Post-Stroke Cognitive Impairments

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Cognitive impairments following stroke have in recent years attracted increasing attention from neurologists. A number of studies have demonstrated that the incidence of impaired cognitive functions can reach 40–60% in elderly patients during the first six months following transient ischemic attacks, minor strokes, and strokes with minimal neurological deficit. The severity of cognitive impairments reaches the level of dementia in 5–7% of cases. Post-stroke cognitive impairments are progressive in nature in a significant proportion of cases, reaching the level of dementia by five years in 20–25% of patients with non-severe ischemic strokes [1–16].

The current syndromal classification of cognitive impairments is based on their severity. Mild, moderate, and severe cognitive impairments are recognized [17]. Severe cognitive impairments, which include dementia, are also termed disturbances to cognitive functions resulting in significant difficulties in a patient’s normal daily activities. Moderate cognitive impairments have no influence on daily life but can have adverse effects on the more complex types of activity. Mild cognitive impairments are recognized subjectively but do not interfere with a patient’s routine professional or social adaptation [14, 18–22].

Post-stroke cognitive impairments [14, 18–22] represent an important factor in rendering patients disabled after acute cerebrovascular accidents [4, 7, 12, 17, 23, 24]. The development of an evidence-based therapeutic approach requires an understanding of the pathogenetic mechanisms leading to the formation of cognitive impairments during the acute period of ischemic stroke. The presence of cognitive impairments in a stroke patient’s neurological status does not automatically demonstrate a cause-effect relationship between the cognitive impairments and the acute cerebrovascular accident. Stroke can lead to recurrence and the clinical manifestation of pre-existing problems, including those of neurodegenerative nature. Thus, according to data from the Nun Study [25], the morphological picture of the most common neurodegenerative disease, Alzheimer’s disease (AD), far from always produces clinical symptoms. At the same time, the development of additional cerebrovascular disease in the form of at least two lacunar infarcts significantly increases the probability that dementia will be clinically apparent.

The coexistence of vascular and degenerative brain lesions is not uncommon. Vascular cerebral failure and AD have common risk factors, such as old age, arterial hypertension and other cardiovascular diseases, carriage of the APOE4 allele, and others. The common nature of the pathogenetic mechanisms of the two diseases is a subject of discussion. In particular, it has been demonstrated that hippocampal ischemia can play a role in the development of AD, while the amyloid microangiopathy characteristic of this disease in turn leads to ischemia of the deep areas of the white matter of the brain [17, 26–28]. Clinical morphological comparisons at the end of the last century and the beginning of this [29–32] demonstrated that the combination of vascular and degenerative brain lesions occurs in about 50% of cases of AD diagnosed during life and 77% of cases of vascular dementia diagnosed during life.

The development of clinical psychological diagnostic methods have in recent years has allowed significantly earlier clinical diagnosis of AD. The main accent has been placed on the identification of the specific features of cognitive impairments associated with hippocampal pathology.
Lesions to this area lead to the formation of primary memory disorders. Primary memory impairments are characterized by inefficiency of the processes of semantic remembering and cueing on reproduction, with decreases in the effectiveness of recognizing information and impressions of associated material. The possibility of diagnosing AD at the pre-dementia stages of this disease in terms of detecting the specific characteristics of memory disorders is currently under discussion [4, 17, 19, 20, 26, 30, 33].

The aim of the present work was to clarify the role of the possible neurodegenerative process in the formation of post-stroke cognitive impairments. This was addressed by performing a qualitative neuropsychological analysis using methods sensitive to the cognitive symptoms typical of AD in comparison with clinical and neuroimaging methods.

MATERIALS AND METHODS

A total of 44 patients (23 men and 21 women), mean age 68.7 ± 7.4 years, were studied. All patients had experienced strokes but at the time at which cognitive functions were studied had no severe motor, sensory, or speech disorders which might hinder performance of neuropsychological tests. Seven patients had had strokes in the vertebrobasilar basin and 37 in the carotid basin. Patients were investigated three months after ischemic strokes. The inclusion criteria for the study were the presence of cognitive impairments beyond age norms.

The “five word” test was used for the diagnosis of concomitant AD. This method involves the semantically mediated remembering of five words followed by their reproduction using a categorical cue. Impairments to the remembering and reproduction of words identified by this method provide evidence of primary memory impairments, which are very specific to AD. Decreases in the results of the “five word” test by even only one point allow the presence of this disease to be proposed with a high probability [34].

Depending on the presence or absence of impairments to semantically mediated remembering and reproduction, all patients were divided into two groups. Group 1 consisted of 16 patients (36.4%), in which impairments to semantically mediated remembering and reproduction were identified (results of “five word” test less than 10 points). Group 2 consisted of 28 patients (63.6%), in which no impairments to semantically mediated remembering and reproduction were found (results of “five word” test 10 points).

The Mini Mental State Examination (MMSE) was also used, along with the clock drawing test, the frontal lobe dysfunction battery, the Boston naming test (BNT), semantically mediated associations, remembering, immediate and delayed reproduction of 10 words, remembering and recognition of 12 words, the symbol-digit combination test, the backward number repetition test, the maze test, and the number crossing-out test. Neurological impairments were assessed in all patients using the NIH-NINDS (National Institutes of Health – National Institute of Neurological Disorders and Stroke) test, the Barthel index, and the Rankin test. Emotional disorders were studied using the Hamilton and Beck scales.

Brain MRI scans were obtained from all patients, with assessment of the locations and areas of ischemic foci and rating of the extent of frontal lobe and hippocampal atrophy (0 points = none; 1 point = mild; 2 points = moderate; 3 points = severe) and the severity of periventricular leukoariosis and its extent (0 points = none; 1 point = “caps” close to the horns of the lateral ventricles; 2 points = “caps” and strips around the lateral ventricles, of less than 2 mm; 3 points = “caps” + strips around the lateral ventricles, of greater than 2 mm; 4 = irregular zones of increased signal intensity in the deep areas of the white matter).

Data were analyzed statistically using a personal computer running SPSS-11.5 for the Student’s t test for comparison of two groups, along with non-parametric statistical methods.

RESULTS

On post-stroke day 7, 28 patients (63.6%) showed severe and 16 patients (36.4%) showed moderate cognitive impairments. At three months, moderate cognitive impairments decreased to mild in five patients, there was no change in the proportion with severe impairments, and dementia was diagnosed. The compositions of group 1 and 2 at seven days and three months remained unaltered, i.e., the nature of memory impairments remained unchanged in all patients throughout the study period. In patients of group 1, impairments to semantically mediated remembering were accompanied by signs of primary memory deficits, such as impaired word recognition and reduced semantic memory. At the same time, the remembering and reproduction of words without a cue were virtually no different from those in patients of group 2, with the exception of the third attempt to remember 10 words (Table 1).

Patients with primary memory disorders were characterized by a higher incidence of dementia. In group 1, 81.3% of patients showed dementia, compared with only 53.6% in group 2 (p < 0.05). Patients with primary memory disorders were also characterized by lower MMSE scores and more severe spatial impairments in the clock drawing test. At the same time, there were no differences between groups in the severity of dysregulatory cognitive disorders or speech impairments, with the exception of one measure (correct responses in the symbol-digit combination test, Table 2). There were also no significant differences in the numbers of categorial and phonematic cues in the BNT.

This is evidence that impairments to visual subject gnosis and nominative speech function were of similar severities in the two groups of patients (see Table 2).