J Neurol (2003) 250 : 10 – 16
DOI 10.1007/s00415-003-0917-3

ORIGINAL COMMUNICATION

Hilde Hénon
Isabelle Durieu
Florence Lebert
Florence Pasquier
Didier Leys

Influence of prestroke dementia on early and delayed mortality in stroke patients

Abstract Causes of early and delayed death after stroke differ. It has been suggested that delayed mortality rate was increased in patients with post-stroke dementia. Prestroke dementia is frequent: its influence on survival in stroke patients has never been evaluated. The aim of this study was to evaluate the influence of prestroke dementia on early and delayed mortality rate after stroke. In a cohort of 202 consecutive stroke patients aged ≥ 40 years admitted between November 1995 and May 1996 in a primary care center, the prevalence of prestroke dementia was determined using the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) with a cut-off of 104. Patients were followed-up for 3 years. Statistics were performed using life-table methods.

Of 202 patients, 33 had prestroke dementia. Of 142 survivors at month–6, 44 were demented, of them 15 having prestroke and 29 new-onset post-stroke dementia. No patient was lost to follow-up. The risk of death at month–6 was higher in patients with prestroke dementia (RR 2.7; 95 % CI: 1.6–4.8). However, independent predictors of early death were age, severity of the deficit at admission, type and etiology of stroke. The risk of delayed death was higher in patients with prestroke dementia (RR 4.97; 95 % CI: 1.76–13.98) as in patients with new-onset post-stroke dementia (RR 6.24; 95 % CI: 2.67–14.57), compared with non-demented patients. The mortality rate did not differ between patients with prestroke and new-onset post-stroke dementia. Dementia at month–6 was an independent predictor of delayed death (RR 5.7; 95 % CI: 2.4–13.4), with age and stroke recurrence. Causes of death did not differ between demented and non-demented patients. Dementia adversely influences vital outcome in stroke patients, perhaps partly because the therapeutic approach differs between demented and non-demented patients.

Key words stroke · dementia · outcome · cerebral ischemia · cerebral hemorrhage

Received: 5 September 2001
Received in revised form: 20 June 2002
Accepted: 26 June 2002

Hilde Hénon, MD, PhD (✉) · I. Durieu · D. Leys
Department of Neurology
Stroke unit
Hôpital Roger Salengro
CHRU of Lille
59037 Lille, France
Tel.: + 33-3 20/44-58 14
Fax: + 33-3 20/44-60 28
E-Mail: hhenon@chru-lille.fr

F. Pasquier · F. Lebert
Memory Clinic
CHRU of Lille
59037 Lille, France

Introduction

Population-based studies [2,3,28] and studies conducted in hospitalized patients [6, 27] have shown that patients with dementia have a higher mortality rate, independently of the effects of age and comorbidities [2]. Early mortality in stroke patients is influenced by the size and location of stroke [5], while late mortality is influenced by age, physical impairment and comorbidity [4, 5, 13, 31].

Mortality rate was found to be higher for patients with vascular cognitive impairment than that of people without cognitive impairment, and to be similar to that of patients with Alzheimer's disease (AD) [25]. Cognitive decline frequently occurs in stroke patients. However, its impact on post-stroke survival remains unsettled [31]. The risk of death within 20 months after stroke was found to be increased in patients who had a low Mini-Mental State Examination [7] (MMSE) score 3 months after stroke [31]. The long-term mortality rate was

JON 917

found to be 3 fold higher in patients demented 3 months after stroke, compared with non-demented patients, after adjustment for demographic factors, associated cardiac diseases, stroke severity and stroke recurrence [29].

Prestroke dementia is frequent in stroke patients [8, 9] but its influence on survival has never been studied.

The aim of this study was to evaluate the influence of prestroke dementia on early and delayed mortality rate in stroke patients.

Materials and methods

The protocol and the first results of the Lille Stroke/Dementia study have already been published elsewhere [9–12]. We included patients aged ≥ 40 years with ischemic stroke or cerebral hemorrhage related to arterial hypertension. We excluded patients (i) with TIA, stroke due to cerebral venous thrombosis, subarachnoid or lobar hemorrhage, history of severe head trauma or neurosurgery, (ii) without reliable informant, (iii) referred from another hospital, and (iv) who did not live in the urban community of Lille (1.2 million inhabitants), because the follow-up was performed in other centers.

