

Jet lag: Heuristics and therapeutics

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ABSTRACT

Jet lag is one of those common medical problems, to which most people don't give a serious thought. However, it is intricately intertwined with our normal circadian rhythm. It is classified as a sleep disorder. There is also a dearth of good scientific literature, not to mention clinical trials on the subject. Slowly but steadily, the scientific community is realizing the various deleterious health effects of jet lag and is devising innovative methods to counter them. This narrative review touches upon the etiopathogenesis, clinical manifestations and therapeutic strategies effective against the nagging problem of jet lag.

Keywords: Circadian rhythm, insomnia, jet lag

Introduction

Jet lag, often deemed as a trivial inconvenience, is actually a recognized sleep disorder.^[1] Despite its limited duration, jet lag can produce deleterious health effects in high functioning individuals. Most people who have experienced an overseas flight have experienced jet lag and its deleterious effect on sleep. It occurs because of disruption of the circadian rhythm due to rapid transition across time zones, resulting in asynchrony between the local time and the human circadian clock (which is normally regulated by the solar light–dark cycle). Internal signals for wakefulness and sleep are thrown in disarray due to mismatch with the local light–dark cycle.

The Normal Human Circadian Rhythm

The human circadian rhythm is intimately intertwined with the sleep-wake cycle and is affected by melatonin secretion and changes in the core body temperature (CBT).

During a normal circadian phase, dim light causes melatonin to increase approximately 2 h before habitual sleep onset.

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This physiological response is known as dim light melatonin onset. A concurrent decrease in CBT results in reduced levels of alertness, which in turn creates a strong propensity for sleep (at night). At dawn, melatonin levels drop and become undetectable. The CBT rises thereby accentuating the circadian alerting signal. This has the overall effect of promoting wakefulness. For approximately 16 h during daytime, the circadian alerting signal counters the increasing homeostatic sleep drive.^[2]

Natural bright light is the most potent modifier of the circadian cycle. However, after a change in the light–dark cycle due to air travel, phase shifts do not occur instantaneously. These phase shifts may take many days to adjust to the new time zone. As a result, the internal circadian clock is still set to the original time of travel onset. Interestingly, the amount of dyssynchrony is dependent on the number of time zones traversed. Jet lag manifests as daytime sleepiness, mood changes, gastrointestinal discomfort, psychomotor retardation, and insomnia [Figure 1].

Generalized fatigue and malaise are common manifestations.^[3] These symptoms may be due to prolonged immobility, dehydration, and variable meal times which may or may not be related to the phenomenon of time zone transition. The problem of malaise

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can be resolved with proper sleep and diet, but until the circadian rhythm realigns, the jet lag persists. Symptoms of jet lag can become chronic in frequent travelers, for example, flight crew and international executives.

Diagnosing Jet Lag

Jet lag is a clinical diagnosis. The International Classification of Sleep Disorders, Third Edition, lists the following criteria for diagnosis:^[4]

- Excessive daytime sleepiness or distortion of sleep cycle along with decreased total sleep time that coincides with jet travel across at least two time zones (east to west or west to east)
- Generalized fatigue or presence of somatic symptoms occurring within 2 days of travel onset
- No other disorder or condition can be attributed for the sleep disturbance.

Jet lag is often mistaken for travel fatigue. The travel fatigue syndrome involves generalized fatigue, occasional headache, and mental weariness as a result of distorted sleep routine. This occurs due to stress of travel. An important distinction is that travel fatigue does not depend on number of time zones traversed. It can occur after northbound or southbound travel. Restful sleep generally abolishes the symptoms of travel fatigue.^[3]

In the absence of specific treatment, the natural circadian rhythm adjusts to the destination time by approximately 1 time zone/day for eastbound travel and 1.5 time zones/day for westbound travel.^[5]

Factors that Produce Jet Lag

Travel direction – Since the inherent body clock cycle exceeds 24 h, it is much more convenient to lengthen the day than to shorten it. Thus, it is easier to travel westward than eastward.

