Prevention and Management of Intraoperative Awareness in High Risk Patients
Kathleen A. Smith, M.D.
University of North Carolina, Chapel Hill, NC

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Stem Case and Key Questions Content
A 30-year-old, 38 week pregnant female presents to labor and delivery 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 one 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 a parturient’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 0.4 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 contributing to 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 during a cesarean delivery under general anesthesia? In any case where you are unable to give as much anesthetic as you would like for hemodynamic instability or other reasons?

8) What is an acceptable MAC in this situation? The patient’s uterine atony 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 a non-depolarizing neuromuscular blocking drug are administered during this period of time as well.

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

10) Is the patient’s description of her experience common for an awareness event?

11) What do you tell this patient about her experience?

12) How do you evaluate a patient for awareness during your postoperative visit? >

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

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

15) What evidence do we have with regard to the efficacy of the BIS monitor? What are the landmark articles on the subject?
16) What does the American Society of Anesthesiologists (ASA) practice advisory say about the BIS monitor and other methods for preventing awareness?

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

**Model Discussion Content**

**Introduction:**
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 delivery under general anesthesia, trauma, emergency procedures, total intravenous anesthesia, and those procedures requiring a light level of anesthesia. The recently published NAP 5 project (5), reported an incidence of awareness of 1:19,000 general anesthetics. They also uncovered a disproportionately high rate of awareness among cesarean delivery (CD) under general anesthesia at 1:670.

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 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 be 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 concluded that the BIS monitoring protocol was not associated with either a reduction in anesthetic drug consumption or faster recovery (13).

**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 further decreasing the volatile anesthetic dose. Whenever 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.

The isolated forearm technique (IFT) has also been used to assess a patient’s depth of anesthesia. Recently, one study (14) used the IFT to determine adequate depths of anesthesia at various times during CD, and correlated this with BIS values. During IFT, the blood pressure cuff is inflated to 200mmHg after induction of anesthesia but prior to administration of NMBD. Patients wear earphones, and are given instructions to open and close the hand on the isolated arm. During various points in the CD, 23-46% of patients had positive IFT responses. BIS was unable predict positive and negative responses. No patients had recall. According to this study, lower than previously recommended BIS values may be needed to prevent awareness.

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 (15).

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 (6). 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 (16, 17). Many of us use an abbreviated version of this on a daily basis.

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 recall. 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 (18). 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 2015, 313 patients have enrolled in this registry.

References
4) Sebel PS, Bowdle TA et al. The Incidence of Awareness During Anesthesia: A Multicenter United