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COGNITIVE IMPAIRMENT IN EPILEPSY

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Abstract

Epilepsy is a neurological disorder that often causes memory problems and other cognitive difficulties. This article examines the reasons behind cognitive impairment in individuals with epilepsy, focusing on memory issues in adults and older adults as well as the long-term effects on thinking and learning. Seizures, interictal discharges, and changes in brain networks all contribute to these cognitive problems. Common memory issues include accelerated long-term forgetting and transient epileptic amnesia. Over time, epilepsy can impact skills such as problem-solving and decision-making. Managing seizures and cognitive as well as emotional health is essential to improving the overall quality of life of patients with epilepsy.

KEYWORDS: brain signals, epilepsy, impairment, learning, memory, seizures, thinking

INTRODUCTION

Epilepsy is a neurological disorder often associated with cognitive and behavioral limitations. It causes complex changes in the genome, gene expression, receptor function, peptide structure, as well as brain damage. These changes result in seizures and some functional abnormalities that cause cognitive difficulties. These difficulties happen because of a mix of seizure activity, unusual brain signals between seizures (called interictal discharges or IDs), and problems in the brain's communication system that helps process information.[1] Even if a patient with epilepsy does not have a full seizure, their brain can show brief abnormal activity, also known as subclinical epileptiform discharges, which can affect memory and executive function.[2] Cognitive impairment is common in adults with new-onset epilepsy, and memory problems are one of the most frequently observed issues in neuropsychological tests.[3] Children with epilepsy, especially those with early-onset seizures, face a higher risk of experiencing learning and developmental difficulties. These issues often stem from underlying brain abnormalities, not just seizure activity.[4] This can be seen in cases of early-onset epilepsy in preschool children who later on have long-term cognitive challenges due to the disruption of critical brain development periods.[5] Recent research has identified potential biomarkers, including changes in how different parts of the brain communicate, which may help predict cognitive decline in epilepsy patients.[6] A better understanding of how these issues develop could help prevent or reduce cognitive decline in people with epilepsy, ultimately improving their quality of life. This article will explore the causes and mechanisms behind cognitive impairment in epilepsy, focusing on memory impairment in adults and the long-term effects of epilepsy on cognitive functions, including thinking and learning.

CAUSES AND MECHANISMS BEHIND COGNITIVE IMPAIRMENT IN EPILEPSY

Cognitive dysfunction is a common factor present in various mental health disorders and emotional or motivational factors can further contribute to said cognitive deficits.[7] Cognitive impairment in epilepsy can result from several factors, including seizures, interictal discharges, and disruptions in brain networks. Repeated seizures, especially in cases of early-onset epilepsy, can lead to significant brain damage, affecting focus, memory and the ability to process new information. The degree of cognitive impairment is often connected to the frequency and intensity of these seizures, with children being particularly vulnerable to long-term cognitive issues. In addition to seizures, brief, abnormal bursts of electrical activity that occur between seizures (better known as IDs) can disrupt cognitive functions. While these discharges do not cause visible seizures, they can impair attention, memory retrieval, and learning. Frequent IDs may contribute to more lasting cognitive deficits over time. Epilepsy has been shown to cause instability in the brain's neural networks, which are responsible for processing information through electrical signals. Such disruption can interfere with normal brain functions, making concentrating, recalling memories, and making decisions difficult. Together, these factors contribute to the cognitive challenges that individuals with epilepsy face, particularly with thinking, learning, and memory.[1]

In temporal lobe epilepsy (TLE) patients, the brain attempts to stop seizures from spreading by creating isolated areas around the focus of the epileptic network, which ultimately makes the brain less flexible, leading to cognitive difficulties.[8]

Epilepsy disrupts brain oscillations, such as theta and gamma waves, which help organize thoughts, store information, and retrieve memories, resulting in cognitive impairment. Additionally, seizures and interictal discharges interfere with neuroplasticity, impairing the brain's ability to adapt

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and store new information efficiently and further affecting cognitive function.[1]

MEMORY IMPAIRMENT IN ADULTS

There are different proposed origins of memory difficulties in epilepsy. It might stem from damage to the hippocampus, brain activities linked to seizures that do not cause noticeable symptoms or issues with brain networks associated with memory. However, it has been shown that even people who are newly diagnosed with epilepsy, without brain damage, frequent seizures or medication history can still have memory problems. This means memory issues in people with epilepsy can happen even without these common causes.[3]

Patients with epilepsy often experience changes in their brain connections when they are at rest which can affect their attention and memory. One key area affected is the "default mode network", which is significant for thinking and remembering.[9] Memory impairment is a common cognitive issue in adults with new-onset epilepsy. Although standard neuropsychological tests often show typical memory performance in about half of these individuals, research suggests that they may experience accelerated long-term forgetting (ALF), where learned information is forgotten faster.[3] Older adults with unmanageable epilepsy, especially those on multiple antiepileptic drugs (AEDs), experience significant cognitive impairments, and depressive symptoms that can further worsen these cognitive difficulties.[10] Sleep disturbances and sleep medication use were, as well as old age, associated with substandard cognitive function in patients with epilepsy.[11] Anxiety is also an important factor contributing to cognitive impairments in older adults with epilepsy, and treating it may improve cognitive outcomes.[12]

