Bispectral Analysis

Bis Monitoring…
is it the way of the future?
2009

What is it? How does it work?

BIS works by:

- Estimating EEG activity through a sensor placed over the patient's forehead. This sensor transduces a number to a monitor.
  - Since it is an external monitor, it is only an estimate of brain function.
  - The sensor estimates a number from 0 (electrical silence) to 100 (wide awake).
  - An adequate depth of anesthesia correlates to a BIS reading of 40-60.

Bis Monitoring…what is it?

•BIS in action

Awareness Discovered

- More than 150 years ago, when William Morton administered ether as the first anesthetic, his patient
- reported being “aware” during the surgical procedure.
  - Anesthesia awareness became a significant subject of inquiry in the 1960s
    - More cases of awareness recognized and reported
      - Psychological consequences of awareness under GA
      - Concern for providers and patients

Recent increase in public awarenss and fear

Awareness Defined

- Patient reports being aware of an event that occurs under anesthesia
- Most devastating:
  - Awake Paralysis
    - Patient is paralyzed but inadequately anesthetized
  - Consequences
    - Pain of incision or the operation itself and inability to convey this message to anyone.
    - Recollection of conversations or music played in OR while patient reportedly asleep.

Explicit vs Implicit Memory

Both have been described

Explicit: Patient can readily recall certain conversations and/or pain from the operative period.

Implicit: Patient cannot recall events but certain triggers can lead to serious emotional sequelae. Ie, Significant post-traumatic stress disorder can and does occur in many of these people.

International Anesthesia Research Study: Descriptions of Awareness

- Numerous cases of "recall" were described in a variety of cases: A few examples….
  - 49 yo Female having abdominal surgery with Fentanyl, Isoflurane and NMB
    - The patient recalled " a great deal of conversation." She remembered hearing conversations about her tattoos and what they found in her abdomen. She described being "unable to move,…like being in a box. It was dark and I could not move at all."

C/O "recall"

- 46 yo Male with cervical stenosis anesthetized with propofol, desflurane, nitrous oxide, fentanyl and morphine
  - The patient recalled the sensation of two flat surfaces moving on each other leaving sharp, intense pain. He felt sensation in his neck, a sensation of choking and felt bone being cut away from his neck.

Establishing credibility

- Credibility of patients reports should ALWAYS be verified.
  - Sometimes patient report can be connected unequivocally to incidents which happened under anesthesia and of which patients had no previous knowledge.
  - Corroboration with other individuals in the OR at the time of the procedure can also be established.
  - There have been some cases of fraudulent claims and false recall reported.
- Incidence of and risk factors for awareness during anesthesia… Best practice and research Vol 21 no3, 2007

Credibility

- **Suggestibility**
  - **Memories that are implanted as a result of leading questions, comments or suggestions when a person is trying to call up a past experience.**
- **Education of expectations a must:**
  - **Some patients may falsely consider themselves to have experienced awareness during anesthesia when their surgeries were performed under regional anesthesia and sedation.**
- Incidence of and risk factors for awareness during anesthesia… Best practice and research Vol 21 no3, 2007

Credibility

- **On rare occasions, awareness does occur and must respectfully and honestly dealt with in a caring and compassionate manner.**
  - **Adequate and prompt follow up must occur if true recall has been diagnosed.**
  - **Imperative a report is made**
  - **Patient must be offered psychological support.**
- **Frequently, anesthetic recall results in:**
  - **post-traumatic stress disorder**
  - **frequent nightmares**
  - **sleep disturbances**
  - **emotional distress**
  - **and depression**
- Incidence of and risk factors for awareness during anesthesia… Best practice and research Vol 21 no3, 2007

Awareness: A case report

- On Jan 19th 2006, A Charleston, W. VA minister, Sherman Sizemore, underwent an exploratory lap to detect the cause of persistent abdominal pain. The patient claimed to have been awake, yet paralyzed for the first half hour of his surgery, fifteen minutes after the first incision was made. He reported pain and fear, unable to convey his awareness to his anesthesia providers…
- The anesthesiologist and CRNA had forgotten to turn on the vaporizer until 29 min into the case. Although the patients account of what had occurred was valid, the ACT did not acknowledge to the patient that they had made an error. They also failed to recognize obvious signs of serious psychological consequences of this episode. Instead, the patient was sent home on Jan 20th 2006. For two weeks this man was tormented by sudden and inexplicable behavioral changes.

