Usage of Bispectral Index in Cardiac Surgery to Facilitate Fast Track Anaesthesia

An Essay Submitted for Partial Fulfillment
Of the Master Degree in Anaesthesia

By

Hesham Saad Abdel Aziz
M.B B.Ch.
National Heart Institute

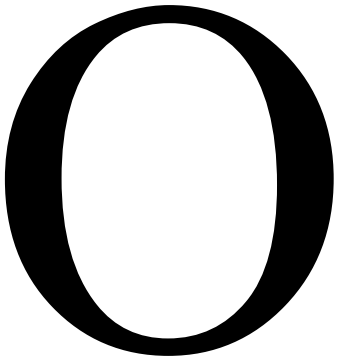
Under supervision of

Prof. Dr. Aiman Dessouki
Professor of Anaesthesia
Faculty of Medicine
Cairo University

Prof. Dr. Amr Abdel El Moniem
Ass. Professor of Anaesthesia
Faculty of Medicine
Cairo University

Dr. Ashraf Ahmed Adel El Masry
Lecturer of Anaesthesia
Faculty of Medicine
Cairo University

Faculty of Medicine
Cairo University
2007



قَالُوا سُبْحَانَكَ لا عِلْمَ لَنَا إِلا مَا عَلَّمْتَنَا
إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ

سورة البقرة: صدق الله العظيم
٣٢

Abstract

BIS index is an FDA approved monitor for assessing the sleep/awake status for patients, BIS monitor is a non invasive device that is easily applied to the forehead, it can be applied in all ages, sex, various medicaland surgical situations.

The use of BIS guided anesthesia can aid in adjusting anesthetic agents required for induction of anesthesia that is sufficient to blunt the stress response accompanying larygoscopy and intubation, maintenance and recovery of anesthesia. BIS benefits can be extended far beyond OR and can be used in the ICU to help in providing sedation and analgesia.

Key Words:

Bispectralindex – Facilit Fast Track Anaesthesia – cardiac Surgery .

ACKNOWLEDGMENT

First and foremost, thanks are due to ALLAH to whom I relate my success in achieving any work in my life.

I would like to express my sincere gratitude and deepest appreciation to Prof. Dr. AIMAN DESSOUKY, Professor of anesthesia, Faculty of Medicine, Cairo University, for his kindness, precious advice, continuous encouragement and guidance throughout the preparation of this work.

I give my thanks to Prof. Dr. AMR ABD EL MONIEM, assistant professor of anesthesia who helped me a lot. They provided me with endless cooperation, effort and support.
I am deeply grateful to Dr. ASHRAF EL MASRY, lecturer of anesthesia , for His patience, guidance, sincere help and meticulous comments have enlightened my way through out this work.

Also I would like to thank all my professors and colleagues in National

Heart Institute, for their valuable help and support throughout this work.
Last but not least, I would like to extend my deepest thanks to my parents for their great help and kind support.

Contents

List of Figures

Abbreviations

BIS	Bispectral index
CABG	Conroy artery bypass graft
CPB	Cardiopulmonary Bypass
DSC	Digital signal converter
ECT	Electro convulsive therapy
EEG	Electroencephalogram
EMG	Electromyogram
ESLD	End Stage Liver Disease
ESRD	End Stage Renal Disease
FDA	Food & drug administration
HR	Heart rate
ICU	Intensive Care Unit
IH	Inguinal hernia
LOC	Loss of consciousness
LOM	Loss of movement
MAC	Minimum alveolar concentration
MAP	Mean arterial blood pressure
OR	Operation Room
PACU	post anesthesia care unit
PET	Positron Emission Tomography

PIC	Patient interface cable
ROC	Recovery of consciousness.
SI	Skin incision
SP	Standard practice
SQI	Signal quality index
SR	Suppression ratio
SV	Spontaneous ventilation
TA	Tonsillectomy adenoidecto

Background & significance:

Anesthesia is a balance between the amount of anesthetic drug administered and the state of arousal of patient. Given that the intensity of surgical stimulation varies throughout surgery and the hemodynamic effects of the anesthetic drugs may limit the amount that can be given safely, critical imbalances between anesthetic drug administration and anesthetic requirements. Underdosing may lead to awareness with subsequent stress and hemodynamic responses, conversely inappropriate titration of the hypnotic components may lead to an excessive depth of anesthesia and might compromise patient outcome(1).

Reports of awareness during surgery has been in anesthesia literature for decades (2, 3). Individuals who have experienced awareness are frequently traumatized by the experience the real incidence of awareness during surgery is not precisely known, however studies have reported incidences in which awareness estimates were alarmingly high (4-6).

