

CHRONOBIOLOGY

Sleep is a complex and little understood phenomenon. If one wants to understand sleep related breathing disorders (SBD), it is imperative to understand first, how sleep is produced? Is it part of circadian rhythm (internal biological clock) or sleep wake cycle that is regulated by some homeostasis? For example, excessive daytime sleep (EDS) one of the important manifestations of obstructive sleep apnoea could be due to disorders of circadian rhythm or abnormality of normal homeostasis.

The existence of circadian rhythm has been known since 1731 when a French astronomer Jean Jacques d'Ortous de Mairan noted circadian rhythm in plants. However, in humans there is no direct presence of in vitro localization of suprachiasmatic nucleus (SCN) in the hypothalamus tissue has been established. Possibly, an intact oscillator (SCN) functions with entrainment to environment cues i.e. light through afferent pathways in the form of reticulo-hypothalamic tract and appropriate effectors mechanisms. The direction and magnitude of the response of the human circadian pacemaker to light depends on the time and phase when light stimulation occurs. The rationale to use light to alter circadian phase therapeutically is based on the understanding of these responses. Although one would expect humans to have a perfect 24 hours circadian cycle linked to the rotation of planet and deriving energy from the sun.

There may be more than one circadian rhythm and one set of physiological functions may oscillate at a period different from other set of functions, this process is called internal resynchronisation. Some functions e.g. body temperature, repetitive eye movements sleep, cortisone secretion continue to oscillate with a circadian (near hormone demonstrate much larger, more variable periodicities. About 80% of total daily secretion of growth hormone occurs during slow wave sleep stage 3 and 4. Similarly melatonin called hormone of darkness occurs during darkness and accepted as marker of circadian rhythm and some believe that it can be used to reset circadian clock.

The most salient behavioural marker of circadian rhythm in human adult is the daily sleep wake cycle. Three basic mechanisms have been proposed for sleep regulation:

- a) A homeostatic process determined by sleep wake cycle.
- b) A circadian process, independent of sleep wake cycle.
- c) An ultradian process occurring within sleep and represented by two basic sleep states – Non-repetitive eye movement (NREM) and Repetitive eye movement (REM).

The main characteristics of homeostasis and circadian facet of sleep regulation are summarized in tabulated form on the next page. The major difference consists in the dependence of the former on prior sleep and independence of the later. The neuro-behavioural basis of sleep factors accumulate in the brain of sleep deprived animals have generated huge research efforts to identify fluctuation in neuronal membrane potential at the origin specifying a counterpart of EEG slow wave activity at the level of single neuron is a promising step and open up new areas of research to understand the regulation of sleep.

HOMEOSTATIC AND CIRCADIAN FACETS OF SLEEP REGULATION

S. NO.		HOMEOSTATIC	CIRCADIAN
1.	Influence of prior sleep and waking	Yes	No
2.	Influence of circadian phase	No	Yes
3.	Sleep parameters most predominantly affected	NREM sleep intensity	REM sleep, total sleep time
4.	Non sleep correlates	Unknown	Core body temp. Plasma levels of certain hormones (Melatonin, Cortisol)
5.	Regulatory structures in the brain	Not yet identified	Suprachiasmatic Nucleus
6.	Effects of scheduled intensive light exposure in humans	Time course of slow wave activity not affected	Evidence for phase shift.