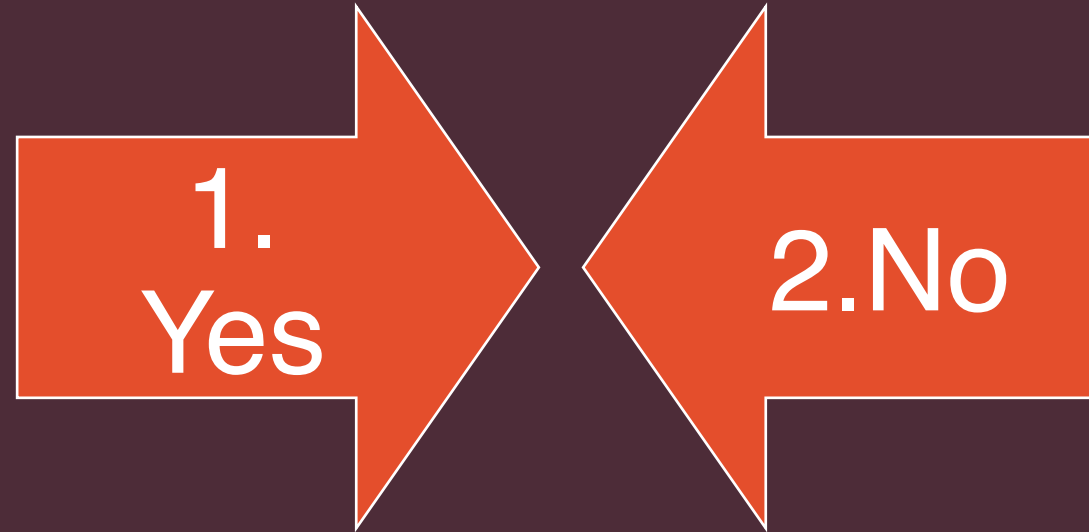


BIS – Love it or Hate it?

By: Anthony Capozucca, DNP CRNA

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How many people use the BIS?



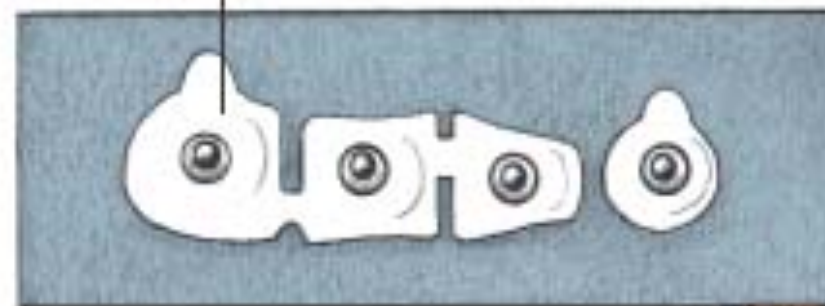
- It's my absolute favorite device for anesthesia Monitoring
- Never heard of it

