# Sleep in Intensive Care Unit

An Essay

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For The Partial Fulfillment of Master Degree in ICU

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2013

بسم الله الرحمن الرحيم

"قَالُوا سُبْحَانَكَ لا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ"

صدق الله العظيم

(سورة البقرة:32)

# Acknowledgement

First of all, I would like to praise Allah who granted me the strength to accomplish this work my True love and thanks to my family for their tremendous help, guidance and support, my special thanks, love and gratitude to my beloved father.

Words do fail to express my deepest gratitude and sincere appreciation to prof. Dr. Bassel Mohammed Nour – El din, professor of anesthesia and ICU, faculty of medicine, Ain - shams university, for his precious advice, invaluable instruction and powerful support.

I would like to express my deepest gratitude and thanks to Dr. Rasha Samir Bondok, Assistant professor of anesthesia and ICU, Faculty of medicine, Ain - shams university for her helpful support, valuable remarks and constructive encouragement.

I wish to direct my special thanks to Dr. Hany Ahmed Abd – El Kader , Lecturer of anesthesia and ICU, Faculty of medicine , Ain - shams university, for his honest supervision and helpful discussion and for providing great effort help and meticulous remarks.

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# Abreviations

| | |
|---|---|
| AHI | Apnea - hypopnea |
| APSSV | Adaptive pressure support servo-ventilation |
| ASD | Acute stress disorder |
| BMI | Body mass index |
| BZRA | Benzodiazepine receptor agonists |
| CHF | Congestive heart failure |
| CNS | Central nervous system |
| COPD | Chronic obstructive pulmonary disease |
| CPAP | Continous positive air way pressure |
| CRT | Cardiac resynchronization therapy |
| CSA-CSR | Central sleep apnea with cheyne stokes respiration |
| DLMO | Dim light melation onset |
| EEG | Electroencephalogram |
| EPA | U.S. Environmental protection agency |
| EPAP | Expiratory positive airway pressure |
| FDA | The U.S. food and Drug administration |
| GABA | Gamma amino butyric acid |
| GHB | Gamma hydroxyl butyrate |
| ICSD | International classification of sleep disorders |
| ICU | Intensive care unit |
| IPAP | Inspiratory positive pressure ventilation |
| LDT | Lateral dorsal tegmentum |
| MT | Melation receptor |
| ND | Nightmare disorder |
| NIPPV | Noninvasive positive pressure ventilation |
| NIV | Noninvasive ventilalian |
| NPPV | Noninvasive positive pressure ventilation |
| NREM | Non rapid eye movement |
| OHS | Obesity hypoventilation syndrome |
| OSA | Obstructive sleep apnea |
| OSAHS | Obstructive sleep apnea - hypopnea syndrome |
| OTC | Over the - counter |
| PAP | Positive airway pressure |
| PAV | Proportional assist ventilation |
| PFT | Pulmonary Function test |
| PLMD | Periodic limb movement disorder |
| PLMS | Peroiodic Limb movements |
| PNS | Parasympathetic nervous system |
| PPT | Pedunculopontinetegmentum |
| $PSC_t$ | Polysomnography |
| RBD | Rapid eye movement sleep behavior disorder |

| | |
|---|---|
| RBD | Rapid eye movement sleep behavior disorder |
| REM | Rapid eye movement |
| RLS | Restless legs syndrome |
| SCN | Supra chiasmatic nucleus |
| SNS | Sympathetic nervous system |
| SRB | Sleep related bruxism |
| $SSRI_s$ | Selective serotonin - reuptake inhibitors |
| SWS | Slow wave sleep |
| TMP | Transmural pressure |

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# Introduction

# INTRODUCTION

The cyclic repetition of sleep and wakefulness states is essential to the basic functioning of human body. As understanding of the neurobiology of sleep increases, sleep is no longer viewed as a passive state i.e. absence of wakefulness but rather as an active neurobehavioral state that is maintained through a highly organized interaction of neurons and neural circuits in the central nervous system **(Markov and Goldman, 2006)**.

Sleep is characterized by a variety of physiologic behavioral, and Electroencephalogram (EEG) changes and is necessary for restoration of cognitive, mood, and physiologic functions **(McCareley, 2007)**.

Sleep consists of two strikingly different states, rapid-eye- movement (REM) sleep. Non-REM sleep can be subdivided further into four stages. Polysomnography is the "gold standard" technique which simultaneously records the three physiologic measures that define the main stages of sleep and wakefulness. These measures are muscle tone recorded through electromyogram, eye movements recorded through electro-oculogram and brain activity recorded through EEG **(Markov and Goldman, 2006)**.

Patients in the ICU are known to have severly disrupted sleep and some patients manifest unique EEG sleep patterns. The etiology of sleep disruption in the intensive care unit (ICU) includes the inherent nature of the environment, medications, ventilator-patient interaction, and the effect of acute illness **(Friese et al, 2007).**

Any agent that acts on or through sleep regulatory neurotransmitters, modulators, or their receptors can impact sleep architecture. Abrupt withdrawal from chronic medications, including recreational drugs, can cause serve sleep

disruption and delirium. In critically ill patients, it is difficult to ascertain a single drug's effect on sleep architecture **(Pandhardipande and Ely, 2006)**.

Studies reveal that sleep deprivation is associated with many derangements in physiologic parameters that could negatively affect the pathophysiology, treatment, and recovery from critical illness; and hencecontributes to an increased morbidity and mortality. An integrative approach that includes both pharmacologic and nonpharmacologic strategies should be undertaken to prevent and treat sleep deprivation. An emphasis should be placed on providing an ICU environment that is both diurnal and sleep friendly **(Bourne and Mills, 2004)**.

# Aim of the Work

# AIM OF THE WORK

This essay aims to provide an overview of neurophysiology and pharmacology of drugs affecting sleep mechanisms and the current knowledge of the causes, effects and management of sleep problems in intensive care units.

# CHAPTER (1)

# NORMAL SLEEP AND CIRCADIAN PROCESSES

# Normal Sleep and Circadian Processes

Sleep is a natural process occurring in animals and human beings. It is a complicated state involving both behavioral and physiological processes. Several brain centers are involved in the production and regulation of sleep using a variety of hormones, neurotransmitters and peptides.

## Normal sleep staging

Sleep is an essential physiologic process for most living organisms. Sleep is divided into non rapid eye movement (NREM) sleep and rapid eye movement sleeps (REM). Older sleep staging developed by Rechtschaffen and Kales divided NREM sleep into four stages, numbered 1, 2, 3, and 4 (Rechtschaffen and Kales, 1968) .

According to the newly released American Academy of Sleep Medicine scoring criteria, NREM sleep is now characterized by three stages (N1, N2, N3), with N3 encompassing the older classification of stages 3 and 4. These stages are based on a constellation of physiologic parameters and are defined by electrophysiologic waveforms and frequencies using electroencephalographic (EEG) monitoring (Iber et al., 2007).

Sleep stage 1 (N1) comprises about 2% to 5% of sleep and consists of a low voltage, mixed frequency pattern, usually in the theta