Awareness: A case report

- His nights were sleepless, he feared going outside, had dreams about suffocation and felt people were trying to bury him alive. He felt abandoned since no-one seemed to believe him. On Feb 2, 2006, just two weeks later, the Baptist minister took his own life. In Jan 2007, the man's family filed suit against the ACT in a wrongful death suit. The case was settled confidentially out of court.

Standard methods for prevention of awareness

- Until the BIS monitor was discovered in 1996, the standard method for monitoring patients for the prevention of recall was primarily end tidal measurement of anesthetic gases. A volatile agent concentration of 0.7 MAC is thought to be sufficient to prevent recall.
- MAC= the alveolar concentration of an anesthetic gas required to prevent movement to noxious stimuli in 50% of cases.
  - Surgical incision
  - Intubation

Anesthetic Potency

- MACs are higher or lower based on age (less in aged and very young), higher in drug and alcohol abusers, cigarette smokers and those on psychoactive drugs.
- All agents have differing MACs depending upon pharmacokinetic properties of the drug. The more potent the drug, the lower the MAC.
- MACs of commonly used agents are as follows: Isoflurane: 1.2%; Sevoflurane: 2.0%; Desflurane: 6.0%; Nitrous Oxide 104%

Standard clinical methods for prevention of awareness

- Parameters for "light" anesthesia are:
  - Tearing
  - Tachycardia
  - Hypertension
  - Patient movement
- BIS was invented as a means to augment detection of "light" anesthesia.
- It is marketed as a tool to aid in the usage of less gas, with subsequent quicker wake-ups, less anesthetic toxicity and fewer overall side-effects.

The pressure is on for a quick turnover

Nurse, let's get moving, I have a three pm golf tournament!

B-Unaware Trial…does BIS work?

- The NEJM came out with this study in March of 2008.
- Single-center prospective study over a 14 month period
  - 2000 patients were randomly divided into two groups.
    - 967 patients were assigned to BIS-guided anesthesia (target range of 40-60)
    - 974 were assigned to ETAG-guided anesthesia. (target ETAG range, 0.7-1.3 MAC).

B-Unaware Trial...does BIS work?

- Post-op patients were assessed for awareness at three intervals (0-24 hours); (24-72 hours); and 30 days after extubation.
- Two cases of definite awareness occurred in each group.
  - BIS value was >60 in one case of definite awareness; ETAG concentrations were <0.7 MAC in three cases.
- In the majority of cases of definite or possible anesthesia awareness,...
  - BIS values were persistently under 60 during the period when anesthesia awareness was likely to have occurred.

B-Unaware Trial

- In patients who did not have anesthesia awareness, there were sustained periods when:
  - BIS values were >60 in 55% of patients
  - ETAG concentrations were < 0.7 MAC in 74.5% of patients.
- Previous studies reported a lower incidence of recall with the use of BIS monitoring
  - Not reproduced in this study
  - BIS protocol not associated with reduced administration of volatile anesthetic gases
  - Anesthetic awareness occurred even when BIS and ETAG values were within target range
  - Routine use of BIS monitoring not supported for standard practice