Bispectral index monitor

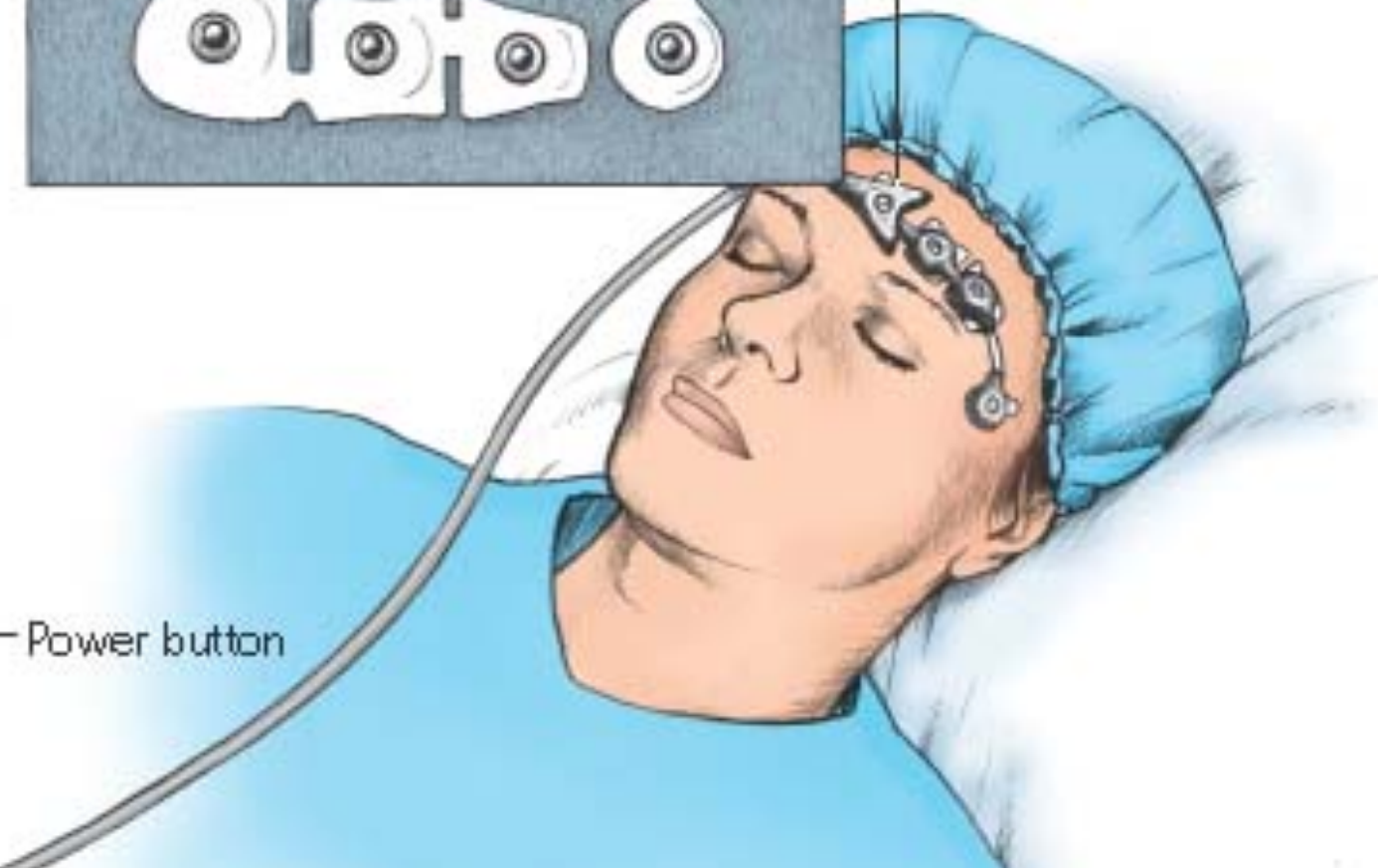
Real-time EEG

Current bispectral
index value

Bispectral index sensor



Power button





What is BIS?

Bispectral Index Monitoring

Allows analysis and processing of EEG which correlates to the level of consciousness

It relies on a combination of bispectral analysis, power spectral analysis and time domain in combination with an algorithm that indexes the anesthetic depth of the patient

Effective with inhalation agents but less predictable with intravenous agents, regional anesthesia and pediatric patients

How does it work?

Processes single frontal EEG to calculate dimensionless number that represents a level of consciousness



