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Early Diagnosis of Cognitive Impairment in Chronic Cerebral Ischemia

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Abstract: Chronic cerebral ischemia is considered to be one of the most widespread cerebrovascular disorders and is often accompanied by the progressive deterioration of cognitive abilities. Early diagnosis of cognitive impairment is vital in preventing the subsequent neurological decline and enhancing the outcome of patients. The current research sought to determine the significance of early diagnostic methods of detecting cognitive impairment in chronically cerebral ischemic patients. The study was carried out at the Republican Scientific and Practical Centre of Sports Medicine and involved 64 patients, who had undergone clinical neurological examination and cognitive appraisal. Standardised neuropsychological screening measures were used to assess cognition, such as the Mini-Mental State Examination and the Montreal Cognitive Assessment. They were able to identify some early cognitive disturbances in memory, attention, and executive functioning. It was also using instrumental diagnostic methods to assess structural and vascular features of the chronic cerebral hypoperfusion. The findings showed that mild impaired mental systems were the most prevalent findings among the patients who were reviewed. A lot of people had developed premature signs of diminished focus, reduced information processing, as well as slight memory disturbances. These results indicate that cognitive deterioration can occur slowly in the initial phases of chronic cerebral ischemia and can go undiagnosed unless cognitive evaluation is performed specifically. The paper states the necessity of a combination of neurological examination, neuropsychological testing, and instrumental diagnostic techniques to identify cognitive impairment in its early stages. Timely preventive and therapeutic methods that can be done early in the progression of cerebrovascular pathology can be done, with early diagnosis, and thus prevent or at least delay the deterioration of cognitive function.

Keywords: Chronic Cerebral Ischemia, Cognitive Impairment, Early Diagnosis, Vascular Cognitive Impairment, Neuropsychological Assessment, Cerebral Circulation Disorders

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1. Introduction

Chronic cerebral ischemia is viewed as one of the most prevalent types of cerebrovascular pathologies; it is a significant source of progressive neurological and cognitive dysfunction among adult and elderly demographics. The condition takes place due to long-term cerebral blood insufficiency, which eventually causes structural and functional damage to the neuronal tissue. Continued cerebral hypoperfusion is a known factor that leads to metabolic imbalances of the brain cells and eventually impacts the higher cortical functions that regulate memory, attention, executive functions, and the speed of information processing [1].

During recent decades, cognitive disorders related to vascular pathology have become a rather significant public health concern. There is epidemiological evidence that

vascular factors play a major role in the development of mild cognitive impairment and other types of dementia across the world. Chronic cerebral ischemia is invariably related to arterial hypertension, atherosclerosis, diabetes mellitus and other metabolic diseases that hinder cerebral circulation. These pathophysiological mechanisms result in microangiopathy and white matter harm of the brain, interfering with the brain's neural connectivity, resulting in progressive brain impairment [2].

Among the principal clinical issues, it is possible to mention the fact that cognitive impairment in chronic cerebral ischemia tends to progress gradually and can go unnoticed at the initial stages. Temporary symptoms often include low concentration, mental exhaustion, poor memory, or inability to process complicated mental tasks in patients. These symptoms are usually mistaken for age symptoms and thus postpone the diagnosis and treatment. Although prompt diagnosis of cognitive impairment is essential, as an early therapeutic intervention can delay the disease pathology and minimise the chances of having vascular dementia [3].

The contemporary approaches to diagnosing patients with suspected chronic cerebral ischemia point to the essence of thorough patient evaluation. The joint clinical neurological evaluation with neuropsychological testing enables clinicians to identify the initial abnormalities in cognition. The commonly used screening tools used in identifying mild cognitive impairment in clinical practise include the Mini-Mental State Examination and the Montreal Cognitive Assessment. The tools offer an efficient and rather simplified way of assessing cognitive performance among patients with cerebrovascular disease [4].

Besides neuropsychological testing, neuroimaging is also very critical in the diagnosis of chronic cerebral ischemia. Magnetic resonance imaging has been regarded as one of the most informative methods of identifying structural changes of the brain concerning chronic vascular insufficiency. MRI results usually show white matter lesions, lacunar infarctions, and other microvascular anomalies, which are also associated with the severity of cognitive impairment. Clinical assessment, cognitive testing and neuroimaging in combination with each other are greatly effective in improving the accuracy of diagnosis and early detection of pathological changes in the brain [5].