Methods

Patients were examined according to a standardized procedure [9–12]. We prospectively collected the following data: age; sex; education level; presence of arterial hypertension; diabetes mellitus; hyperlipemia; previous TIA or stroke; cigarette smoking; high risk cardiopathies according to the TOAST criteria [1]; and significant stenosis of the internal carotid arteries (narrowing of 50 % or more of the lumen). The severity of the clinical deficits was scored according to the Orgogozo's scale[21]. Stroke subtypes were defined at discharge according to the TOAST criteria [1].

On CT without contrast performed at admission, we determined the presence of silent infarcts, the presence and severity of leukoaraiosis and of cerebral atrophy [9–12]. The location of the index stroke (hemispheric territory or posterior fossa) was determined on the neuroimaging data judged as the most appropriate, i. e. a delayed CT (87 patients) or MRI (82 patients). In 33 patients delayed neuroimaging was not performed because of early death (27 patients) or refusal (six patients). When the stroke lesion was not seen on the first CT, stroke location was determined on the basis of clinical data.

The assessment of prestroke dementia was conducted within 48 hours of stroke onset by means of a French translation of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) [14, 15, 16, 17, 20]. The main interest of the IQCODE at the acute stage of stroke is that it does not require any participation of the patient at a stage of the disease when neuropsychological functions may be influenced by stroke. We classified as having pre-existing dementia, patients with IQCODE scores of 104 or more [14].

Patients were followed-up at 6 months and then annually after stroke over a 3-year period, by a visit with a neurologist or by telephone contact with the patient's family or general practitioner. We recorded the occurrence of new stroke either during the visit with the neurologist, or by telephone contact. We considered as stroke recurrence the occurrence of a focal deficit clearly different from that of the index stroke and lasting for more than 24 hours, with stroke involving a different anatomic site or vascular territory from that of the index stroke, or with stroke related to another presumed cause according to TOAST criteria [1]. When possible, the diagnosis of recurrent stroke was confirmed by hospital charts. We did not take into account TIA.

Patients who received the visit with the neurologist underwent a battery of neuropsychological tests. Cognitive functions were assessed according to a previously reported procedure [9–12]. Dementia was diagnosed according to the ICD–10 criteria [30], Alzheimer's disease (AD) according to the NINCDS-ADRDA criteria [18] and vascular dementia (VaD) according to the NINDS-AIREN criteria [26]. For patients who could not undergo the neuropsychological testing, who could not or refused to undergo the visit with the neurologist, or who died over six months after the last visit or telephone contact, the diagnosis of dementia was based on the IQCODE score obtained from the patient's closest relative with a cut-off of 104 and a duration of cognitive symptoms of more than 6 months required for the diagnosis of dementia.

For each patient who died within the follow-up period, the date and the probable cause of death were recorded by an interview of the family or the general practitioner: we distinguished vascular deaths (deaths secondary to stroke: cerebral edema, non-specific complications related to decubitus; deaths secondary to stroke recurrence, myocardial infarction, other cardiovascular pathology), non-vascular deaths (pneumonia, other infection, deaths secondary to another known cause) and deaths of unknown cause.

Statistics

As the causes of early and delayed death differ, we first determined the predictive factors of mortality within 6 months after stroke, evaluating the influence of prestroke dementia. Deaths were recorded for patients with and without prestroke dementia and the unadjusted mortality rate was estimated using life-table methods. Specific causes of death were tabulated for the 2 groups and compared using the chi square test of association. Kaplan-Meier survival analysis was used to determine the cumulative proportion of patients surviving in the groups with and without prestroke dementia.

The influence of demographic variables and of other potential predictors of survival was assessed using the log-Rank test for the following variables: sex, primary education level, arterial hypertension, diabetes mellitus, dyslipemia, cigarette smoking, previous stroke/TIA, stroke severity (severe deficit if Orgogozo's score at admission < 50), stroke etiology according to TOAST criteria [1], stroke topography (hemispheric territory/posterior fossa), presence of silent infarcts on CT, stroke recurrence occurring within 6 months or between stroke and death. The relative risk was computed using the Cox proportional-hazards analysis. Cox proportional-hazards analysis was also used for categorical variables (age, cerebral atrophy score and leukoaraiosis score). Multivariate analysis was performed using the Cox proportional-hazards analysis including prestroke dementia and other potential predictors of survival. Only variables with a $p < 0.20$ in the bivariate analysis were considered for multivariate analysis.

