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SLEEP DISORDER IN CARDIAC CARE UNITS: A SPECIAL LOOK AT NOISE AND LIGHT EFFECTS

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Abstract: In intensive care units, many factors play a role in the occurrence of sleep disorder, with noise, light, treatment procedures, pain, and mental pressures being just a few of them. Patients with hard to treat diseases face similar factors and, contrary to patients in better conditions, experience disturbances that result from the intensity of their diseases. These disturbances are revealed by using vital signs machine, X-ray and phlebotomy equipment, and through treatment management. Most often, the effects of these factors on sleep can be reduced, and these factors can be largely eliminated, by taking simple steps. As far as we know, noises show their effects on sleep even under the best conditions. The importance of noise level in hospitals even surpasses that considered in recommendations and standards determined by the U.S. Environmental Protection Agency regarding levels of noise in hospitals; and many studies have investigated the effects of steps taken to reduce noise.

Key Words: Sleep Disorder, CCU, Noise, Light

INTRODUCTION

Many patients consider sleep disorder they experience during hospitalization something normal and natural, especially patients in the intensive care units. Like water and food, sleep is one of the primary needs of man, and sleep disorder may end in sleep deprivation. This disorder has many negative effects: changes in the performance of body systems and of metabolic processes in internal glands, changes in the wound healing process, tiredness, disorder in daily bodily functions and in short-term memory, changes in mood, reduced motivation and disorder in social and family interactions (26). In intensive care units, many factors play a role in the occurrence of sleep disorder, with noise, light, treatment procedures, pain, and mental pressures being just a few of them (27). Patients with hard to treat diseases face similar factors and, contrary to patients in better conditions, experience disturbances that result from the intensity of their diseases. These disturbances are revealed by using vital signs machine, X-ray and phlebotomy equipment, and through treatment management (28). Most often, the effects of these factors on sleep can be reduced, and these factors can be largely eliminated, by taking simple steps. As far as we know, noises show their effects on sleep even under the best conditions. The importance of noise level in hospitals even surpasses that considered in recommendations and standards determined by the U.S. Environmental Protection Agency regarding levels of noise in hospitals; and many studies have investigated the effects of steps taken to reduce noise (29-30).

Problems resulting from sleep disorder

Sleep has many physical and mental benefits for man as evidenced by problems that insufficient sleep causes. In most information gained regarding benefits of sleep, no reference has been made to the effects of sleep disorder and deprivation, while these are considered among the common problems in hospitals (44-45). Sleep disorder can result in physiological and psychological problems that are listed in Table 1 (47). In addition to these problems, other symptoms and signs of sleep deprivation are behavioral changes, numbness, speech disorder, ptosis, weak judgment, and energy deficiency (52). Panic, restlessness, paranoia or deliriousness, and impulse control disorder are among the behavioral changes. Some of these effects are depicted in Figure 1 (53-54).

Table 1: Effects of sleep disorder

Physiological effects	Psychological effects
Reduced immune system response	Aggressiveness
Increased level of thyroid hormone secretion	Touchiness
Increased level of cortisol secretion	Antisocial behaviors
Increased level of epinephrine secretion	Memory loss
Reduced level of growth hormone secretion	Hallucination
Reduced level of pain threshold	
Dysfunction of upper skeletal muscles	Fantasy
Slowing down of hypercapnic and hypoxic reactions	

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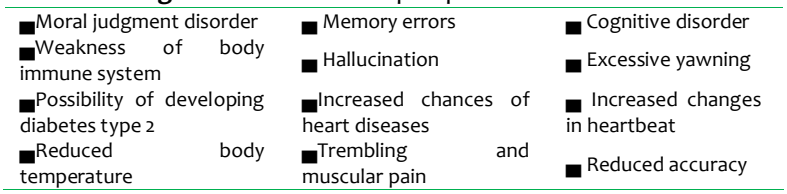
Figure 1: Effects of sleep deprivation



Factors causing sleep deprivation in hospitals

Many physiological, psychological, and environmental factors are involved in the occurrence of sleep deprivation disorder in hospitals. Pain and stages in the treatment of patients are among the physiological factors referred to in studies that have been carried out (35). Environmental factors include noise, light, and activities related to taking care of patients (52). Vital signs machine, phlebotomy equipment, assessments, nurses' activities, and diagnostic tests are among healthcare activities that cause sleep disorder in patients (31-34). Therefore, sleep disorder occurrence can be reduced, and can be prevented, in hospitals by making some changes in the environmental factors and in the activities related to healthcare.

