

Al-Mustaql university college

Department of anesthesia

Lecture of anesthesia equipment

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Bispectral Index (BIS)

is used for monitoring depth of anesthesia using a proprietary algorithm derived from complex electroencephalogram (EEG) parameters.

It's useful in preventing intraoperative awareness and guiding the anesthetist to administer hypnotic drugs especially in high-risk patients.

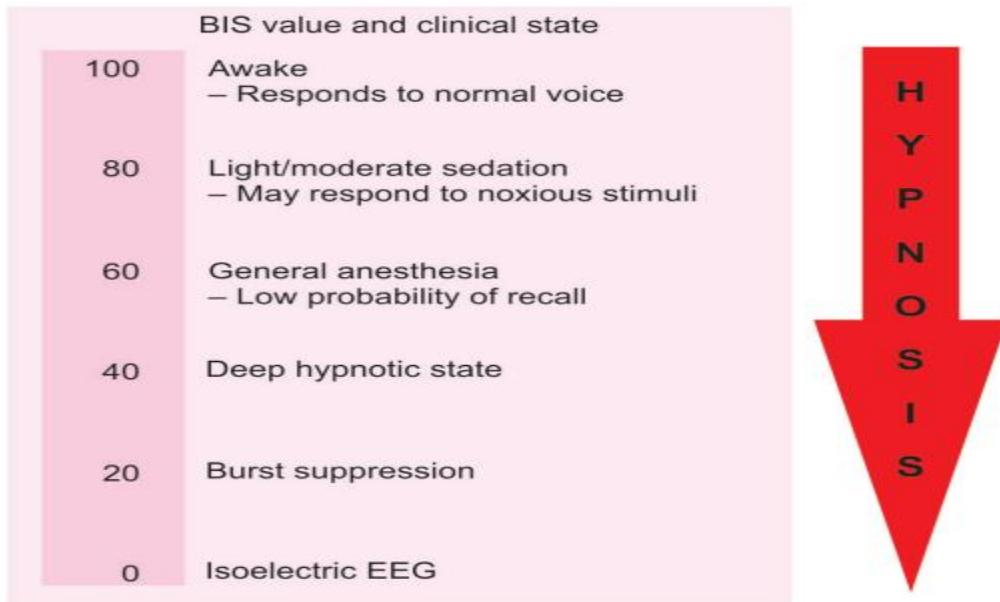
It also decreases the requirement of intraoperative anesthetic drug besides facilitating early extubation and postoperatively decreasing the recovery time and the incidence of postoperative nausea and vomiting.

EQUIPMENT:

The BIS monitoring system consists of the following components:

- BIS sensor
- BISx (digital signal converter and processing unit) with the monitor interface cable and the patient interface cable (PIC)
- BIS monitor.





Bispectral Index Sensor:

The BIS sensor is a replaceable single-use self-prepped multielectrode component. After wiping the patient's forehead with an alcohol swab and letting it dry to ensure a signal of reasonable good quality, the four electrodes are applied to the patient's forehead.

