FUNCTIONAL–METABOLIC NEUROPHYSIOLOGICAL FEATURES OF DEPRESSIVE STATES IN CHRONIC HEADACHE

Jabborov Azizxon Akmaljonovich
Assistant, Department of Pediatrics No. 2, Fergana Institute of Public Health.

https://doi.org/10.5281/zenodo.18092589

Abstract. *Chronic headaches often co-occur with depressive symptoms, affecting quality of life. Functional neuroimaging shows altered activity in prefrontal, cingulate, and limbic regions, while metabolic studies reveal glucose, mitochondrial, and neurotransmitter disturbances. These functional–metabolic changes contribute to pain chronification and emotional dysregulation.*

Understanding them is essential for developing targeted therapies and improving patient outcomes.

Keywords: *Chronic headache; Depression; Neurophysiology; Metabolic dysfunction; Pain modulation.*

Introduction

Chronic headaches represent a prevalent neurological condition that significantly impairs quality of life. Chronic forms of headache are often associated not only with somatic symptoms but also with psychological and cognitive disturbances. Clinical observations indicate that a substantial proportion of patients suffering from chronic headaches also experience depressive symptoms and mood disturbances.

Recent studies using neuroimaging and metabolic analyses have revealed a complex functional and metabolic relationship between chronic headaches and depression.

Neurophysiological investigations have particularly highlighted dysfunctions in specific brain regions, including the prefrontal cortex, anterior cingulate cortex, and limbic system.

These dysfunctions play a crucial role not only in pain signal processing but also in regulating emotional states and motivation. Therefore, investigating the functional–metabolic neurophysiological basis of depressive states associated with chronic headaches represents a pressing scientific challenge in modern neurology and psychiatry. This study aims to explore these complex interactions, contributing to the improvement of patient quality of life and the development of individualized therapeutic approaches.

Main part

Chronic headaches are among the most common neurological disorders worldwide, affecting millions of individuals across all age groups. Epidemiological studies show a higher prevalence in females and in populations with elevated stress levels. The clinical presentation of chronic headaches often includes tension-type headaches, migraines, and mixed headache syndromes. In addition to persistent pain, patients frequently report fatigue, irritability, sleep disturbances, and cognitive difficulties.

A significant proportion of patients with chronic headaches also experience depressive symptoms, ranging from mild mood disturbances to major depressive disorder. The co-occurrence of chronic headaches and depression increases disability, reduces quality of life, and complicates treatment. Longitudinal studies indicate that the presence of depressive symptoms may exacerbate headache frequency and intensity.

Clinical assessments often reveal overlapping symptomatology, making differential diagnosis challenging. Standardized rating scales, including the Hamilton Depression Rating Scale and Beck Depression Inventory, are commonly employed to quantify depressive symptoms in patients with chronic headaches. Identifying these comorbidities is essential for holistic patient management. Understanding the epidemiology and clinical characteristics of this comorbidity provides the foundation for exploring underlying neurophysiological mechanisms. Comprehensive evaluation enables clinicians to implement more effective pharmacological and non-pharmacological interventions tailored to individual patient needs.

Functional neuroimaging studies have highlighted the involvement of several key brain regions in patients with chronic headaches and comorbid depression. The prefrontal cortex, anterior cingulate cortex, insula, and limbic structures demonstrate altered activation patterns in response to pain and emotional stimuli. These changes suggest a disruption in the neural networks responsible for pain modulation, emotional regulation, and cognitive processing. Resting-state functional MRI and task-based imaging have revealed abnormal connectivity between the prefrontal cortex and limbic regions, indicating impaired top-down control of nociceptive input.

Functional alterations in the anterior cingulate cortex are associated with enhanced pain perception and heightened emotional response. Electroencephalographic studies further support these findings by showing aberrant oscillatory activity in frontal and temporal regions. Patients often exhibit increased theta and alpha power, which may correlate with depressive symptoms and impaired attention.

