Sleep Board Review Questions: The Late Riser

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A 22-year-old male presents to Sleep Clinic for sleep onset insomnia and difficulty waking up in the morning. He plans to begin a new job in a few weeks, which would require him to wake up at 6 AM. He usually goes to sleep at 2 AM and wakes up at 10 AM. He remembers having this problem through high school and college. He admits to being unable to sleep even if he goes to bed at an earlier time. He reports sleeping through alarms in the morning. His sleep log and actigraphy (non-invasive method of monitoring activity) are consistent with delayed sleep phase disorder (DSPD).

In order to maximally advance the sleep-wake phase in this patient, when should the administration of bright light take place?

1. Between 5 AM to 6 AM.
2. Between 8 AM to 9 AM.
3. Between 2 AM to 3 AM.
4. Between 10 PM to 11 PM.

Correct!
2. Between 8 AM to 9 AM.

Delayed sleep phase disorder (DSPD), also known as 'Circadian Rhythm Sleep Disorder - Delayed Sleep Phase Type' is characterized by a habitual delayed sleep-wake time relative to conventional or socially acceptable time. The patient's circadian phase of sleep is delayed but relatively stable. Attempts to conform to conventional sleep-wake cycle will lead to difficulty falling asleep and problems awakening in the morning. This syndrome is most common among adolescents and young adults (1, 2). DSPD is associated with polymorphisms in *Per*3 gene.

The master mammalian circadian pacemaker is the suprachiasmatic nuclei (SCN) within the anterior hypothalamus. The pacemaker generates and maintains circadian rhythms in many physiological and psychological processes, including the sleep-wake cycle, core body temperature, and synthesis and secretion of melatonin (3). The intrinsic period of the human biological clock is ~24.2 hours, and to synchronize the circadian system to the exact 24-hour sleep/wake cycle, the SCN needs to adjust daily by external cues, the so-called Zeitgebers. By far the most important Zeitgeber is light or the solar light/dark cycle (4).

The SCN targets the pineal body that in turn synthesizes melatonin from tryptophan. This production is highly rhythmic with a low daytime level, increases after the onset of darkness, has high output during the night (peak between 11 PM and 3 AM), and falls sharply before the onset of light (5). However, ambient light intensities suppress the production of melatonin. If the individual's phase is approximately normal, the dim light melatonin onset (DLMO) occurs about 2 to 3 hours before habitual bedtime or about 7 hours before core body temperature minimum (CBTmin) (7:30 PM to 10 PM) (6).

The circadian rhythm of the core body temperature (CBT) determined by the combined action of heat production and heat loss. When heat loss exceeds heat production, CBT declines and vice versa (7). In humans, sleep is typically initiated when this curve is declining at its maximum rate. In normal sleepers, after reaching its minimum or nadir (at approximately 5 AM), CBT rises and reaches its maximum (at approximately 5 PM) during the day, because then heat production surpasses heat loss (5).

CBTmin usually occurs 2–2.5 hours before habitual wake time. In patients with DSPD, proxy markers for the circadian rhythm such as core body temperature minimum and melatonin secretion peak are shifted to the later times in the circadian phase. Light exposure soon after CBTmin can produce significant advancement in sleep phase. However, light exposure prior to CBTmin can actually produce large delays in sleep phase (8). Hence, attempts to advance sleep phase more than 1-2 hours at a time should not be made. While melatonin given 2-6 hours prior to the habitual sleep time or at the desired bedtime can advance sleep phase, light exposure after CBTmin is the most potent way of advancing sleep. It is important to assess timing of the temperature minimum with sleep logs. Actigraphy may also provide information about the habitual

sleep-wake time. In this patient who habitually wakes up at 10 AM, CBTmin might occur around 7 AM to 8 AM. Light exposure after this period will advance sleep phase, while light exposure before this period will result in a delay.

References

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