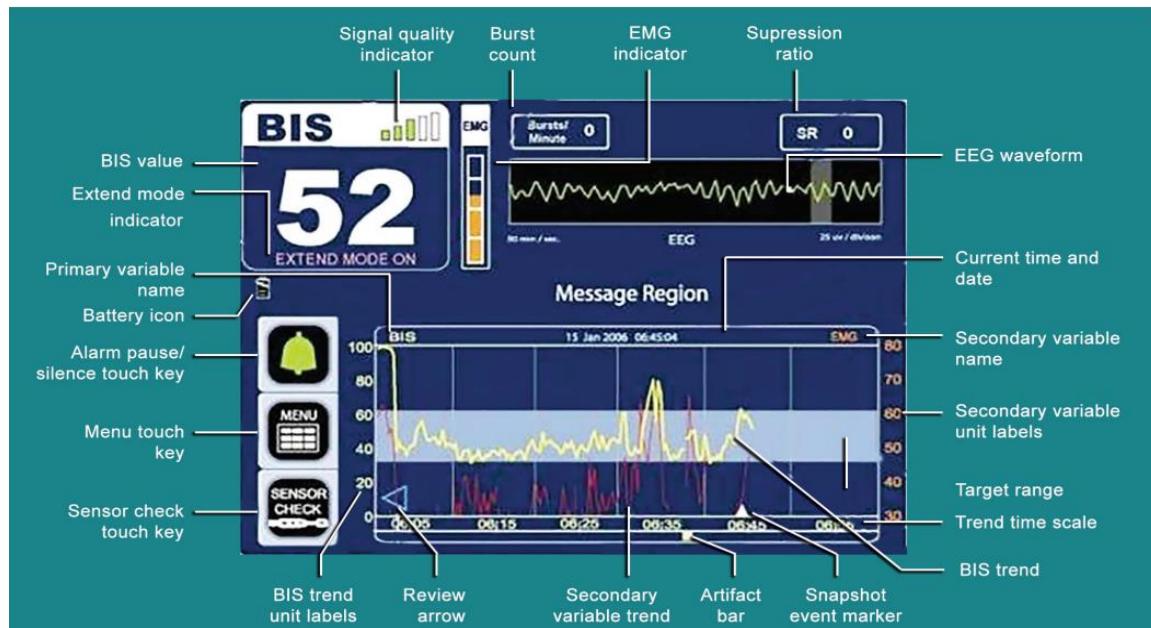


Bispectral Index-X Device The BISx device consists of the digital signal converter and is the component that continuously receives and processes the patient's EEG signals.

The BISx device is placed close to the patient's head to prevent interference of the EEG signal from other medical equipment.

Bispectral Index Monitor

The BIS monitor is a touch screen monitor, which, other than the numeric BIS value also displays the SQI, EMG, burst count and suppression ratio.



Electromyograph indicator is a bar graph that displays the power from muscle activity (i.e. EMG in the frequency range 70–110 Hz) and indicates presence of muscle activity or other high-frequency artifacts (oscillating ventilator modes, convective warming blanket, fluid warmer, oscillating air mattress). BIS monitoring conditions are optimal when the bar is empty

A high EMG may occur as a result of pain or other noxious stimuli, lightening sedation, and/or neuromuscular blocking agent (NMB) wearing off.

Numerous studies over the years have suggested that BIS-guided general anesthesia (within the ranges 40–60) reduced the requirement of propofol or volatile agents, reduced the recovery time, time to extubation, early response to verbal command, duration of postanesthesia care unit (PACU) recovery and stay, postoperative delirium and cognitive dysfunction, decreased incidence of postoperative nausea and vomiting.

FACTORS AFFECTING THE BISPECTRAL INDEX VALUE:

1. Equipment Related Factors

- a. wrong placement of the BIS sensor or lesser adherence can cause difference in the BIS values (usually false high due to elevated electrode impedance).
- b. There is also a time lag range of 14–155 seconds to update the BIS levels and this could limit the efficiency of the monitor in the period of transition from an awake state to the unconsciousness and vice versa.
- c. Electromyographic activity (especially from the patients facial or forehead muscles) can affect the BIS readings and often low frequency EMG signals may interfere with the EEG signals, causing a false elevation in the BIS reading. Higher the EMG, greater is the muscle activity and greater the chances of the BIS value being falsely elevated.
***Clinically this may indicate that the patient may be more deeply sedated than what is reflected on the displayed BIS value.*

2. Anesthetic or Clinical Factors:

- a. Anesthetic or Clinical Factors Certain drugs routinely used in anesthesia may affect the BIS values. Ketamine, nitrous oxide (N₂O), etomidate are some of the drugs which may result in either no alteration or an elevation in the BIS values.

[Nitrous oxide](#) has weak cortical action and at concentrations ranging from 50% to 70% does not change the BIS value.

[Ketamine](#) in doses ranging from 0.25 mg/kg to 0.5 mg/kg, a rapid bolus shows a rise in the BIS value in anesthetized patients receiving propofol or sevoflurane, with deepening of the hypnotic state. Ketamine causes an increase in high frequency EEG activity reflecting the high BIS value.

[Etomidate](#), when used for induction of anesthesia, frequently causes myoclonus and hence raised EMG activity and can display a falsely high BIS value.