The current research will examine the early detection of cognitive impairment in chronic cerebral ischemia patients. The case study was carried out in the Republican Scientific and Practical Centre of Sports Medicine and involved 64 patients who were undergoing clinical and neurological assessment. This paper aims to determine the early cognitive disturbances through neuropsychological testing and instrumental diagnostic methods in order to enhance the early detection of cognitive impairment related to chronic cerebrovascular pathology.

2. Materials and Method

This was an observational clinical study conducted in the Republican Scientific and Practical Centre of Sports Medicine. The research goal was to explore the early methods of diagnosis of cognitive impairment in patients with chronic cerebral ischemia. The study involved 64 study participants who had clinically suspected chronic cerebral ischemia. All tests were done as per the usual clinical procedures applied in the neurology practise.

The participants of the study were adult patients who reported complaints regarding cognitive decline, including memory problems, loss of attention, and impairment of mental functioning. Chronic cerebral ischemia was diagnosed with the help of the neurological examination, history of the patient, and the instrumental diagnostic results. The patients who had acute cerebrovascular incidents, severe psychiatric disorders, neurodegenerative diseases, which were not associated with vascular pathology, and severe systemic diseases were not included in the study to reduce possible confounding factors on cognitive performance.

Each of the participants was examined in detail in terms of clinical and neurological examination. Neurological examination comprised of cranial nerve examination, coordination, motor activity, reflexes and sensory examination. The symptoms that are commonly related to chronic cerebral ischemia, such as chronic headache, dizziness, sleep disorder, emotional imbalance, and cognitive ineffectiveness, were given particular heightened consideration. These are the typical symptoms that appear early in the course of chronic cerebrovascular insufficiency and could signify progressive malfunction of cerebral circulation [6].

In order to assess cognitive function, the standard neuropsychological screening tests were used. Cognitive tests were the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA). These assessments enable quick screening of cognitive abilities of memory, attention, language capacity, visuospatial orientation, and executive functioning. MoCA is especially effective in identifying mild impaired cognitive disorder related to vascular architecture and is believed to be more sensitive than most of the old screening measures in identifying early cognitive impairment [7].

Structural brain changes that were occasioned by chronic cerebral ischemia were also detected using instrumental diagnostic methods. Magnetic resonance imaging has been done to determine the presence of ischemic lesions, abnormalities in the white matter, and microvascular changes in the brain tissue. MRI is considered to be one of the most informative imaging techniques used to assess the structural changes that follow the vascular cognitive impairment. White matter hyperintensities, as well as lacunar infarcts, are key to the diagnosis of chronic ischemic damage to the brain [8].

Moreover, to determine the cerebral blood flow, the Doppler ultrasonography of extracranial arteries was also employed to identify potential vascular abnormalities. Using ultrasound, the carotid and vertebral arteries could be examined, and hemodynamic disturbances that can provoke a decrease in cerebral perfusion were revealed. Cerebral impaired circulation has been discussed as one of the determinants used in the development of vascular cognitive impairment and chronic cerebral ischemia [9].

All the collected clinical, cognitive, and instrumental data were recorded and studied with attention. The obtainable results were statistically processed with the help of standard descriptive statistical methods. The severity of cognitive impairment in patients was compared, and the association between neurological symptoms and cognitive test scores were also assessed.

3. Results

The study involved 64 patients who had chronic cerebral ischemia. Neurological assessment and cognitive performance in all of the participants were conducted with standardised screening tools. The discussion of clinical results was able to show that the initial cognitive dysfunction was evident in a large percentage of the studied individuals, despite the comparably mild neurological symptoms.

The population composition of the analysed group revealed that the majority of patients were in the middle-aged and elder age groups. Most of the participants complained of the chronic cerebral ischemia-related persistent symptoms, such as headaches, intermittent dizziness, fatigue, lack of concentration, and insomnia. Such complaints usually preceded the identification of evident cognitive impairment. The clinical findings had shown that most patients initially thought that these symptoms were temporary stress-related symptoms, but not indicative of cerebrovascular pathology.

