



## **CIRCADIAN SLEEP DISORDERS**

### **Facts and Tips**

**From an NS Presentation, August 2013**

- Properly speaking, the sleep-wake cycle is controlled by the interaction of two endogenous oscillatory processes and by external factors which can affect these processes.
- The two processes are:
  1. The Circadian Rhythm and;
  2. The Homeostatic Drive.
- Sleep researches speak of the circadian wake-promoting signal that becomes progressively stronger during the biological day and they contrast that with the homeostatic sleep drive which also builds progressively throughout the wake period.
- The homeostatic drive is more labile; its locus is not known. In general, it is less understood than the circadian rhythm.
- Disruption of the phase relationship between circadian rhythmicity and sleep homeostasis underlies disorders such as jet lag and shiftwork disorder.
- We call these circadian rhythm disorders but the role of the homeostatic sleep drive must always be recognized.
- “Circadian” rhythm refers to the daily oscillations that characterize all studied biological processes for example the sleep-wake cycle, core body temperature and hormone release.
- “Circadian” translated literally is “about a day”; humans’ endogenous circadian rhythm is almost, but not exactly, a 24-hour rhythm.
- Circadian processes are driven by an internal timekeeping system and though they can be affected by external influences, they are not, by definition, caused by external factors.

- Circadian rhythm relies on a complex neuronal structure.
- A central circadian pacemaker called the suprachiasmatic nuclei is located in the hypothalamus.
- We now know that there are circadian oscillators at the cellular level.
- Zeitgeber is German for timekeeper; it refers to the endogenous processes and exogenous factors that influence entrainment, i.e. adherence to a 24-hour cycle even though humans have a cycle that is slightly longer and therefore would tend to progressively delay sleep.
- The most potent exogenous Zeitgeber is light. That is to say that entrainment occurs primarily due to the light-dark cycle.
- SCN (Suprachiasmatic Nuclei) receives direct input from the retina.
- Timing of light exposure is of critical importance. Bright light before the core temperature nadir (CTmin) will delay sleep and light received shortly after CTmin will advance sleep the following night.
- Outdoor light is preferred (10K-100K lux) but very bright indoor light may be sufficient (max is about 2500 lux). Light box is preferred if outdoor light is impractical. They can achieve app. 3500 lux.
- We now know that short, blue wavelength is the most potent modulator of the circadian clock.
- The most important endogenous Zeitgeber is melatonin although the mechanism by which it modulates the sleep-wake cycle is poorly understood.
- There is a temporal relationship between circulating melatonin levels, a decrease in core body temperature and an increase in sleepiness, but no causal relationships between or among these processes have been established.
- Melatonin is a hormone secreted from the pineal gland primarily during the biological night and is influenced by the light-dark cycle.
- One hypothesis is that melatonin acts on the SCN and thereby reduces the circadian drive for wakefulness but again the mechanism of action is not known.
- DLMO (Dim Light Melatonin Onset) occurs approximately 2 hours before natural or habitual sleep onset in good sleepers. Low dose (0.5 mg) melatonin can help phase

advance if administered 3-5 hours before DLMO or 5-7 hours before desired bedtime. This coupled with strict wake times followed immediately by bright light therapy of sufficient intensity and duration can advance sleep times.

- To delay sleep time, melatonin is taken in the morning and bright light is used in the early evening, i.e., the reverse of the techniques used to phase advance.