Comparing Melatonin Use to Bright Light Therapy in Mitigating Cardiovascular Effects due to Shift Work Disorder in Shift Working Adults

Alexandra Hirt, MPH, MMS (c)
Faculty Advisor: Zachary Weik, MHS, PA-C
Department of Medical Science

Abstract

Shift workers often end up in a vicious cycle of being in a state of chronic circadian misalignment, which can lead to health problems, extreme fatigue, and insomnia, known as Shift Work Disorder (SWD). There have been several studies interventions to help mitigate circadian misalignment in shift workers however two of the least expensive and most accessible methods are exogenous melatonin use and timed exposure to bright light. This review examines the use of melatonin versus bright light therapy in mitigating the poor cardiovascular effects seen as a result of shift work disorder.

Introduction

- SWD has been studied in night shift workers who, when compared to daytime workers, have an increased risk of developing metabolic syndrome, DM, and coronary heart disease. These results are independent of any behavioral risk factors, such as smoking and poor diet, that typically complement shift work lifestyles.
- Exogenous melatonin promotes sleep similarly to the way endogenous melatonin works, by lowering core body temperature and altering autonomic activity.
- Bright light (BL) exposure can suppress melatonin, “tricking” the body and enabling circadian system adaptation.
- Inflammatory markers such as CRP IL-1 as well as sleep blood pressure are indicative in cardiovascular health and were increased in shift workers.

Methods

- Literature Search
  - PubMed, Academic Search Ultimate, Google Scholar
- Search Terms
  - melatonin AND bright light therapy AND shift work disorder
- Inclusion Criteria
  - Published in peer reviewed journal, later than 2000
  - Case studies or RCT only done on human subjects
  - Only articles including cardiovascular outcomes
- Exclusion Criteria
  - Studies involving <18 or >44 years of age
  - Systemic reviews

Results

- The 6 articles selected suggested melatonin and bright light were both effective in their phase shifting properties and had effects such as lowering blood pressure, decreasing inflammatory markers and reducing cardiac intima media thickness.
- Morris et al (2016) wrote short term circadian misalignment increased 24 hr BP change similar to that of antihypertensive medications.
- Vandewalle et al (2017) concluded that melatonin was able to shift heart rate and HRV variability. This is significant due to the increased risk of stroke, heart attack, and cardiac death in morning hours. Uncovering the circadian rhythm of the CV system could assist in future treatments.
- Similarly, a third study showed that high levels of melatonin significantly decreased HR and SBP, and the research indicated that melatonin may work on the heart itself, unlike other research has found (autonomic system). A decrease of 3–4 beats/min was associated with high melatonin dosages, similar in magnitude to the decrease in hypertensive subjects after beta-blocker use (Burgess et al., 2001).

Study Design N Tx Regimen Outcome Measures

1 RCT 17 BL: 10,000 lux, 30 minutes/ night, x 4 nights during a night shift week. M: 3 mg 1 hour before bedtime x 4 days during a week of night shifts.

2 RCT 14 Moderate light: 150 lux during waking hours BL: 10,000 lux 5-8 hrs/day x 4 days

3 RCT 8 M: 1.5 mg administered at 1600 h x 13 days P: administered at 1600 h x 13 days

4 RCT 16 BL: >3.000 lux 14 hours after waking time MBl: >3.000 lux 14 hours after habitual waking time

5 RCT 14 BL (~450 lux) after a night shift

6 RCT 36 BL: 4.000-7.000 lux for 4 hrs between 2400- 0400 hrs x 3 nights M: 2 mg at 0800 hrs, 1 mg at 1100 hrs and 1 mg at 1400 hrs x 3 x 3 nights

Discussion

- The six studies presented each showed a small facet of how melatonin and BL reduce shift work disorder symptoms.
  - Improvements in BP, HRV (autonomic heart function), inflammatory markers, cortisol levels, body temperature, or phase shifting.
  - These small changes could potentially decrease or delay onset of poor cardiovascular health in shift workers.

Study Strengths:
- Melatonin, cortisol, core body temperature, inflammatory markers, HRV, and BP were all measured using consistent and validated methods across studies.
- Wide variety of interventions and combinations studied as not all shift workers have the same schedules, preferences or resources.
- No negative side effects associated with melatonin or bright light use and both relatively easy to implement into lifestyle.

Study Limitations:
- Short term use of the interventions, which is problematic. Shift work disorder is a result of chronic circadian misalignment and increased time in shift work increases CVD risk.
- Small sample sizes in all studies
  - largest: 36 participants
  - Measuring sleep/sleep quality in a laboratory setting may be inaccurate.

Conclusion

- BL and melatonin use both show promise in decreasing cardiovascular effects due to shift work disorder, but more studies are needed.
  - In order to truly confirm the efficacy of bright light versus melatonin, there needs to be established guidelines, dosages and recommendations for the usage in shift workers, which do not yet exist.
  - Future research needs to establish usage guidelines of melatonin and bright light therapy.
    - Research has shown 0.5 mg of melatonin an hour before bed is an effective dose, however the guidelines on bright light therapy are not as well defined.
    - Needs to determine a lux level, amount of time, and frequency that is comparable to the melatonin dosage.
  - Compare these defined guidelines in various shift-working schedules to evaluate long term cardiovascular effects.

Key: RCT: Randomized Control Trial, BL: Bright Light, M: Melatonin, P: Placebo, SOL: Sleep onset latency, TST: Total Sleep time, SE: Sleep Efficiency, SQ: Sleep quality, HRV: Heart Rate Variability

REFERENCES


To Download this article, please visit: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0030037.

In summary, melatonin and bright light are both relatively easy to implement into lifestyle, no negative side effects associated with melatonin or bright light use and both relatively easy to implement into lifestyle.

Future research needs to establish usage guidelines of melatonin and bright light therapy.

- Research has shown 0.5 mg of melatonin an hour before bed is an effective dose, however the guidelines on bright light therapy are not as well defined.
- Needs to determine a lux level, amount of time, and frequency that is comparable to the melatonin dosage.
- Compare these defined guidelines in various shift-working schedules to evaluate long term cardiovascular effects.

Faculty Advisor: Zachary Weik, MHS, PA-C

Department of Medical Science

Department of Medical Science