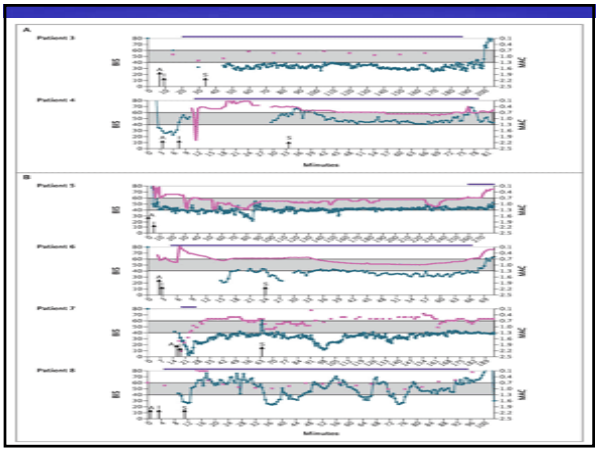
Does it work?

- **Intra-operative awareness may occur even when monitoring devices are utilized.**
- A recent study by Myles and colleagues hypothesized a lower incidence of awareness among high-risk patients monitored with BIS.
  - This was a prospective, nonrandomized cohort study involving 19,875 patients
  - Purpose was of study was
    - to establish the incidence of awareness with recall during routine GA
    - to determine BIS values associated with intra-operative awareness
- Again, the authors found no statistically significant difference when the monitor was used.
- CMAJ January 15, 2008

Does it work?

Anesthesiology V 104, No 3, March 2006

- Aspect medical would say so….
- Numerous studies support the research of NEJM.
- BIS has several downfalls….



BIS downfalls

- All available monitors require time to calculate an index value.
- The exact duration of this delay if unknown for most monitors but is a MAJOR FACTOR for the efficacy of a monitor.
- This may be critical for detection of awareness or at transitions from awareness to unconsciousness or vice versa.
- NONE of the available monitors can predict awareness in advance
  - Time delay for the BIS monitor is estimated at 60 seconds
  - Wakefulness >30 seconds significantly increases risk of recall.

Does it work?

Anesthesiology V 104, No 3, March 2006

- The overshoot at transition from “awake” to “GA”… and a slow detection of decreasing index values (ie, with induction) both bear the risk of a potential anesthetic overdose.
- The signals are only simulated and not true EEG values.
  - They are affected by artifact in a patient who is not paralyzed.
  - ^EMG due to slight muscle movement in a patient who is breathing spontaneously can erroneously be transmitted as a high BIS reading,..
  - …again leading to potential anesthetic overdose.

Patient Education

- It is vital we educate our patients.
- Laypersons frequently do not distinguish between GA and LMAC anesthetics.
- They often confuse *conscious sedation* with a general anesthetic.
  - (I was “out” for my colonoscopy or “my inguinal hernia repair” and “I woke up in the middle. I don’t remember much because they immediately put me back down.”)
- If the patient is not clearly educated on the differences between LMAC and GA, they will often fear they “will not be able to be put under GA because they woke up last time”.

Patient education

- If the patient is to receive LMAC, it is imperative they are told:
  - they MIGHT hear conversations or power tools
  - they may feel pressure, possibly even pain.

Patient education

- It is also imperative the anesthesia care provider stresses to the patient
  - he/she will be with the patient at all times ensuring his/her comfort and relaxation.
- Ongoing communication between patient, anesthesia care provider and surgeon periodically throughout a mac anesthetic will give great comfort to our patients….both physically and emotionally.

Actual incidence

- The reported incidence of true anesthetic recall is 0.1-0.2% or 1-2 cases per thousand. (Of the 21,000,000 GA cases annually, this factors out to 20-40,000 cases)
- Causes:
  - Inadequate anesthesia
    - Inexperienced or inattentive provider
  - Up-regulation of receptors affecting drug metabolism in
    - narcotic addicted patient
    - alcoholic patient
    - Patients on numerous psychoactive meds

