THE VALUE OF BISPECTRAL INDEX MONITORING IN SHORTENING RECOVERY TIME IN ENDOSCOPIC NEUROSURGICAL PROCEDURES

Essay

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By

Nehal Mohamed Aldesouki

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Under Supervision of

Prof. Dr. Alaa Eid Mohamed

Prof of Anesthesia, Intensive care & Pain Management

Faculty of Medicine - Ain Shams University

Dr. Khaled Hassan Saad

Assistant Prof. of Anesthesia, Intensive Care & Pain Management

Faculty of Medicine - Ain Shams University

Dr. Mohamed Osman Taeimah

Lecturer of Anaesthesia, Intensive Care & Pain Management

Faculty of Medicine - Ain Shams University

Ain Shams University (2014)

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Nehal Mohamed Aldesouki

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LIST OF ABBREVIATIONS

Abb.	Meaning
BBB	Blood Brain Barrier
BIS	Bispectral Index
BSR	Burst Suppression Ratio
CBF	Cerebral Blood Flow
CMR	Cerebral Metabolic Rate
$CMRO_2$	Cerebral Metabolic Rate of Oxygen
CNS	Central Nervous System
CSF	Cerebrospinal Fluid
CVR	Cerebral Vascular Resistance
DSC	Digital Signal Converter
EEG	Electroencephalogram
EMG	Electromyogram
EP	Evoked Potential
ETV	Endoscopic Third Ventriculostomy
FDA	US food and Drug Administration
GABA	G-Amino Butyric Acid
ICP	Intracranial Pressure
ICU	Intensive Care Unit
LMA	Laryngeal Mask Airway

Abb.	Meaning
MAC	Minimum Alveolar Concentration
MAP	Mean Arterial Pressure
MED	Microendoscopic Discectomy
N_2O	Nitrous Oxide
NMB	Neuromuscular Block
NO	Nitric Oxide
Non REM sleep	Non Rapid Eye Movement sleep
NPH	Normal-Pressure Hydrocephalus
OR	Operating Room
PET	Positron Emission Tomography
PIC	Patient Interface Cable
REM sleep	Rapid Eye Movement sleep
SEF	Spectral Edge Frequency
SQI	Signal Quality Index
SR	Suppression Ratio

INTRODUCTION

During every surgical procedure we must keep the anesthetic level at an appropriate level so that the patient will neither feel pain nor remember the operation. Yet this anesthetic depth must be balanced against the negative effects and consequences of excess anesthetic and the associated potential for delayed wake up. A wide range of monitoring devices allows us to avoid the risks of pain, unwanted movements, hemodynamic changes, delayed recovery as well as awareness. **(Zhang et al, 2011)**

During the past few years processed EEG signals have become available that help gauge the depth of anesthesia by generating a score linked to EEG activity, which becomes depressed as anesthesia deepens. The bispectral index (BIS) represents one of these innovative methods of monitoring in anesthesia. (**Avidan et al, 2011)**

Bispectral Index (BIS) monitoring systems allow anesthesia professionals the ability to access processed EEG information as a measure of the effect of certain anesthetics

during the care of patients they select to monitor. The clinical impact of BIS monitoring has been demonstrated in a variety of randomized controlled trials that reveal the potential for BIS monitoring to facilitate improvements – including patient safety – in anesthesia and post-anesthesia care. **(Gan et al, 2005)**

BIS monitoring systems are intended for use by healthcare personnel trained in their proper use. They are intended for use on adult and pediatric patients to monitor the state of the brain by data acquisition of EEG signals. **(Myles, 2004)**

Neuroendoscopy comprises a promising minimal invasive technique being applied in an increasing amount of cases as diseases of cerebrospinal fluid dynamics, brain and spinal tumors, cysts, infections, evacuation of hematomas et al. representing an important scientific modality neuro-endoscopy favors the rapid recovery of the patients and improves its quality of life.**(Hardavella and Ianovici, 2005)**

