EDITORIAL VIEW

The introduction of bispectral index (BIS) in anesthesia practice

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SUMMARY

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 to avoid the risks of pain, unwanted movements, hemodynamic changes as well as awareness. 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, even if more studies are still needed to make it more precise, especially in pediatric patients and neonates where reliability has yet to be well established.

Key words: Bispectral index; Neurological monitoring; Awareness; Depth of anesthesia

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The Bispectral Index™ (Aspect Medical Systems Inc., Newton, Mass) is a complex EEG parameter that combines power spectrum analysis, time domain analysis and it values their changes over time. The analysis was introduced by geophysics in 1960 to study the motion of the ocean changes in atmospheric pressure and the seismic activity. Following its scope has been extended to the study of electrophysiology in particular the coupling of the frequencies waking and sleeping. In 1996 BIS was approved by the Food and Drug Administration as a measure of the depth of anesthesia induced by sedatives and hypnotics.[1]

In October 2005, the American Society of Anesthesiologists adopted the "Practice Advisory for Intraoperative Awareness and Brain Function Monitoring". The approval of this advisory by the ASA signals a heightened concern regarding intraoperative awareness and establishes an important role for brain monitors within anesthesia practice.[2]

BIS is calculated using a combination of three key elements in his analysis:

a) It fragments the EEG signal captured by sensor second by second and it identifies the artifacts
b) It calculates the index of the state of sedation due to changes induced by anesthetics by an algorithm
c) It obtains the value that is recorded by means of a sensor placed on the patient's forehead

BIS-index is a number between 0 (*absence of brain activity, EEG isoelectric*), and 100 (*patient awake*). An optimal value for the maintenance of the anesthesia should be between 40 to 60.

The results regarding the sensitivity and specificity of the values obtained by BIS-index are conflicting.

In 2002, Bergman IJ studied 8372 incidents and he reported to the Anesthetic Incident Monitoring Study: there were 81 cases in which peri-operative recall was consistent with awareness and he concluded that an objective central nervous system depth of anesthesia monitor may have prevented 42 of these incidents.[3]

Zhang et al. confirmed, in a recent study performed on 5228 patients during total intravenous anesthesia, that BIS-guided TIVA (between 40–60) decreased the risk of awareness compared with routine TIVA and it concludes that the main reason for awareness was light anesthesia.[4]

Avidan et al. suggested in a recent study on 6041 patients (high risk for awareness) that a protocol based on the bispectral index (BIS) is superior to a control protocol that evaluates the agent concentration (ETAC) to prevent episodes of awareness and he concludes that the superiority of the BIS protocol was not established although it is slightly higher to ETAC.[5]

Sammartino et al evaluated the possibility to improve the monitoring during pediatric sedation with BIS. BIS monitoring reduces the anesthetic dose, the time of opening eyes and time to discharge from the hospital. Standard monitoring in pediatric sedation, e.g. ECG, pulse oximetry and noninvasive blood pressure, isn't sufficient during sedation; BIS monitoring and capnography should be recommended for the prevention of complications during sedation in children. They concluded that the data were, however, still insufficient.[6]

The Department of Anesthesiology, Emory University School of Medicine, Atlanta, analyzed the effectiveness cost of using BIS-monitoring. They concluded that its use justified in every general anesthetic because it reduces anesthetic drugs, decreases time to extubation, decreases incidence of nausea and vomiting and decreases intraoperative awareness.[7]

Another system of neurological monitoring is Entropy (GE Healthcare™). The Entropy module allows to obtain numerous informations of the cerebral activity of the patient thanks to the concept of spectrum (the figure obtained is the sum of energy of each individual activity) and it describes the irregularity of the signal and not the predictability of the same. The module describes an entropy SE (state entropy) and RE (reaction entropy). BIS shows the limit of working with fixed windows set of 30 or 15 s compared to entropy that allows to use different windows and it can, therefore, with greater sensitivity discriminate EEG and EMG signals. Bispectral entropies, State Entropy (SE) and Response Entropy (RE), are processed EEG and FEMG variables which have been shown to correlate with the amount of certain anesthetic agents administered to the patient. Entropy may be used as an aid in adjusting the anesthesia according to individual needs. E-Entropy is available with anesthesia monitor and compact anesthesia monitor using software L-ANE03(A) or later.

A recent multicenter trial confirmed that the values of RE and SE during target-controlled infusion (TCI) with propofol are similar. The Entropy evaluates the degree of sedation than BIS at time point of unconsciousness. After the elimination of myoelectric activation, all values of RE, SE and BIS decreased significantly but the cardiovascular system is more sensitive to noxious stimuli of RE, SE and BIS to do![8]

The neurological monitoring reveals numerous advantages for the patient and it should be used as routine monitoring of anesthesia and it must support and be helped by good hemodynamic and ventilatory monitoring techniques. By providing us a possibility of being able to ensure the patient a '*customized drug dose*' and then an optimal sedation, it has its advantages in intra and post-operative period. For every new and experimental technique the presence of an experienced operator is necessary, who, on the basis of good clinical practice, could lead a good anesthetic practice for the health of the patient. It's time that every operating room complex has at least one BIS monitor that is used to impart hands-on training to anesthetists, monitor selected difficult cases and to gain valuable information about the dose-effect relationship of volatile anesthetic agents as well as intravenous narcotics, hypnotics and sedatives.

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