We used the same statistical methodology to evaluate the influence of prestroke and of new-onset post-stroke dementia diagnosed at 6 months on the risk of delayed death among the 6-month survivors. For this analysis we considered recurrence which occurred between month–6 and the death or the end of the follow-up period.

We then evaluated the relation between prestroke dementia and (i) the use of the most efficacious antithrombotic drugs based on stroke etiology at discharge and before the month–6 visit and (ii) drugs for the treatment of the main vascular risk factors prescribed at discharge and received by the patient before the 6-month visit. We evaluated the relation between dementia at month–6 and (i) the use of the most efficacious antithrombotic drugs based on stroke etiology before the month–6 visit, and (ii) drugs for the treatment of the main vascular risk factors received by the patient before the month–6 visit. We considered as the most efficacious antithrombotic treatment for stroke prevention the prescription of antiplatelet drug for infarcts related to atheroma or lacunar stroke, anticoagulant for cardioembolic stroke, absence of antithrombotic drug for cerebral hemorrhage, either antiplatelet drug or anticoagulant for stroke of undetermined etiology and for dissection of cervical arteries. When antiplatelet drug was prescribed in patients with cardioembolic stroke because of

contra-indication to anticoagulant, the treatment was considered as adequate but not as the most efficacious.

Results

At the end of the follow-up period, no patient was lost to follow-up.

Of the 202 patients, 33 had prestroke dementia. At month–6, of the 142 survivors, 44 patients were demented: 15 had prestroke dementia, 29 were diagnosed as new-onset post-stroke dementia at the 6-month visit. The etiology of dementia could be determined in 39 out of the 44 demented patients: 19 patients were diagnosed as AD (10 with prestroke dementia, 9 with new-onset post-stroke dementia) and 20 as VaD (4 with prestroke dementia, 16 with new-onset post-stroke dementia).

Of the 202 patients, 12 had a recurrent stroke within 6 months after the index stroke: hospital charts could be obtained in 11 patients who suffered from a recurrent ischemic stroke. Of the 142 survivors at month–6, 18 suffered from at least one recurrent stroke: hospital charts could be obtained in 17 patients (12 ischemic stroke, 5 cerebral hemorrhages).

Predictive factors of early death

Of 202 patients, 60 (29.7 %) died within 6 months after stroke.

Bivariate analysis

The mortality rate was higher in patients with prestroke dementia: 18 of the 33 (54.5 %) patients with prestroke dementia and 42 of the 169 (24.9 %) patients without prestroke dementia died within 6 months. The 2 survival curves differed significantly ($p < 0.0001$) with a relative risk of 2.7 (95 % CI: 1.6–4.8) (Fig. 1).

Causes of early death are detailed in Table 1. There was no difference in the breakdown of vascular versus non-vascular causes of death ($p = 0.85$) between patients with and without prestroke dementia. Stroke recurrences were not more frequent in the group of patients with prestroke dementia ($p = 0.695$): 1 of the 33 patients with prestroke dementia (3 %) underwent stroke recurrence within 6 months while 11 of the 169 patients without prestroke dementia did (6.5 %).

The significant results of the bivariate analysis for categorical variables are detailed in Table 2. Bivariate analysis for continuous variables revealed that the risk of early death was higher in older patients (RR 1.07; 95 % CI: 1.04–1.09), severe cerebral atrophy (RR 1.8; 95 % CI: 1.4–2.4) and severe leukoaraiosis (RR 1.5; 95 % CI: 1.2–1.9).

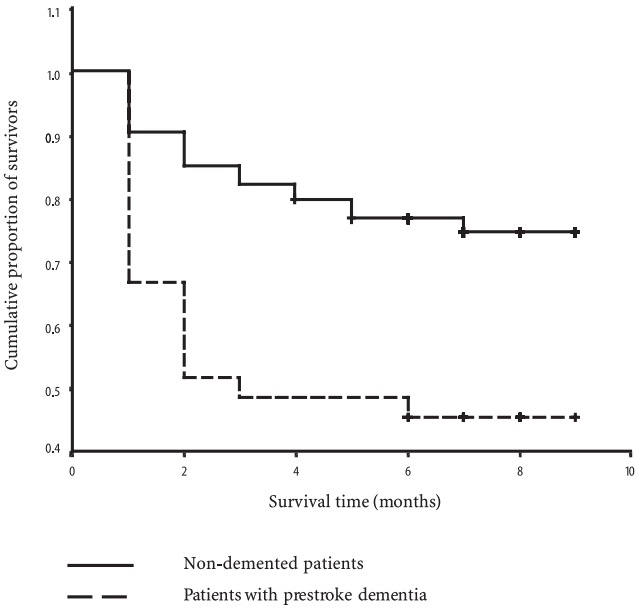

Fig. 1 Risk of early death in function of prestroke dementia

Table 1 Causes of early death as a function of prestroke dementia.

