | | 0 | – | | – | – | |
| Transcortical motor | 2 (2%) | 62.6 | | 50 | 62.5 | 3.5 | 1 (1%) | 71.7 | | 0 | 60.0 | |
| Wernicke's | 6 (5%) | 35.2 | 12.1 | 33 | 81.7 | 5.8 | 4 (5%) | 35.9 | 14.1 | 50 | 82.5 | 5.5 |
| Transcortical sensory | 1 (1%) | 59.9 | | 0 | 82.0 | – | 0 | – | | – | – | |
| Conduction | 6 (5%) | 72.5 | 16.0 | 33 | 79.7 | 8.5 | 5 (6%) | 71.9 | 17.8 | 40 | 78.4 | 8.8 |
| Anomic | 32 (29%) | 86.7 | 7.0 | 34 | 77.0 | 8.0 | 24 (29%) | 85.6 | 7.6 | 25 | 76.5 | 7.2 |

1 Including 9 patients unable to cooperate with the assessment on admission.
2 Including only patients able to cooperate with the assessment on admission.

**Table 3.** Mortality in aphasic patients

| | Deceased | Mortality, % |
|---|---|---|
| All aphasic patients | 54 | 27 |
| Global | 22 | 34 |
| Broca's | 4 | 16 |
| Isolation | 2 | 67 |
| Transcortical motor | 2 | 50 |
| Wernicke's | 8 | 25 |
| Transcortical sensory | 4 | 29 |
| Conduction | 1 | 10 |
| Anomic | 11 | 22 |

the test. Thus 103 of the patients could be reassessed. 65 (60%) were still aphasic. Out of 84 with first-ever strokes, 51 (61%) were still aphasic. In addition to the first part of the WAB, 35 patients were assessed with the reading part of the WAB, 34 patients were assessed with the writing part of the WAB, and 33 patients were assessed with non-verbal tests from the WAB.

Table 2 shows (1) the type and severities of aphasia in the 112 patients assessed 1 year after stroke, including 9 patients who were unable to cooperate with the test on admission, and (2) 84 with first-ever strokes, including only patients able to cooperate with the assessment on admission. The following analyses include exclusively first-ever stroke patients able to cooperate on admission unless otherwise indicated. Table 3 shows the mortality. The 54 deceased patients had a nonsignificant tendency towards a lower AQ on admission (35.2, SD 32.9) than the 84 surviving and reassessed patients (42.8, SD 32.3, t = 1.8, NS). Figure 1 shows a scattergram of the AQs on admission and at 1 year with a regression line. Only one patient had deteriorated (a 78-year-old right-handed woman), and there was a wide range of outcomes even for patients with initial AQs in the lowest end. The regression formula is initial AQ = 45.3 + 0.65 AQ at 1 year. $R^2$ for the regression line is 0.47.

In order to find the variables in acute stroke that will predict language outcome, a multiple linear regression analysis was performed with AQ at one year as the dependent variable and the following admission variables: AQ, neurological stroke severity (modified SSS), age, and sex as the independent variables. The resulting model explained 60% ($R^2$) of the variation in the 1-year AQ and included initial AQ and neurological stroke severity, but neither sex nor age.

Table 4 shows the change in type of aphasia during the first year. For those patients, who did not fully recover, any change in type of aphasia was always to a milder form, and while some patients changed from a nonfluent to a fluent type, the reverse did not happen. It should be noted that even patients with global aphasia on admission might fully recover their language function.

In order to compare the remission of different types of aphasia, we analyzed the three frequent types of aphasia with initial mean scores well below maximum: global, Broca's and Wernicke's with a one-way ANOVA. No sig-

**Table 4.** Change in type of aphasia in survivors

| Admission | Global | Broca's | Isolation | Trans. mot. | Wernicke's | Trans.sens. | Conduction | Anomic | No aphasia |
|---|---|---|---|---|---|---|---|---|---|
| Global | 6 (22%) | 10 (35%) | | | 2 (7%) | | | 6 (22%) | 4 (15%) |
| Broca's | | 2 (18%) | | 1 (9%) | | | | 4 (36%) | 4 (36%) |
| Isolation | | | | | | | | | – |
| Trans.mot. | | | | | | | | 1 (100%) | 0 |
| Wernicke's | | | | | 2 (18%) | | 4 (36%) | 3 (27%) | 2 (18%) |
| Trans.sens. | | | | | | | | 1 (17%) | 5 (83%) |
| Conduction | | | | | | | 1 (14%) | 1 (14%) | 5 (71%) |
| Anomic | | | | | | | | 8 (38%) | 13 (62%) |

Trans. mot = Transcortical motor aphasia; Trans. sens. = transcortical sensory aphasia.

nificant between-groups difference in AQ-gain was found.