A study of 38 adults with new-onset epilepsy done by Pugh et al. assessed memory performance using a Rey Auditory Verbal Learning Test (RAVLT) at baseline (30-minute delay) and after one week, alongside psychological measures such as mood and anxiety. [3] The results showed that, as a group, people with epilepsy performed worse than control groups across all memory tests, as 44% of epilepsy patients showed memory impairment at the 30-minute delay, and even those who scored within the normal range initially exhibited more significant memory loss over one week compared to controls. Contextual memory (memory for tasks performed at baseline) was also significantly lower in the epilepsy group after one week. Despite objective memory impairments, self-reported memory complaints were not linked to actual performance but were closely tied to mood and anxiety levels. This study confirms that memory deficits in individuals with new-onset epilepsy are evident both in the short and long term. While extended delay memory testing is unnecessary for all patients, it may be helpful for those with persistent memory complaints. This study shows how both cognitive and emotional factors should always be considered in patient care with those who have epilepsy and cognitive impairment.

Memory problems in adults with epilepsy can appear in different ways. Some individuals suffer from Transient Epileptic Amnesia (TEA), where they have brief episodes of memory loss as a primary symptom of their epilepsy. Others experience Accelerated Long-Term Forgetting (ALF), meaning they can initially learn and recall new information usually, but they forget it much faster than expected over days or weeks. Additionally, some people struggle with Remote Memory Impairment, which affects their ability to remember past events, including personal memories and general knowledge. These memory difficulties are most commonly noticed in individuals with temporal lobe epilepsy, as this brain region plays a crucial role in memory processing. [13]

THE LONG-TERM IMPACT OF EPILEPSY ON THINKING AND LEARNING

Epilepsy's effects on thinking and learning can be long-term, especially among those who have frequent seizures or early-onset epilepsy. It has been associated with lower IQ scores, poorer academic performance, and less developed cognitive skills in children. For adults with chronic epilepsy, cognitive decline is a significant concern. Long-term epilepsy increases the risk of memory loss and problems with problem-solving and decision-making. The severity of these issues depends on seizure frequency, abnormal brain activity between seizures, and the overall impact of epilepsy on brain networks. Research shows repeated seizures can lead to lasting changes in brain structure and function, especially in memory-related areas like the hippocampus (exceptionally verbal memory in temporal lobe epilepsy)[14]. These changes potentially lead to cognitive decline, making early and effective epilepsy management crucial to preserve brain function.[13]

Short-term effects of epilepsy can cause brief disruptions in attention and memory, making it more difficult to complete everyday tasks. Over time, if seizures and interictal discharges persist, they can lead to lasting cognitive problems, especially in younger individuals whose brains are still developing. Although antiepileptic drugs and surgery can help control seizures, they do not continuously improve cognitive function. Some medications may even slow down cognitive abilities in some instances, creating additional challenges for individuals with epilepsy.[1]

Studies show that memory problems after seizures (postictal memory deficits) in people with temporal lobe epilepsy can help predict how their memory might change after epilepsy surgery. Patients who experience more severe memory issues after seizures are at a higher risk of further decreasing their memory after surgery, as the procedure often affects brain areas involved in memory processing. This information can help doctors estimate potential risks before suggesting surgery.[15]

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CONCLUSION

Cognitive impairment, especially memory issues, is a common and serious concern for people with epilepsy, affecting both those who are newly diagnosed and those with long-term epilepsy. The causes of these impairments are complicated and represent a combination of seizure activity, interictal discharges, and network disturbance, especially within regions of the brain associated with memory. Research shows that repeated seizures and abnormal brain activity between those seizures can damage memory, attention, and learning, leading to long-lasting cognitive impairment, particularly in younger individuals and those with temporal lobe epilepsy. Although treatments can help control seizures, they do not always improve cognitive problems and, in some cases, can even worsen them. This indicates that patient care focusing on seizure control and cognitive and emotional health support is essential. The links between epilepsy and cognitive impairment need to be further explored so that new methods could lead to better ways of preventing or lessening cognitive decline and enhancing the quality of life for patients with epilepsy. Furthermore, continued research into biomarkers for cognitive impairment could improve our understanding of epilepsy and help us predict how epilepsy progresses, allowing for more effective seizure management and cognitive impairment treatment strategies.

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KOGNITIVNA OŠTEĆENJA KOD EPILEPSIJE

Sažetak

Epilepsija je neurološki poremećaj koji često uzrokuje probleme s pamćenjem i druge kognitivne poteškoće. Ovaj članak istražuje uzroke kognitivnih oštećenja kod osoba s epilepsijom, naglašavajući probleme s pamćenjem kod odraslih i starijih odraslih te dugoročne učinke epilepsije na razmišljanje i učenje. Napadaji, interiktalna izbijanja i promjene u mrežama mozga doprinose tim kognitivnim problemima. Uobičajeni problemi s pamćenjem uključuju ubrzano dugoročno zaboravljanje i prolaznu epileptičku amneziju. S vremenom, epilepsija može utjecati na vještine poput rješavanja problema i donošenja odluka. Ključno je upravljati napadajima i očuvanjem kognitivnog zdravlja kako bi se poboljšala kvaliteta života kod osoba s epilepsijom.

KLJUČNE RIJEČI: epilepsija, mozgovni signali, napadaji, oštećenje, pamćenje, razmišljanje, učenje