RESEARCH ARTICLE

NON-PHARMACOLOGIC NURSING INTERVENTIONS TO REDUCE DELIRIUM RISK AND PROMOTE QUALITY SLEEP

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Abstract

The average ICU patient sleeps less than two hours/day with as many as 61% reporting sleep deprivation, placing it among the most common ICU stressors. Sleep disturbances, lack of sleep and sleep disruption are common in older adults and a core risk factors for delirium. Significant reductions and fragmentation of sleep lead to an absence of restorative sleep. A significant amount of invasive care known to be a major risk contributor to the development of delirium occurs in the ICU. Nurses should be able to identify delirium risk factors earlier and contribute greatly to their prevention by promoting good sleep hygiene interventions.

Keywords: Delirium, Sleep, Deprivation, Sedatives, Medications, Critical Illness, Geriatric, Sleep hygiene interventions \

Introduction

Spirituality is a multifaceted concept. Grounded in both conceptual and empirical studies, spirituality refers to an individual's feeling of connectedness to self, other persons, and a powerful being or nature or the world; an individual's perception of life purpose or meaning; and transcendence indicating the ability to modify the personal perspective of life including suffering. Spirituality is paramount in the life of an individual because it brings about the relief of suffering; promotes a feeling of wellbeing, adaptive capacity for life adversities, peacefulness, and strength within. Likewise, spirituality spawns a sense of hope, motivation, love, and happiness among others (Weathers, McCarthy, & Coffey, 2015).

Sleep disturbances, lack of sleep and sleep disruption are core risk factors for delirium (American Psychiatric Association, 2013). Nursing is the leading discipline responsible for continuous direct patient care and in a position to identify delirium risk factors earlier and provide significant contributions toward delirium prevention. The paradox is that while being most capable of identifying and reducing delirium, nurses perform a significant amount of invasive care known to be a major risk contributor to the development of delirium. For example, noise, light and patient activity have been found to contribute to 30% of sleep disruption (Pandharipande & Ely, 2006), which is in turn associated with increased risk for delirium.

Physiology of Sleep

Sleep-wake cycles and circadian rhythm are controlled by a complex system of neurotransmitters and structural neurons that respond to internal and external stimuli. Part of the ascending reticular activating system includes the suprachiasmatic nucleus (SCN) in the hypothalamus which responds to environmental factors, primarily light exposure. The amount of light exposure affects nighttime melatonin secretion, a neurohormone derived from serotonin (Burry et al., 2017). The amount of light and darkness exposure can impact secretion of melatonin from the pineal gland and alter the circadian rhythm. When the amount of darkness is not sufficient in a 24-hour period, the default is the awake phase of sleep such that sleep cycles will advance a little each night. In addition to light, environmental factors, sepsis, systemic inflammatory response, hormone interactions, medications (including opioids and benzodiazepines), critical illness, burn, and mechanical ventilation have been shown to alter melatonin excretion (Mulkey, Hardin, Olson, & Munro, 2018; Pandharipande, Girard, & Jackson, 2013). When there is

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insufficient melatonin, disrupted circadian rhythms, fragmented sleep/wake cycles and nighttime awakenings result (Jaiswal et al., 2018).

Blue light is primarily present in the morning and has a wavelength of 460-480 nm (Estrup, Kjer, Poulsen, Gogenur, & Mathiesen, 2018). When blue light reaches the photoreceptors in the retina, signals are sent from the SCN to the pineal gland resulting in suppression of melatonin. In the absence of blue light, melatonin secretion promotes sleep. In the hospital, artificial light is turned on around-the-clock. This results in constant exposure to blue light and melatonin suppression which may alter the natural sleep-wake cycle. Sleep pattern disturbance is a known risk factor for developing delirium. These disturbances of melatonin secretion have been demonstrated in critically ill patients (Burry et al., 2017). It is, therefore, relevant to understand the impact of circadian light on the incidence of delirium (Estrup et al., 2018).