Cause of death	Patients with prestroke dementia (n = 18)	Patients without prestroke dementia (n = 42)
Vascular death	**14 (77.8 %)**	**33 (78.6 %)**
Death related to stroke	11 (61.1 %)	22 (52.4 %)
Stroke recurrence	1 (5.5 %)	5 (11.9 %)
Myocardial infarction	1 (5.5 %)	0
Other cardiovascular cause	1 (5.5 %)	6 (14.3 %)
Non-vascular death	**3 (16.7 %)**	**8 (19 %)**
Pneumonia	3 (16.7 %)	4 (9.5 %)
Other infection	0	2 (4.8 %)
Cancer	0	2 (4.8 %)
Other known cause	0	0
Unknown cause	**1 (5.5 %)**	**1 (2.4 %)**

Multivariate analysis

The following variables were entered in the model: age, dyslipemia, tobacco, cerebral hemorrhage, cardioembolic stroke, lacunar stroke, prestroke dementia, hemispheric stroke, Orgogozo's score at admission, leukoaraiosis score, stroke recurrence < 6 months. Because of multicollinearity, the variables cerebral atrophy and high-risk cardiopathy were not entered in the model.

Multivariate analysis revealed the following independent predictors of early death: age (RR 1.06; 95 % CI: 1.03–1.09), Orgogozo's score < 50 (RR 3.9; 95 % CI: 2.2–7.0), cerebral hemorrhage (RR 3.5; 95 % CI: 1.7–7.2), cardioembolic stroke (RR 2.0; 95 % CI: 1.1–3.6), stroke recurrence < 6 months (RR 2.7; 95 % CI: 1.3–5.4).

Table 2 Predictive factors of early death: results of the bivariate analysis (Kaplan-Meier analysis). RR: Relative risk estimated using the Cox proportional-hazards method. CI: confidence interval. **Only significant results are given.**

Variable		Number of patients	Deaths	RR (95% CI)
Vascular risk factors				
Dyslipemia	No	157	54 (34%)	**0.4 (0.2–0.8)**
	Yes	45	6 (13%)	
Tobacco	No	166	57 (34%)	**0.2 (0.1–0.7)**
	Yes	36	3 (8%)	
High risk cardiopathy	No	146	33 (23%)	**2.3 (1.4–3.9)**
	Yes	56	27 (48%)	
Cognitive status				
Prestroke dementia	No	169	42 (25%)	**2.7 (1.6–4.8)**
	Yes	33	18 (55%)	
Etiology of stroke				
Cardioembolic stroke	No	154	36 (23%)	**2.3 (1.4–3.9)**
	Yes	48	24 (50%)	
Lacunar stroke	No	165	57 (35%)	**0.2 (0.1–0.7)**
	Yes	37	3 (8%)	
Cerebral hemorrhage	No	177	48 (27%)	**2.1 (1.1–3.9)**
	Yes	25	12 (48%)	
Severity of stroke				
Orgogozo's score < 50	No	120	15 (13%)	**5.6 (3.1–10.1)**
	Yes	82	45 (55%)	
Stroke recurrence				
Stroke recurrence < 6 months	No	190	50 (26%)	**3.6 (1.8–7.1)**
	Yes	12	10 (83%)	

Predictive factors of delayed death in 6-months survivors

During 76 person-years of follow-up in the group of 44 demented patients, 20 patients died, with a mortality rate of 26.3 deaths for 100 person-years (22.2 deaths for 100 person-years in the group of patients with prestroke dementia and 28.6 for 100 person-years in the group with new-onset post-stroke dementia). During 211 person-years of follow-up in the group of 98 non-demented patients, 9 patients died, with a mortality rate of 4.3 for 100 person-years.

