

ANESTHESIOLOGY™ 2014

OCTOBER 11-15 | NEW ORLEANS, LA

Session: L046
Session: L069

Prevention and Management of Intraoperative Awareness in High Risk Patients

Kathleen A. Smith, M.D.
University of North Carolina, Chapel Hill, NC

Disclosures: This presenter has no financial relationships with commercial interests

Stem Case and Key Questions Content

A 30 year-old, 38 week pregnant female presents to labor and delivery. In triage, the fetal heart rate is determined to be 60 bpm. She is rushed to the operating suite for emergent delivery. Her medical history is significant for obesity and childhood asthma, as well as tobacco and heroin abuse. She is currently on methadone maintenance and reports no drug use in the last 3 months. She continues to smoke 1 pack of cigarettes per day.

1) What are this patient's risk factors for intraoperative awareness?

2) How common is awareness? In high risk patients?

3) What other types of surgeries and patient factors are considered high risk for intraoperative awareness?

Once in the operating room, fetal heart rate is confirmed to be in the 60's. Standard monitors are applied, the patient is pre-oxygenated and a rapid sequence induction is performed. Endotracheal intubation is successful and confirmed with sustained ETCO₂, bilateral breath sounds and chest rise. Sevoflurane and 100% oxygen are administered. You tell the surgeons to proceed. Incision is made and one minute later a healthy male infant is born.

4) How does this patient's cardiac output affect anesthetic depth during the induction period?

The placenta is delivered and an oxytocin infusion is started. Four minutes after the oxytocin is initiated, the obstetrician tells you the uterus is not contracting normally. The oxytocin infusion is doubled. You decrease the sevoflurane to 0.2 MAC and add 50% nitrous oxide. Uterine tone continues to be poor and you administer a dose of IM methylergonovine. Given the persistence of uterine atony, you initiate a propofol infusion and convert the patient to a total intravenous anesthetic.

5) How is this patient's uterine atony playing into her risk for intraoperative awareness?

6) Could this patient's anesthetic have been managed differently to minimize her risk of awareness?

7) How do you monitor the depth of anesthesia in cesarean sections under general anesthesia?

ANESTHESIOLOGY™ 2014

OCTOBER 11-15 | NEW ORLEANS, LA

In any case where you are unable to give as much anesthetic as you would like for hemodynamic instability or other reasons?

8) Should a brain function monitor, such as the Bispectral index (BIS), be routinely used when performing a total intravenous anesthetic?

9) What is an acceptable MAC in this situation?

The patient's uterine anatomy does not improve despite discontinuation of the volatile anesthetic. She continues to bleed from the placental bed. Blood loss is estimated to be 1.5L and she is becoming hemodynamically unstable. The propofol infusion is decreased. An arterial line is placed and additional peripheral IV access is obtained. The patient is resuscitated with fluids and a phenylephrine infusion is initiated. The patient continues to deteriorate and ultimately the decision is made to perform a hysterectomy. At one point, the propofol is discontinued secondary to extreme hypotension. Several doses of non-depolarizing neuromuscular blocking drugs are administered during this period of time as well.

10) What additional risk factors does this patient have for experiencing intraoperative awareness?

11) Are neuromuscular blocking drugs appropriate in this situation?

The patient is taken to the ICU in stable condition. She is extubated the next morning. During your postoperative visit, you ask the patient if she remembers anything from her surgery. She tells you yes! The patient describes being awake but unable to move or talk. She felt surgical manipulation, but denies having felt any pain. She can recall specific conversations that you confirm occurred during her surgery.

12) Is this patient's description of her experience common for an awareness event?

13) What do you tell this patient about her experience? What services can you offer her?

14) What tools are available to help you identify awareness events?

15) Have you ever been in a situation where your patient had possible or definite intraoperative awareness? How did you handle it?

16) Should awareness specifically be included in the informed consent process?

17) Would a BIS monitor have prevented this complication?

18) What evidence do we have with regard to the efficacy of the BIS monitor? What are the landmark articles on the subject?

19) What does the American Society of Anesthesiologists practice advisory say about the BIS monitor and other methods for preventing awareness?

20) Can BIS help us achieve a faster recovery? Safely reduce the amount of anesthetic we deliver? Reduce the cost of anesthesia delivery?