One year after stroke, the severity of aphasia (AQ) was still not associated with age of the patient (r = –0.02, NS), and the sex difference in aphasia severity had decreased and become insignificant. Mean AQ for men was 60.5, SD 31.4 and for women 60.3, SD 31.2 (t = –0.01, NS). No significant sex difference was found in scores on any WAB subtest for patients with aphasia 1 year after stroke; thus, the sex difference in fluency had also decreased to insignificance (table 5). Nonfluent patients had a much lower mean AQ (26.2, SD 17.7) than fluent patients (77.5, SD 19.3, t = –9.4, $p < 0.001$).

One year after stroke 33.3% of the males and 36.1% of the females had a nonfluent aphasia ($\chi^2$ = 0.04, NS). However, nonfluent patients were then significantly younger (71.6 years, SD 11.1) than fluent patients (77.6 years, SD 7.3, t = –2.3, p = 0.03). A logistic regression analysis was performed with fluency as the dependent variable and sex, age, and sex × age (interaction) as the independent variables. Only age contributed significantly to the correct classification (68.6% were correctly classified).

At this time, there was no significant difference either in the sex distribution between patients with Broca's and Wernicke's aphasia (when including patients with prior strokes and patients uncooperative on admission to obtain sufficient power in the analyses). Seven male patients and 9 female patients had Broca's aphasia; 2 male patients and 4 female patients had Wernicke's aphasia ($\chi^2$ = 0.2, NS). A difference in mean age between patients with Broca's and Wernicke's aphasia was very close to being significant. Sixteen patients with Broca's aphasia had a mean age of 70.3 years (SD 11.6), 6 Wernicke's patients had a mean age of 80.7 years (SD 5.8, t = –0.21, p = 0.051).

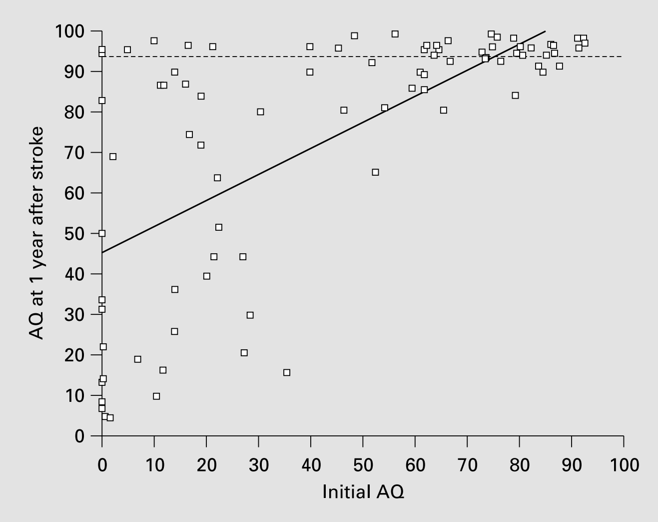


**Fig. 1.** Scattergram of the AQ on admission and at 1 year after stroke with regression line and a reference line for the Y-axis indicating a cut-off score for aphasia of 93.8.

There were no obvious differences in improvement for the different parts of WAB (gain percentages ranged from 54% for comprehension to 78% for naming). There was, however, much more inconsistency in the improvement of repetition (r = 0.38) than in other parts of the WAB (r ranging from 0.62 to 0.67).

Global aphasia may occasionally be associated with a relatively good – although not normal – nonverbal functioning, as demonstrated by 1 patient with global aphasia who obtained a score of 29 (out of a maximum of 37) in Raven Coloured Matrices. The best Raven score obtained by patients with Broca's aphasia, Wernicke's and anomic aphasia was 28, 19 and 34, respectively.

