Frequency and Determinants of Poststroke Dementia in Chinese

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Background and Purpose—Both dementia and stroke are major health problems in Chinese societies. Stroke is a frequent cause of dementia. Only a few studies have been published on poststroke dementia (PSDE), none of which has investigated a consecutive stroke cohort in Asian patient populations. The objective of this study was to examine the prevalence and clinical correlates of PSDE in Chinese stroke patients in Hong Kong.

Methods—Two hundred eighty stroke patients consecutively admitted to the medical wards of a university-affiliated regional hospital were interviewed by a psychiatrist 3 months after stroke. The presence of dementia and vascular dementia was diagnosed according to the Diagnostic and Statistical Manual, 4th edition. In addition, a wide range of demographic and clinical variables were examined.

Results—Fifty-five participants (20%) had PSDE. Univariate analysis found that PSDE was associated with age; level of education; prestroke Rankin Scale score; prestroke Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) score; National Institutes of Health Stroke Scale (NIHSS) best language score, dysarthria score, and total score; urinary incontinence; cortical infarct; leukoaraiosis; bilateral lesions; number of lesions; involvement of middle cerebral artery circulation; and cerebral atrophy index. Multivariate logistic regression suggested that prestroke IQCODE score, NIHSS total score, leukoaraiosis, involvement of middle cerebral artery territory, and cerebral atrophy index were independent risk factors of PSDE. After removal of 22 patients with prestroke dementia, which was defined as a prestroke IQCODE score ≥4.0, the frequency of PSDE dropped to 15.5%. Furthermore, involvement of the middle cerebral artery territory and cerebral atrophy index were replaced by level of education and bilateral lesions as independent predictors in the final logistic model.

Conclusions—PSDE is common among Chinese stroke patients in Hong Kong. Its frequency is comparable to that in white populations. The clinical determinants of PSDE, after the exclusion of patients with prestroke dementia, include premorbid level of cognitive function, severity of stroke, leukoaraiosis, level of education, and bilateral lesions. (Stroke. 2004;35:930-935.)

Key Words: Chinese ■ dementia ■ risk factors ■ stroke
the presence of aphasia,11 dysphasia, urinary incontinence, low blood pressure, and gait impairment.9 Laboratory risk factors include elevated cholesterol level.20 A MEDLINE search assisted by a manual search and cross-referencing targeting PSDE in Asian populations found only 1 article on this subject21 in which the frequency of poststroke dementia was 3.7% and no data on any risk factor of dementia were reported. The sample was not consecutively admitted stroke patients; the study included patients with transient ischemic attack but excluded patients with disabling stroke.

The aim of the present study was to examine the frequency and clinical determinants of PSDE in a consecutive cohort of Chinese stroke patients.

Materials and Methods

Subjects

Participants in the study were recruited from patients who were consecutively admitted to the acute stroke unit of the Prince of Wales Hospital (PWH) with first-ever or recurrent stroke over a period of 9 months. PWH is a university-affiliated general hospital serving a population of 800 000 in Hong Kong. Inclusion criteria for the study were (1) Chinese ethnicity; (2) age of ≥50 years; (3) well-documented (clinical presentation and CT and/or MRI scan of the brain) first or recurrent acute stroke occurring within 7 days before admission; (4) ability to give consent or the availability of relative to give proxy consent to participate in the study; and (5) a primary language of Cantonese. Exclusion criteria were transient ischemic attack, subdural hematoma, or subarachnoid hemorrhage and history of central nervous system disease such as tumor, trauma, hydrocephalus, or Parkinson’s disease. The study protocol was approved by the Clinical Research Ethics Committee of the Chinese University of Hong Kong. All participants signed a written consent form.