Examines four components within the EEG that is associated with anesthetic state

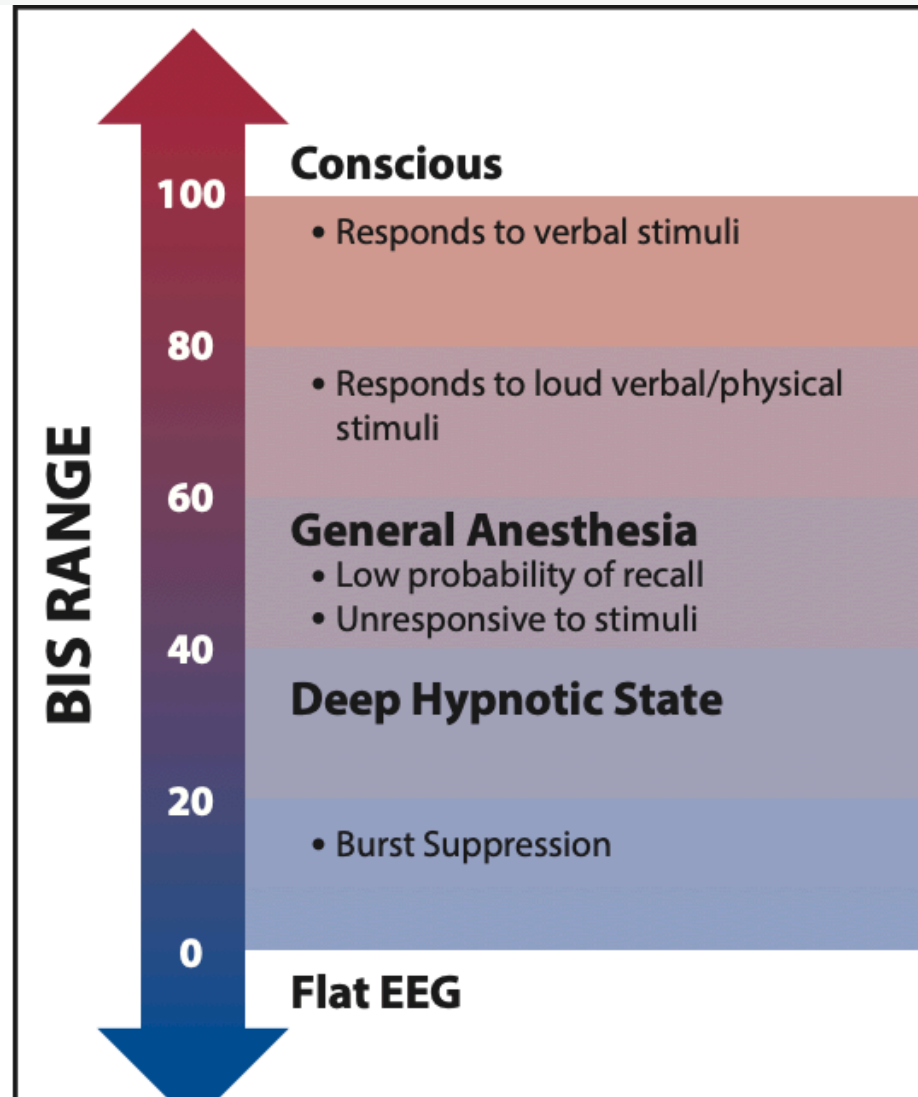


Range of 40 to 60 represents adequate level of anesthesia for surgery



Range from 100 (completely awake) to 0 (absent brain activity)

Methods for assessing CNS integrity



What is Awareness?