Other potential causes for anesthetic awareness

- Intentionally light anesthesia
  - Hypovolemic, or"shocky" patients.. ie, trauma
  - Patients with limited cardiac reserve who may not tolerate large doses of anesthesia
    - (vasodilation and cardiac depression of meds)
  - Emergency OB cases
- During induction
  - with difficult and prolonged intubation attempts when anesthesia has begun to wear off
  - During rigid bronchoscopy
- Complete muscle paralysis
  - raises the likelihood of unrecognized light anesthesia

Risk factors for awareness

- Types of surgery
  - OB
  - Cardiac
  - Trauma
  - Rigid Bronchoscopy
  - Extensive surgery
- Conditions associated with increased anesthetic requirements
  - History of awareness
  - Chronic use of alcohol, opioids, sedative hypnotics and acute use of amphetamines
  - Genetic resistance to some anesthetics
  - Incidence of and risk factors for awareness during anesthesia by Ghoneim, MD, Best Practice and Research Clinical Anesthesiology

Preventive measures

- The AANA and ASA have developed a joint patient ed brochure to assist in the prevention of awareness under anesthesia and aid in patient education.
- Since 2002, the AANA has helped ID patients at risk and promoted preventive measures to avoid intra-op awareness. These measures include:
  - Periodic maintenance of the anesthesia machine and vaporizers
  - Measurement and monitoring of anesthetic agent concentrations
  - Avoidance of neuromuscular blocking agents when not surgically indicated.
  - Journal of perianesthesia nursing, Vol 22, No 2 April 2007

Preventive techniques

- The AANA states that anesthesia care providers must remain vigilant while monitoring clinical parameters that may indicate anesthetic inadequacy:
  - Tachycardia
  - Hypertension
  - Tachypnea
  - Patient movement
- Hemodynamic signs may be masked by beta blocker therapy---increased vigilance needed
  - Journal of perianesthesia nursing, Vol 22, No 2 April 2007

Preventive techniques

- Other strategies for prevention of awareness include:
  - the provision of amnestic agents pre-op (consider Ativan for alcoholics or in patients chronically on benzodiazepines)
  - increased dose of induction agents, particularly in those
    - who are anticipated to have high anesthetic requirements
    - Or in difficult, prolonged intubation.
  - avoiding nmb whenever possible.
  - Journal of perianesthesia nursing, Vol 22, No 2 April 2007

Conclusion

- There is a 0.1-0.2% incidence of reported anesthetic awareness annually.
  - 21,000,000 general anesthetics annually
  - 20-40,000 cases of reported awareness
- Intraoperative BIS monitoring is very expensive
  - Benefit should outweigh risk
    - If BIS monitoring were routinely applied to all patients receiving GA , the cost of disposable electrodes alone would exceed $360 MILLION dollars annually!!! (NEJM (3/08)
- BIS can be employed to assist in the detection of light anesthesia—especially useful in TIVA when measurement of ETAG not available.

BIS…not foolproof

- False lows > false sense of security (and administration of less anesthetic)
- False high numbers> overdosing medications (for fear of recall)
- Values are inconsistent in a patient who is not paralyzed
  - BIS values can be recorded as high when in actuality, the EMG, not the BIS is high, due to muscle movement. (artifact)
- NONE of the available monitors can predict potential awareness in advance
- Should always be used within the context of the whole picture
  - Look for tearing, hypertension, tachycardia, tachypnea, patient movement.

Closing Remarks

- Anesthetic providers must ALWAYS listen to the patients concerns.
  - If a patient states recall occurred, listen with compassion and empathy.
  - Ask for others in the room to validate what patient has said.
  - Be prepared to assist patient with psychological support.
- The patient who has had true anesthesia awareness generally wants two things:
  - Compassion
  - Validation

Closing Remarks

- Patient education is vital
  - Assist patient to understand difference between GA and MAC. Be sure they know they will possibly see, hear and feel (pressure) during MAC.
  - Explain possibility of awareness to those patients who are at highest risk.
  - Maintain vigilance at all times.

The end….Questions?