A recent study has found eastward travel to have more deleterious effect on sleep than westward travel.

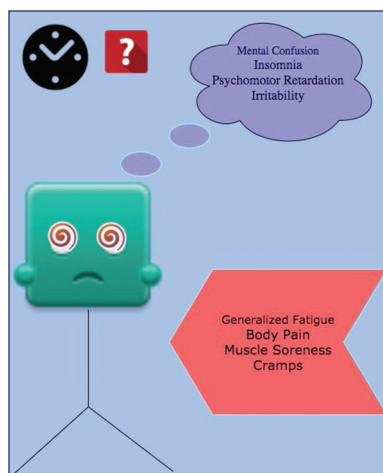


Figure 1: Common symptoms of jet lag

Subjective fatigue and overall motivation were also found to be reduced. Results were more pronounced for travel time <3 days.^[6]

Number of time zones traversed: The greater the number of time zones traveled, the greater the circadian disarray. Another factor which increases fatigue is the duration of travel.

In another recent study, a direct correlation was seen between subjective ratings of jet lag and distance traveled during flight. Rather sleep and subjective responses were decreased as a result of change in environment.^[7]

Lost sleep time during travel: Overnight travel causes the most sleep loss, but it may be reduced if the passenger is seated in first class (with the fully reclining option). Jet lag symptoms, however, will not abate until the circadian clock is resynchronized at the destination.

Idiosyncratic tolerability: Tolerance to circadian phase misalignment varies among individuals and decreases with age.

Local light exposure: For realignment of the circadian clock, local light exposure is very important. It is affected by arbitrary factors such as activity level and work schedule of the passenger.

Evidence-Based Therapeutics to Counter Jet Lag

Resetting the circadian clock

As the circadian rhythm slowly synchronizes with the local time zone, symptoms of jet lag gradually wane. It has been postulated that the circadian clock resets an average of 57 min earlier after eastward travel and 92 min later after westward travel.^[5] A study corroborated these findings using melatonin secretion timing as a marker of circadian timing.^[8] The circadian clock is slightly longer than 24 h. The process of resynchronization can be sped up by utilizing naturally existing clock-resetting mechanisms to compensate for minor differences between the 24-h solar time and the natural body clock.

Role of light exposure

It is believed that the timing of light exposure is a vital cue for circadian rhythm realignment. This phenomenon is prevalent in most animals as well as humans. To compensate for any deviation from a 24-h cycle, morning light exposure moves the clock to an earlier time while evening light exposure moves it to a later time.^[9] At night, the separation between phase delays (evening response) and phase advance (morning response) diminishes. Since people normally sleep in darkness with closed eyes, sleep timing by itself does not resynchronize the rhythm. Sleep halts exposure to light temporarily, thereby assisting in circadian clock modulation.

When the individual's flight lands at a time zone destination, the timing and intensity of light is critical to clock realignment. Local factors such as season, weather, and activity level of the traveler also contribute to determining the rate of synchronization.

Intentional exposure to bright light at local day times may expedite the process.

It is recommended to seek bright light exposure in the evening after westbound journey and in the morning after eastbound journey. This may be useful when the individual has traversed as many as eight time zones of travel. Avoiding bright light exposure may be helpful in circumstances where eight or more time zones have been crossed so that light which was previously experienced as “morning” is now experienced as “evening”. The reverse is true as well. Thus, it is also recommended to avoid 1st h of daylight after an eastward journey and 1st h of evening after a westward journey [Figure 2].^[10,11]

Avoidance of light can be discontinued after few days, at the point when the circadian rhythm will have readjusted. Some studies show that an alternative to direct avoidance of bright light is the use of sunglasses.^[12] More research needs to be done in the field of light avoidance before conclusive guidelines can be established.

