PAPER

Influence of cognitive impairment on the institutionalisation rate 3 years after a stroke

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Background and purpose: Pre-existing cognitive decline and new-onset dementia are common in patients with stroke, but their influence on institutionalisation rates is unknown.
Objective: To evaluate the influence of cognitive impairment on the institutionalisation rate 3 years after a stroke.
Design: (1) The previous cognitive state of 192 consecutive patients with stroke living at home before the stroke (with the Informant Questionnaire on COgnitive Decline in the Elderly (IQCODE)), (2) new-onset dementia occurring within 3 years and (3) institutionalisation rates within 3 years in the 165 patients who were discharged alive after the acute stage were prospectively evaluated.
Results: Independent predictors of institutionalisation over a 3-year period that were available at admission were age (adjusted odds ratio (adjOR) for 1-year increase = 1.08; 95% confidence interval (CI) 1.03 to 1.15), severity of the neurological deficit (adjOR for 1-point increase in Orgogozo score = 0.97; 95% CI 0.96 to 0.99) and severity of cognitive impairment (adjOR for 1-point increase in IQCODE score = 1.03; 95% CI 1 to 1.06). Factors associated with institutionalisation at 3 years that were present at admission or occurred during the follow-up were age (adjOR for 1-year increase = 1.17; 95% CI 1.07 to 1.27) and any (pre-existing or new) dementia (adjOR = 5.85; 95% CI 1.59 to 21.59), but not the severity of the deficit of the neurological deficit.
Conclusion: Age and cognitive impairment are more important predictors of institutionalisation 3 years after a stroke than the severity of the physical disability.

Institutionalisation after a stroke increases with the severity of the neurological deficit, increasing age, female gender, low socioeconomic level, marital status and poor social environment.[1–6]

Dementia is common after a stroke,[7] leading to autonomy loss.[8] Pre-existing dementia is present in up to 16% of patients with stroke,[9–12] and post-stroke de mentia (PSD) occurs in up to one third.[7] Several studies have found a link between cognitive impairment and institutionalisation after a stroke,[1–5] but they had several methodological limitations: (1) cross-sectional studies were performed in long-term stroke survivors and did not take into account patients who had been institutionalised but died before the study[6]; (2) there was no systematic cognitive assessment[13] or only a Mini Mental State Examination,[14] which is not appropriate for patients with stroke; and (3) most studies included only patients recruited in rehabilitation centres, leading to selection bias.[1–5] To our knowledge, no study has prospectively evaluated the influence of pre-existing cognitive impairment and PSD on the institutionalisation rate after a stroke.

The aim of this study was to evaluate the influence of the previous cognitive state and new-onset dementia on the institutionalisation rate 3 years after a stroke.

PATIENTS AND METHODS

This study is an ancillary one of the Lille Stroke/Dementia study.[9 15 16] Consecutive ischaemic and haemorrhagic patients with stroke admitted as emergency patients between November 1995 and March 1996 to the stroke unit of the Lille University Hospital were eligible, provided that they were fluent French speakers and had a reliable informant. Inclusion and exclusion criteria have been detailed elsewhere.[9 15 16] For the purpose of this study, we excluded patients who were already institutionalised.

At admission, we assessed stroke severity by the Orgogozo's Rating Scale,[17] a scale that was widely used in France before the National Institute of Health Stroke Scale progressively replaced it: a score of 0 means a severe deficit and 100 no deficit. From the computed tomography scan performed at admission, we determined the presence of (1) silent infarcts using the criteria of Mounier-Vehier *et al*,[18] (2) leucoaraiosis according to the method of Blennow *et al*,[19] and (3) brain atrophy according to the method of Leys *et al*.[20] More details of analysis of leucoaraiosis[21] and atrophy [22 23] have already been given in previous studies on the same cohort. We defined ischaemic stroke subtypes according to the TOAST (Trial of Org 10172 in Acute Stroke Treatment) criteria.[24] We recorded with whom patients were living before the stroke. We evaluated the pre-existing cognitive status with the Informant Questionnaire on COgnitive Decline in the Elderly (IQCODE),[25] The IQCODE is a questionnaire administered to a close relative who should have known the patient for at least 10 years and met him or her at least once a week. It consists of 26 questions investigating whether any change has occurred in the patient over the past 10 years in aspects of daily behaviour requiring memory and other intellectual abilities. Each item can be scored from 1 to 5 (1, has become much better; 2, has become a bit better; 3, has not changed; 4, has become a bit worse; and 5, has become much worse). The global score ranges from 26 to 130 points. The cut-off for the diagnosis of pre-existing dementia is 104.[25] Delirium was defined according to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition criteria,[26] and symptoms were evaluated with the Delirium Rating Scale.[27]