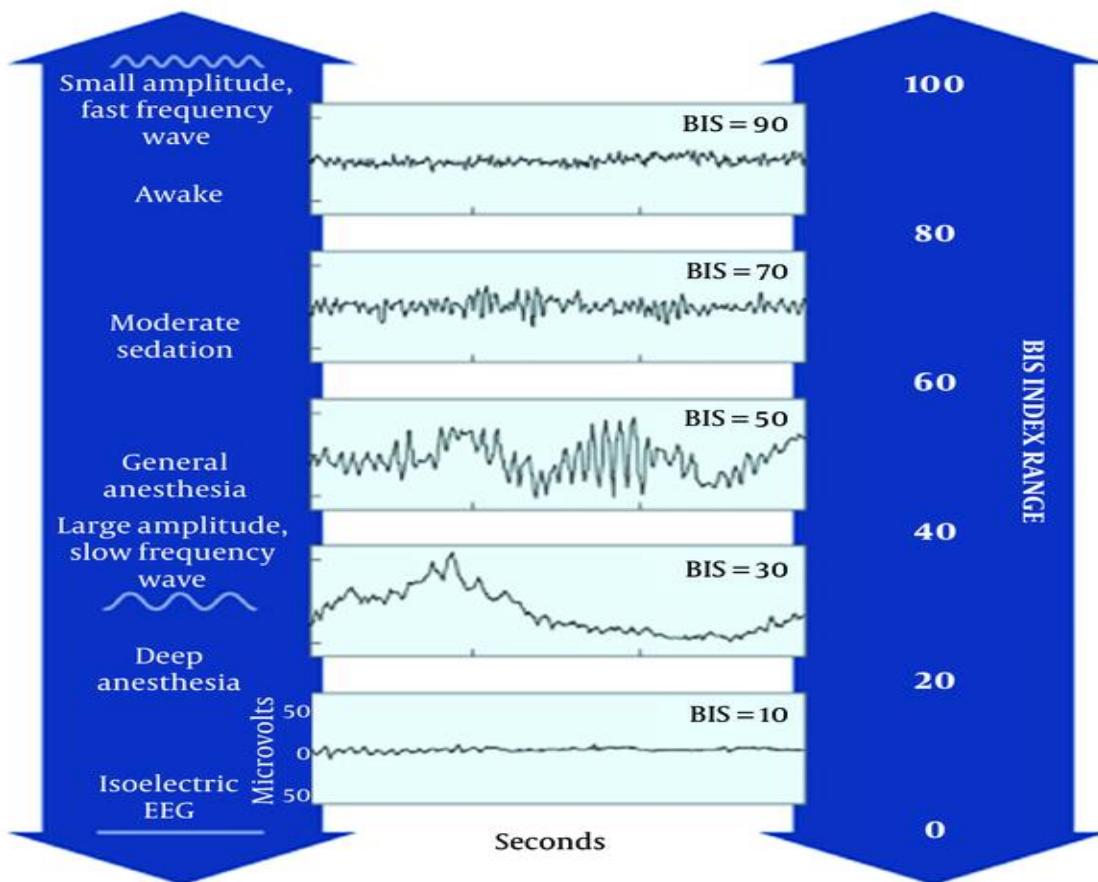
Electrical or Mechanical Interference

Use of different electrical equipment in the operating room during surgery can affect the BIS values. Electrical interference has been reported in literature from the use of atrial pacemaker during cardiac surgeries and theoretically other equipment such as electric scalpel can also cause similar interference. Recent modifications in the BIS algorithm have decreased the probability interference and clinically monitoring the SQI bar can help detect these.

CLINICAL CONDITIONS AFFECTING THE BISPECTRAL INDEX VALUE:

- a. 5–10% of the population exhibit a normal low voltage genetically determined EEG variant not associated with any cerebral dysfunction and is not recognized by the monitor.³⁷ It is thus important that the BIS monitor be applied before anesthetic induction.
- b. studies have shown a reduced BIS value in patients with dementia related to Alzheimer's compared to a control population of elderly individuals and in children with cerebral palsy compared to normal children both during anesthesia and during emergence from the anesthetic.
- c. BIS monitoring during two reported cases of hypovolemic cardiac arrest showed a corresponding decrease in the BIS values to 0 (isoelectric EEG). Fluid resuscitation and restoration of arterial blood pressure returned the BIS values to prearrest status. This variation in the BIS value is related to the cerebral and brain perfusion and reflected in the hemodynamic changes occurring during asystole following cardiac arrest.
- d. Hypothermia may affect BIS monitoring and values were seen to decrease by an average of 1.12 units for every degree Celsius drop in body temperature.
- e. Hypoglycemia causes a gradual increase in low frequency waves as the blood glucose levels decrease from 72 mg/dL to 54 mg/dL. On further reduction in blood glucose levels to 32 mg/ dL, the waveform

is similar to one during general anesthesia and reflected correspondingly by decreased BIS values.



Best regards