Noise in the intensive care unit: a summary review

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ESPAÑOL

Ruido en la unidad de cuidado intensivo: resumen de una revisión

Palabras clave

Ruido, unidad de cuidado intensivo, complicaciones, sueño, privación de sueño

Resumen

- En la unidad de cuidado intensivo la presencia de luces intensas y de dispositivos mecánicos que producen mucho ruido pueden ser molestos para los pacientes. Además, el personal y los visitantes pueden aumentar los niveles de ruido, los que sucesivamente puede aumentar el estrés de los mismos.
- La conciencia de este problema y de su importancia, hace necesario llevar a cabo medidas preventivas para evitar la aparición de complicaciones de sobrecarga auditiva tales como el delirio.
- Este artículo presenta una revisión de la literatura en el tema y sugiere estrategias que ayudan a minimizar los niveles de ruido en el ambiente de cuidado intensivo.

SUMMARY

- Within the intensive care unit, the presence of bright lights and mechanical devices can produce many sounds which can be distressing to patients. Additionally, staff and visitors can add to the noise levels, which in turn may add to patients' stress.
- Awareness of this problem, and of its importance, makes it necessary to carry out preventive measures in order to avoid the onset of complications of auditory overload, such as delirium.
- This paper provides an overview of the literature in this area and suggests strategies to help minimise noise levels within the intensive care environment.

INTRODUCTION

Noise, in clinical areas such as the intensive care unit (ICU) can be an unpleasant auditory stimulus, which may not be easily eliminated (Van de Leur et al., 2004). It may be caused by devices (such as ventilators, infusion pumps, and monitors) that are used during the delivery of care, often to support or optimise the patient's physiological status. The frequency of medical bleeps, telephones ringing and alarms triggering clinical devices can be constant and annoying and may lead to a worsening of the patient's condition and increase in staff errors (Hodge et al., 1990; Murthy et al., 1995; Allaouchiche et al., 2002). One of the main effects of noise on patients is sleep deprivation and this may lead to serious complications, such as the development of delirium, which is associated with increased morbidity and mortality (Webb et al., 2000; Robert, 2001; Marshall et al., 2003; Ely et al., 2004). In this paper, we aim to review the literature and explore developments of research in this field.

To identify and access the relevant literature we searched a number of electronic databases, including MedLine and CINAHL. Several words alone or combination were used to access relevant sources. The terms used were: intensive care units [MeSH], sleep deprivation [MeSH], sleep [MeSH], noise [MeSH], discomfort [MeSH] alarm [MeSH]. Through this literature search and consultation of the most important nursing and medical association web-sites, dealing with critical care, several contributions were found. To increase the comprehensiveness of the search, papers in English and/or Italian were retrieved and reviewed. However, publications relating to paediatrics and neonates were excluded. With a few exceptions, because of their specific relevance, only articles less than ten years old were retrieved.

The key research that was found is summarised in table 1.

Sound basics

The human ear is sensitive to both the frequency of sound waves and the intensity or mechanical strength of the sound wave. Pitch, or sound frequency, is measured in units called Hertz (Hz); 1 Hz = 1 vibration per second. The unit of sound intensity is the decibel (dB), and is used to measure sound intensity using a scale based on multiples of ten (also called a logarithmic scale). On such a scale, if the threshold of hearing (the sound intensity at which no sound perceivable) is 0 dB, then a sound ten times more intensive is 10 dB, a sound 100 times more intensive is 20 dB. While sound intensity can be measured objectively, perceived loudness is subjective and dependant on a variety of factors, including the ear's inherently variable sensitivity to sounds at different frequencies.

Study	Population	Design	Aims/objectives	Results	Comments
Studies that analyse sleep-wake rhythm: noise study					
Meyers et al. 1994	ICU lights and noise monitoring	Observational study	To show the relationship between night and daily noise issue	ICU noise during the night (79.7 db) and day (83.4 db) was higher than normal levels (45 db)	Night nursing care procedures were a problem
Freedman et al. 2001	24 patients aged 28-57 years, in ICU 18-20 days	Observational study	To assess sleep quality with respect to environmental noises	ICU patients' sleep quality disorders are caused by environment noise	During both night and day, the REM phase of sleep was decreased, fragmented or absent
Wallace et al. 1999	6 volunteers paid by a sleep disorders centre	Observational study	To measure the effects of sound in healthy people with ICU noise simulation	Inconclusive	The study was inconclusive
Calvete Vazquez et al. 2000	33 ICU patients	Cohort study	To determine the cause of sleep disorders	63% of patients reported that they had had enough sleep	Those patients who had sleep disorders reported the causes as mechanical ventilation pain and monitor sounds
Studies that analyse sleep-wake rhythm: nursing procedure/noise					
Freedman et al. 1999	203 ICU patients (121 male, 82 female)	Cohort study	To assess patients' responses about events that disturb sleep-awake rhythm in ICU	Patients reported that noise during nursing procedures disturbs sleep.	Is important to reduce disturbance caused by nursing procedures
Cooper et al. 2000	21 ICU patients and 15 nurses for 340 observations	Observational study	To assess if nursing procedures influenced sleep and if drug prescriptions such as sedatives and analgesics influenced quality of sleep	Patients with mechanical ventilation had similar sleep disorders as non-ventilated patients	Patients have sleep disorders that cause daily functional disturbance
Gabor et al. 2003	7 mechanical ventilated patients and 6 healthy people in ICU	Observational study	To analyse differences between mechanically ventilated patients and healthy people in relation to feelings about disturbance factors	Noise and nursing procedures were not causes of sleep disturbance	No main cause for broken sleep in ventilated patients
Monsen et al. 2005	Neurosurgical ICU patients	Observational study	To assess the influence of noise disturb before and after application of a behaviour program to prevent awakening	The most frequent disturbance factor was nursing procedures	Is was necessary to modify behaviours to focus on procedures during awake periods

