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Working night shifts affects surgeons' biological rhythm

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Circadian rhythm;
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Abstract

BACKGROUND: Chronic sleep deprivation combined with work during the night is known to affect performance and compromise residents' own safety. The aim of this study was to examine markers of circadian rhythm and the sleep-wake cycle in surgeons working night shifts.

METHODS: Surgeons were monitored prospectively for 4 days: pre call, on call, post call day 1 (PC1), and post call day 2 (PC2). The urinary metabolite of melatonin and cortisol in saliva were measured to assess the circadian rhythm. Sleep and activity were measured by actigraphy. Subjective measures were assessed by the Karolinska Sleepiness Scale and Visual Analog Scale of fatigue, general well-being, and sleep quality.

RESULTS: For both metabolite of melatonin and cortisol, a significant difference ($P < .05$) was found in the measurement period between on call and pre call values. There was increased sleep time during the day on call and on PC1. For all subjective measures, a marked deterioration was seen on PC1.

CONCLUSION: Surgeons' circadian rhythm was affected by working night shifts.

Subjective markers for general well-being, fatigue, and quality of sleep deteriorated on the post call day, compared with the pre call day and second post call day.

Shift work displaces work to night time and sleep to daytime, which interferes with the circadian and homeostatic regulation of sleep.[1] These work hours may constitute a health problem with respect to sleep and fatigue, cardiovascular diseases, accidents, and cancer.[1–3] Shift workers usually report more sleep disturbances than people working daytime and their disturbed sleep pattern has been well described.[4,5] In physicians working night shifts, cognition, psychomotor skills, and surgical performance are known to be negatively affected by sleep deprivation, especially on the post call morning.[6–8] In qualitative studies, it was shown that sleep loss had an impact on surgeons' ability to perform and that they used coping mechanisms to handle fatigue.[9,10] Furthermore, the surgeons mentioned that physical impact of sleep deprivation lasted for days after the night shift.

There appears to be a physiological impact of sleep deprivation, as studies on anesthesiologists and surgeons have found decreased heart variability during night shifts.[11,12] This decreased heart variability was a measure of increased physiological stress and could be because of circadian

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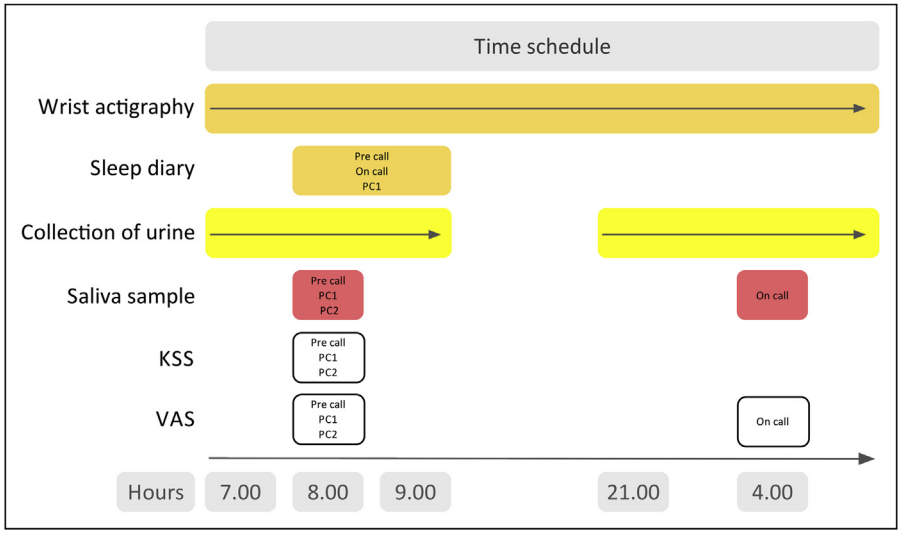

Figure 1 Study design.

disturbances as a result of working night shifts. Many of the physiological outcomes that are affected by sleep deprivation are also affected by a disturbed circadian rhythm. One of the central circadian regulators of biological rhythms is melatonin—a hormone synthesized in the pineal gland.[13] It is known that disturbances in the synchrony of melatonin/circadian rhythm and the sleep-wake cycle may cause cognitive dysfunction.[14,15] In medical residents, chronic sleep deprivation combined with work during the night was known to affect performance during the night shift,[16] increase the risk of medical errors,[17] and to compromise residents' own safety by the increased risk of motor vehicle crashes on their way home from work.[18] However, little is known about the circadian rhythm in surgeons exposed to acute sleep deprivation because of night shifts.

The aim of this study was to evaluate the effect of night shifts on surgeons' sleep-wake cycle and circadian rhythm before and after the on call night.

Methods

Design

Thirty surgeons were monitored prospectively for 4 days. The monitoring period started on the first day pre call at 07:00 hours and continued through the second day where the surgeons worked 17 hours on call from 15:30 to 08:30 hours. The monitoring period continued through the first post call day (PC1), where the surgeons had the day off to rest, and the second post call day (PC2). The monitoring ended at 09:00 hours on the third post call day (PC3). The surgeons worked an average of 37 hours per week, in accordance with the Danish work-hour regulations. It was not possible to standardize all workdays, thus some surgeons had the day off and others worked daytime from 08:00 to 15:00 hours on the pre call day and PC2. Sleep diaries were filled out when the surgeons woke in the morning on call, PC1, and PC2, assessing sleep the prior nights (pre call, on call, and PC1). For all 4 days of monitoring, the surgeons continuously wore an actigraph to assess hours of sleep and wake condition, and collected urine from 21:00 to 09:00 hours to determine the level of the urinary metabolite of melatonin (aMT6s). The Visual Analog Scale (VAS) for fatigue, general well-being, and quality of sleep and the Karolinska Sleepiness Scale (KSS) were all performed at 08:00 hours pre call, on PC1 and PC2. The VAS general well-being and quality of sleep were additionally performed at at 04:00 hours on call. If the surgeons did not sleep on call, they were instructed not to fill out the VAS quality of sleep. Saliva samples for the estimation of cortisol were also delivered at 08:00 hours pre call, PC1, PC2 and at 04:00 hours on call. A chart of the study design is presented in Fig. 1. Data on psychomotor performance have been published separately.[19]

Subjects

The subjects were male and female interns, residents, and attending surgeons from an academic surgical department. They did not work night shifts within 72 hours of the commencement of the study to avoid sleep deprivation from previous night shifts. During this period, the subjects were instructed to get their usual amount of sleep. Participants in medical treatment because of endocrine, autoimmune, or cardiac disorders were excluded, as were subjects previously diagnosed with a sleep disorder. Pregnant or breastfeeding women were not included. The consumption of alcohol or central stimulating medicine was not allowed 24 hours before study and during the study. The intake of caffeine was not controlled.

Melatonin

Night time production of melatonin can be measured by the aMT6s in urine. In adults, the increase of aMT6s