Functional neurophysiology provides insight into the complex bidirectional relationship between chronic pain and mood disturbances. Understanding these mechanisms is critical for developing targeted neuromodulatory interventions. Techniques such as transcranial magnetic stimulation and neurofeedback aim to restore functional network balance, thereby alleviating both pain and depressive symptoms in affected individuals.

Metabolic imaging studies have identified significant neurochemical and metabolic alterations in patients suffering from chronic headaches with depressive comorbidity. Proton magnetic resonance spectroscopy has shown changes in glutamate, gamma-aminobutyric acid, and N-acetylaspartate levels within the prefrontal cortex and limbic structures.

These alterations reflect neuronal dysfunction and impaired inhibitory-excitatory balance.

Neuroinflammatory processes also contribute to the pathophysiology, with elevated levels of proinflammatory cytokines such as interleukin-6 and tumor necrosis factor-alpha observed in both central and peripheral systems.

These cytokines influence pain sensitivity, neurotransmitter metabolism, and mood regulation. Alterations in serotonergic and dopaminergic pathways have been consistently reported, affecting both affective and nociceptive processing. Reduced serotonin availability may exacerbate depressive symptoms, while dopaminergic dysregulation can impact motivation and reward circuits.

Metabolic and neurochemical assessments thus provide essential biomarkers for disease severity and therapeutic response. Integrating functional and metabolic findings can guide personalized treatment approaches, optimizing outcomes for patients experiencing chronic headaches with comorbid depressive states.

Conclusion

Chronic headaches accompanied by depressive states represent a complex clinical condition with significant implications for patient quality of life and functional capacity. The interplay between persistent pain and mood disturbances involves intricate functional and metabolic neurophysiological mechanisms.

Functional neuroimaging studies reveal altered connectivity and activity in the prefrontal cortex, anterior cingulate cortex, limbic system, and other related brain regions, indicating disruptions in pain modulation, emotional regulation, and cognitive processing. Metabolic and neurochemical analyses further support these findings, demonstrating changes in neurotransmitter levels, neuroinflammatory markers, and neuronal integrity.

These alterations underline the bidirectional relationship between chronic pain and depression, where each condition can exacerbate the other. Understanding the functional–metabolic neurophysiological basis of this comorbidity is essential for developing targeted therapeutic interventions.

Integrating clinical assessment, neuroimaging, and metabolic biomarkers can guide personalized treatment strategies, ultimately improving both pain management and mental health outcomes. Future research should focus on longitudinal studies and advanced neuromodulatory approaches to optimize patient care and mitigate the long-term impact of these interrelated conditions.

References

1. Grech, O., Sassani, M., Terwindt, G., Lavery, G., Mollan, S., & Sinclair, A. (2022). Alterations in metabolic flux in migraine and the translational relevance. The Journal of Headache and Pain, 23(1), 127.
2. Zhao, C., et al. (2024). ^1H-MRS reveals abnormal energy metabolism and excitatory-inhibitory imbalance in a chronic migraine-like state induced by nitroglycerin in mice. The Journal of Headache and Pain, 25, 163.
3. Абдукадирова, Д. Т., Абдукадиров, У. Т., & Жабборов, А. А. (2022). ДИАБЕТИЧЕСКАЯ ПОЛИНЕЙРОПАТИЯ: ПУТИ ПОЛНОЦЕННОЙ КОРРЕКЦИИ НЕВРОЛОГИЧЕСКОГО ДЕФИЦИТА. *Новости образования: Исследование в XXI веке*, *306*.
4. Джабборов, А. А. О. (2025, February). ОСОБЕННОСТИ ПОРАЖЕНИЯ ПЕРИФЕРИЧЕСКОЙ НЕРВНОЙ СИСТЕМЫ У БОЛЬНЫХ САХАРНЫМ ДИАБЕТОМ II ТИПА И АЛГОРИТМ ПРОФИЛАКТИКИ. In *Scientific Conference on Multidisciplinary Studies* (pp. 158-164).