The Role of Circadian Rhythms in the Control of Sleep/Wake Function and Quality of Life

Most circadian rhythms are controlled by the body's "master clock," the suprachiasmatic nuclei (SCN), in the hypothalamus. The SCN comprise two collections of 20,000 neurons, which synchronize cellular activity by rhythmically coursing throughout the body via the neuroendocrine and autonomic nervous systems.

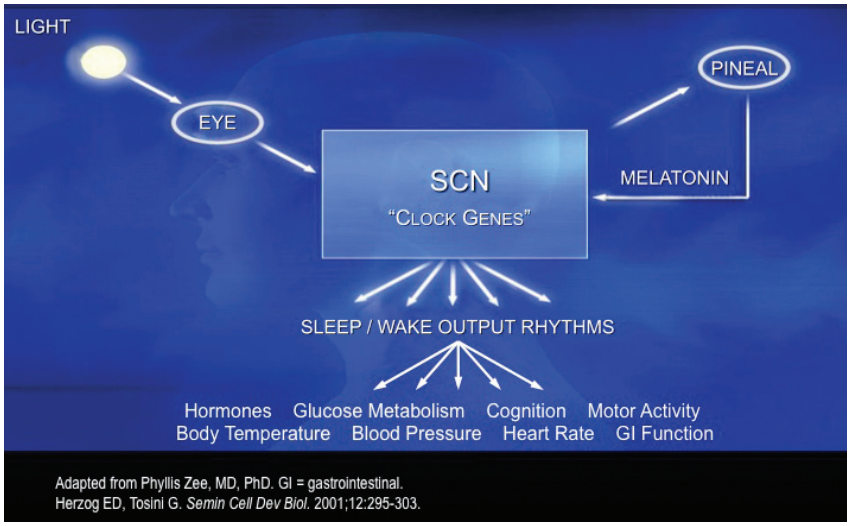
Physiologic functions synchronized by the circadian clock include glycolysis, gluconeogenesis, fatty acid metabolism, and cholesterol metabolism.[1] Other processes include cognition, motor activity, body temperature, blood pressure changes, heart rate, urine production, and gastrointestinal function.[2] The SCN also activates the adrenal gland, which releases the stress hormone cortisol in the morning and aids arousal from sleep.[3]

In the morning, photoreceptors in the retina are stimulated by daylight and create signals as they move along the optic nerve to the SCN and the pineal gland,[4] where melatonin secretion is stimulated by darkness and inhibited by light. In response to the light-induced signals, the pineal gland suppresses melatonin production, resulting in wakefulness (**see Figure**).

When darkness falls at night, the opposite occurs. The SCN triggers the release of, and increases the level of, melatonin in the body, suppressing the SCN-alerting signal. This results in the onset of drowsiness and facilitates the transition from wakefulness to sleep.

As the day progresses, the sleep homeostatic drive increases, reaching a maximum near the conventional sleep time.[5] The circadian signal increases proportionately in opposition, counterbalancing the progressive accumulation of sleep load and maintaining normal wakefulness.

Circadian Timing System



Adapted from Phyllis Zee, MD, PhD. GI = gastrointestinal.
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Circadian rhythm sleep disorders can occur when there is a misalignment between the timing of sleep and the desired sleep-wake cycle—as in shift work disorder—leading to impaired functioning, safety issues, and associated morbidities.[6]

References

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4. Berson DM, Dunn FA, Takao M. Phototransduction by retinal ganglion cells that set the circadian clock. *Science.* 2002;295:1070-1073.
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