Bivariate analysis

Of 142 survivors at month–6, the cumulative proportion of survivors at the end of the follow-up period was 80.26%. The cumulative proportion of survivors was 54.55% in the group of demented patients and 91.84% in the group of non-demented patients. The 2 survival curves differed significantly ($p < 0.0001$) with a relative risk of 5.8 (95% CI: 2.6–12.8). Among the 15 patients with prestroke dementia, 6 died by the end of the follow-up period; among the 29 patients with new-onset post-stroke dementia, 14 died by the end of the follow-up period. The cumulative proportion of survivors was 60% in the group of patients with prestroke dementia and 51.72% in the group of patients with new-onset post-stroke dementia, with no significant difference between the 2 groups (RR 1.4; 95% CI: 0.5–3.5) (Fig. 2). Among the 19 patients diagnosed as AD at month–6, 11 died by the end of the follow-up period; among the 20 patients diagnosed as VaD at month–6, 5 died by the end of the follow-up period. The cumulative proportion of survivors at the end of the follow-up period was 42.11% in the group of patients diagnosed as AD and 75% in the group of patients diagnosed as VaD, with no significant difference between the 2 groups (RR 0.4; 95% CI: 0.1–1.1).

Causes of delayed death are detailed in Table 3. There was no difference in the breakdown of vascular versus non-vascular causes of death ($p = 0.69$) between demented and non-demented patients. There was also no difference in the breakdown of vascular versus non-vascular causes of death ($p = 0.64$), between patients with prestroke dementia and patients with new-onset post-stroke dementia. In the group of patients diagnosed as AD, causes of death were vascular in 45% of patients, non-vascular in 45% and unknown in 10%; in the group of patients diagnosed as VaD, causes of death were vascular in 80% of patients and non-vascular in 20%. There was, however, no difference in the breakdown of vascular versus non-vascular causes of death ($p = 0.308$) between patients diagnosed as AD and patients diagnosed as VaD. Stroke recurrences were not more frequent in the group of demented patients: at the end of the follow-up period, the cumulative proportion of survivors without stroke recurrence was 83.14% in the group of demented patients and 71.77% (in the

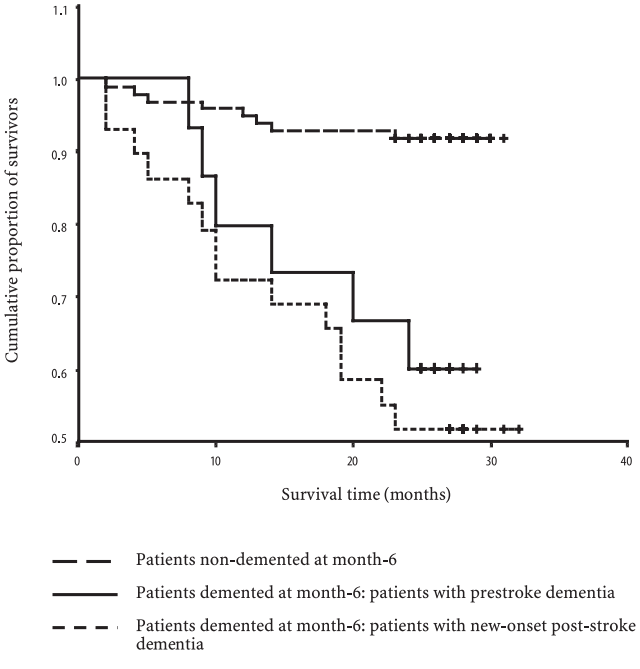

Fig. 2 Risk of delayed death in function of dementia at month-6

Table 3 Causes of delayed death in function of dementia at month–6.

Cause of death	Patients with prestroke dementia (n = 6)	Patients with new-onset post-stroke dementia (n = 14)	Non-demented patients (n = 9)
Vascular death	**2 (33.3 %)**	**9 (50 %)**	**3 (33.3 %)**
Stroke recurrence	2 (33.3 %)	3 (15 %)	1 (11.1 %)
Myocardial infarction	0	3 (15 %)	0
Other cardiovascular pathology	0	3 (15 %)	2 (22.2 %)
Non vascular death	**2 (33.3 %)**	**8 (42.9 %)**	**5 (55.6 %)**
Pneumonia	1 (17 %)	3 (15 %)	1 (11.1 %)
Other infection	0	2 (10 %)	1 (11.1 %)
Cancer	0	1 (5 %)	2 (22.2 %)
Other known cause	1 (17 %)	2 (10 %)	1 (11.1 %)
Unknown cause	**2 (33.3 %)**	**3 (7.1 %)**	**1 (11.1 %)**

group of non-demented patients (RR = 1.9; 95 % CI: 0.9–4.3).