UNINTENDED
INTRAOPERATIVE
AWARENESS



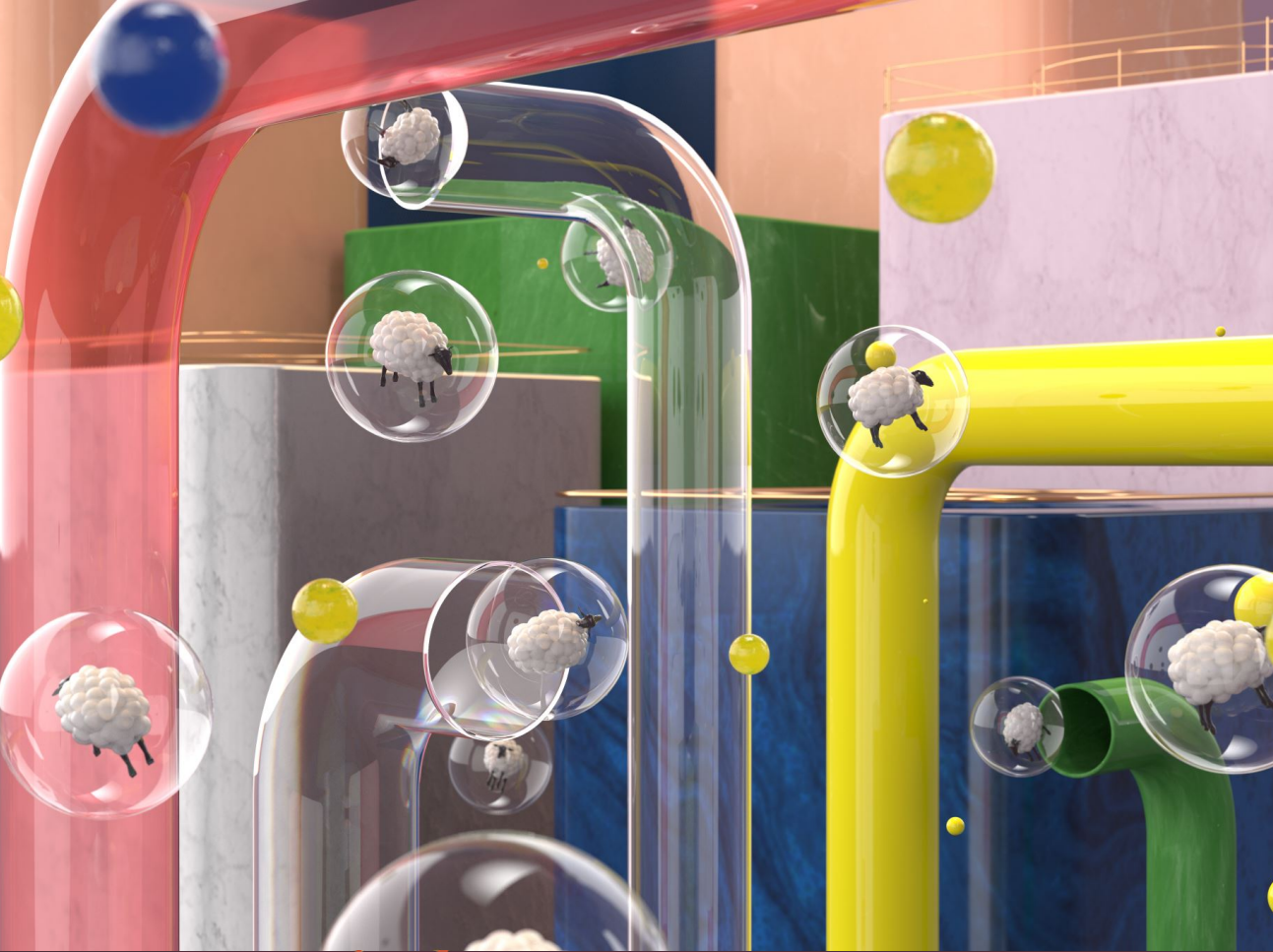
EXPLICIT RECALL OF
SENSORY PERCEPTIONS
DURING PERCEPTIONS



ASLEEP AND PARALYZED
BUT AWAKE UNDERNEATH

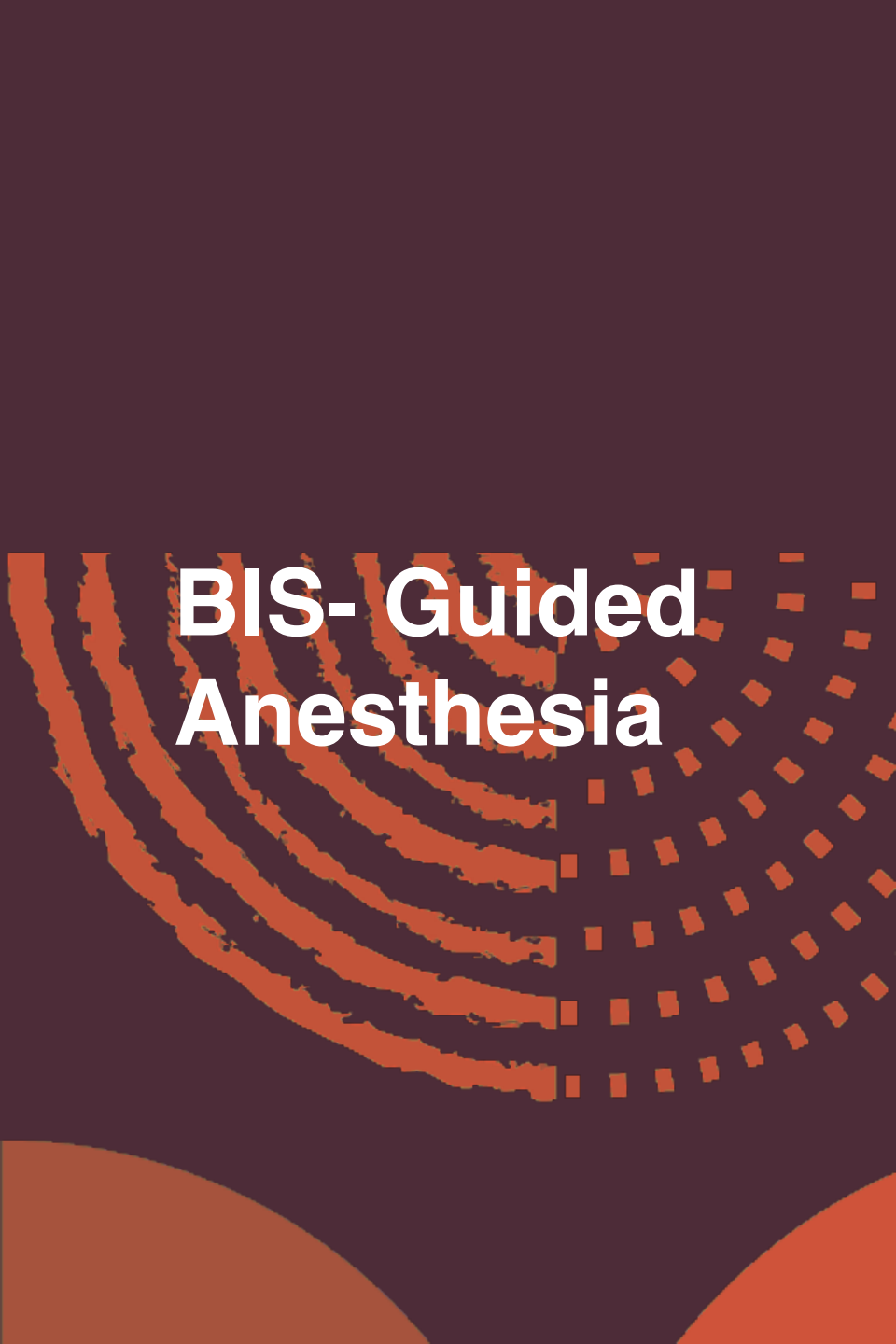
Why is awareness important?