Model Discussion Content

Intraoperative awareness (IOA) occurs when a patient becomes conscious while under general anesthesia and is able to recall specific events (explicit memory) that took place during this period of time (1). The first case of awareness was reported in 1950 (2). Fortunately it is rare, occurring in 0.1-0.2%, or 1-2 per every 1000 anesthetics (3, 4). Some surgeries are associated with a higher incidence of awareness, such as cardiac surgery, cesarean section under general anesthesia, trauma, emergency procedures, total intravenous anesthesia, and those procedures requiring a light level of anesthesia. In addition, there are some patient characteristics that incur an increased risk. These include a history of substance abuse, chronic opioid and/or benzodiazepine use, ASA IV-V classification, EF <40%, difficult intubation and a history of awareness. The risk of IOA in these patients and procedures may be as high as 1% (2, 5-7). The incidence of awareness has not changed significantly over the past 2 decades, despite increased knowledge of this anesthetic complication.

Brain Function

Monitoring: The Evidence

The Bispectral index (BIS) monitor was introduced by Aspect Medical Systems in 1994, and received FDA approval in 1996 for use in monitoring anesthetic depth. BIS and other brain function monitors process brain electrical activity via electrodes placed on the forehead. Using a mathematical equation, the information is converted into a number, generally between 0 (isoelectric electroencephalogram) and 100 (awake). This number varies with depth of anesthesia and is marketed as a device to improve our ability to assess the hypnotic effect of anesthesia (8). Maintaining BIS values between 40 and 60 is recommended by the manufacturer for ensuring lack of consciousness under general anesthesia (1). Several investigative groups have attempted to evaluate the validity of BIS monitoring. In 2004, the first large, randomized controlled trial (B-Aware) was conducted on the use of BIS as a marker for hypnosis and a possible tool to reduce the incidence of intraoperative awareness. The study compared a BIS guided group with a standard practice group, and found a risk reduction of 82% when the BIS was maintained between 40 and 60 (6). Since that time, Avidan et al. has published two large, randomized controlled trials (B-Unaware and BAG-Recall) showing no difference in incidence of IOA between a BIS guided group and a group guided by a minimum end-tidal anesthetic concentration of ≥ 0.7 MAC (9,10). The Cochrane Collaboration reviewed IOA in 2009. This report included the literature spanning from 1990 to 2007. The B-Aware was the only prospective, randomized controlled trial looking at this rare phenomenon published at that time. The authors concluded that BIS-guided anesthesia may significantly reduce the risk of IOA in high risk patients (11). The B-Unaware and BAG-Recall trials that have subsequently been published have led the majority of the anesthesia community to believe routine use of BIS monitoring is not warranted. The Cochrane Collaboration also reviewed the potential for BIS monitoring to reduce anesthetic consumption and speed recovery. It concluded that BIS-guided anesthesia

may have the ability to reduce the overall consumption of intravenous and volatile anesthetics, as well as decrease time to orientation and extubation, but not discharge (11). Cost savings resulting from this would likely be irrelevant when factoring in the cost of the monitor. In 2006, the American Society of Anesthesiologists (ASA) released a practice advisory regarding intraoperative awareness and concluded that routine use of the BIS monitor is not warranted at this time (1). The monitor may still have a role in very high risk patients and procedures, such as total intravenous anesthesia, where end-tidal anesthetic concentrations cannot be monitored, the need for a light plane of anesthesia, and patients who have a history of IOA. Most recently, Mashour et al. (12) published the Michigan Awareness Control Study (MACS), which is the largest prospective randomized control trial to date, including >21,000 unselected surgical patients. Patients were randomly assigned to OR's where providers received an electronic alert if either BIS exceeded 60 or age adjusted end-tidal anesthetic gas concentration was <0.5 MAC. The overall incidence of definite IOA was found to 0.1%. The incidence did not vary between the groups whose providers received alerts based on either low BIS or low end tidal anesthetic gas concentrations.

However, post hoc analysis of a “no intervention group” where the providers received no intraoperative alerts, revealed a 4.7 fold increase in the risk of awareness when compared with the BIS protocol. This suggests that BIS monitoring may be superior in preventing IOA when compared to no audible alert at all. In addition, Mashour and his colleagues concluded that the BIS monitoring protocol was not associated with either a reduction in anesthetic drug consumption or faster recovery (12).