Effects of noise on sleep

Noise levels in hospitals are above those mentioned in the recommendations made by the U.S. Environmental Protection Agency regarding hospitals (53). The U.S. Environmental Protection Agency and the World Health Organization have established 35 decibels as the maximum noise level in hospitals at any time during the day and night. In some studies on sound levels in different wards of hospitals, it has been shown that most often sound levels exceed the recommended one by about 15-40 decibels (52).Busch-Vishniac et al. measured noise levels at many periods during the day and night and found that they dropped by up to 10 decibels during the night. Noise is an environmental factor that causes sleep disorder, and has been investigated in many research studies conducted on hospitalized patients. Noise can be substantially reduced by taking some simple steps such as lowering the sound of alarms, closing the doors in patients' rooms, and using headphones. Research must be carried out to find ways of improving sleeping conditions of patients in hospitals in order to prevent and avoid problems resulting from sleep disorder. Moreover, strategies for using headphones must also be studied with the purpose of helping to raise the quality of sleep in patients with hard to treat diseases.

The Biological Basis for the Effects of Noise on Sleep

Although the fact that noises have effects on cardiovascular health has attracted great interest in recent years (65-66), yet it is important to know this question has a long history and many experiments have been conducted on people and animals regarding these effects. Especially, after the complications caused by wars, some research was carried out to identify the biological basis of the mechanism governing these effects (67-70). The General Stress Theory is a reason foe assuming that noises affect the autonomic nervous system and the endocrine system, and that these effects in turn influence the body's homeostasis (71-75). Constant changes in endogenous risk factors that follow disruption and disorder in metabolic functions resulting from noises increase and spread chronic diseases including atherosclerosis and ischemic heart diseases over time. One important and noteworthy point regarding the harmful effects of noises is that not all kinds of noises cause these complications. According to some reports, noises have harmful effects when they are stronger than 80 decibels at the workplace, more than 65 decibels at homes, or more than 50 decibels when somebody is asleep. Another important point is that evenings, when people get back home from their workplace to rest and nights, when their bodies require recovery and their brains need rest to recover, are very important times that may be susceptible to sounds. Sleep is a strong modulator of the cardiovascular system, and sounds and noises disrupt sleep and, hence, this disruption is a potential cause of developing heart diseases (76-77).

Epidemiological reasons for the effects of noise on sleep

Short-term laboratory studies on people have shown the destructive effects resulting from sounds on the sympathetic and endocrine systems elicit unclear physiological responses in the form of changes in heartbeat, blood pressure, blood vessel contraction, stress hormones, and in ECCs. These effects are especially caused by average-level environmental noises when people are engaged in mental activities such as concentrating and paying attention to learn something (78-80).

Instant spontaneous responses to noises do not happen only when people are awake but also occur at sleep when EECs do not indicate any signs of wakefulness (81). These responses will not become routine over time but rather will cause the development of a series of mental habits (82-83). For example, a person who has worked in a noisy environment for many years still responses to stimulations caused by sounds and these repeated stimulations during sleep can be accompanied by constant rises in blood pressure during the day (84). The long term effects of chronically experiencing loud noises at high levels have been studied in animals, and it has been found these noises cause physiological changes that increase the risk of death in the animals (85-88).

Effects of light on sleep

In cardiac care units, nurses need light day and night to facilitate their activities and provide service to patients. Light is one of the factors that disrupt sleep, it suppresses melatonin secretion, disturbs diurnal sleep rhythms, and prevents sleep (which slows down processes that help the body to recover). In cardiac care units, a wide range of light intensities (5 to 1400 lux) is used. Of course, there is this very interesting point that natural light during the day affects light receptors in the eyes, and thereby regulates the sleep-wakefulness cycle (89-90). Nowadays, a new strategy proposed by researchers for overcoming this problem is to use eye pads in these units (21).

