Cerebral Cysticercosis as a Risk Factor for Stroke in Young and Middle-Aged People

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Background and Purpose: A probable association between cerebral cysticercosis and susceptibility to stroke, especially among young and middle-aged patients, has been reported. We examined the association between cerebral cysticercosis and stroke and the possible factors causing this association.

Methods: In 169 stroke patients (75 males and 94 females) under 65 years of age admitted to our neurology department, we evaluated the following possible risk factors: arterial hypertension, diabetes, cardiac disease, hyperlipidemia, smoking, alcohol abuse, and cerebral cysticercosis. In 169 control patients under 65 years of age matched by sex and age, we evaluated the same possible risk factors for stroke.

Results: In the univariate matched analyses, the frequencies of cerebral cysticercosis (p < 0.001), arterial hypertension (p < 0.001), cardiac disease (p < 0.001), hyperlipidemia (p > 0.05), and alcohol abuse (p = 0.05) were higher in the stroke patients than in the control patients. After controlling for possible confounding factors, we found that arterial hypertension (p < 0.001), cardiac disease (p < 0.001), and cerebral cysticercosis (p < 0.001) were independent risk factors for stroke.

Conclusions: Cerebral cysticercosis should be considered a risk factor for stroke in young and middle-aged individuals.

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KEY WORDS • cerebral cysticercosis • cerebrovascular disorders • risk factors • young adults

Neurocysticercosis, endemic in many areas of the world,12 is considered one of the causes of stroke.3-9 Various pathophysiological mechanisms of stroke have been proposed in patients with cerebral cysticercosis,3-10 and it has been suggested that cerebral cysticercosis can be a risk factor for stroke.11 The association between cerebral cysticercosis and stroke is greater among young and middle-aged patients.10

We conducted a case–control study to evaluate the role of cerebral cysticercosis and its relation to other risk factors in the development of stroke in young and middle-aged persons.

Subjects and Methods

The cases comprised 420 patients admitted with a diagnosis of stroke at the Department of Neurology, Eugenio Espejo Hospital, between October 1985 and November 1988. We established the definitions, subtypes, and guides for the diagnostic classification of stroke in a previous publication.10

The diagnosis of stroke was determined by neurological examination, computed tomography (CT), cerebral angiography, cerebrospinal fluid analysis, or autopsy.10 To reduce the influence of confounding factors associated with focal deficit, we excluded patients with subarachnoid hemorrhage, those who had a history of stroke or were over 65 years of age, and those who had intracranial hypertension (defined as the presence of headache and papilledema12). One hundred sixty-nine patients (75 males and 94 females) met the criteria of inclusion and were included as cases. They had a mean±SD age of 48.7±13.6 (range, 12-65) years and a follow-up period of 12.5±8.3 months. The control group was established with 169 patients matched with the cases by sex and age (within 3 years) who had been admitted consecutively to the Department of Internal Medicine of our hospital during the same period of time as the case patients. We excluded patients with a history of stroke. The 169 control patients had a mean±SD age of 49.7±12.8 (range, 15–68) years and a follow-up period of 13.4±9.6 months. The control group included patients with a diagnosis of gastrointestinal diseases (48), infectious diseases (40), chronic respiratory diseases (30), cardiac disease (12), neoplasm (18), hematological disorder (four), anemia (12), diabetes (two), and connective tissue diseases (three).

In the 338 case and control group patients, the following possible risk factors were evaluated:10 arterial hypertension (>160/90 mm Hg); diabetes mellitus (fasting blood sugar >140 mg/dl or glucose tolerance test with 2-hour postprandial value >200 mg/dl); cardiac disease, based on assessment by a cardiologist for rheumatic heart disease, nonrheumatic atrial arrhythmia, left ventricular hypertrophy, coronary insufficiency, myocardial infarction, or cardiomyopathy; hyperlipidemia (cholesterol level >200 mg/dl or triglycerides >150 mg/dl); habitual cigarette smoking; alcohol abuse; and cerebral cysticercosis. The
338 patients underwent cardiological evaluation, blood test, and CT scan, and we performed immunologic tests on the cerebrospinal fluid of the patients who showed evidence of cerebral cysticercosis on the CT scan. We established a diagnosis of epilepsy when the patient had two or more seizures unrelated to stroke or that occurred at least 2 weeks after the stroke.