Abbreviations: adjOR, adjusted odds ratio; IQCODE, Informant Questionnaire on COgnitive Decline in the Elderly; mRS, modified Rankin Scale; PSD, post-stroke dementia

We assessed the outcome by the modified Rankin Scale (mRS).[28]

Patients were followed up at 6, 12, 24 and 36 months. When they could attend the follow-up visit, we performed a global examination of cognitive functions with the Mattis Dementia Rating Scale,[29] evaluated the functional outcome with the mRS[28] and diagnosed dementia with the International Classification of Diseases, 10th revision criteria.[30] In patients with aphasia, impairment in non-verbal memory was required to diagnose dementia. When patients could not attend the follow-up visit, we organised an interview with the family or with the general practitioner to obtain reliable information on the residential status of the patient and their cognitive status: for these patients the diagnosis of dementia was based on an IQCODE score[25] $\geqslant$104 during follow-up.

The first step of the statistical analysis consisted of an evaluation of the risk of institutionalisation within 3 years, by a life-table method. Candidate variables available at admission were assessed using the log-rank test (Kaplan–Meier analysis). We used Cox proportional hazards to determine independent predictors of institutionalisation; for this analysis, we used IQCODE values.

The second step of the statistical analysis consisted of a cross-sectional comparison between patients institutionalised and the remainder at 3 years, for all variables available at admission and for those collected during the follow-up (χ^2 test with Yate's correction or Fisher's exact test; odds ratio (OR) with 95% confidence interval (CI); and Mann–Whitney U test), and a logistic regression analysis with ''institutionalisation at 3 years'' as dependent variable; for this analysis, the term ''dementia'' included all dementias—that is. pre-existing dementia and dementia occurring after a stroke. At each step, $p<0.05$ was regarded as significant, and only variables associated with institutionalisation with $p<0.20$ in the bivariate analysis were included in the model. All analyses were computed using the SPSS V11.5 for windows package.

This study was approved by the ethics committee of Lille University Hospital for the assessment and follow-up of patients. The ethics committee did not allow investigation of demographic, socioeconomic and medical characteristics of the family members.

RESULTS

Of 192 patients who met the inclusion criteria, 27 died at the acute stage. Therefore, the study population consisted of 165 patients; table 1 lists their baseline characteristics.

Table 2 gives in detail the living arrangements at discharge and at 3 years. At –3 years, 54 patients were dead, and one patient, still alive, was lost to follow-up.

Among the 165 patients, 19 were institutionalised within 3 years. Tables 3 and 4 give in detail the factors available at admission that were associated with institutionalisation within 3 years in the bivariate analysis.

The logistic regression analysis found age (adjOR for 1-year increase = 1.08; 95% CI 1.03 to 1.15), IQCODE scores (adjOR for 1-point increase = 1.03; 95% CI 1 to 1.06) and Orgogozo's scores (adjOR for 1-point increase = 0.97; 95% CI 0.96 to 0.99) as independent predictors of institutionalisation available at onset.

At 3 years, 18 of 110 survivors were institutionalised. Twenty seven patients had dementia. The logistic regression analysis aimed to identify variables (available at onset or during the follow-up) associated with institutionalisation at 3 years found increasing age (adjOR for 1-year increase = 1.17; 95% CI 1.07 to 1.27) and any dementia at 3 years (adjOR = 5.85; 95% CI 1.59 to 21.59; r^2 0.510; prediction of the model: 85.45%), but neither mRS at discharge nor Orgogozo's scores at admission or at discharge.