Prevention:

Preoperative evaluation of all patients should include an assessment of the risk of intraoperative awareness. Informed consent should include mention of this rare phenomenon. Despite best medical practice and knowledge of this anesthesia complication, IOA still occurs. As in our case, it is often very difficult to counsel a patient on their risk of awareness when presented with emergent surgery. If time permits, this discussion should take place. The ASA practice advisory on intraoperative awareness, recommends routine preventative measures for risk reduction, including a thorough check of the anesthesia delivery system, including the anesthesia machine, infusion pumps, fresh gas flows, intravenous lines and medication type and dose. Prophylactic benzodiazepines should be administered on a case-by-case basis (1, 2). Many cases of awareness are the result of inadequate anesthetic dosing secondary to drug administration error (wrong drug given) or drug delivery error (lower than intended concentration of volatile anesthetic delivered). While some patients do exhibit an increased anesthetic requirement, most cases of awareness are associated with overly light anesthesia (2). Intraoperatively, the risk of awareness can be minimized with vigilance and frequent assessment of depth of anesthesia. This can be accomplished by monitoring end-tidal anesthetic gas concentration and maintaining at least 0.7 MAC whenever possible. As the MACS trial demonstrated, the absence of any audible alert or alarm for low end-tidal anesthetic gas concentration may result in an increased risk of awareness. Therefore, providers should ensure these audible alarms are functional. If intraoperative hypotension occurs and MAC is ≤ 0.7 consider other methods of treatment before

decreasing the volatile anesthetic dose. If possible, use a potent inhalational agent, rather than a total intravenous anesthetic. In addition, clinical signs (heart rate, blood pressure, lacrimation, sweating and movement) can be useful, but are historically unreliable. In one study of 271 cases of awareness, intraoperative hypertension and tachycardia were present in only 1 out of every 5 patients (2). The use of neuromuscular blocking drugs should only be used when necessary, as they may prevent spontaneous movement in a patient who is aware. The combination of light anesthesia and muscle relaxation is generally inappropriate. In select procedures/patients it may be beneficial to use a brain function monitor, such as the BIS. In cases where end tidal anesthetic gas concentration cannot be measured, such as a total intravenous anesthesia, BIS may be useful in preventing unintended light anesthesia, and therefore IOA. The role of the BIS monitor in reducing/preventing intraoperative awareness has not been established, and is therefore not recommended for routine use. Benzodiazepines have not been shown to cause retrograde amnesia and it is not recommended that they be administered to a patient who is believed to have become conscious during the procedure (13).

Detection & Treatment:

Given a risk of 1-2 per 1000 anesthetics, we are all likely to have a patient with IOA at some point in our careers. The best way to identify a patient who has experienced IOA is to perform an interview postoperatively, asking questions geared towards determining what the patient remembers about their surgery. Several studies have shown that a single postoperative interview is inadequate for detecting an awareness event. Many episodes of IOA are not recalled until several days to weeks following the event (5). Ghoneim and colleagues reported that in 37% of the 271 cases of IOA they reviewed, the patient did not report awareness until 1 week postoperatively (2). A modified Brice questionnaire was most commonly used to assess for the possibility of recall in the studies listed above (14, 15). Many of us use an abbreviated version of this on a daily basis. This questionnaire is attached for your review. Those who experience awareness most commonly report inability to move, feelings of helplessness, anxiety and panic, and hearing noises. Pain is much less commonly reported (2). If a patient does endorse recall either spontaneously or upon questioning, it is important not to dismiss the patient's concerns or deny the possibility of this complication. A more structured interview should be conducted to determine if and what the patients recalls. Listen to the patient and validate their feelings and concerns. Review the anesthetic record and discuss with them why and when this might have occurred. Patients may exhibit a variety of sequelae following an awareness event ranging from anxiety, sleep disturbance and nightmares to post traumatic stress disorder (PTSD). Many case reports and studies have documented the occurrence of PTSD, which can occur in up to 70% of these patients, and may be more common in patients who experience pain as part of their awareness event (16). Psychological follow-up should be offered to all patients who have experienced IOA. Patients may voluntarily register themselves in the "Anesthesia Awareness Registry", which can be found at <http://depts.washington.edu/awaredb>. As of January 2014, 278 patients have enrolled in this registry.