The significant results of the bivariate analysis comparing the risk of delayed death between demented and non-demented patients for categorical variables are detailed in Table 4. Bivariate analysis for continuous variables revealed that the risk of delayed death was higher in older patients (RR 1.06; 95 % CI: 1.02–1.09), severe cerebral atrophy (RR 1.9; 95 % CI: 1.3–2.8) and severe leukoaraiosis (RR 1.8; 95 % CI: 1.3–2.6).

Multivariate analysis

The following variables have been entered in the model: age, arterial hypertension, previous stroke, high-risk cardiopathy, dementia at month–6, Orgogozo's score at admission, leukoaraiosis score, stroke recurrence. Because of multicollinearity, the variable cerebral atrophy was not entered in the model.

Multivariate analysis found the following independent predictors of delayed death: age (RR 1.04; 95 % CI: 1.01–1.09); dementia at month–6 (RR 5.2; 95 % CI: 2.3–12.0); stroke recurrence (RR 4.1; 95 % CI: 1.7–9.7).

Table 4 Predictive factors of delayed death in 6-months survivors: results of the bivariate analysis (Kaplan-Meier analysis). RR: relative risk estimated using the Cox proportional-hazards method. CI: confidence interval. **Only significant results are given**

Variable		Number of patients	deaths	RR (95 % CI)
Vascular risk factors				
Previous stroke	No	122	20 (16 %)	**3.4 (1.6–7.6)**
	Yes	20	9 (45 %)	
High risk cardiopathy	No	113	19 (17 %)	**2.4 (1.1–5.3)**
	Yes	29	10 (34 %)	
Cognitive status				
Dementia at month–6	No	98	9 (9 %)	**5.8 (2.6–12.8)**
	Yes	44	20 (45 %)	
Severity of stroke				
Orgogozo's score < 50	No	105	17 (16 %)	**2.1 (1.0–4.5)**
	Yes	37	12 (32 %)	
Stroke recurrence				
Stroke recurrence between month–6 and year–3	No	124	21 (17 %)	**3.0 (1.3–6.8)**
	Yes	18	8 (44 %)	

Dementia and treatment

At discharge, of 175 survivors, 143 received the most efficacious antithrombotic treatment. There was no significant relation between prestroke dementia and prescription of the most efficacious antithrombotic treatment (p = 0.38), prescription of drugs for diabetes mellitus (p = 0.66), dyslipemia (p = 0.54) or arterial hypertension (p = 0.61).

Data about treatments received by the patients before the 6-months visit were available only in the 110 of 142 survivors who underwent the visit with the neurologist at month–6. Demented patients received less frequently than non-demented patients the most efficacious antithrombotic treatment (p = 0.006), a drug for the treatment of diabetes mellitus if any (p = 0.04). There was no significant relation between dementia at month–6 and prescription of drugs for dyslipemia (p = 0.90) or arterial hypertension (p = 0.71).

Discussion

Dementia 6 months after stroke is associated with a higher long-term mortality rate. However, even if the risk of death is higher in patients who were demented before stroke, prestroke dementia was not an independent predictor of death after stroke. Early death is related to age, severity of the deficit at admission, etiology of stroke, and stroke recurrence. Besides dementia at month–6, independent predictors of 3-year mortality are age and stroke recurrence. The delayed mortality rate did not differ between patients with prestroke dementia and patients with new-onset post-stroke dementia.