- Lead to anxiety and post-traumatic stress disorder
- Fear of hospitals and all providers post-operatively
- Sentinel event
- 20,000 to 40,000 cases of anesthesia awareness occur yearly in the US



- Standard Practice
- Monitor the concentration of exhaled volatiles by infrared light absorption, quantifying and identifying the gases.
- Standard metric for assessing and comparing potency of anesthetic gas concentration is MAC equivalent.
- When gases are combined → MAC equivalents are additive
- At $\frac{1}{3}$ of the MAC → 50% patients are NOT awake.
- MAC maintenance of 0.7 MAC or above → decreases likelihood of anesthesia awareness

End-Tidal Anesthetic Gas Model



BIS- Guided Anesthesia

Titration of anesthetic gases to a value in accordance with guidelines from BIS production

BIS correlates with hypnotic state and anesthetic drug concentrations

Created due to belief that clinical signs (Heart rate and BP), which are routinely used by anesthesiologists to monitor depth of anesthesia, is unreliable

B-AWARE Trial

- Assess whether BIS Monitoring decreases awareness incidence during relaxant during GA in high-risk patients
- Double-blind randomized parallel group study
- Primary outcome→ incidence confirmed awareness (defined as: patient's recollection of intraoperative events)
- Awareness occurred at BIS values of 79-82 and 55-59
- Restrictions: populations was restricted so results may not be applicable to all patients undergoing GA

B-Unaware Trial

Conducted in response to B-Aware Trial to determine whether, in patients at high risk, incidence of anesthesia awareness is reduced when clinicians follow BIS-guided protocol versus ETAG- Guided protocol



All patients in the study have BIS monitors applied. If in the ETAG group- BIS values were omitted from the monitor to skew results



In both groups- practitioners could see ETAG concentrations but were not given instructions on titration protocols



Results: Awareness occurred with BIS values persistently under 60

BAG- RECALL Trial

- BIS or Anesthetic Gas to Reduce Explicit Recall
- Purpose: investigate whether a structured BIS protocol was superior to a structured ETAC protocol
- Addressed limitations of B-Unaware Trial
- Implementation for the future?