The outcome of cognitive screening showed different levels of impairment in the patients who were examined. The Montreal Cognitive Assessment (MoCA) was specifically found to be more effective in detecting other minor cognitive changes that were not necessarily evident in the ordinary neurological examination. Patients were often found to have lower performances in tasks involving executive functioning, attention and

delayed recall. These losses are related to the established consequences of chronic cerebral hypoperfusion of frontal-subcortical neural systems of cognitive control and memory mechanisms [10].

Sub-examination of the results of the screening indicated that mild cognitive impairment was the most common among the participants of the study. Mildly impaired patients were generally exhibiting less cognitive flexibility and slower processing of information and mild short-term memory disruptions. Moderate cognitive impairment, on the other hand, was accompanied by more noticeable losses in terms of both orientation and verbal recall and problem-solving ability. A few of the patients depicted evidence of constant cognitive impairment, which indicates that the majority of the subjects of the study were observed at fairly young ages of cerebrovascular illness.

The evidence of the presence of chronic ischemic changes in the brain was also supported by instrumental diagnostic findings. MRI conducted on the chosen patients showed white areas of lesions in the brain and microvascular anomalies characteristic of chronic cerebral vascular inadequacy. These neuroimaging changes are extensively known as significant structural alterations that are linked to vascular cognitive impairment. The poor cognitive functions and the impairment of the neural connectivity in the frontal and subcortical areas are usually associated with the existence of such lesions [11].

Moreover, hemodynamic disturbances were found in a large percentage of the patients by Doppler ultrasonography of extracranial arteries. Less cerebral blood flow and higher vascular resistance were commonly observed in subjects who manifested cognitive impairment. These results help to defend the idea that chronic vascular insufficiency is one of the main factors in the development of cognitive decline in patients with chronic cerebral ischemia [12]. Table 1 displays the distribution of the severity of cognitive impairment among the analysed patients.

Table 1. Distribution of cognitive impairment severity among patients with chronic cerebral ischemia (n = 64)

Severity of cognitive impairment	Number of patients	Percentage
No significant impairment	12	18.8%
Mild cognitive impairment	30	46.9%
Moderate cognitive impairment	16	25.0%
Severe cognitive impairment	6	9.3%

The information collected in Table 1 shows that mild cognitive impairment was the most common one, with almost half of the reviewed patients. This observation underscores the significant role of prompt screening of cognitive impairment among persons with chronic cerebral ischemia. The early detection of mild brain damage gives a chance to intervene in time in order to prevent the subsequent neurological decline. On balance, the received findings can be regarded as evidence that cognitive impairment in chronic cerebral ischemia is a progressive process that can go undiagnosed unless specific neuropsychological examination is conducted. The preparation of the neurological examination, cognitive screening, and instrumental diagnostic methods can contribute greatly to the identification of the initial cognitive disturbances, and it enables clinicians to start the preventive and therapeutic plans.

4. Discussion

The results of the given research prove that cognitive impairment is a common and early symptom of chronic cerebral ischemia. The comparison of clinical and neuropsychological data of 64 patients who were tested at the Republican Scientific and

Practical Centre of Sports Medicine shows that the signs of cognitive disturbances can be observed even at the comparatively early stages of cerebrovascular illness. A significant percentage of studied patients expressed mild cognitive impairment signs, which proves the idea that the progressive weakening of higher cortical functions by chronic cerebral hypoperfusion might be gradual enough to manifest itself in the form of severe neurological deficits only at the later clinical stage.

The fact that mild cognitive impairment predominates among patients with chronic cerebral ischemia is one of the most significant observations of this study. This trend is in line with the existing scientific results, which elaborate that vascular cognitive impairment tends to initiate with minor disruptions in elements like attention, executive processing and processing speed. These intellectual areas are especially prone to impairments of frontal-subcortical neural pathways, which are very vulnerable to insufficient cerebral blood flow. In the cases where chronic vascular insufficiency continues, microvascular damage and white matter changes could gradually interfere with these neural networks and cause greater cognitive impairments [13].