The duration of jetlag symptoms may also depend on direction of travel.^[10]

It may be more pronounced in travelers with pretravel-inverted circadian rhythms, for example, night shift workers or a traveler on a prolonged eastbound flight.^[13] This is because clock advancement is harder than clock delaying. Thus, some experts recommend that any flight that traverses more than eight time zones should be regarded as westward.^[3]

Melatonin – the darkness signal

Melatonin is secreted for about 10 h each night in tandem with the light–dark cycle. It is a darkness signal, with effects which antagonize those of light exposure. If melatonin is taken in the morning, it resets the circadian clock to a later time, and if taken in the evening, it resets it to an earlier time.

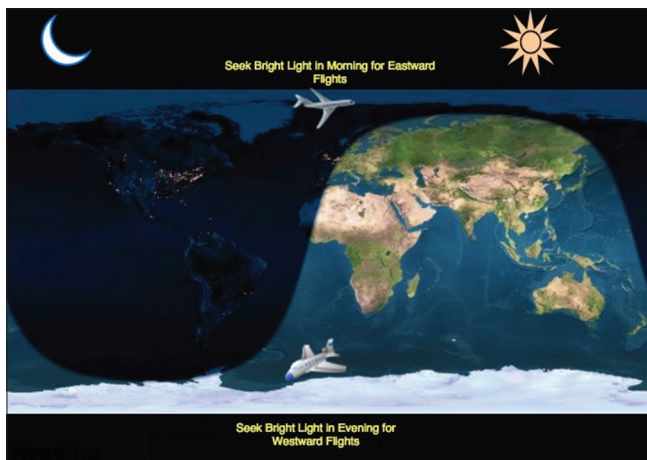


Figure 2: Recommended light exposure for respective travel direction

At higher doses, it may act as a hypnotic. Studies have shown a significant benefit of melatonin in reducing symptoms of jet lag.^[14-16] With a usual dose of 5 mg, no major adverse effects have been reported.

Customizing the sleep cycle

Another approach is to attempt the same sleep–wake home routine upon arrival at the destination.^[17] Often, it is not possible due to social or business obligations. Studies involving simulated conditions of long-distance international air travel in hyperbaric chambers have been done. Fowler *et al.* found that decreasing travel-induced sleep disruption might lessen travel fatigue. However, any improvements in recovery of physical performance were not observed.^[18]

Role of stimulants

Caffeine intake might combat jet lag-induced daytime sleepiness. In one study involving passengers traveling eastward, slow-release caffeine (300 mg) enhanced alertness.^[19] However, the downside of caffeine use is the potential exacerbation of jet lag-induced insomnia. In one study, Armodafinil demonstrated improvement in wakefulness after flight travel across six time zones.^[20] Modafinil, a similar drug, may have similar beneficial effects and is being evaluated in ongoing trials.

Role of sedative drugs

A short course of sedatives has been shown in randomized trials to alleviate insomnia arising from jet lag.^[21-25]

One randomized, placebo-controlled trial demonstrated that the use of zolpidem (10 mg q.h.s) for 3–4 nights after traveling eastward (over more than 5 time zones) significantly improved sleep time and quality.^[26]

For overnight flights, short-duration hypnotic agents (3–4 h) may be particularly useful.

The potential side effects of hypnotics include confusion and amnesia.^[27]

Global amnesia was seen in many individuals taking triazolam during flight travel.^[28] A test dose at home, a few days before travel, may help obviate this problem.

Hypnotics may also increase immobility, thereby accentuating the risk of deep vein thrombosis during flight travel.^[29]

Conclusion

Jet lag is a common and underdiagnosed medical problem that can have varying effects on motor and cognitive performance. With international travel becoming increasingly common among professionals, jet lag warrants significant medical attention. Few treatment strategies exist to counter the deleterious effects of jet lag on the normal circadian cycle. More research trials

need to be performed in order to establish concrete treatment recommendations.

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Conflicts of interest

There are no conflicts of interest.

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