Assessment Procedures

During the first week of stay in PWH, a participant’s relatives gave an account on the participant’s cognitive function before the index stroke by completing the Chinese version of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE).22 The IQCODE has 26 items that rate changes in cognitive abilities on a 5-point scale (1=much better, 5=much worse). The final score is the average rating of all scores. A research assistant administered the Chinese version of the Mini-Mental State Examination (MMSE)23 to all participants within the first week of hospitalization. Participants and their relatives attended an interview at the outpatient clinic 3 months after the onset of index stroke, in which a psychiatrist (W.K.T.) who was blinded to the vascular risk factors and the features of the index stroke administered the MMSE, conducted a psychiatric interview with participants, and collected relevant diagnostic information from their relatives. The diagnosis of dementia and vascular dementia was made according to criteria from the Diagnostic and Statistical Manual, 4th edition (DSM-IV).24 The severity of dementia was rated with the Clinical Dementia Rating (CDR).25 A second psychiatrist (S.S.M.C.) examined a randomly selected subset of participants and their relatives and performed the MMSE to establish intrater reliability of psychiatric diagnoses. PSDE was diagnosed if the clinical presentation fulfilled DSM-IV criteria of vascular dementia.

Collection of Demographic and Clinical Data

A research nurse blinded to the psychiatrist’s diagnosis assessed all participants and collected the following data: demographics (age, sex, educational level, occupation), vascular risk factors (history of smoking, hypertension, diabetes mellitus, myocardial infarction, atrial fibrillation, transient ischemic attack, stroke), features of the index stroke (functioning level in the past 5 years with the modified Rankin Scale26), date of onset of stroke, blood pressure on admission, fasting serum cholesterol level, presence of urinary inconti-

<table>
<thead>
<tr>
<th>TABLE 1. Demographic Variables by PSDE Status</th>
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<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Age, y</td>
</tr>
<tr>
<td>Female sex, %</td>
</tr>
<tr>
<td>Education, y</td>
</tr>
</tbody>
</table>

*aLogistic regression. †Mean±SD.

ence during hospitalization, and stroke severity in terms of the National Institute of Health Stroke Scale (NIHSS).27

Radiological Examination

A noncontrast CT scan examination (10-mm slice thickness at 10-mm intervals supratentorially and 5-mm slice thickness and 5-mm intervals through the posterior fossa) was performed. A radiologist who was blinded to the psychiatric diagnosis read the scans. The following radiological data were collected: timing of CT scan examination in terms of number of days after stroke, presence of hemorrhage, infarct subtypes,28 number and laterality of lesions, cerebral circulation involvement, and cerebral atrophy index (CAI).29 Cerebral infarcts were further divided: (1) cortical infarcts, any hypodensity involving cortical surface; (2) subcortical infarcts, any infarct >15 mm sparing the cortical surface; (3) lacunar infarcts, any infarct ≥15 mm; (4) cerebellar infarcts; (5) brainstem infarcts; and (6) leukoaraiosis. Cerebral circulation involvement was identified by use of cerebral templates.30 To calculate CAI, we first measured the intracranial and parenchymal volumes. Afterward, the cerebrospinal fluid volume was determined by subtracting the parenchymal volume from the intracranial volume. The following formula was used: CAI=(cerebrospinal fluid volume/intracranial volume)×100%.

The number of lesions was recorded on a 4-point scale in which scores of 0, 1, 2, and 3 represented the number of lesions corresponding to 0, 1, 2 to 3, and >3, respectively.

Statistical Analysis

Demographic and clinical variables between the participants and patients who were excluded from the study were compared by χ² and Mann-Whitney U tests. To investigate the clinical determinants of PSDE, a univariate logistic regression was first performed to identify possible risk factors. Risk factors with a value of P<0.10 were then analyzed by multivariate logistic regression analysis using a forward stepwise selection strategy. If the correlations between any of these putative risk factors were ≥0.50, then additional models were examined to rule out multicolinearity. All statistical tests were performed by SPSS for Windows (release 11.0, SPSS Inc).

Results

Over the 9-month period of recruitment, 484 patients with acute stroke were admitted to PWH. Of these, 280 (57.9%) participated in the study; 54.6% of them were male. The participants’ mean age was 70.9±9.6 years and mean NIHSS score was 6.7±5.6. Of the 204 excluded patients, 44% were male; their mean age was 72.8±13.2 years and mean NIHSS score was 13.7±11.8. The excluded group was older (P=0.001), had significantly fewer males (P=0.026), and had a higher NIHSS score (P<0.001). Reasons for exclusion from the study included death (n=53; 26.0%), admission to other PWH wards (n=43; 21.1%), a primary language other than Cantonese (n=26; 12.7%), refusal to be interviewed at the 3-month follow-up (n=21; 10.3%), prolonged (>3 months) hospitalization (n=18; 8.8%), age <50 years (n=17,
TABLE 2. Features of Index Stroke by PSDE Status

