МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ`Я УКРАЇНИ
БУКОВИНСЬКИЙ ДЕРЖАВНИЙ МЕДИЧНИЙ УНІВЕРСИТЕТ

МАТЕРІАЛИ

III науково-практичної інтернет-конференції

РОЗВИТОК ПРИРОДНИЧИХ НАУК ЯК ОСНОВА НОВІТНІХ ДОСЯГНЕНЬ У МЕДИЦИНІ

м.Чернівці
21 червня 2023 року

СЕКЦІЯ 3. ВПЛИВ ТЕХНОГЕННИХ ЧИННИКІВ НА ЗДОРОВ'Я ЛЮДИНИ. НАНОТОКСИКОЛОГІЯ

UDC 577.175.1/615.851

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FACTORS OF DESYNCHRONOSIS: METABOLIC DISORDERS CAUSED BY MELATONIN IMBALANCE

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Abstract. Desynchronosis refers to a condition characterized by disturbances in circadian rhythms, commonly caused by melatonin imbalance. The article aims to explore the factors contributing to desynchronosis and its associated metabolic disorders.

Key words: melatonin, circadian rhythms, desynchronosis, metabolic disorders.

Introduction. Melatonin, a hormone produced by the pineal gland, plays a crucial role in regulating circadian rhythms and sleep-wake cycles. Circadian rhythms are daily cycles of biological processes that are regulated by the molecular clock, which consists of clock genes that generate circadian rhythms through transcriptional-translational feedback loops [2].

Desynchronosis is a disruption of the body's internal clock, including the rhythm of melatonin secretion leading to a misalignment between the endogenous circadian rhythms and external environmental cues. Several factors can contribute to desynchronosis, including shift work, jet lag, exposure to artificial light at night, and irregular sleep patterns. Disruption of the molecular clock can lead to desynchronosis and metabolic disorders [3].

Circadian rhythms regulate various aspects of glucose metabolism, including insulin secretion, glucose uptake, and hepatic glucose production. Desynchronosis can disrupt these rhythms, leading to impaired glucose homeostasis and insulin resistance. For example, shift work has been shown to increase the risk of type 2 diabetes due to circadian misalignment, which can impair insulin sensitivity and glucose tolerance [8]. Furthermore, desynchronosis can affect the expression of clock genes in pancreatic β-cells, which can impair insulin secretion and contribute to the development of insulin resistance [10]. Disrupted circadian rhythms can alter the expression and activity of key insulin signaling components, such as insulin receptors and downstream signaling

molecules. These changes can impair insulin-mediated glucose uptake, utilization, and storage in target tissues, including skeletal muscle, adipose tissue, and the liver.

Circadian misalignment can also disrupt the secretion of hormones such as cortisol, which can contribute to insulin resistance and impaired glucose homeostasis [4]. Desynchronosis, can modulate the expression and activity of enzymes involved in gluconeogenesis, such as phosphoenolpyruvate carboxykinase (PEPCK) and glucose-6-phosphatase (G6Pase) [9].

Circadian rhythms also regulate lipid metabolism, including lipogenesis, lipolysis, and cholesterol synthesis. Circadian misalignment has been associated with increased triglyceride levels and altered cholesterol metabolism [9]. Additionally, desynchronosis can affect the expression of clock genes in the liver, which can impair the regulation of lipogenic and lipolytic enzymes, leading to dyslipidemia [1].

Circadian misalignment can disrupt the secretion of hormones such as leptin and ghrelin, which can affect appetite regulation and lipid metabolism, contributing to dyslipidemia [5]. Dyslipidemia associated with desynchronosis often manifests as elevated levels of triglycerides, low-density lipoprotein cholesterol, and decreased levels of high-density lipoprotein cholesterol. Circadian disruption affects the expression and activity of lipid transporters, such as ATP-binding cassette transporters and lipoprotein lipase. These alterations in lipid transport mechanisms can result in impaired clearance of lipids from circulation and their deposition in peripheral tissues. These lipid abnormalities contribute to the development of atherosclerosis, cardiovascular diseases, and other metabolic disorders [11].

Desynchronosis can impair the process of lipolysis, which is the breakdown of triglycerides stored in adipose tissue to release fatty acids into circulation for energy utilization. Altered expression and activity of lipolytic enzymes, such as hormone-sensitive lipase and adipose triglyceride lipase, leading to reduced lipolytic capacity which contributes to increased adiposity, elevated circulating triglyceride levels, and the accumulation of ectopic lipids in non-adipose tissues, promoting metabolic dysfunction [1].

Mitochondria play a crucial role in cellular energy production through oxidative phosphorylation. Disrupted circadian rhythms can influence the expression and activity of mitochondrial enzymes, respiratory chain complexes, and transcriptional regulators involved in mitochondrial function. Mitochondrial dysfunction contributes to compromised ATP production, increased reactive oxygen species (ROS) generation, and impaired metabolic flexibility. These alterations can further exacerbate metabolic disorders and contribute to cellular damage and dysfunction [12].

Desynchronosis can lead to alterations in energy expenditure, substrate utilization, and mitochondrial biogenesis, which can contribute to the development of metabolic disorders such as obesity and insulin resistance [5]. For example, circadian disruption can impair the expression of clock genes in skeletal muscle, which can affect mitochondrial function and energy metabolism [4].