**Table 5.** Scores on WAB subtests 1 year after stroke for patients with aphasia at this time

| | Males | | | Females[1] | | | All patients | | |
|---|---|---|---|---|---|---|---|---|---|
| | n | mean | SD | n | mean | SD | n | mean | SD |
| Fluency (0–10) | 15 | 6.2 | 3.6 | 36 | 6.1 | 3.4 | 51 | 6.1 | 3.4 |
| Information (0–10) | 15 | 5.9 | 3.4 | 36 | 5.7 | 3.5 | 51 | 5.7 | 3.5 |
| Spontaneous speech (0–20) | 15 | 12.1 | 6.9 | 36 | 11.8 | 6.6 | 51 | 11.8 | 6.6 |
| Comprehension (0–10) | 15 | 6.4 | 3.1 | 36 | 7.4 | 2.8 | 51 | 7.1 | 2.9 |
| Repetition (0–10) | 15 | 5.8 | 3.3 | 36 | 6.7 | 6.8 | 51 | 6.4 | 6.0 |
| Naming (0–10) | 15 | 5.4 | 3.4 | 36 | 4.9 | 3.6 | 51 | 5.0 | 3.5 |
| Aphasia quotient (0–100) | 15 | 59.5 | 31.4 | 36 | 59.4 | 31.2 | 51 | 59.4 | 30.9 |
| Reading (0–10) | 11 | 6.2 | 3.4 | 24 | 5.6 | 3.2 | 35 | 5.8 | 3.2 |
| Writing (0–10) | 11 | 5.0 | 3.3 | 23 | 3.1 | 2.9 | 34 | 3.7 | 3.1 |
| Apraxia (Praxis, 0–10) | 10 | 7.5 | 2.9 | 23 | 7.0 | 3.0 | 33 | 7.1 | 2.9 |
| Drawing (0–30) | 10 | 16.2 | 7.7 | 23 | 14.1 | 7.8 | 33 | 14.7 | 7.7 |
| Block design (0–9) | 10 | 5.3 | 2.6 | 23 | 5.1 | 2.9 | 33 | 5.2 | 2.8 |
| Calculation (0–24) | 10 | 17.9 | 5.6 | 22 | 14.5 | 6.9 | 32 | 15.6 | 6.6 |
| Raven coloured matrices (0–37) | 10 | 20.1 | 6.4 | 21 | 16.9 | 8.1 | 31 | 17.9 | 7.7 |
| Construction score (0–10)[2] | 10 | 5.9 | 1.9 | 21 | 5.2 | 1.9 | 31 | 5.5 | 1.9 |
| Cortical quotient (0–100) | 10 | 68.3 | 24.1 | 20 | 59.0 | 26.1 | 30 | 62.1 | 25.4 |

1 No significant sex-differences were found for any score.
2 Includes drawing, block design, calculation and Raven Coloured Matrices.

## Discussion

The present study prospectively and consecutively included patients with acute aphasic stroke from three hospitals in Copenhagen, Denmark, with well-defined catchment areas owing to the public and free Danish health care system. However, during the study period, all patients were not admitted to stroke or neurological departments and, thus, some patients had to be traced on wards of general medicine. In spite of this limitation, our population is probably considerably less biased in selection than those of any previous study describing initial type of aphasia and its evolution during recovery. The sample found at the stroke unit of Bispebjerg Hospital (where all patients with acute stroke were admitted to the stroke unit during the entire study period) may be considered a community-based sample as 88% of all stroke patients are hospitalized in the Copenhagen area [22]. The mean AQ found in the other two hospitals did not differ from the mean AQ found at Bispebjerg.

The WAB aphasia classification employed in this study does not allow for unclassified or mixed aphasia, and this may be considered a weakness. However, we decided to use its original classification system because its reliability and validity have been well described and because it allows our results to be compared with those of other studies.

### *Type and Severity of Aphasia on Admission*

The two major classic types of aphasia – Broca's and Wernicke's – were altogether found in only a quarter of the acute aphasic stroke patients. This might seem surprising, but it is – in spite of differences in sampling – quite close to previous findings (table 6). Two studies [6, 10] employed the same test and classification method as the present study, but Kertesz and Sheppard [6] probably assessed the patients somewhat later after stroke. Pashek and Holland [4] employed the same test and did the testing at about the same time after stroke as in the present study, but used another method for classification. The tendency to less severe types of aphasia in Kertesz and Sheppard's sample [6] is expected due to the somewhat later testing. The sample presented by Pashek and Holland [4] has a tendency towards more severe forms of aphasia, but is not totally comparable because of another classification method. Only Kauhanen et al. [10] found a higher percentage of Wernicke's aphasia (but a corresponding lower percentage of the other fluent types: conduction and transcortical sensory aphasia). From the data, it seems quite safe to assume that 30–40% of stroke patients assessed within the first week will have global aphasia, about 12% will have Broca's aphasia, and about 15% will have Wernicke's aphasia. The frequency of anomic aphasia is more uncertain.