In October 1996, bispectral index (BIS) achieved approval by the Food and Drug Administration (FDA) as the first electroencephalogram (EEG) based monitor of anesthetic effect (7). BIS reduces complex EEG processing to a simple number ranging from 0-100. The bispectral index (BIS) offers a simple method for continuous brain status monitoring throughout the administration of anesthetic or sedative drugs. Bispectral index monitoring is considered a reliable tool in assessing the level of consciousness. It is currently accepted that induction and maintenance of anesthesia are associated with a decrease in BIS value, and that increasing concentrations of either volatile or intravenous anesthetics further decrease the BIS value. This measurement of the hypnotic effect proved to be accurate and reliable in nearly all patients and clinical settings. The use of

BIS monitoring has grown rapidly in the care of patients, as it is safe and inexpensive and it does not require special training.

Bispectral index monitoring has been reported to be superior in evaluating anesthetic depth compared with other clinical signs. In noncardiac anesthesia, BIS monitoring helps to avoid underdosage or overdosage and their consequences as light anesthesia or unjustified prolongation of awakening. Furthermore, the usefulness of BIS as an objective tool for the evaluation of needs and the analysis of costs has also been documented (8-12).

Fast track anesthesia in cardiac surgery is a common practice nowadays, due to development of ultra short acting drugs that is capable to provide the desired level of anesthesia and at the same time has a very short duration of action. Moreover, fast track anesthesia in cardiac surgery had proven to exhibit a shorter ICU and hospital stay than conventional techniques. In cardiac anesthesia, some of the advantages of BIS monitoring are minimized because the intraoperative anesthetic drug support is usually based on the administration of large amounts of opiods. Although its utility in the titration of anesthetics or its accuracy is not altered with the use of high doses of opiods, also, BIS has proven to efficiently predict hemodynamic and arousal reactions resulting from induction of anesthesia and endotracheal intubation (13).

During cardiac surgery, one of the aims of anesthetic management is to achieve a level of adequacy that eliminates the stress response, without unjustifiably prolonging the postoperative mechanical support of breathing. In these operations, the result of anesthetic drugs may be affected by various factors. Acute and significant fluctuations in plasma drug concentration as a result of priming, alterations in the rate of diuresis or in

the concentration of binding proteins, modification of the function of organs contributing to drug metabolism, and temperature fluctuations are some of the factors that may alter drug kinetics or affect the pharmacodynamic action of anesthetic or sedative administration. Furthermore, the relation between the hypnotic and analgesic depth and the usual clinical criteria of their estimation is unclear because of the administration of various drugs such as catecholamines and β-blockers, among others, and because of the manipulations in the central circulation. All of the above, combined with the problem of "awareness" and the benefits of early extubation, justify the application of BIS monitoring in assessing the patient's hypnotic state. In this essay will focus on the usefulness of BIS index in decision making during cardiac surgery and its aid to early extubation and recovery following cardiac surgery. We will discuss the following issues in regard to BIS:

- Overview of BIS monitor.
- The cardiac surgery dilemma: the value of BIS Index?
- Fallacies and pitfalls of BIS index.
- Getting the most from your BIS system.
- How BIS monitoring can guide to fast track anesthesia?

Overview of BIS monitor

WHY BIS?

During the evolution of modern anesthesia practice, patient assessment has undergone gradual change and refinement. Observation of clinical signs as pupil size, patterns of breathing and quality of pulse were augmented by direct measurement of physiologic endpoints as blood pressure, respiratory rate and heart rate. With the development of pulse oxymetry and capnography the precise management of ventilatory settings had become much easier and safer. The use of end tidal agent analysis and peripheral nerve stimulators provided anesthesiologists with great information regarding drug target and effects. Nowadays cardiac functions can be easily assessed via various advanced tools ranging from pulmonary artery catheters and Transoesophageal echocardiography to continuous blood pressure and cardiac output monitoring. Thus changes in monitoring throughout history used to add to the currently adopted parameters more precision, ease and usefulness.

Despite remarkable advances in assessment of cardiovascular system during anesthesia, direct determination of the effect of anesthetic and sedative agents on the central nervous system has remained a challenge. Moreover hemodynamic response to anesthetic agents do not necessarily reflect the central nervous system response to that particular agent (14). Thus if a technology that permits direct monitoring of the central nervous system status during anesthesia is introduced, in combination with assessment of clinical signs and traditional monitoring will allow better adjustment of anesthetic, analgesic and

sedative agents in the perioperative period in attempt to achieve the best possible outcome for each patient.