The Features of Light: The word visible light is defined as electromagnetic radiation. The human eye is only sensitive to a small port ion of the electromagnetic spectrum of light (about 3500-800nm) (91). Vision occurs when this wavelength enters the eye and stimulates the rods and cones in the retina. This is the light which makes vision and different methods of measurement in the environment possible. Photographers make use of photometer as a measuring device, because the human eye is not reliable for detecting the illumination of the light in the environment and requires more reliability for improved results of photography with more appropriate discernment. Candle foot was an old measurement standard used in photometers which photographers and scientists used to evaluate the illumination. A candle foot measures the illumination of a standard candle in a dark room one foot away; however, nowadays a modern photometer called lux is used. One lux of illumination is almost equal to the brightness of a candle in a dark room with a distance of one meter. According to the scattering of light, the amount of illumination measured with the unit of lux in one meter equals one tenth of the illumination measured in one foot, thus it can be said that one lux equals 0.1 candle foot (93). The human eye is normally capable of experiencing a visual spectrum of 01/0 lux (a starry night with no moon) to 50,000 to 20,000 lux (a bright sunny day). The lights around us typically range from almost 50-20 lux in a common room to 500-100 lux in a bright office. The illumination in the environment which is commonly known with the environmental light is necessary for visual ability and also as a non-visual need of the body (94). When electromagnetic beam enters our eyes, it creates a non-visual response 24 hours a day; the light beam enters our eye and creates a signal which goes to suprachiasmatic hypothalamic nucleus of the brain which is responsible for regulating the daily rhythm through the bonds of the central nervous system (95). The entrance of environmental light to our eye is the primary adaptor of the rhythm of the body throughout day and night (96).

The light in the hospital: The light inside a hospital is an important part of points of emphasis for healing and beneficial results of hospitalization. One of the documented and popular researches in this field is the work of Olrish and colleagues on designing a hospital and creating a new pattern compared to the classic pattern which was done in 1984. In this study, the place of windows for the entry of light was well studied and patients' recovery was evaluated, based on the properties of the existing windows (97). Although this study evaluated light generally, but it can be considered from the perspective of patients' sleep disorders resulting from light in hospitals. Later, many researches were carried out by different instruments of light measurement to evaluate the spectrum of light in hospitals (98-103).

Patterns of light in sleep and waking: Lots of studies have evaluated the relationship between exposure to sunlight and health and sanitary ramifications for the patients and measured the 24-hour rhythm of sleep and waking. There's a biological link between the sleep-waking patterns and exposure to light. There's a link between the suprachiasmatic nucleus and the hypophysis (the hormone secreted after exposure to darkness) (104-105). Melatonin has a 24-hour production cycle whose level of production is high at night. Melatonin is normally at its peak between 2-4 a.m. and is reduced during the day between 7-9 a.m. Exposure to light at night causes the secretion of melatonin with a slow rhythm and this rhythm moves toward a decrease in secretion much faster in the morning; thus it is now thought that the synthesis of melatonin is responsible for the biological link between sleep-waking patterns and exposure to light (106).

Given the above, it is clear that hospitalization significantly disrupts the sleep patterns (107-108). The effects of the disease, environmental factors disrupting sleep, medications, anxiety and depression are the most common causes of acute insomnia in hospitalized patients. Researchers have shown that insomnia in the hospital leads to fatigue, irritability, and lower pain threshold (107). Overall, insomnia can be treated by reforming the underlying disease, reducing environmental disturbing factors of sleep and reducing anxiety with psychiatric interventions and relaxation trainings or medical treatment (109). Benzodiazepines are the most common types of medicines used to control acute insomnia in in-patients and out-patients (110). Among the existing drugs, short-acting and intermediate-acting benzodiazepines such as Lorazepam and Oxazepam are most commonly used. Although these medicines are effective and quite safe, they have many side effects which are more observed in indiscriminate use of high doses for a prolonged period of time (111).

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