**Table 6.** Type of aphasia in acute and subacute stroke compared with previous studies

| | Kertesz and Sheppard [6] (1981) | Pashek and Holland [4] (1988) | Kauhanen et al. [10] (2000) | Present study |
|---|---|---|---|---|
| Patients | 192[1] | 43[2] | 31[3] | 119[4] |
| Global, % | 20 | 40 | 26 | 36 |
| Broca's, % | 18 | 12 | 13 | 11 |
| Isolation, % | 2 | 0 | 0 | 2 |
| Transcortical motor, % | 4 | 2 | 6 | 2 |
| Wernicke's, % | 12 | 16 | 29 | 14 |
| Transcortical sensory, % | 8 | 2 | 3 | 5 |
| Conduction, % | 9 | 7 | 0 | 5 |
| Anomic, % | 28 | 9 | 23 | 25 |
| Unclassifiable, %[5] | | 12 | | |

[1] Seen within 45 days.
[2] Seen within 5 days.
[3] Seen after a median interval of 3 days after the stroke.
[4] First-ever stroke, subset seen within 5 days.
[5] All the studies employed the Western Aphasia Battery, but Pashek and Holland [4] did not use its actuarial taxonomy for determination of type of aphasia. The Western Aphasia Battery classification does not have an 'unclassifiable' category.

The severity of aphasia expressed by the AQ is a bit higher in the present study compared to Kertesz and Sheppard [6], which fits well with time of testing. The subtest score distribution is very comparable across the two studies.

*Changes in Aphasia Associated with Recovery*

61% of the patients still had aphasia 1 year after stroke, but usually in a milder form. The change in aphasia from admission to 1 year later was always a progression to a 'milder' type of aphasia. Moreover, the change was always from nonfluent to fluent, never the reverse. This finding is in accord with previous findings [4, 9, 10]. It is interesting to note that most of the patients with Broca's aphasia 1 year after stroke had global aphasia on admission. Thus, most patients with global aphasia on admission are later what is usually considered good candidates for speech therapy. It is, accordingly, necessary to exercise great care not to announce a grave prognosis with great certainty to the relatives of the acute stroke patient with global aphasia.

*Improvement in Speech and Comprehension*

A related question is whether there is more improvement in comprehension than in spontaneous speech and naming with the remission of aphasia. Two previous studies have found more improvement in comprehension than in speech [23, 24], whereas three other studies have not [25–27], and the evidence now favors the view that the extent of recovery is similar for comprehension and spontaneous speech and naming. Improvement in repetition ability was much more varied than was the case for impairments of other language functions, a phenomenon that seems hard to explain.

*Determinants of Initial Severity and Type*

*Sex.* A univariate sex difference in aphasia severity was found on admission, women having more severe aphasia than men. However, when included in a multiple regression analysis also including stroke severity, sex was no longer a significant determinant of AQ. After early findings of less severe aphasia in women than in men [28, 29], a considerable number of well-designed studies have since failed to confirm a sex difference in aphasia severity [2]. We also found a higher frequency of nonfluent aphasia in females, which is to be expected as nonfluent aphasia is associated with lower AQ (as global aphasia is included here). No sex difference was found comparing Broca's and Wernicke's aphasia. Two previous studies found more nonfluent aphasia in males [3, 12], two studies found no sex difference in distribution of type of aphasia [6, 14], and one study found no sex difference in the frequency of global aphasia [5]. There was, however, no control for age and stroke severity in these studies. Finally, Godefroy et al. [7] found no influence of sex on the distribution of type of aphasia in general.