The BIS may be used during neuro-endoscopic procedures as an aid in monitoring the effects of certain anesthetic agents; and its usage with certain anesthetic agents may be associated with a reduction in primary anesthetic use

and a reduction in emergence and recovery time. Use of BIS monitoring to help guide anesthetic administration may be associated with the reduction of the incidence of awareness with recall in adults during general anesthesia and sedation, reduction in anesthetic drug use, shortening recovery time, reducing stay in post-anesthesia care unit and total hospital stay and reducing the whole cost. **(Klopman, 2011)**

AIM OF THE WORK

The aim of the work is to focus on the value of the Bispectral Index monitoring as a processed EEG monitor in shortening recovery time in endoscopic neurosurgical procedures and to describe causes of prolonged unconsciousness after anesthesia.

BRAIN ANATOMY AND BASIC BRAIN PHYSIOLOGY

Brain Anatomy:

The Nervous System

The nervous system can be divided into two categories: the central nervous system (CNS) and the peripheral nervous system (PNS).

The central nervous system is composed of the brain and spinal cord.

The peripheral nervous system is divided into the somatic and autonomic nervous system. **(Scanlon, 2011)**

The central nervous system:

- **The Brain**

The brain in an adult is one of the body's largest organs. The brain is divided into four major parts: the cerebrum, diencephalon, brain stem, and cerebellum. **(American Association of Neurological Surgeons, 2006)**

- **Spinal Cord**

The spinal cord is the primary structure that connects the brain and peripheral nervous system. The spinal cord is made up of 31 segments: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 coccygeal vertebrae. While a pair of the spinal nerves exits from each segment of the spinal cord**. (Scanlon, 2011)**

Peripheral Nervous System

The peripheral nervous system is subdivided into the somatic nervous system and the autonomic nervous system. The somatic nervous system consists of the twelve pairs of cranial nerves and thirty one pairs of spinal nerves. **(Marieb & Hpehn, 2013)**

- **Somatic Nervous System**

The somatic nervous system is typically under voluntary control. The somatic nervous system includes all nerves controlling the muscular system and external sensory receptors. The somatic nervous system has both motor and sensory divisions. Motor fibers are efferent fibers which innervate skeletal muscle. They are present in spinal nerves and cranial nerves III, IV, VI and XII and terminate at the skeletal muscles. Sensory fibers are afferent fibers that relay sensations such as

touch, pain and temperature from the skeletal muscles via peripheral, spinal, and cranial nerves V, VII, IX and X to the central nervous system **(Affifi & Bergman, 2005).**

- **Autonomic Nervous System**

In contrast, the autonomic nervous system is not voluntary. The autonomic nervous system regulates the activities of the internal organs. It consists of two main parts: the sympathetic and the parasympathetic systems. These two "opposite" systems often operate in opposition to each other.

Many internal organs are stimulated by both systems. When one stimulates an organ, the other tends to depress the organ.

The sympathetic nervous system is responsible for the "fight-or-flight" response. This response prepares us for emergency situations.

The parasympathetic nervous system, oppositely, tends to inhibit these reactions. The response of our body depends on the proportionate strength of stimulation supplied by each system at any given instance. **(Scanlon, 2011).**

Basic Brain Physiology:

Basic Unit of the NS: Neurons

Within the brain and nervous system are specialized cells known as neurons. Neurons are responsible for delivering chemical messages to other cells to stimulate a response. This is the basis. Within the brain, there are approximately 100 billion neurons. Neurons are typically classified by the direction that they send information. Sensory, or afferent, neurons send impulses from sensory receptors in the periphery or some organ to the central nervous system. Motor, or efferent, neurons send impulses away from the central nervous system to muscles or glands. **(Fernando et al, 2011)**

Neurons have specialized extensions called dendrites and axons. Dendrites bring information to the cell body (soma) and axons take information away from the cell body. Some neuronal axons are myelinated (have a fatty substance coating them) that speeds impulse transmission and some are not. Nodes of Ranvier are short unmyelinated segments of an axon. **(Jarvis, 2008)**