

Chronopharmacology

Time-Dependent Pharmacotherapy

Editors

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Foreword

Medicine is evolving, with chronopharmacology leading the way. By aligning drug therapy with natural rhythms, it improves outcomes, reduces side effects, and personalizes treatments. “Chronopharmacology: Time-Dependent Pharmacotherapy” delves into how medication timing impacts conditions like heart disease, cancer, sleep disorders, and diabetes. It explores circadian science, AI-driven schedules, and time-sensitive drug systems, bridging research and practical applications for smarter healthcare.

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1 | The Circadian System and Biological Rhythms

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The circadian clock is a crucial biological mechanism that regulates the timing of various physiological and behavioral processes throughout the day. At the center of this system lies the hypothalamic suprachiasmatic nucleus (SCN), often referred to as the master clock. The SCN orchestrates the rhythmic production of genes, hormones, and other functions, including hormone release, body temperature regulation, metabolism, and the sleep-wake cycle. Circadian rhythms are governed by both internal biological clocks and external environmental cues, such as light and darkness. These rhythms play a vital role in aligning the body's physiological processes with the day-night cycle, ensuring optimal health. Disruptions to these cycles—resulting from factors like shift work or extreme sleep deprivation—can lead to sleep disorders, metabolic irregularities, cardiovascular diseases, and mental health issues. Furthermore, research has linked circadian clock abnormalities to the development of chronic illnesses such as diabetes and cancer. Understanding the molecular mechanisms behind circadian rhythms and their interaction with environmental stimuli is essential for advancing medical research and public health. By implementing interventions, such as behavioral adjustments, it is possible to mitigate the adverse effects of circadian disruption and restore or optimize circadian rhythms. This chapter explores the evolution and function of the circadian system, its influence on biological cycles, and its broader implications for health and disease.

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