Assessment

Sleep is most accurately and objectively assessed using polysomnography (PSG), simultaneous electroencephalographic (EEG) recordings and physiologic parameters. Sleep periods are generally classified as wake, wake after sleep onset, non-rapid eye movement (NREM) and rapid eye movement (REM) sleep. NREM sleep is further subdivided into four stages. Sleep onset occurs with stage 1 which is usually short-lived. The cycle then progresses to stage 2, occupying about half of the total sleep time, and finally to stages 3 and 4. These last two stages of sleep, Stages 3 and 4 are characterized by delta or slow-wave sleep (SWS); these are periods when sleep is deeper and more restful. These phases account for as much as 15-20% of the total sleep time in a healthy middle-aged adult. Stage 3 and 4 have been found to be unobtainable in critical populations due to noise and interruptions during sleep (Su & Wang, 2018). Although REM sleep is considered more restful, the brain is quite active and, as the name suggests, distinctive intermittent rapid eye movements occur. Each sleep cycle is approximately 90 to 110 minutes in duration, with REM sleep periods increasing in length with each full cycle as the night progresses. REM sleep usually alternates with stage 2, accounting for 20-25% of the total sleep time (Su & Wang, 2018).

Significant reductions and fragmentation of sleep lead to an absence of SWS and REM sleep. This is the phase during the sleep cycle considered to be restorative sleep, and patients may exhibit cognitive changes as a result of sleep deficits. Although not well established, limited and sometimes absent restful or restorative sleep is thought to be a significant contributor to the onset of delirium may help reduce the risk for delirium (Van Rompaey, Elseviers, Van Drom, Fromont, & Jorens, 2012).

Sleep and Delirium

Despite significant advances in knowledge regarding delirium and sleep, the pathophysiology continues to be the least understood. Sleep pattern disruption and delirium are thought to be related both to deficits and imbalances in the neurotransmitters that modulate the control of cognitive function, behavior and mood. Sleep is not merely a passive state but requires complex regulation by the brainstem and diencephalic structures. While there is typically no distinct structural defect in the brain's anatomy, the cortical and sub-cortical areas are involved in delirium regardless of etiology.

Over time, sleep disturbances can lead to a decline in cognitive function including psychomotor vigilance, memory and disturbances in language and perception, characterized by hallucinations and delusions (Mulkey et al., 2018). Evidence has shown newly learned material and skills are consolidated during REM sleep that is significantly disrupted thereby leading to dysfunction in the brain's information integration capacity. This dysfunction can lead to the hallucinations and delusions seen during delirium and is thought to be partially responsible for post-traumatic stress seen in patients who recover from delirium (Bilotta, Lauretta, Borozdina, Mizikov, & Rosa, 2013; Numan et al., 2017).

Elderly patients are more likely to develop delirium due to the normal physiologic changes associated with aging (Mulkey, Hardin, S.R., Olson, Munro, Everhart, 2019). This partially explains why delirium is often present with an acute illness. During the normal aging process, cerebral blood flow decreases by 28% and a loss of neuronal cells occurs along with lower concentrations of cerebral neurotransmitters, such as acetylcholine, dopamine, gamma-aminobutyric acid (GABA), and norepinephrine (Maldonado, 2017). These changes likely result in less physiologic reserve to adapt to the additional neurologic stress occurring with metabolic disturbances, infection and trauma. The inability to adapt alters secretion of neurotransmitters that regulate the sleep/wake cycle (Thille et al., 2018). This is thought to be the result of modulation occurring slowly and having long-term effects over diverse and widespread systems (Maldonado, 2017). These effects can produce a sustained response that plays a role in maintenance of the sleep-wake cycle (Thille et al., 2018).

Even in healthy individuals, sleep deprivation has been shown to impair memory, attention, response time and other aspects of neurologic function (Pisani et al., 2015). In healthy volunteers, sleep deprivation has been shown to impair memory, attention, response time, and other aspects of neurologic function. The relationship between sleep deprivation and delirium in the ICU is currently unproven. However, because sleep deprivation affects cognitive function, a connection between delirium and sleep deprivation in critically ill patients may exist.

Sleep disturbance is a common concern in the acute care setting, especially the ICU (McLaughlin, Hartjes, & Freeman, 2018). The average ICU patient sleeps less than two hours/day with as many as 61% reporting sleep deprivation, placing it among the most common stressors (Maldonado, 2008). The reason for these disturbances is multifactorial. The patient's predisposing risk factors such as age or prior cognitive impairment combined with an acute illness or surgical procedure, the hospital environment and medication exposure. Objective studies have indicated the noise

generated within the hospital environment is not conducive to sleep (Basner & McGuire, 2018; Darbyshire, Müller-Trapet, Cheer, Fazi, & Young, 2019; Garside et al., 2018).

