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Mini Review

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Enhancing Cancer Therapy: The Role of Melatonin and Herbal Medicine in Modulating Circadian Rhythms

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Description

Melatonin and its multifaceted role in cancer therapy

Melatonin, a hormone synthesized by the pineal gland during the dark phase of the circadian cycle, has been extensively studied for its ability to regulate circadian rhythms and its potential therapeutic applications in cancer treatment. The original article highlights melatonin's oncostatic properties, which include the induction of apoptosis in cancer cells, inhibition of tumor growth and proliferation, and enhancement of the efficacy of conventional chemotherapy and radiotherapy treatments. These properties underscore melatonin's potential as a valuable adjunct in cancer therapy.

The synthesis and release of melatonin are closely linked to the body's circadian rhythms, serving as a physiological signal of darkness. This hormone influences various biological functions, including sleep regulation, immune response, and antioxidant defense mechanisms. Beyond these roles, melatonin's ability to regulate circadian rhythms suggests its potential in synchronizing the internal clock disrupted by cancer, thereby mitigating the adverse effects of circadian disruption on cancer prognosis.

Herbal medicine as a source of melatonin

Herbal medicine offers promising avenues for cancer prevention and treatment, with several herbs known for their high melatonin content. The article mentions St. John's Wort (hypericum perforatum) as an example, highlighting its traditional use for its medicinal properties and high melatonin content. These herbs contribute to the exogenous supply of melatonin and offer a synergistic combination of compounds that may enhance melatonin's therapeutic effects. Integrating herbal medicine into cancer treatment regimens highlights the importance of natural products in developing effective and holistic approaches to cancer therapy.

Circadian cancer therapy: A novel treatment paradigm

The role of circadian rhythms in cancer therapy has emerged as a critical area of research, with evidence suggesting that the timing of cancer treatment according to the body's internal clock can significantly impact treatment outcomes. This approach, known as circadian cancer therapy, aims to optimize the timing of drug administration to coincide with periods of maximum efficacy and minimum toxicity, thereby improving the therapeutic index of anticancer agents. By aligning treatment schedules with the patient's circadian rhythms, circadian cancer therapy seeks to enhance drug effectiveness, reduce side effects, and improve the quality of life for cancer patients.

Clinical implications and future directions

The findings from clinical studies on melatonin's efficacy in cancer therapy are promising. Melatonin has been shown to reduce the relative risk of death, improve the quality of life for cancer patients, and increase life expectancy. Moreover, melatonin's safety profile, characterized by the absence of significant side effects, further supports its potential as a therapeutic agent in oncology.

Future research should focus on elucidating the mechanisms underlying melatonin's anticancer effects, optimizing its pharmacokinetic properties, and exploring its potential in combination with other therapeutic agents (Figure 1). Additionally, the integration of herbal medicine into cancer treatment regimens warrants further investigation to identify the most effective combinations and dosages [1-27].

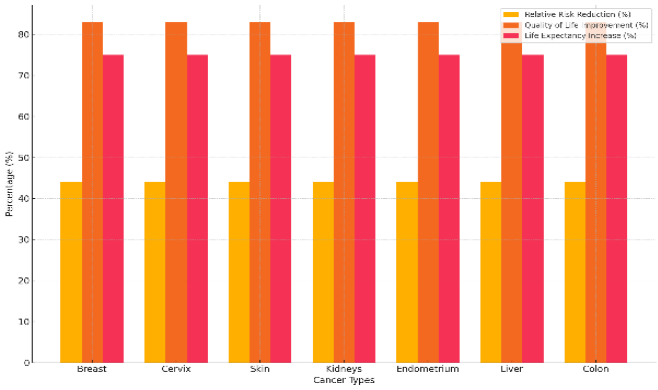

Figure 1: Therapeutic potential of melatonin in oncology.

The summary graph chart above illustrates the therapeutic potential of melatonin in oncology, focusing on late-stage cancer treatment across various cancer types. The chart highlights three key metrics:

Relative risk reduction: Melatonin demonstrates a 44% reduction in the relative risk of death across all cancer types studied.

Quality of life improvement: An 83% improvement in the quality of life for patients receiving melatonin treatment.

Life expectancy increase: A 75% increase in life expectancy compared to statistical averages.