ANESTHESIOLOGY™ 2014

OCTOBER 11-15 | NEW ORLEANS, LA

References

- 1) Practice Advisory for Intraoperative Awareness and Brain Function Monitoring. A Report by the American Society of Anesthesiologists Task Force on Intraoperative Awareness. *Anesthesiology* 2006; 104:847-64.
- 2) Ghoneim MM, Block RI, Haffarnan M, Mathews MJ. Awareness During Anesthesia: Risk Factors, Causes and Sequelae: A Review of Reported Cases in the Literature. *Int Anesth Research Soc* 2009;108(2):527-35.
- 3) Sandin RH, Enlund G, Samuelsson P, Lenmarken C. Awareness during anaesthesia: a prospective case study. *Lancet* 2000;355:707-11.
- 4) Sebel PS, Bowdle TA et al. The Incidence of Awareness During Anesthesia: A Multicenter United States Study. *Anesth Analg* 2004;99:833-9.
- 5) Paech MJ, Scott KL, Clavisi O, Chuna S, McDonnell N. A prospective study of awareness and recall associated with general anesthesia for cesarean section. *IJOA* 2009;17:298-303.
- 6) P S Myles, K Leslie, J McNeil, A Forbes, M T V Chan, for the B-Aware trial group. Bispectral index monitoring to prevent awareness during anaesthesia: the B-Aware randomized controlled trial. *Lancet* 2004; 363: 1757-63
- 7) Phillips AA, McLean RF, Devitt JH, Harrington EM. Recall of intraoperative events after general anesthesia and cardiopulmonary bypass. *Can J Anaesth* 1993;40:9228) Sigl JC, Chamoun NG. An introduction to bispectral analysis for the electroencephalogram. *Journal of Clinical Monitoring* 1994;10(6):392-404.
- 9) Avidan MS, Zhang L, Burnside BA et al. Anesthesia Awareness and the Bispectral Index. *N Engl J Med* 2008;358(11):1097-1108.
- 10) Avidan MS, Jacobsohn E, Glick D, Burnside BA, Zhang L, Villafranca A, Karl L, Kama S, Torres B, O'Connor M, Evers AS, Gradwohl S, Lin N, Palanca BJ, Mashour GA. Prevention of Intraoperative Awareness in a High-Risk Surgical Population. *N Engl J Med* 2011;365(7):591-600.
- 11) Punjasawadwong Y, Phongchiewboon A, Bunchungmongkol N. Bispectral index for improving anaesthetic delivery and postoperative recovery (Review). *The Cochrane Collaboration*. Published by John Wiley & Sons, Ltd. 2009: 1-66.
- 12) Mashour GA, Shanks A, Tremper KK et al. Prevention of Intraoperative Awareness with Explicit Recall in an Unselected Surgical Population: A Randomized Comparative Effectiveness Trial. *Anesthesiology* 2012;117(4):717-25.
- 13) Bulach R, Myles PS, Russnak M. Double-blinded randomized controlled trial to determine extent of amnesia with midazolam given immediately before general anesthesia. *Br J Anaesth* 2005;94:300-5.
- 14) Brice DD, Hetherington RR, Utting JE. A simple study of awareness and dreaming during anesthesia. *Br J Anaesth* 1970;42:535-42.
- 15) Avidan MS, Palanca BJ, Glick D, et al. Protocol for the BAG-RECALL clinical trial: a prospective, multi-center, randomized, controlled trial to determine whether a bispectral index-guided protocol is superior to an anesthesia gas-guided protocol in reducing intraoperative awareness with explicit recall in high risk surgical patients. *BMC Anesthesiol* 2009;9:8.
- 16) Leslie K, Chan MT, Myles PS, Forbes A, McCulloch TJ. Posttraumatic stress disorder in aware patients from the B-aware trial. *Anesth Analg*. 2010 Mar 1;110(3):823-8. Epub 2009 Oct

ANESTHESIOLOGY™ 2014

OCTOBER 11-15 | NEW ORLEANS, LA

27.

17) Intraoperative Awareness: *From Neurobiology to Clinical Practice*. Mashour GA, Orser BA, Avidan MS. *Anesthesiology* 2011;114(5):1218-33.