As previously described, these factors along with alterations in the circadian rhythm result in a synergistic effect. Studies looking at sleep deprivation in critically ill patients have revealed ICU patients average approximately two hours of sleep in a 24-hour period with <6% spent in REM sleep (Pandharipande & Ely, 2006). This disturbance in sleep leads to detrimental effects on protein synthesis, immunity, energy expenditure, hemodynamics and cognitive function.

Medications

Medications that disrupt the sleep wake cycle include antiarrhythmic agents, inotropes and vasopressors, antibiotics, antidepressants, steroids, anticonvulsants, and bronchodilators (Pandharipande & Ely, 2006). Beta-blockers, clonidine, ibuprofen, naloxone, alcohol, opioids and benzodiazepines as well as high cortisol levels decrease the amount of melatonin release (Olofsson, Alling, Lundberg, & Malmros, 2004) Table 1. displays information on the relationship of sleep and common medications.

Sedatives and analgesic medications are routinely administered to patients to promote sleep. While patients appear to be sleeping, sleep architecture is typically adversely affected. Researchers looking at melatonin levels have discovered an abolition of melatonin release in deeply sedated ICU patients (Maldonado, 2008). Sedatives (propofol, midazolam, lorazepam) and opioids, administered to reduce discomfort, are known to inhibit slow wave sleep (SWS) and REM sleep leading to the development of delirium. Benzodiazepines and propofol prolong stage two NREM sleep and decrease slow wave and REM sleep. Opioids on the other hand increase stage one NREM sleep and decrease slow wave and REM sleep (Su & Wang, 2018). Because of promoting lighter sleep stages, there is a reduction in restorative sleep. These findings suggest sedative agents may contribute to the development of delirium by more than one mechanism (i.e., disruption of sleep patterns, central acetylcholine inhibition, and disruption of melatonin circadian rhythm; Maldonado, 2008).

Many organizations, including American Society of Anesthesiologists, American Geriatrics Society, American Heart Association, Society of Critical Care Medicine recommend the use of multimodal analgesia for acute pain management. Using more than one analgesic agent, technique and non-pharmacological interventions that use different mechanisms to provide better pain relief with less opioids to address acute pain, known as multimodal analgesia (Apfelbaum, Ashburn, & Connis, 2012; Devlin, Skrobik, Rochwerg, et al., 2018; Shah, 2018). By combining different analgesics, multimodal analgesia can optimize efficacy with a lower dose of each respective agent and may also reduce the risk for dose-related adverse events, including delirium.

Nursing Implications

Nurses play a vital role in improving a patient's sleep wake cycle through the use of non-pharmacological nursing interventions. When considering interventions to promote sleep nurses need to consider the patient's perspective of their "healing environment." Nursing interventions focused on optimizing the quality of sleep can have a significant impact on the overall outcome for patients. High quality patient centered nursing care is the only intervention that has been shown to consistently reduce the harmful effects associated with delirium (Siddiqi et al., 2016). Therefore, providing good quality bedside nursing care focused on meeting the patients basic needs should be a central focus. A recent Cochrane review recommends the use of multi-modal nursing interventions for the prevention and treatment of delirium, one of which is sleep hygiene (Siddiqi et al., 2016).

Managing the Patient Factors

There are many patient factors associated with sleep disturbances and therefore delirium. While not all of them, such as poor overall health and chronic illnesses, are in the nurse's control, there are several important ones that nurses can play a key role in the management including pain, anxiety and sleep hygiene. The Society of Critical Care Management published the Pain, Agitation, Delirium guidelines in 2018 (Devlin, Skrobik, Gelinas, et al., 2018). In these guidelines, they recommend providing multi-model analgesia to address pain prior to the use of sedatives (Barr et al., 2013). Hata and colleagues recommend including the patient and family in evaluation of sleep quality (Hata et al., 2014). Considering the patient's environment is also important. It may be challenging for many nurses who may be experiencing alarm fatigue. With the number of devices in patient's rooms today, alarm noise can be overwhelming (Potharajaroen et al., 2018). Staff conversations patient emotional concerns are also frequently a source of interruption especially at night. Promoting family and use of the patient's social network support may help relieve anxiety, promote rest and ultimately reduce delirium risk. Additional research is needed regarding the impact of providing emotional support on sleep quality and healing (Hata et al., 2014).