<table>
<thead>
<tr>
<th>Variable</th>
<th>PSDE</th>
<th>Odds Ratio (95% CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (n=55)</td>
<td>No (n=224)</td>
<td></td>
</tr>
<tr>
<td>Prestroke Rankin score†</td>
<td>0.6±0.8</td>
<td>0.3±0.6</td>
<td>1.554 (1.058–2.283)</td>
</tr>
<tr>
<td>Prestroke IQCODE score†</td>
<td>3.6±0.6</td>
<td>3.2±0.3</td>
<td>12.582 (5.490–28.836)</td>
</tr>
<tr>
<td>NIHSS total score†</td>
<td>18.8±8.2</td>
<td>5.7±4.3</td>
<td>1.147 (1.088–1.209)</td>
</tr>
<tr>
<td>NIHSS dysarthria score†</td>
<td>0.96±0.64</td>
<td>0.64±0.53</td>
<td>2.925 (1.638–5.224)</td>
</tr>
<tr>
<td>NIHSS best language score†</td>
<td>1.20±1.01</td>
<td>0.58±0.55</td>
<td>3.246 (2.035–5.177)</td>
</tr>
<tr>
<td>Urinary incontinence, ‰</td>
<td>54.7</td>
<td>15.3</td>
<td>6.681 (3.479–12.832)</td>
</tr>
</tbody>
</table>

*Logistic regression.
†Mean±SD.

8.3%), too physically frail to attend follow-up (n=17; 8.3%), missing baseline IQCODE (n=5; 2.5%), recurrent stroke before follow-up (n=3; 1.5%), and concurrent neurological disease (n=1; 0.5%).

The final sample (n=280) had the following characteristics: 64.2% were married; mean educational level was 4.3±4.2 years; and 11.5% were employed. A CT scan was performed in 97.5% of the sample (n=273). Prestroke IQCODE scores ranged from 2.91 to 4.90, with a mean of 3.29±0.37. MMSE score on admission and follow-up ranged from 0 to 30, with means of 22.0±6.2 and 22.2±6.8, respectively. The psychiatric assessment took place 14.4±1.3 weeks after the index stroke. Relatives were interviewed in 74.8% of participants (n=209). The χ value for dementia and vascular dementia between the 2 psychiatrists, established in 71 participants, was 0.88; the intraclass reliability of the MMSE was 0.96. Fifty-six participants (20.0%) had a DSM-IV diagnosis of dementia, and their mean CDR score was 2.2±1.0. Of these participants, 55 (98.2%) also fulfilled DSM-IV diagnosis of vascular dementia and hence met the criteria for PSDE. The only participant who did not meet the diagnostic criteria of vascular dementia was excluded from further analysis.

Demographic characteristics, features of index stroke, vascular risk factors, and CT scan findings stratified by PSDE status are shown in Tables 1 through 4, respectively. Univariate analyses revealed that PSDE was significantly associated with age; level of education (Table 1); prestroke Rankin score; pre-stroke IQCODE score; NIHSS best language, dysarthria, and total scores; and urinary incontinence (Table 2). None of the vascular risk factors was associated with PSDE (Table 3). Of the CT scan data, PSDE was associated with cortical infarction, leukoaraiosis, number and bilaterality of lesions, involvement of the middle cerebral artery circulation, and the CAI (Table 4). The Pearson correlation between age and CAI (0.635), NIHSS score and best language score (0.629), NIHSS score and dysarthria score (0.549), and best language score and dysarthria score (0.588) and the Spearman ρ between NIHSS score and urinary incontinence (0.501) and bilateral lesions and number of lesions (0.787) were significant. Age, dysarthria score, best language score, urinary incontinence, and number of lesions were removed from the final model of the multivariate logistic regression, which revealed that the pre-stroke IQCODE score, NIHSS total score, leukoaraiosis, involvement of middle cerebral artery territory, and CAI were independent predictors of PSDE (Table 5).