Desynchronosis can impair thermogenesis, the process by which the body generates heat to maintain body temperature and regulate energy expenditure. Disrupted circadian rhythms can affect the expression and activity of thermogenic proteins, such as uncoupling protein 1 (UCP1) in brown adipose tissue. Impaired thermogenesis contributes to reduced energy expenditure and metabolic efficiency, which can promote weight gain and metabolic dysregulation [6].

Circadian rhythms regulate key metabolic pathways involved in energy metabolism. Desynchronosis disrupts the circadian regulation of metabolic processes such as glycolysis, gluconeogenesis, lipid metabolism, and mitochondrial function. Disrupted circadian rhythms can affect the expression and activity of clock genes and transcription factors that control these metabolic pathways. Altered circadian regulation of metabolic pathways contributes to energy metabolism dysregulation and metabolic disorders associated with desynchronosis [6].

Circadian rhythmsт disorder can lead to imbalances in neurotransmitter levels, which can affect various physiological processes, including sleep, mood, and metabolism. Circadian disruption can alter the release of neurotransmitters such as serotonin, dopamine, and norepinephrine, which can contribute to sleep disturbances, mood disorders, and metabolic dysregulation [14].

For example, desynchronosis can impair the release of serotonin and dopamine, which can affect mood disorders such as depression, addiction anxiety, appetite regulation and energy expenditure, leading to weight gain and obesity [7]. Disrupted circadian rhythms can affect the expression and activity of enzymes involved in serotonin and dopamine synthesis, such as tryptophan hydroxylase and tyrosine hydroxylase, as well as their receptors and transporters [14].

Sleep restriction, another consequence of desynchronosis, can impair the release of neurotransmitters such as norepinephrine, which can affect alertness, mood, and cognitive function, attention, and stress response [14].

GABA is an inhibitory neurotransmitter that helps regulate neuronal excitability and anxiety levels. Altered GABA function is associated with anxiety disorders and sleep disturbances. Disrupted circadian rhythms can affect the expression and activity of GABA synthesizing enzymes, such as glutamic acid decarboxylase, and GABA receptors [14].

Melatonin is a hormone primarily synthesized and released by the pineal gland during darkness. It acts as a potent antioxidant and plays a crucial role in regulating oxidative stress in the body. Melatonin scavenges free radicals, reduces the production of reactive oxygen species (ROS),

and protects against oxidative damage to cells and tissues [11]. Oxidative stress, resulting from melatonin disruption and increased ROS production, can have detrimental effects on cellular components, including lipids, proteins, and DNA. It can lead to cellular dysfunction, tissue damage, and contribute to the development of various diseases, including metabolic disorders, cardiovascular diseases, neurodegenerative disorders, and cancer [12].

Understanding the biochemical abnormalities associated with desynchronosis provides insights into potential therapeutic interventions. Chronotherapy, melatonin supplementation, lifestyle modifications, and targeting specific biochemical pathways hold promise for managing metabolic disorders linked to desynchronosis [12]. Various therapeutic approaches have been proposed to address melatonin imbalance and its associated metabolic disorders. These include melatonin supplementation, light therapy, and lifestyle modifications such as maintaining regular sleep patterns and reducing exposure to artificial light at night [2].

Conclusion. Desynchronosis, characterized by melatonin imbalance and disturbances in circadian rhythms, leads to a range of biochemical metabolic disorders with significant clinical implications. Understanding the factors contributing to desynchronosis and the role of melatonin in metabolic regulation can help develop effective therapeutic strategies to prevent and treat these disorders.

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УДК: 613.168:612.014.426

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ВПЛИВ ЕЛЕКТРОМАГНІТНИХ ПОЛІВ НА ЗДОРОВ'Я ЛЮДИНИ

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Анотація. За останні десятиліття вплив штучних радіочастотних електромагнітних полів значно зріс. Тому існує зростаючий науковий і соціальний інтерес до його впливу на здоров'я, навіть якщо рівень впливу значно нижчий від відповідних стандартів. Інтенсивність електромагнітного випромінювання в оточенні людини зростає і в даний час досягає таких рівнів, яких ніколи раніше не було на нашій планеті. Найбільш вагомим процесом впливу електромагнітного поля на живі організми є його безпосереднє проникнення в тканини. В статті розглянуто вплив електромагнітного поля на організм людини.

Ключові слова: електромагнітне поле, частота, здоров'я, людина.

З початку 20-го століття людство перевантажено зростаючими джерелами електромагнітного поля (ЕМП), яке надходить від телекомунікацій, електрики, приладів, медичного обладнання та багатьох інших приладів, якими ми користуємося в повсякденному житті. Досягнення технологій призвели до їх використання в повсякденному житті, але електромагнітні поля, які вони створюють, можуть спричинити ризики для здоров'я та небезпеки людини.

Деякі дослідження [1-4] показують зв'язок між впливом електромагнітних полів і збільшенням рівня лейкемії, раку, пухлин головного мозку та інших проблем зі здоров'ям. Крім того, залишається певна невизначеність до того, який тип полів, магнітних чи електричних, чи обох, має більший вплив на організм людини і це викликає занепокоєння.

Мета статті полягає в розкритті чинників та ефектів впливу електромагнітного поля на організм людини.

Найбільш впливовим процесом впливу електромагнітного поля на живі організми є