Our results on the influence of dementia on the vital

outcome in stroke patients who survived the acute stage are in the same direction as those from the New York group [29]. The reasons of this increased mortality rate remain difficult to explain. Dementia could be associated with a more severe global vascular disease, and a higher risk of complications [29]: however, in our study, the causes of death did not differ between demented and non-demented patients, even if the number of vascular deaths tended to be higher in the group of demented patients and the highest in the group of patients with VaD. In Tatemichi's study [29], deaths secondary to stroke recurrence tended to be more frequent in demented patients but the difference between groups was not statistically significant. However, we cannot exclude a type II error in both studies (New York and Lille). Another possibility is that dementia could be a worsening factor when an intercurrent disease occurs, either because of a decreased capacity of responding to aggressions or because demented patients receive less aggressive treatment: in our study, at discharge, the choice of the antithrombotic drug and the prescription of drugs aiming to treat vascular risk factors were not influenced by prestroke cognitive status; however, 6 months later, demented patients received less frequently the most efficacious antithrombotic drug and a drug for the treatment of diabetes mellitus if any. This is in accordance with previously reported studies [19, 24] that suggested that antithrombotic drugs are less frequently prescribed in demented patients [19] and that often vascular risk factors are not treated in patients with severe dementia [24]. However, this is certainly not the only explanation, as in our cohort, causes of death did not differ between demented and non-demented patients; moreover, stroke recurrences were not more frequent in demented patients. However, our data are incomplete: they are only available in patients who underwent the visit with the neurologist; we did not have any data concerning observance, which could be decreased in demented patients [23]; we do not know the reason why treatments have been withdrawn in some patients; we do not have any data concerning the way associated diseases are treated in the 2 groups of patients.

Prestroke dementia in our study was not an independent predictor of early death: However, patients with previous dementia were older and had more severe deficit at admission [9]. In patients with prestroke dementia, as in non-demented patients, early death appears to be related to stroke characteristics more than to patient's characteristics.

Our study concerning the influence of type and cause of stroke confirms previous data [4, 5, 13, 22, 31] leading to the opinion that our population is not too severely biased: the risk of early death is higher in patients with cerebral hemorrhage, and in patients with cardioembolic stroke. Our results concerning the influence of age and of the severity of the clinical deficit are also in accordance with the literature data [4, 5, 13, 22, 31]. The short-term like the long-term mortality rates are higher in patients with recurrent stroke: this finding emphasizes the importance of secondary stroke prevention.

Our study confirms the adverse influence of dementia on the long-term mortality rate in stroke patients. In drug trials conducted at the acute phase of stroke, the prestroke cognitive status should be taken into account as the delayed mortality rate is increased in patients with prestroke dementia. Moreover, the evaluation of the efficacy of new drugs is usually performed after 3 or 6 months: the evaluation of cognitive functions should be considered as a secondary end-point, because new-onset post-stroke dementia is independently associated with long-term mortality.

Acknowledgments We thank Mrs. J. Campos for her technical assistance, Mrs. S. Pollet and Mrs. C. Mouly for neuropsychological assistance. This study was supported by the CH&U de Lille (grant 9306), association pour la recherche et l'enseignement en pathologie neurovasculaire (APREPAN), association d'étude et de recherche sur la maladie d'Alzheimer (ADERMA), ADRINORD, and the grant MENRT from the French Ministry of Education, Research and Technology for the Research group on Cognition in Degenerative and Vascular Disorders (grant n° EA 2691).

References

1. Adams HP Jr, Bendixen BH, Kappelle, et al. (1993) Classification of subtypes of acute ischemic stroke. Definitions for use in a multicenter clinical trial. Stroke 24:35–41
2. Aevarsson O, Svanborg A, Skoog I (1998) Seven-year survival rate after 85 years. Arch Neurol 55:1226–1232
3. Baldereschi M, Di Carlo A, Maggi S, et al. (1999) Dementia is a major predictor of death among the Italian elderly. Neurology 52:709–713
4. Bonita R, Ford MA, Stewart AW (1988) Predicting survival after stroke: a three-year follow-up. Stroke 19: 669–673
5. Chambers BR, Norris JW, Shurvell BL, Hachinski VC (1987) Prognosis of acute stroke. Neurology 37:221–225
6. Desmond DW, Bagiella E, Moroney JT, Stern Y (1998) The effect of patient attrition on estimates of the frequency of dementia following stroke. Arch Neurol 55:390–394
7. Folstein MF, Folstein SE, McHugh PR (1975) "Mini Mental State": A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 12:189–198
8. Hénon H, Durieu I, Lucas C, Godefroy O, Pasquier F, Leys D (1996) Dementia in stroke. Neurology 47:852
9. Hénon H, Pasquier F, Durieu I, et al. (1997) Preexisting dementia in stroke patients: baseline frequency, associated factors and outcome. Stroke 28: 2429–2436
10. Hénon H, Pasquier F, Durieu I, Pruvo JP, Leys D (1998) Medial temporal lobe atrophy in stroke patients. Relation to pre-existing dementia. J Neurol Neurosurg Psychiatry 65:641–647
11. Hénon H, Lebert F, Durieu I, et al. (1999) Confusional state in stroke: relation with pre-existing dementia, patients characteristics and outcome. Stroke 30:773–779