With a pre-stroke IQCODE score of ≥4.0 used as a definition of prestroke dementia,31,32 22 patients were identified as having prestroke dementia and removed from the following analysis. The frequency of dementia in the remaining sample (n=258) dropped to 15.5% (n=40). The results of

TABLE 3. Vascular Risk Factors by PSDE Status

<table>
<thead>
<tr>
<th>Variable</th>
<th>PSDE</th>
<th>Odds Ratio (95% CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (n=55)</td>
<td>No (n=224)</td>
<td></td>
</tr>
<tr>
<td>Current smoker or ex-smoker, ‰</td>
<td>49.1</td>
<td>45.1</td>
<td>1.174 (0.651–2.120)</td>
</tr>
<tr>
<td>Hypertension, ‰</td>
<td>67.3</td>
<td>67.0</td>
<td>1.014 (0.541–1.901)</td>
</tr>
<tr>
<td>Diabetes mellitus, ‰</td>
<td>30.9</td>
<td>29.0</td>
<td>1.094 (0.577–2.076)</td>
</tr>
<tr>
<td>Atrial fibrillation, ‰</td>
<td>9.0</td>
<td>4.0</td>
<td>2.389 (0.767–7.437)</td>
</tr>
<tr>
<td>Ischemic heart disease, ‰</td>
<td>9.1</td>
<td>9.4</td>
<td>0.967 (0.347–2.689)</td>
</tr>
<tr>
<td>Previous transient ischemic attack, ‰</td>
<td>5.5</td>
<td>4.5</td>
<td>1.235 (0.328–4.646)</td>
</tr>
<tr>
<td>Previous stroke, ‰</td>
<td>36.4</td>
<td>25.9</td>
<td>1.635 (0.875–3.057)</td>
</tr>
<tr>
<td>Systolic blood pressure, ‰ mm Hg</td>
<td>174.6±27.6</td>
<td>167.0±27.6</td>
<td>1.010 (0.999–1.021)</td>
</tr>
<tr>
<td>Diastolic blood pressure, ‰ mm Hg</td>
<td>85.6±17.5</td>
<td>84.4±15.2</td>
<td>1.005 (0.986–1.024)</td>
</tr>
<tr>
<td>Serum cholesterol, ‰ mmol/L</td>
<td>5.4±1.2</td>
<td>5.4±1.0</td>
<td>0.955 (0.715–1.259)</td>
</tr>
</tbody>
</table>

*Logistic regression.
†Mean±SD.
subsequent univariate analysis compared with the entire group (n = 280) were unchanged except that prestroke Rankin score became insignificant (P = 0.175) and the probability value of posterior territory involvement rose from 0.057 to 0.295. Both variables were removed from the multivariate analysis. In the final logistic regression model, NIHSS total score, IQCODE score, and leukoaraiosis continued to be independent predictors of PSDE. However, middle cerebral artery involvement and CAI were replaced by educational level and bilateral lesions (Table 6).

Discussion

The frequency of dementia after stroke varies between studies. Pohjasvaara et al14 reported a figure of 31.8% in a group of 337 patients with a mean age of 70 years, whereas Madureira et al10 found the frequency of PSDE to be only 6%. Possible reasons for the low figure in the latter study include the exclusion of patients with previous functional dependency and the fact that the mean age of the sample was only 59 years. Our finding falls between these extremes and is comparable to most of the literature.11,13,15 Barba et al16 commented that the frequency of PDSE depends on various factors such as the exclusion of hemorrhage or recurrent stroke, age range, length of follow-up, and diagnostic criteria. Ours is the first published study on consecutive Asian stroke patients.

After the removal of patients with prestroke dementia, we identified 5 independent risk factors for PSDE: stroke severity, prestroke cognitive function, leukoaraiosis, level of education, and bilateral lesions. Stroke severity and level of education are well-known risk factors.9–11,13,16 Similarly, an association between the extent of white matter lesions and PSDE has been reported,10,33 although not consistently.15 For instance, Miyao et al34 have demonstrated that, after the first lacunar infarction, the prevalence of dementia is higher in patients with leukoaraiosis. Only a few previous studies have examined the role of prestroke cognitive decline in the development of PSDE. Pohjasvaara et al9 found no difference in the proportion of demented and nondemented stroke patients with prestroke cognitive decline. However, Pohjasvaara et al35 later reported that prestroke cognitive was positively correlated with poststroke cognitive decline. Our finding concurs with that of Barba et al,16 who found that