Daytime Routine

By promoting activity during the day with scheduled rest periods, many units have a "quiet time" during the day. It is thought that if patients are provided a two-hour quiet time, this will allow for a complete sleep cycle. Studies evaluating these daytime rest periods have had significant limitations such as pre-ICU sleep quality, confounders related to patients themselves, pharmacological exposure, and ICU practices that complicate efforts. Additionally, ICU interventions that can interact and influence the reported outcome have raised questions about the standard, randomized controlled trial research methods that have been used to evaluate delirium and sleep-related outcomes in the ICU. Unfortunately, these challenges are inherent to an aspect of ICU care such as sleep. As is the case with many ICU studies, these confounders complicate efforts to establish causality. Alternative research strategies that permit the integration of multiple interventions and rapid adaptation to updated clinical results in the research environment, such as the use of an

adaptive platform trial design, may better serve the exploration of complex clinical questions such as the link between delirium and sleep in critical illness (Skrobik & Devlin, 2018; Skrobik, Duprey, Hill, & Devlin, 2018; Thille et al., 2018; Yu et al., 2013).

While there remains uncertainty regarding the relationship between sleep and delirium, this association is one of many "accepted" by the critical-care community (Skrobik & Devlin, 2018; Y. Skrobik et al., 2018; Thille et al., 2018; Yu et al., 2013). Having a daytime rest period has been found to be beneficial for the patient while also providing an opportunity for nurses to complete tasks and chart patient care. During these quiet times some patients may like having the door closed or earplugs to limit noise, blinds or curtains closed and eyes masks to limit light distractions (Van Rompaey et al., 2012). For this to be successful, it may be necessary to have standardized orders or implement these practices in standard patient care routines.

Night-time Routines

To obtain quality sleep one complete 90-minute cycle is needed. Care providers are the primary barrier to patients obtaining quality sleep (FitzGerald et al., 2017). Implementing strategies that are thought to be natural "sleep cues" such as reducing the lights and decreasing the noise level, whether truly effective, improve the individual's perception of the quality of the sleep obtained (FitzGerald et al., 2017). When there is frequent deprivation of N3 and REM phase of the sleep cycle, sleep is not restorative and therefore strategies minimizing the number and frequency of sleep disruption should be considered (Su & Wang, 2018). Strategies that promote sleep hygiene such as implemented earplugs and eye masks need to be included in the patient plan of care (Su & Wang, 2018).

Limiting Interruptions

As a result of the need for care related to the patient's medical condition, many patients are not provided with enough time to meet optimal sleep needs. Routine nighttime awakenings often occur to complete tasks needed for clinicians during the day, such as vital signs, blood draws, and daily weights. It is important to consider both sleep quality and efficiency (Ghaeli, Shahhatami, Mojtahed Zade, Mohammadi, & Arbabi, 2018). Data from observation studies of hospitalized patients have shown that patients rarely obtain 2-3 hours of uninterrupted sleep (Barr et al., 2013; Ghaeli et al., 2018; Hata et al., 2014).

When nurses are planning to implement "quiet time" or any sleep program, recruiting all the disciplines who interact directly with patients is needed. For example, if the laboratory technicians come to the unit at 0300 to draw morning labs or respiratory therapy changes oxygenation tubing during the proposed "quiet times" it will be necessary to work with those departments to change their workflow to meet these expectations. Nurses will need to give up some of the "sacred cows" such as nighttime bathing (Ghaeli et al., 2018).