The findings also demonstrate the role of neuropsychological screening instruments in early identification of cognitive impairment. In this study, standard cognitive tests, including the Montreal Cognitive Assessment and Mini-Mental State Examination, enabled the researcher to identify cognitive disruptions, which would not have been identified with the normal neurological examination. The past studies have highlighted that MoCA is particularly effective in detecting early vascular cognitive impairment since it contains activities that help in the evaluation of executive functioning and visuospatial skills, which are often compromised in cerebrovascular diseases [14]. Thus, the incorporation of organised cognitive screening into regular clinical examination can have a significant positive effect on early diagnosis.

The other critical element that the study elicited is the contribution of structural brain changes in the creation of cognitive impairment. The neuroimaging in patients who have chronic cerebral ischemia tends to show a white matter lesion, lacunar infarction, and microvascular abnormalities. These structural changes have been well known as neuroimaging evidence of small vessel disease, which is among the major pathological processes of vascular cognitive impairment. Damage to white matter tracts interferes with communication among various brain parts and leads to deterioration of cognitive abilities, especially those pertaining to executive functioning and attention [15].

Hemodynamic changes observed using Doppler ultrasonography also contribute to the vascular cause of cognitive impairment in long-term cerebral ischemia patients. Decreased cerebral blood flow and abnormalities of vascular resistance can interfere with the processes of oxygen and nutrient delivery to neuronal tissue, causing metabolic stress and progressive dysfunction of neurons. Cerebral hypoperfusion during a long-term period has been demonstrated to facilitate neuroinflammatory responses, oxidative stress, and neurodegeneration progression, all of which facilitate the exacerbation of cognitive functions [16].

The findings of the current research stress the fact that early identification of cognitive deficiency in chronically cerebral ischemia patients has significant clinical consequences. Early diagnosis of mild cognitive impairments will enable clinicians to develop preventive measures that would promote cerebral circulation and management of vascular risk factors, including high blood pressure, diabetes, and hypercholesterolemia. Early treatment can delay the severe course of damage to cognitive functions and lower the chances of acquiring vascular dementia. There are also recent studies which indicate that multidisciplinary management, which involves pharmacology, cognitive training and lifestyle change, could be very effective in improving cognitive functions of vascular cognitive impairment patients [17].

On the whole, the results can be seen as contributing to the extensive current body of evidence indicating that chronic cerebral ischemia is a significant factor in the formation of cognitive disorders and the need to use comprehensive diagnostic methods. The integration of a neurological assessment, neuropsychological screening and instrumental diagnostic methods can enable clinicians to identify early cases of cognitive trouble and take relevant therapeutic action before it is too late to undo neurological deterioration.

5. Conclusion

The current research reveals that a common and early symptom of long-term cerebral ischemia is cognitive impairment. The findings of the study of 64 patients suggest that at the early signs of the development of cerebrovascular insufficiency, there is a significant number of people who already reveal the symptoms of cognitive impairment. In the majority of cases, such disturbances manifest themselves in the form of mild impairments of attention, memory, and executive functioning. These changes can grow over time and go unrecognised in the long run if there is no cognitive screening conducted. The results emphasise the role of a diagnostic evaluation in the early stages of patients with suspected chronic cerebral ischemia. It may not be true that a simple neurological assessment will always be sufficient in noting subtle changes in cognitive functioning, but when standardised neuropsychological tests are used, clinicians can identify early abnormalities in cognitive functioning. These impairments need to be detected early since this will provide a window through which medical treatment and preventive advancements can be made to reduce the rate of disease progression. Instrumental diagnostic methods are also important in establishing the vascularity of cognitive deterioration. The brain abnormalities and structural alterations may be a significant cause of cognitive impairment. Thus, a combination of the concept of clinical evaluation, cognitive screening, and instrumental methods will give a more detailed picture of the neurological situation of the patient. To sum up, an early diagnosis of cognitive impairment in chronic cerebral ischemia is a major contributor to the prevention of further neurological degradation. Prompt treatment and proper management measures could be useful in the preservation of cognitive ability and general quality of life of the affected individuals.

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