The Bispectral Index (BIS Index) offers the anesthesia professional a direct and accurate method for continuous brain status monitoring throughout the course of anesthetic or sedative administration. Specifically, the BIS Index provides a measurement of the hypnotic effect of anesthesia. It has proven to be accurate and reliable in nearly all patients and clinical settings and it is robust in the presence of the most commonly used anesthetic and sedative agents (8).

Developmental process to BIS:

At the core of brain monitoring technology is the surface electroencephalography (EEG). This complex physiologic signal is a waveform that represents the sum of all brain activity produced by the cerebral cortex. The normal waveform is notable for two characteristics; small amplitude (20-200 microvolt) and variable frequency (0-50 Hz). It has been known for decades that the EEG changes in response to the anesthetic and sedative/ hypnotic agents (15). Although individual drugs can induce some unique effects on the EEG, the overall pattern of changes is quite similar for many of these agents. Typical EEG changes during general anesthesia include: an increase in average amplitude (Power) and a decrease in average frequency (Figure 1)

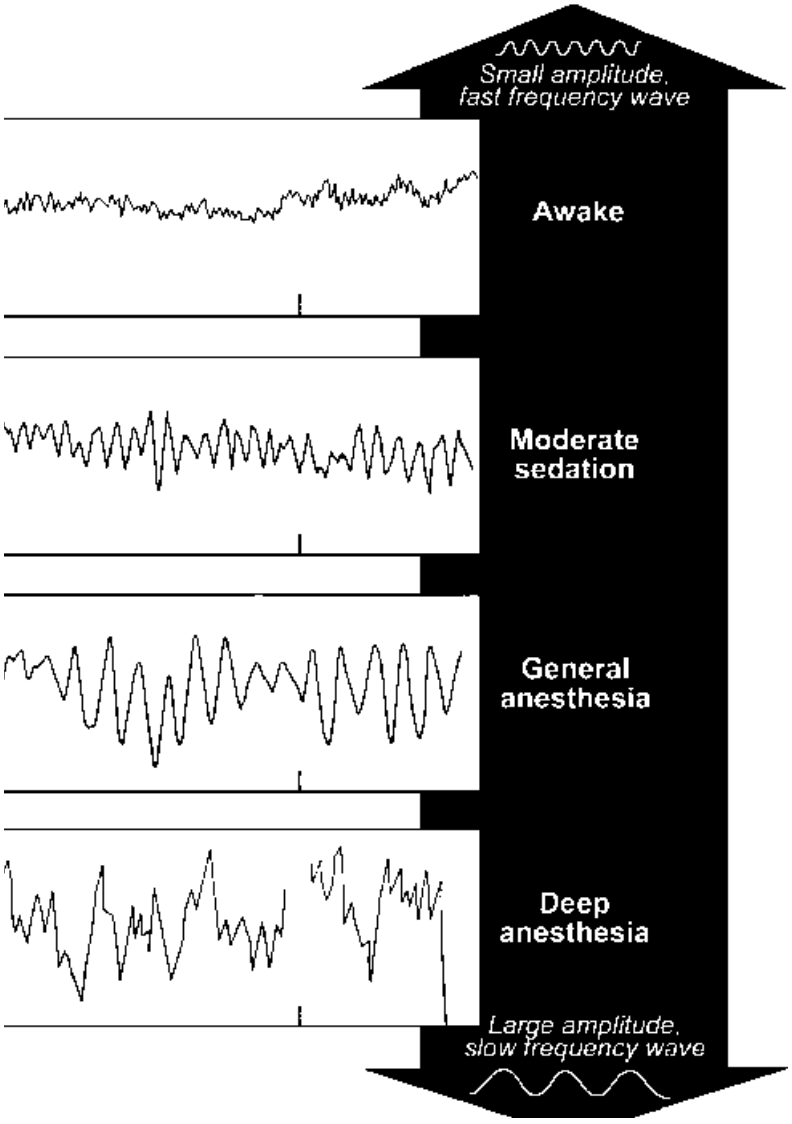


Figure 1 General pattern of EEG changes observed during increasing doses of anesthesia.

These changes become more evident as the EEG waveform frequency patterns move from Beta to Delta the pattern consistent with deep anesthesia. The complex EEG waveform can be broken down into its individual components. This data can then be analyzed using a technique called power spectral analysis and displayed as power per frequency component in a power spectrum. Power spectral analysis can result in one or more numeric descriptions known as processed EEG parameters.

Processed EEG Parameters: