Awareness Under General Anesthesia: Where Are We Now?

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A (Semi) Hypothetical Case…

- 63 y.o., 5'2", 88 kg female for hand assisted laparoscopic tranversecolectomy
- Co-morbidities include:
  - Hypertension controlled with lisinopril and atenolol.
  - Obesity
  - Remote smoking hx
  - Mild depression controlled with fluoxetine.
- Plan for GETA:
  - Midazolam pre-med
  - Propofol, lidocaine, fentanyl, rocuronium for induction and intubation
  - Fentanyl, desflurane, rocuronium for maintenance

- Hypotension after induction, corrected with 20 mg ephedrine x 2.
- 1400 cc LR
- EBL 250cc
- Urine output:
  - Initial 25cc
  - Intraop 80cc
- Uneventful reversal of NMB, extubation, and tranport to the PACU on O2 3 l/m via n.c.

Post Operatively…

- Tearful in the recovery room.
- Denies significant pain
- Denies shortness of breath
- Seems confused, when asked, "what's wrong?" simply responds, "I don't know…"
- On post operative visit on POB#1 states simply, "I remember my surgery, all of it…"

Unintended Awareness Under General Anesthesia

- How do we define recall and what are the risk factors?
- When does does recall most commonly occur?
- What can we do to reduce the incidence of recall?
- What are the consequences of recall?
- How should patients experiencing recall be managed?

"Awake" The Movie

The Response of the Professions

- Joint PR effort from ASA & AANA
- Print, and other media materials are prepared.
- Public service messages and materials.
- Private screening for Carol Weir.

Defining the Issue…

- Explicit recall [ER]: awake during surgery, aware of peri-operative events, and the memory of the experience after surgery.
- Rate of about 0.18% of patients receiving general anesthesia with neuromuscular blockade (0.11% without NMB).
- 26,000 cases/yr or 100/day in U.S.*.

*The Incidence of Awareness During Anesthesia: A Multicenter United States Study. Sebel et al. Anesthesia and Analgesia 2004;99:833-9

Defining the Definitions

- Consciousness: State in which information from the patient's surroundings can be processed.
- Recall: Ability to retrieve stored memories
- Explicit Memory: Recall of specific intra-operative clinical events.
- Implicit Memory: Post-operative evidence of priming but without recall.

Priming: Presentation of material to an anesthetized patient.

Patients at Increased Risk

- Cardiac surgery patients
- Acute trauma with hypovolemia
- C/S under general anesthesia
- ASA status 3,4, and 5 patients
- Impaired CV function
- History of severe end stage lung disease

Patients at Increased Risk

- Expected intra-operative hypotension
- Bronchoscopy, laryngoscopy
- Anticipated difficult intubation
- History of awareness
- Heavy alcohol intake
- Chronic use of bz's, opioids or both

Example: C/S Under GA

- Incidence about 0.26%*
- Rapid redistribution of induction agents prior to establishment of target (0.8 MAC) [ET gas] increase risk of recall.
- Propofol redistributed more quickly than STP, but has greater amnesic effects.
- Ketamine and midazolam reduce awareness, but not commonly used.

*Paech et al. Int J Obstet Anesth 2008;17:298-303

Example: C/S Under GA

- During pregnancy MAC is reduced 25-40%
  - Decreased FRC
  - Increased minute ventilation
- During C/S 0.5 MAC in 50% N_2O results in a BIS between 57 and 64
- BIS monitoring shown to reduce awareness by 82%*

Myles et al. Lancet 2004;363:1757-63.

Timing of Awareness

- During endotracheal intubation
- At skin incision
- Other times of intense or changing stimulation

Awareness Descriptions…

Variable	n	%
Auditory perceptions	12	48
Unable to move or breathe	12	48
Anxiety/stress	9	36
Pain	7	28
Sensation of ET tube	6	24
Feeling surgery without pain	2	8

The Incidence of Awareness During Anesthesia: A Multicenter United States Study. Sebel et al. Anesthesia and Analgesia 2004;99:833-9

Consequences of Awareness

- PTSD sx are common after AUGA:
  - Pain
  - Anxiety
  - Delayed neurotic symptoms…
- Symptoms can persist for years post operatively&be psychologically debilitating
- Major source of dissatisfaction and anxiety
- Can result in litigation (2-12% of claims)

Common Causes of Awareness

Administration of general anesthesia inadequate to maintain unconsciousness & prevent recall during surgical stimulation*.

- Exaggeratedanesthetic requirements.
- Equipment misuse or failures.
- Smaller doses of anesthetic drugs.

*The Incidence of Awareness During Anesthesia: A Multicenter United States Study. Sebel et al. Anesthesia and Analgesia 2004;99:833-9

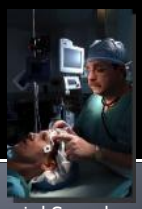
Strategies for Prevention…

- Periodic maintenance of anesthesia machines and vaporizers
- Pre-op check of pumps and equipment
- Use of amnestic agents
- Use of adequate dose of induction agents
- Measurement & documentation of end tidal concentrations of agents
- Recognize meds that place patients at risk
- Awareness of effects of neuromuscular blocking agents

The Million Dollar Question.

Can brain function monitors reduce the incidence of unintended awareness under general anesthesia?

"Reduction in the incidence of awareness using BIS monitoring"



Ekman, Lindholm, et al. Acta Anaesthesiol Scand 2004;48:20-26

Ekman, Lindholm et al.

	No BIS	BIS
Number	7826	4945
TIVA	3.7%	5.2%
GA+RA	752 (10%)	644 (13%)
NMB	7752 (99%)	4729 (96%)
Intubated	7796 (100%)	4926 (100%)
ET gas monitoring	6028 (80%)	4688 (99%)

Ekman, Lindholm et al.

- Used BIS A-2000 monitors
- All providers trained to use BIS
- Target: BIS < 60 during induction and maintenance (40-60)
- Data analyzed during induction and maintenance
- Patients questioned for recall in PACU, POD 1-3, & POD 7-14 (3 times)

Questions

- What is the last thing you remember before going to sleep?
- What is the first thing you remember waking up?
- Do you remember anything between going to sleep and waking up?
- Did you dream during your procedure?
- What was the worst thing about your operation?

Results…

- Awareness in the non-BIS group = 0.18%
- Awareness in the BIS group = 0.04%, a total of two patients (2:4945)
- Both patients remembered intubation, had BIS values greater than 60 at intubation. Both were young, healthy non-smokers, received STP, fentanyl, rocuronium, and sevoflurane anesthetic technique.

Of Note…

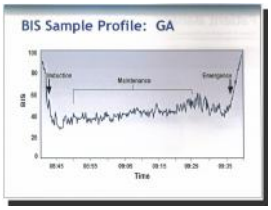
- Average BIS was 38 (+/- 8).
- 8% of patients had BIS > 60 for four minutes or more (no ER).
- 1.7% of patients had BIS > 70 for four minutes or more (no ER).
- Specificity of high BIS < 100%.
- Sensitivity (upper limit of BIS = 60) is satisfactory.

What is BIS?

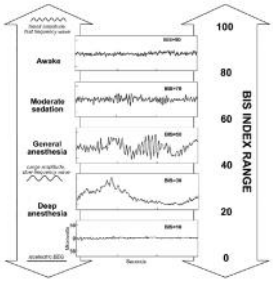
- The BIS system processes raw EEG signals and calculates a number between 0 and 100 that reflects the effects of anesthetics and sedatives on brain activity
- BIS near 100 indicates the patient is fully awake
- BIS value of zero indicates the absence of brain activity.
- Displays extensive clinical validation

Typical BIS Changes

- Classic decrease during induction
- Plateau during maintenance
- Increase with discontinuation of anesthetic agents

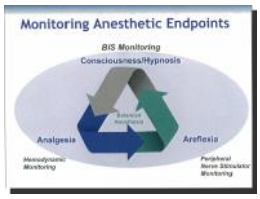


BIS Changes with Depth



Potential Benefits of BIS Monitoring

- Drug savings $$$
- Reduced frequency of awareness under general anesthesia
- Reduced PONV
- Faster wake ups
- Shorter PACU stays



Recent Results/Studies

- Reduced
  - Time to eye opening
  - Time to response
  - Time to extubation
  - Time to orientation
- Insignificant effect
  - Opioid & NMB use
  - Home readiness

- Incidence of recall in high risk groups reduced.
- Total drug costs are reduced.

Bispectral Index for Improving Anaesthetic Delivery and Postoperative Recovery (Review) Punjasawadong et al. 2007

"Anesthesia Awareness and Bispectral Index"

- 2000 patients at high risk for recall
- BIS group target 40-61 (n=967)
- ETAG target 0.7-1.3 MAC (n=974)
- No difference in incidence of recall
  - 2 in each group
  - Rate = 2:1000 or 0.21%
- High risk rate assumed: 1:100 or 1%

Avidan et al. N Engl J Med 2008;358:1097-1108

"Mortality within 2 Yrs after Surgery…Low BIS"

- ASA status was the most reliable predictor of 2 yr mortality.
- Duration of deep anesthesia (BIS<45) was a significant risk factor (immuno-suppression?).
- Pre-existing malignancy and major surgery were associated with higher 2 year mortality.

Lindholm et al. AnesthAnalg 2009;108: 508-12

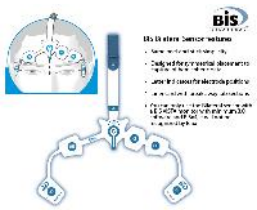
"Awareness During Anesthesia: Risk Factors, Causes &Sequelae: A Review"

- Light anesthesia a major risk factor (for all of the aforementioned considerations).
- Prior history of awareness is a major risk factor.
- Patient subjective experiences were consistent with previous reports.
- Untoward sequela may occur in as many as 33% of cases.

Ghoneim et al. AnesthAnalg 2009;108:527-35

Latest Sensor Evolution

- Captures bi-hemispheric data
- Four channels of continuous real time data
- Intended to improved management of cases with risk of acute changes in cerebral blood flow, or with known cerebral vascular dz.



Joint Commission Sentinel Event Alert on Awareness

Requires that institutions:

- Develop a policy that:
  - Educates clinical staff
  - Identifies patients at risk
  - Addresses equipment maintenance
  - Provides for follow up post op for all patients
  - Identification of patients experiencing AUGA
- Assures access to counseling, or other support for patients experiencing PTSS

Questions & Discussion…