### TABLE 5. Multivariate Logistic Model of the Clinical Determinants of PSDE

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIHSS total score</td>
<td>1.210 (1.127–1.299)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Prestroke IQCODE score</td>
<td>15.109 (4.880–46.780)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Leukoaraiosis</td>
<td>1.226 (1.031–1.458)</td>
<td>0.021</td>
</tr>
<tr>
<td>CAI</td>
<td>1.148 (1.015–1.297)</td>
<td>&lt;0.027</td>
</tr>
<tr>
<td>Middle cerebral artery territory involvement</td>
<td>4.099 (1.162–14.461)</td>
<td>0.028</td>
</tr>
</tbody>
</table>

n = 279.

### TABLE 6. Multivariate Logistic Model of the Clinical Determinants of PSDE After Exclusion of Patients With PSDE

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIHSS total score</td>
<td>1.199 (1.116–1.288)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pre-stroke IQCODE score</td>
<td>14.653 (2.299–93.375)</td>
<td>0.004</td>
</tr>
<tr>
<td>Bilateral lesions</td>
<td>2.935 (1.154–7.466)</td>
<td>0.024</td>
</tr>
<tr>
<td>Level of education</td>
<td>0.855 (0.744–0.982)</td>
<td>0.027</td>
</tr>
<tr>
<td>Leukoaraiosis</td>
<td>1.226 (1.021–1.472)</td>
<td>0.029</td>
</tr>
</tbody>
</table>

n = 257.
prestroke IQCODE is an independent risk factor of PSDE in general as well as in a subgroup of probable vascular dementia as defined by the Internationale pour la Recherche et l’Enseignement en Neurosciences’ (NINDS-AIREN) criteria. No previous study had examined the role of bilateral lesions in the development of PSDE; however, the number of lesions, which is highly correlated with bilateral lesions in the present study, is an established risk factor.10,37

Although associations between various vascular risk factors and PSDE have been reported,38 the findings were inconsistent. Inzitari et al11 found that hypertension, diabetes mellitus, and previous transient ischemic attack were not related to PSDE. Similarly, Censori et al15 reported that hypertension, ischemic heart disease, and smoking did not predict the development of PSDE. In the present study, no vascular risk factor was identified as a predictor of PSDE. The small number of patients with atrial fibrillation may have limited the power to detect an association between atrial fibrillation and PSDE. Another reason for our negative findings is that we used DSM-IV criteria of vascular dementia, which are less specific than other criteria39 such as the NINDS-AIREN criteria, so we may have labeled an unknown proportion of participants who had Alzheimer’s disease with concurrent stroke as vascular dementia. If the NINDS-AIREN criteria are used, the frequency of PSDE would be lower,40 but the role of vascular risk factors may be better illustrated. Desmond et al13 revealed that, after removing the nonvascular dementia group, the odd ratio of the vascular risk factors increased in a subsequent logistic model.

This study has limitations. First, it involved only a hospital-based sample. Nevertheless, PWH provides >95% of inpatient services for the catchment area. Second, the present study required both clinical and neuroimaging evidence in the definition of stroke. The rationale behind this definition is to rule out nonstroke cases, and this definition has been adopted by other researchers.10,15 Our definition of stroke excluded patients with normal CT scan and may make comparison of findings between the present study and studies that required either clinical or neuroimaging evidence of stroke difficult.13 Third, the attrition rate was 42% and excluded patients who were older and had more severe strokes. Because stroke severity is associated with PSDE, we have probably underestimated the frequency of PSDE. Fourth, relatives of only 73.7% of the participants were interviewed. Fifth, although the interrater reliability between the 2 psychiatrists was measured, we did not examine the reliability between the research assistant and the psychiatrist in the administration of MMSE, so the possibility of inconsistency in rating of the MMSE cannot be ruled out.

In summary, PSDE is common among Chinese stroke patients in Hong Kong. Its frequency is comparable to that in white populations. The clinical determinants of PSDE, after exclusion of patients with prestroke dementia, include premorbid level of cognitive function, severity of stroke, leukoaraisis, level of education, and bilateral lesions.

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References


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