12. Hénon H, Durieu I, Guerouaou D, Lebert F, Pasquier F, Leys D (2001) Post-stroke dementia: incidence and relationship to prestroke cognitive decline. Neurology 57:1216–1222
13. Howard G, Walker MD, Becker C, et al. (1986) Community hospital-based stroke programs: North Carolina, Oregon, New York, III: factors influencing survival after stroke: proportional hazards analysis of 4219 patients. Stroke 17:294–299
14. Jorm AF, Jacomb PA (1989) The informant questionnaire on cognitive decline in the Elderly (IQCODE): sociodemographic correlates, reliability, validity and some norms. Psychol Med 19:1015–1022
15. Jorm AF, Korten AE (1988) Assessment of cognitive decline in the elderly by informant interview. Br J Psychiatry 152:209–213
16. Jorm AF, Broe GA, Creasey H, et al. (1996) Further data on the validity of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). Intern J Geriatric Psychiatry 11:131–139
17. Jorm AF, Scott R, Cullen JS, MacKinnon AJ (1991) Performance of the informant Questionnaire on cognitive decline in the Elderly (IQCODE) as a screening test for dementia. Psychol Med 21:785–790
18. McKhann G, Drachman D, Folstein M, Katzman R, Price D, Stadlan EM (1984) Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA work group under the auspices of Department of Health and Human Services Task Force on Alzheimer's disease. Neurology 34:939–944
19. Moroney JT, Tseng CL, Paik MC, Mohr JP, Desmond DW (1999) Treatment for the secondary prevention of stroke in older patients: the influence of dementia status. J Am Geriatr Soc 47:824–829
20. Mulligan R, Mackinnon A, Jorm AF, Giannakopoulos P, Michel JP (1996) A comparison of alternative methods of screening for dementia in clinical settings. Arch Neurol 23:532–536
21. Orgogozo JM, Dartigues JF (1991) Methodology of clinical trials in acute cerebral ischemia: survival, functional and neurological outcome measures. Cerebrovasc Dis 1(suppl 1):100–111
22. Oxbury JM, Greenhall RCD, Grainger KMR (1975) Predicting the outcome of stroke: acute stage after cerebral infarction. B M J 3:125–127
23. Richards SS, Emsley CL, Roberts J, Murray MD, Hall K, Gao S, Hendrie HC (2000) The association between vascular risk factor-mediating medications and cognition and dementia diagnosis in a community-based sample of African-Americans. J Am Geriatr Soc 48:1035–1041
24. Rockwood K, Ebly E, Hachinski V, Hogan DB (1997) Presence and treatment of vascular risk factors in patients with vascular cognitive impairment. Arch Neurol 54:33–39
25. Rockwood K, Wentzel C, Hachinski V, Hogan DB, MacKnight C, McDowell I (2000) Prevalence and outcomes of vascular cognitive impairment. Vascular Cognitive Impairment Investigators of the Canadian Study of Health and Aging. Neurology 54:447–451
26. Roman GC, Tatemichi TK, Erkinjuntti T, et al. (1993) Vascular dementia: diagnostic criteria for research studies. Report of the NINDS-AIREN International Workshop. Neurology 43: 250–260
27. Roth M (1955) The natural history of mental disorder in old age. Br J Psychiatry 101:281–301
28. Schoenberg BS, Okasaki H, Kokmen E (1981) Reduced survival in patients with dementia: a population study. Trans Am Neurol Assoc 106:306–308
29. Tatemichi TK, Paik M, Bagiella E, Desmond DW, Pirro M, Hanzawa LK (1994) Dementia after stroke is a predictor of long-term survival. Stroke 25:1915–1919
30. World Health Association. The International Classification of Diseases, 10th Revision (ICD-10). (1989) Geneva, Switzerland: World Health Organization 25–31. WHO typescript document MNH/MEP/87.1
31. Woo J, Kay R, Yuen YK, Nicholls MG (1992) Factors influencing long-term survival and disability among three-month stroke survivors. Neuroepidemiology 11:143–150