Table 1 Baseline characteristics of the study population (n = 165)

Demographic characteristics	
Age*	73 (42–100)
Male†	84 (50.9)
Level of education <8 years†	131 (79.4)
Medical history	
Previous stroke†	23 (13.9)
IQCODE score*	81 (78–128)
Pre-existing dementia†	16 (9.7)
Stroke characteristics	
Primary cerebral haemorrhage†	15 (9.1)
Cerebral infarct†	150 (90.9)
Atherothrombotic infarct†	23 (13.9)
Cardioembolic infarct†	38 (23)
Lacunar infarct†	34 (20.6)
Other determined causes of infarcts†	4 (2.4)
Infarcts of undetermined origin†	51 (30.9)
Right hemisphere strokes†	61 (37)
Left hemisphere strokes†	86 (52.1)
Posterior fossa strokes†	22 (13.3)
CT scan findings at admission	
Leucoaraiosis score*	1 (0–3)
Cerebral atrophy score*	1 (0–3)
Presence of one silent infarct or more†	42 (25.5)

*Median (range). †Number of patients (%)
CT, computed tomography; IQCODE.

DISCUSSION

Our study showed that: (1) predictors of institutionalisation within 3 years of a stroke, available at admission, were increasing age, increasing severity of the neurological deficit, and increasing IQCODE scores at admission; and (2) increasing age and dementia (pre-existing or new) were independently associated with institutionalisation at 3 years.

This is the first study that has prospectively evaluated the influence of cognitive functions before and after a stroke on institutionalisation within 3 years of the stroke. However, this

Table 2 Living arrangements of patients at discharge from the stroke unit and at 3 years, according to their social environment before the stroke

	At discharge	Year 3
All patients	n = 165	n = 110
At home	75 (45.4%)	92 (83.6%)
Rehabilitation	45 (27.3%)	0 (0%)
Convalescence department	30 (18.2%)	0
Institution	2 (1.2%)	18 (16.4%)
Other medical or surgical departments	13 (7.9%)	0 (0%)
Patients living with spouse before	n = 91	n = 64
At home	50 (54.9%)	59 (92.2%)
Rehabilitation	32 (35.2%)	0 (0%)
Convalescence department	5 (5.5%)	0 (0%)
Institution	0 (0%)	5 (7.8%)
Other medical or surgical departments	4 (4.4%)	0 (0%)
Patients living with children before	n = 20	n = 11
At home	7 (35%)	9 (81.8%)
Rehabilitation	2 (10%)	0 (0%)
Convalescence department	9 (45%)	0 (0%)
Institution	0 (0%)	2 (18.2%)
Other medical or surgical departments	2 (10%)	0 (0%)
Patients living alone before	n = 54	n = 35
At home	18 (33.3%)	24 (68.6%)
Rehabilitation	11 (20.4%)	0 (0%)
Convalescence department	16 (29.6%)	0 (0%)
Institution	2 (3.7%)	11 (31.4%)
Other medical or surgical departments	7 (13%)	0 (0%)

Table 3 Predictors of institutionalisation within 3 years that were available at baseline (results of the bivariate analysis, Kaplan–Meier)

	All patients at baseline (n = 165)	Patients institutionalised within 3 years (n = 19)	HR (95% CI)
Demographic characteristics			
Male	84	8	0.69 (0.28 to 1.72)
Schooling <8 years	131	14	0.74 (0.26 to 2.04)
Living alone	55	11	2.87 (1.15 to 7.13)
Past medical history			
Previous stroke	23	3	1.31 (0.38 to 4.53)
Cognitive status before stroke			
Pre-existing dementia	16	3	2.08 (0.60 to 7.17)
Stroke characteristics			
Cerebral infarct	150	18	1.90 (0.25 to 14.23)
Atherothrombotic	23	2	0.71 (0.16 to 3.09)
Cardioembolic	38	9	3.85 (1.55 to 9.55)
Lacunar infarct	34	2	0.40 (0.09 to 1.71)
Other determined	4	0	NA
Undetermined	3	1	3.77 (0.50 to 28.31)
Unknown origin	48	4	0.40 (0.09 to 1.71)
Delirium	36	11	6.26 (2.50 to 15.68)

Fifty four patients were dead at 3 years. p calculated by the log-rank test.
NA, not assessable.