Environmental Disruptions

The Environmental Protection Agency recommends noise levels less than 45 decibels during the day and lower than 35 decibels during the night. The noise level in most hospitals is between 50-70 decibels with night time levels closer to the 70-decibel range (Ghaeli et al., 2018; Stewart & Arora, 2018). As a result of these findings Medicare now includes noise level at night as part of the publicly reported HCAHPS surveys patients receive after discharge. Medicare uses this data as part of their determination for the amount reimbursement or payment hospitals receive. This metric continues to be the most challenging. Even with "quiet at night" impacting reimbursement, this is the patients report that as many as 42% of hospitals are not quiet at night. Additional studies have shown that more than half of the noise is unnecessary (Darbyshire & Young, 2013). For example, staff conversations and television volumes have been reported as the most irritating cause of sleep disruption (Stewart & Arora, 2018). Electroencephalogram studies have shown these noise levels do interfere with sleep. When considering the limited diurnal light-dark cycles and sleep disruption, the hospital environment interferes with circadian rhythm that guides the patients sleep structure,

Elevated noise levels during hospitalization are more than just annoyance. When clinicians do not provide quiet environments, patient's clinical outcomes may be impacted through several mechanisms, sleep disruption, an increase in medical errors, and by increasing the body's response to stress.

Therefore, nurses should promote the delivery of high quality and compassionate care by making a concerted effort to reduce the noise levels in the patient care environment as the minimum standard of care (Stewart & Arora, 2018).

Alternative Therapy

Over the years a variety of complementary and alternative therapy have been utilized to promote sleep(FitzGerald et al., 2017; Ghaeli et al., 2018; Stewart & Arora, 2018). Some therapies than can be implemented by nurses include aromatherapy, massage and relaxation strategies (FitzGerald et al., 2017; Stewart & Arora, 2018). Music therapy, phototherapy and acupressure will likely require collaboration from integrative medicine. A few small studies and one meta-analysis have evaluated the use of bright light therapy. The data from these studies suggest that day time bright level therapy is a protective factor against delirium onset (FitzGerald et al., 2017; Ghaeli et al., 2018; Moyce, Rodseth, & Biccard, 2014; Stewart & Arora, 2018). The use of phototherapy has been evaluated in case reports with suppression of delirium symptoms when resistant to haloperidol with mixed results (FitzGerald et al., 2017; Ghaeli et al., 2018; Luther & McLeod, 2018; Potharajaroen et al., 2018; Stewart & Arora, 2018).

Conclusions

Sleep disorders are extremely frequent among all patient population. Sleep deprivation and disturbances in quality are known to have significant consequences for patient outcomes. However, more severe disturbances in sleep fragmentation and the sleep-wake cycle have been associated with delirium.

Therefore, careful consideration is warranted when providing care to older patients, especially those with dementia (Huson, Stolee, Pearce, Bradfield, & Heckman, 2016). Nurses have the capacity to integrate non-pharmacological interventions for sleep promotion that can have a significant impact on patient outcomes. By removing barriers to quality uninterrupted sleep, nurses are therefore able to improve the healing process.

Providing multi-modal analgesia to reduce opioid use, decreasing nursing care activities at night to provide periods of uninterrupted sleep, and promoting family and social support are interventions that may improve sleep and are unlikely to have unintended effects. Sleep hygiene interventions that have been effective in healthy populations might also be helpful in promoting sleep in the ICU, such as maintaining a quiet dim nighttime environment, reducing blue light at night, and use of white and pink noise. Scheduling "quiet time" or rest periods during the day has repeatedly been shown to improve sleep, but is limited to only a few hours (Dennis, Lee, Woodard, Szalaj, & Walker, 2010; Olson, Borel, Laskowitz, Moore, & McConnell, 2001). Moreover, daytime napping runs counter to well establish advice for patients with sleep problems to avoid sleeping during the day. Likewise, it is unclear whether ear plugs and eye masks will improve sleep in the ICU, or whether blocking appropriate environmental stimuli might increase risk of delirium. Melatonin use in the ICU also requires additional research (Jaiswal et al., 2018).

Sleep disturbances are common in the acute care setting. A review of the literature raised the question of how important it is to monitor the quality of sleep to avoid clinical consequences including delirium. Delirium is independently associated with worse outcomes including increased length of stay and increased mortality risk at a rate of 10% each day delirium is present. Nursing is the primary discipline capable of impacting modifiable delirium risk factors. Both non-pharmacologic and pharmacologic measures such as those previously mentioned can reduce the incidence and duration of delirium. Nurses can provide interventions which impact the environment through limiting interruptions in sleep and by providing an environment that promotes sleep.

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