These findings underscore the significant benefits of incorporating melatonin into cancer treatment regimens, particularly for patients with advanced-stage cancers.

Conclusion

The original article provides valuable insights into the multifaceted role of melatonin in cancer therapy, the potential of herbal medicine as a source of melatonin, and the emerging paradigm of circadian cancer therapy. Melatonin's regulatory effect on circadian rhythms and its oncostatic properties underscore its potential as a valuable adjunct in cancer therapy. The integration of herbal medicine into cancer treatment regimens further supports the importance of natural products in developing effective and holistic approaches to cancer therapy. Moreover, the advent of circadian cancer therapy represents a novel treatment paradigm that leverages intrinsic biological rhythms to maximize therapeutic efficacy and minimize toxicity. Together, these elements highlight the significance of circadian rhythms in cancer treatment and the potential of melatonin and circadian-based strategies as innovative approaches to combat cancer.

In the Form of Summarize

- Experimental and clinical observations have established that melatonin exhibits multiple mechanisms of antitumor action, including antiproliferative, apoptosis-stimulating, endocrine and immune system modulating, and antiangiogenic activities.
- Melatonin is produced in the upper part of the brain (epiphisis - pineal gland) during the dark period of the day and night and serves as the primary marker of circadian or daily biological rhythms.
- Melatonin is unique because its receptors are found on all cells. It exists across a wide range of organisms, from the simplest to fungi, highlighting its significant biological importance.
- Through its potent antioxidant activity, melatonin inhibits the initiation process of carcinogenesis. In experiments, melatonin reduced the mutagenic effect of the carcinogen N-methyl-nitrosourea by 1500 times compared to the control group.
- Removing the pineal gland (epiphysectomy) in animals with cancer stimulates tumor growth.
- Exposing animals to 24-hour light for three months or more leads to the formation and development of various types of malignant tumors in 20-55% of laboratory animals due to suppressed melatonin secretion.
- For animals with malignant tumors, maintaining a regime of constant darkness or administering pineal gland extract significantly slows, and sometimes completely halts, tumor progression.
- Melatonin has been found to provide genoprotection to cancerous cells, activating enzymes involved in DNA repair under pathological conditions.
- Tumors, especially hormone-dependent malignant ones, tend to grow less at night and are less aggressive in autumn and winter than in spring and summer.
- Breast cancer is almost non-existent in blind women, and prostate cancer is similarly rare in blind men.
- A significant increase in melatonin concentration, twenty times or more, is characteristic of severe mental illnesses such as schizophrenia. Melatonin is considered one of the molecular etiopathogenic factors of hallucinations in this pathology. The excess of melatonin also contributes to the rare occurrence of oncological diseases in patients with schizophrenia and their high resistance to infectious diseases.
- In tumor tissues, melatonin inhibits the proliferation of malignant cells and activates their apoptosis, suppresses the action of mutagens and clastogens, and inhibits the expression of oncogenes at the genetic level.
- During cancer, the concentration of melatonin in the blood plasma decreases, and pathological changes in the pineal gland are often observed. The extent of damage to the pineal gland correlates with the stage of the cancerous disease, not the tumor's location or origin.
- Botanical experiments have shown that plant tumors disrupt the metabolism of heteroauxin, a substance whose content in plant biological fluids decreases. Heteroauxin is identical to human and animal melatonin, and its biosynthesis exhibits a circadian and seasonal rhythm.
- Plasma levels of melatonin are moderately elevated in patients with Hodgkin's lymphoma. The age at which this disease emerges and its clinical manifestation directly correlate with the peak of endocrine activity of the pineal gland.
- The judicious use of melatonin and other bioactive molecules, alone or in combination, in medical practice significantly improves the prognosis of oncological diseases and sometimes serves as universal preventive agents.

Data availability statement: The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

Author contributions: A. Tavartkiladze, G. Simonia, and L. Tavartkiladze conceived and designed the experiment; A. Tavartkiladze and D. Kasradze performed the experiments, analyzed the data, and wrote the manuscript; A. Tavartkiladze and L. Tavartkiladze contributed to data collection and manuscript revision; A. Tavartkiladze, G. Simonia and L.Tavartkiladze provided technical support and assisted with the experimental design. All authors contributed to manuscript revision and have read and approved the submitted version.

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