Table 4 Predictors of institutionalisation within 3 years

	HR (95% CI)
Age	1.08 (1.03 to 1.13)
Score IQCODE	1.04 (1.01 to 1.07)
Orgogozo score at admission	0.97 (0.96 to 0.99)
Duration of hospitalisation	1.10 (1.05 to 1.15)
Brain atrophy score	2.06 (1.25 to 3.40)
Leuckoaraiosis score	1.47 (0.98 to 2.21)
Orgogozo score at discharge	0.97 (0.96 to 0.99)
mRS at discharge	1.91 (1.35 to 2.73)

Results of bivariate analysis (Cox model; quantitative variables)
IQCODE, Informant Questionnaire on COgnitive Decline in the Elderly; mRS, modified Rankin Scale.

study has several limitations. We included patients who were not institutionalised before and had a reliable informant—that is, with a favourable social environment. Only 19 patients were institutionalised 3 years after their stroke, limiting the generalisation of our findings. It would have been helpful to analyse other sociodemographic characteristics, especially age, professional activities, medical history, cognitive state, socioeconomic level and incomes of spouses, as these factors play an important part, but the ethics committee did not allow us to investigate family members. It would have been interesting also to determine whether aphasia contributes to the rate of institutionalisation, but the size of the cohort did not allow inclusion of too many variables in the model. These possible confounders were, therefore, not taken into account.

We evaluated pre-existing dementia with the IQCODE, a valuable screening tool for dementia irrespective of its cause, which is more effective than the Mini Mental State Examination in detecting mild dementia.[31] Also, we used the IQCODE to diagnose dementia in patients who could not attend a face-to-face follow-up visit. The information from relatives has proved to be useful for the diagnosis of dementia in structured interviews.[32] We used the IQCODE in a conservative way, with a threshold of 104 for a diagnosis of dementia, because we wanted to be very specific for a diagnosis of dementia.[33] Therefore, the risk in patients who could not attend a follow-up visit was underdiagnosis of dementia. In this type of study, cases censored because of death and patients not attending follow-up visits are major issues. A structured family interview is the only way to assess the cognitive state, and it is therefore of utmost importance to provide a useful tool to limit these issues present in most studies on PSD. It would have been interesting to test the influence of cognitive impairment and not only of dementia. However, this would have required the use of the IQCODE scores obtained during the follow-up in the analysis, instead of the diagnosis of dementia: the study protocol was not designed to use an IQCODE during follow-up in patients who could attend the follow-up visits.

Living alone the before stroke was not independently associated with higher risk of institutionalisation after 3 years. This difference from previous studies[1 4 6] may be due to (1) the inclusion of a smaller proportion of patients with a poor social environment than in the community, and (2) a lower prevalence of cognitive impairment in patients who lived alone before the stroke, explaining why the statistical relationship disappeared when the pre-existing cognitive state was taken into account. The influence of delirium at the acute stage on the risk of institutionalisation within 3 years disappeared after adjustment of age, severity of the neurological deficit and IQCODE: the reason is probably the higher incidence of delirium in previously cognitively impaired patients.[34]

Pre-existing cognitive impairment increased the risk of institutionalisation within 3 years of a stroke, but not the severity of the neurological deficit, suggesting that the severity of the clinical deficit is less important than pre-existing cognitive impairment for institutionalisation 3 years later. This may be explained by the higher rate of new-onset dementia after a stroke in cognitively impaired patients.[15] To our knowledge, this is the first study showing that, after the acute stage, dementia, and not the severity of clinical deficit, influences living arrangements, and therefore probably also the cost of stroke care.

Cognitive impairment is a strong predictor of institutionalisation within 3 years of a stroke, irrespective of the severity of physical disability. The cognitive evaluation at the acute stage of stroke, and during the follow-up, is therefore crucial to predict the social outcome and should be part of the diagnostic procedure for patients with stroke.

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