Cost Quality Analysis

Questionable Cost Effectiveness

Implications for Hospital Systems

Cost effective

- Lack of BIS monitoring equals less equipment, less training, less devices
- Awareness is a costly consequence from surgery



Anesthesia providers should be aware of the subject of awareness and the heightened/ at risk population in which it can occur. May need to alter practice for certain patient groups

Multi-disciplinary approach to change

- Anesthesia personnel
 - Help educate CRNAs/ MDAs/ Anesthesia Techs on the literature saying that BIS Monitoring does not help reduce awareness occurrence
- Pharmacy
 - Multi-modal approach to prevent awareness and education of volatile anesthetics
- Nursing
 - Decrease chaos in operating room at crucial points of anesthesia (i.e., induction, emergence, procedural tasks)
- Clinical Facilities/ Engineering
 - Education on BIS Monitor, Make sure monitors are properly calibrated for anesthetic gases and reading accurate values

Limitations of BIS Monitoring

Adapted from: Trueman, Wikipedia, UpToDate
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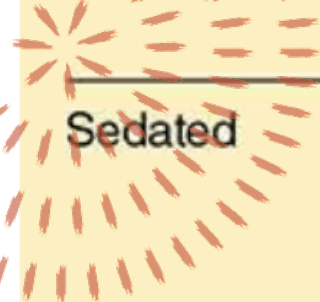
Limitations of the BIS monitor

The bispectral index (BIS) is a monitor that measures the depth of anesthesia using electroencephalography (EEG); generating a value between 0 (isoelectric EEG, no activity) and 100 (fully awake).

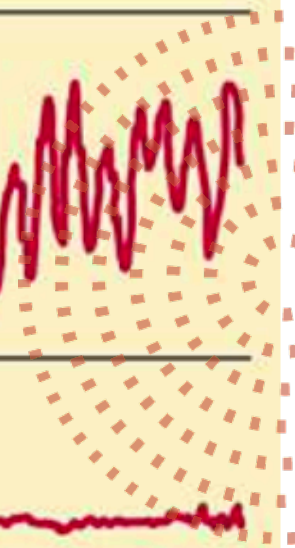
But it's not perfect:

- Doesn't correlate with end-tidal sevoflurane in children under 12 mo.
- Inaccurate in children (6 months to 12 years) at high ET sevo, where BIS paradoxically increases as ET sevo increased from 3.0 to 4.0%.





	ETAG	EEG Age-adjusted MAC	0 MAC	50 μ V
Sedated	EEG SEF ₉₅ BIS Entropy AAI NI ETAG	α oscillations High teens Low β ratio High entropy $\uparrow$ ing lat, $\downarrow$ ing Δ Amp EEG f band analysis Age-adjusted MAC	$\downarrow \gamma, \beta, \uparrow \alpha, \theta, \delta$ 19 Hz. 78 85 45 B/C 0.4 MAC	
Unresponsive	EEG SEF ₉₅ BIS Entropy AAI NI ETAG	Spindles, K, $\downarrow f$ Low teens Bispectral coherence Entropy drop $\uparrow$ ing lat, $\downarrow$ ing Δ Amp EEG f band analysis Age-adjusted MAC	$\uparrow \alpha, \theta, \delta$ 14 Hz. 52 43 30 D 0.8 MAC	
Surgically Anesthetized	EEG SEF ₉₅ BIS Entropy AAI NI ETAG	Slow δ waves, $\downarrow f$ < 12 Hz. Bispectral coherence Low entropy $\uparrow$ ing lat, $\downarrow$ ing Δ Amp EEG f band analysis Age-adjusted MAC	δ dominance 10 Hz. 42 38 22 E 1.3 MAC	
Deeply Anesthetized	EEG SEF ₉₅ BIS Entropy AAI NI ETAG	BS, isoelectricity < 2 Hz. (BS corrected) High BSR Burst suppression $\uparrow$ latency, $\downarrow \Delta$ Amp EEG f band analysis Age-adjusted MAC	Bursts & flat 2 Hz. 9 8 11 F 2 MAC	



TARGET RANGE

- Optimal BIS during general anesthesia: 40–60
- Helps avoid both excessive anesthesia and unintended awareness

BUT BIS ISN'T PERFECT...

- Inaccurate with certain agents:
 - Nitrous oxide and ketamine can alter BIS readings
 - Neuromuscular blockers can artificially lower the BIS despite preserved consciousness



CLINICAL USE

- Helpful in high-risk patients for intraoperative awareness
- Valuable when precise depth-of-anesthesia control is needed
- Aids anesthetic titration and may support smoother emergence



**Always interpret BIS
in context with other
clinical signs, vitals,
and anesthetic depth
indicators!**

Resources

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