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Neurobiology of the relationship between sleep disorders and headaches: an integrative review

Pablo Guarisco Ferreira; Kleber Fernando Pereira; Lara Henriqueta Bussolaro Ricardi; Marcelo Alvarenga de Carvalho Neto; Luis Gustavo Pagliarin; Cristiano de Bem Torquato de Souza; Alcântara Ramos de Assis César

Universidade Federal do Paraná, Toledo, Brazl.

Introduction

Headaches are among the most prevalent and disabling diseases worldwide. Sleep can alleviate, trigger, or modify the pain syndrome. Some headache types are directly related to sleep, such as hypnic headache, while others are indirectly related through neurobiological convergences, such as cluster headache and migraine, or even sleep deprivation (migraine and TTH) or excessive sleep as a trigger (cluster headache).

Objective

In the present study, the relationship between sleep disturbances and primary headaches is highlighted based on neurobiology.

Methods

This is an integrative review paper. A search was performed on PubMed and Google Scholar platforms using the keywords "headache and sleep" and "headache and sleep disorders".

Results

Sleep and headache share several nervous system structures and mechanisms that play a central role in their regulation. The cortex plays a role in sensory processing of pain and its modulation, both in primary sensitivity (nociceptive afferents of the trigeminocervical complex-CTC) and in cognitive and affective processing of pain and modulation of direct and indirect descending pathways for CTC. Studies report alterations in cortical excitability and pain modulation in patients with headache and patients with sleep disorders, such that a reduction in sleep quality promotes a reduction in pain threshold. The hypothalamus, the major structure linking headache and sleep, plays a fundamental role in the pathophysiology of headache, including migraine and cluster headache, and in the regulation of the circadian cycle. In migraine, the hypothalamus has a direct action, through connections with the CTC and an indirect action, through connections with the periaqueductal gray matter (PAG) and with the locus coeruleus (LC); hyperactivation of the hypothalamus is present during the pain crisis as well as during the premonitory phase. Individuals suffering from migraine also exhibit alterations in orexin levels, possibly related to the shortening of REM sleep duration in these individuals, which is related to hyperalgesia during the crisis. In addition, the hypothalamic dopaminergic nucleus A11 participates in CTC modulation and has an inhibitory effect on sympathetic neurons and on the dorsal horn of the medulla. Its dysfunction has been associated with migraine prodrome and restless legs syndrome. In the brainstem, the main related regions are the dorsal raphe nucleus (DDR), LC and PAG, which promote wakefulness and REM-off and modulate nociception. The LC, the main source of cerebral noradrenaline, receives nociceptive afferents from the CTC and hypothalamic nuclei; its activation promotes intracerebral vasoconstriction and extracerebral vasodilation. The NDR, the main cerebral serotonergic nucleus, has an antinociceptive function in the suppression pathway of spinothalamic nociception and promotes wakefulness that follows circadian rhythm. In migraine, there are alterations in serotonin metabolism with a decrease in levels during the interictal phase and an increase during crises12. PAG acts on medullary and trigeminal enkephalinergic internuncial neurons and has an analgesic effect. In the ventrolateral region (vlPAG), its stimulation inhibits trigeminal afferents, and like LC and the NDR, it receives orexinergic afferents.

Conclusion

Sleep disorders and headaches are two closely related conditions. They share common dysfunctions in anatomical structures and neurobiological pathways, so one exacerbates the other when accompanied. Therefore, point out the importance of investigating the presence of alterations in sleep behavior in headache patients to achieve better therapeutic assertiveness.

Keywords: Headache; Sleep disorders; Physiopathology.