*Age.* Generally, whether age differences are found between fluent and nonfluent aphasia or Broca's and Wernicke's aphasia [3, 6, 11–14, 16, 25, 30, 31] depends on time after stroke, as has been noted by Code and Rowley [15]. In the present study, we also found an age difference 1 year after stroke, but not in acute stroke. Code and Rowley [15] suggest that the evolution in type of aphasia explains the difference. As a number of patients evolve from nonfluent to fluent aphasia (e.g., global to Wernicke's or Broca's to anomic), this is certainly possible. It might be fair to claim that the 'true' type of aphasia is masked by a temporary nonfluency in the acute patient. This may be caused by diaschisis and the 'penumbra' phenomenon – neurons temporarily not functioning but surviving with collateral blood supply.

Another question is why there is an age difference in fluency in chronic aphasia. One hypothesis is 'continuing lateralization' – that comprehension continues to be still more lateralized with increasing age [15]. Another possible explanation takes the biological basis for the recovery process into account. It might be that comprehension, to a larger degree than is the case for speech, may be taken over by other parts of the left hemisphere or by the right hemisphere; and such plasticity might diminish in high age. Finally, a recent study has explained this finding with observation of a larger proportion of posterior infarcts in elderly patients [16]. A quite different possible explanation worth future studies is that some elderly patients may have early and undetected Alzheimer's disease impairing the semantic system, endowing a stroke-caused aphasia with Wernicke's aphasia-like qualities.

Code and Rowley [15] found an interaction of age and sex such that the age difference in fluency only held up for males. We found a similar tendency in the univariate analyses. It is, however, statistically not sufficient to find a statistical test significant for one sex and another statistical test insignificant for the other sex. All variables need to be included in the same analysis in order to analyze the possible effect of the sex difference. In such an analysis, we found no effect of sex on fluency. Only age was significant.

### *Determinants of Recovery*

*Initial Severity.* Numerous studies have shown initial severity of aphasia to be far more important for the final outcome of aphasia than any other factor [2, 9, 13, 23, 26, 32–36]. While there is a very strong relationship between severity on acute admission and final outcome, the relation is not strong enough for individual prognosis until the second to fourth week [2, 13]. The present study confirmed the strong relationship between initial severity and outcome, but also found that the inclusion of neurological stroke severity on admission improved the accuracy of the prognosis of aphasia, as we have previously found with another assessment procedure for aphasia and another population of stroke patients [2]. The need to be cautious with early individual prognosis is amply illustrated by figure 1 which shows that a number of patients with very low initial AQs ended up in the normal or nearly normal range. Enderby et al. [34] found a similar rather fixed degree of improvement unaffected by initial severity within the first 3 months after stroke. We found that the slope of the regression line showed slightly lesser gains with increased initial score.

*Type of Aphasia.* Previous studies do not agree on whether the gain in language function during recovery depends on the type of aphasia. Kertesz and McCabe [9] found the lowest recovery rates in untreated global aphasia and in anomic aphasia and the highest recovery rates in Broca's and conduction aphasia. Sarno and Levita [37] found no clear differences in recovery, but a tendency for patients with fluent aphasia to have the major part of their recovery earlier than was the case for patients with global and nonfluent aphasia. Demeurisse et al. [26] found no difference between Broca's and Wernicke's aphasia, but found less recovery in global aphasia. Finally, two studies of patients selected as controls [13] or for speech therapy [33] found no effect of type of aphasia on recovery. The analysis of this problem is somewhat difficult as different types of aphasia are associated with different levels of AQ. Thus, the types of aphasia associated with higher mean AQs leave less room for improvement. We did two types of analyses to compensate for this and found no effect of type of aphasia on improvement in AQ in either case.

*Sex.* We found no sex difference in recovery of aphasia. This is in line with most previous studies: Four studies found no influence of sex on recovery in aphasia [2, 9, 13, 34], while a single study found a slightly better improvement in males [38].

*Age.* Most previous studies found no influence of age on recovery of aphasia [2, 38–40]. Curiously, one study group found an influence of age on treated [33] but not on untreated patients [13]. Finally, one study found an influence of age [35], and one study found a nonsignificant tendency towards an age influence [9]. The present study did not find any influence of age on recovery and is thus in accord with most previous studies.

## Conclusion

This study confirms the dramatic but also quite variable extent of recovery of language seen in aphasic stroke patients. There is an orderly progression in type of aphasia, but the initial type of aphasia does not predict the degree of recovery beyond its association with aphasia severity. Neither age nor sex predicts the degree of remission. Beyond the initial severity of aphasia, the only useful variable to improve prediction is the general stroke severity.

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