Table 1. Research studies on noise in ICU

To accurately reflect the ear's sensitivity to sound intensity over the range of audible frequencies, researchers developed a weighted unit of sound intensity, know as the A-weighted decibel, or dB(A) scale. Using this scale, an increase of 10 dB(A) results in a perceived doubling of loudness (Cmeil et al., 2004)

NOISE IN THE INTENSIVE CARE UNIT

With respect to noise levels in the clinical environment, it is the sudden and unexpected emission of sounds that causes unwelcome distress to patients, who are not in a position to regulate or control this. In the ICU there are multiple sources of auditory stimuli and the patients are the prime victims. The noise that is produced mainly causes sleep disorders and alterations in the normal sleep/wake rhythm. Sleep deprivation is a significant problem for all patients in ICU, although there are no studies that report the percentage of those people who are involved in these situations. However it has been demonstrated that factors such as pain, lights, sounds, attending staff activities and stress may disturb the patient's rest.

Meyers et al. (1994) studied noise in ICU, comparing it to a hospital ward and measuring the decibels. They found that sleep deprivation occurred most frequently in ICU, and may cause a decrease in respiratory muscle function and hypercapnia. Aaron et al. (1996) found that in intensive care and high dependency areas, including night time, there are very high sound peaks of noise (up to 80 dB).

According to the International Noise Council, the appropriate value should be around 45 dB during the day, 40 dB in the evening hours, and 20 dB at night.

As far as sound intensity is concerned, differences in the various intensive care treatments typologies do not vary and this is especially important for the paediatric environment. Philbin and Gray (1995) pointed out that even by cutting down human activity noise and that of mechanical devices, the level in dB caused by the structure (for example flooring, tubes, air conditioning et cetera) was always high. That is why, in the planning of the intensive care structures and their the construction, it is necessary to use soundproof materials. Even the daily life activities can create disturbance and may affect the patient's sleep (see table 2).

Among the recollections of intensive care patients the most annoying things are the presence of the orotracheal tube, the various attending staff activities and noise. These situations are considered by all as connected to stress and discomfort (Van de Leur et al., 2004).

Patient monitoring and noise

Monitor warning signals produce about 80 dB of noise and can cause sleep deprivation in patients (Balogh et al., 1993) and significant higher stress levels both to patients and operators (Chambrin, 2001).

Although there is little research on the subject, chiefly doctors and nurses who work in heavily sound polluted environments do not give their best practice as they are at the risk making mistakes which may be due to noise. This situation could damage the relationships between doctors and patients and other professional staff members (Blomkvist et al., 2005; Parthasarathy, 2005).

NOISE	dB
Whisper voice	20
Computer cooling system	30
Laser printer	30
Phone calls	40
Copy machine	50
Normal voice tone	50
Electric typewriter	60
Loud voice	60
Mechanical typewriter	70
Mobile tones	75

Table 2. Noise and daily life activities (Malaguti Aliberti, 2003)

CONCLUSIONS

The presence of very high noise in ICU is a serious problem, particularly for patients. Noise negatively affects not only the patient's health but also that of the operators. The causes of noise are principally environmental (linked to the technology utilised, but also to the structural characteristics of the unit, and the social interactions of operators). From the literature analysed, it appears that it is necessary to move in two directions: work organisation and structural planning in order to try to solve the noise issue in ICU. Strategies need to be in place to assess and reduce needless and excessive noise levels. This should embrace structural planning, and development of technological equipment. Among the instruments to implement and aid sleep in ICU, some studies concentrated on the introduction of a 'quiet time', where the involvement of health workers in patient-related activity is reduced to a minimum to help the patients to rest (Olson & Borel, 2001; Tamburri, 2004; Monsén & Edéll-Gustafsson, 2005).

There are several key messages for intensive care nurses:

- noise is an important cause of discomfort for patients in ICU
- staff should plan strategies to minimise and prevent noise levels within the ICU environment
- interventions are necessary to plan structures and use technology that produces less noise

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