The differences in potential risk factors for stroke between case and control patients were tabulated and analyzed using EPI INFO 5. The univariate odds ratio and odds ratio for matched pairs with 95% confidence intervals were computed using $2 \times 2$ tables. The $\chi^2$ test, Mantel-Haenszel test, and Yates' corrected test were used for the statistical significance. With the variables that we found significant with the univariate analysis, we applied the multivariate logistic regression method using the LOG RESS program.

### Results

Of the 169 case patients, arterial hypertension was present in 68 (40.2%) (Table 1), cardiac disease in 65 (38.4%), cerebral cysticercosis in 19 (11.2%), alcohol abuse in 28 (16.5%), and hyperlipidemia in 22 patients (13.0%). Among the 169 control patients, we found arterial hypertension in 19 (11.2%), cardiac disease in 18 (10.6%), cerebral cysticercosis in three (1.7%), alcohol abuse in 16 (9.4%), and hyperlipidemia in 12 (7.1%). Sixteen case patients and two control patients had epilepsy; one control patient with epilepsy had neurocysticercosis.

The average age of the 19 case patients with cerebral cysticercosis was 44.5 ±14.6 (range, 17-65) years. Seven patients were males, and 12 were females. Fourteen patients had epilepsy. Among the 19 case patients with cerebral cysticercosis, three had hyperlipidemia, four cardiac disease, three arterial hypertension, and one diabetes mellitus; two had smoking habits, and two abused alcohol. Of the four patients with cardiac disease, three had hypertrophy of the left ventricle, and one showed rheumatic heart disease with atrial fibrillation.

Using univariate matched analyses, it was possible to establish significant differences between case and control patients (Table 1) in the prevalence of arterial hypertension, cardiac disease, cerebral cysticercosis, alcohol abuse, and hyperlipidemia. However, the odds ratio for matched pairs was significant only for smoking exposure (OR=2.40; $p<0.05$). After adjusting for the variables that were significant in the univariate analyses, using the logistic regression method and taking the factors one by one and combined, we found significant differences ($p<0.001$); the independent risk factors for stroke were arterial hypertension, cardiac disease, and cerebral cysticercosis. We found no significant relation between alcohol abuse and hyperlipidemia and stroke in the matched analyses.

### Discussion

Cerebral cysticercosis has been recognized as a possible risk factor for stroke only in the last few years.\textsuperscript{3-11} One potential association between cerebral cysticercosis and stroke has been suggested by us in previous studies.\textsuperscript{10,11,13} Controlled epidemiological studies could contribute to better knowledge of cerebral cysticercosis as a risk factor for stroke and other factors that could contribute to this association. In our study, which examines for the first time this possible association, we found that arterial hypertension, cardiac disease, and cerebral cysticercosis were independent risk factors for stroke in our young and middle-aged patients. Because of the small number of cases for each factor analyzed, the standard deviations were considerable, the significance levels were reduced, and the odds ratio for matched pairs was significant only for smoking.

Although several pathophysiological mechanisms of stroke in patients with cerebral cysticercosis have been sufficiently explained, others remain obscure.\textsuperscript{3-10} We do not know with certainty whether the damage resulting from cerebral cysticercosis directly affects the cerebral blood vessels or whether it is mediated by arterial hypertension, cardiopathy, or other indirect mechanisms. In other words, we do not know whether there are possible factors that cause the association between cerebral cysticercosis and stroke.

In only four of the 19 patients with cerebral cysticercosis did we find the two main risk factors for stroke.\textsuperscript{14,15} Three of the 19 patients had arterial hypertension and four had cardiac disease, which in one case was deemed potentially emboligenous. In 11 case patients, the only possible risk factor for stroke was cerebral cysticercosis.

In conclusion, our study shows that cerebral cysticercosis is a risk factor for stroke in young and middle-aged patients. We find that the effect of cerebral cysticercosis is independent from the other risk factors. Further research is necessary to confirm our results and to
determine the mechanisms whereby cerebral cysticercosis can damage the cerebral blood vessels.

References
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