Lesson S13: PreAnesthetic Assessment of the Patient with a History of Intraoperative Awareness

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A COURSE OF STUDY FOR AMA/PRA CATEGORY 1 CREDIT
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Needs statement
Intraoperative awareness during anesthesia has been the subject of popular films receiving a good amount of publicity over the past few years. Questions about the true incidence have arisen because of variable study results. A thorough understanding of all aspects of this phenomenon is considered to be required knowledge for practicing anesthesiologists.

Learning Objectives
At the end of this activity, the participant should be able to:

1. Define intraoperative awareness.
2. Describe diagnostic instruments used for recognition of awareness.
3. Cite risk factors for awareness.
4. Discuss the psychological impact of awareness.
5. Outline a management plan for the patient who reports intraoperative awareness.
6. List preoperative considerations for the patient who has experienced intraoperative awareness.
7. Discuss the prevention of awareness.
8. Recognize the limitation of brain function monitors.
9. State the incidence of postoperative awareness.
10. List the types of surgery most likely to result in awareness.

Case History

A 36-year-old woman with a history of gastric reflux, depression and anxiety was scheduled for robotic myomectomy. Operating time was expected to be 3.5 hours. She reported that while anesthetized for an upper endoscopy 6 months prior, she heard the anesthesiologist and endoscopist arguing. She sensed that she was choking and was acutely aware of a tube being pushed down her throat. She panicked and believed that she was going to die but was unable to move or signal her distress. Since that procedure, she has experienced nightmares and symptoms of post-traumatic stress syndrome. Her medications included omeprazole, zolpidem and sertraline. The patient’s weight was 275 lbs and her height measured 65 inches. She reported that her internist recommended a sleep study to address her snoring but it had not been completed.

Introduction

The incidence of intraoperative awareness under general anesthesia is rare (0.1-0.2%).\textsuperscript{1} The ASA Closed Claims Project (an ongoing structured evaluation of adverse anesthetic outcomes) showed that awareness while under anesthesia represented 2% of all claims in the database. The majority of patients were female, ASA 1-2, less than 60 years old, and underwent elective surgery.\textsuperscript{2} Given that more than 20 million anesthetic procedures are performed annually in the United States, as many as 40,000 cases of awareness may occur each year.

Anesthesia awareness is a distressing complication with significant psychological sequelae including persistent post-traumatic stress disorder (PTSD).\textsuperscript{3} Widespread media attention has made this rare complication a general public concern with increased professional liability.\textsuperscript{1,4} In an analysis of 1,067 closed claims against the National Health System in the United Kingdom, 161 cases of inadequate anesthesia were identified, representing 19% of anesthesia related claims. Intraoperative awareness was noted in 79 cases and awake paralysis in another 20.\textsuperscript{5}

As part of the Sentinel Event Policy, The Joint Commission (TJC) issued an alert in 2004 on prevention and management of the impact of anesthesia awareness.\textsuperscript{6} TJC concluded that anesthesia awareness is under-recognized and under-treated and subsequently issued guidelines for prevention and management. Preventive measures include educating practitioners about the complication, identifying patients at risk, using monitoring techniques, and performing appropriate postoperative follow up of all patients who have undergone general anesthesia, including children.

Administration of anesthesia in the patient who has had previous intraoperative awareness is challenging and requires careful perioperative management.
Definition of Awareness

Intraoperative awareness is defined as a recalled event by a patient who becomes conscious during a procedure while being given general anesthesia. The term “awareness” is limited to explicit memory during anesthesia and does not include the time before general anesthesia is fully induced or the time of emergence from general anesthesia. Dreaming, although possibly associated with awareness, is not considered intraoperative awareness. It is not uncommon for patients to state that they had some level of awareness or were able to hear the conversations of surgical staff during a previous anesthetic experience. Review of such cases frequently reveals that the procedure was performed under monitored anesthetic care or moderate sedation. It is appropriate to inform all patients for whom this level of anesthesia is deemed appropriate that they may be aware of what is happening but will not feel pain or discomfort.

Detection of Awareness

The structured interview is the most common method of diagnosing prior anesthesia awareness. The interview process is ongoing because the nature of awareness involves memory which may emerge over time. Studies revealed that patients who denied awareness when interviewed immediately after surgery confirmed awareness at subsequent interviews. Sebel et al uncovered 50% of the awareness cases following a second interview.

The delayed memory for awareness may be due to residual anesthetic effects or mental distractions such as pain, nausea and vomiting during the early recovery phase. It has also been suggested that the psychological trauma associated with awareness may lead to memory dissociation which impairs the recall process. The detection of awareness depends on the interview technique and structure, as well as timing and frequency. In 1970, Brice et al presented a questionnaire to serve as a tool for detecting awareness during the interview process. The questionnaire was later simplified to five questions:

1. What is the last thing you remember before going to sleep?
2. What is the first thing you remember after waking up?
3. Do you remember anything in between?
4. Do you remember any dreams during your operation?
5. What was the worst thing about your operation?

To maximize detection of awareness, patients should be interviewed using the modified questionnaire during a structured interview on three occasions -- before discharge from the postanesthesia care unit (PACU), 1 - 3 days and 7 – 14 days after anesthesia.

Risk Factors for Awareness

The low incidence of awareness provides limited data to identify risk factors. However, the literature reveals some significant risk factors. (See Table 1.)
Patients at risk for intraoperative awareness should be identified by review of the medical record, physical examination, and a patient or patient-and-family interview. Patient characteristics, such as female gender and younger age, have been identified as risk factors for intraoperative awareness in the analysis of closed claims in 1999 and in other recent studies. However, in a multicenter study, Sebel et al did not find sex and age as factors associated with awareness during anesthesia. This discrepancy could be explained by numbers of patients that were lost to follow-up at the postoperative interviews especially at institutions with large populations of study patients. Obese patients are likely to be more susceptible to awareness due to associated risks such as a difficult airway, longer time for endotracheal intubation or awake intubation, and improper dosing of anesthetic agents creating light anesthesia. Anesthesiologists tend to administer lower doses of anesthetic agents in patients with poor cardiac reserve and hemodynamic instability. Such patients would have an increased risk of intraoperative awareness.

A patient with a history of intraoperative awareness must be carefully evaluated for emotional and psychological repercussions. Patients are commonly reluctant to reveal psychological changes to medical personnel. These patients should be provided with information about intraoperative awareness and reassurance that all possible measures will be in place to prevent awareness.

The most common cause of intraoperative awareness is light anesthesia or inadequate anesthetic dosing. The risk of anesthesia awareness increases with difficult endotracheal intubation, interruption of anesthetic drug supply, or improper technique with low fresh gas flows. Rapid tapering of anesthesia (to facilitate operating room turnover) can increase the risk of intraoperative awareness. Another factor is the choice of anesthesia. A closed claims analysis revealed an increased
Incidence of intraoperative awareness when nitrous oxide, opioids, muscle relaxants and no or low concentrations of volatile agents were the primary anesthetic technique. Conclusions from several studies are varied. Eger and Sonner suggested that patients adequately anesthetized with a potent inhaled anesthetic at 0.5 MAC or more had a lesser incidence of awareness. In contrast, Bowdle et al cautioned against relying on standardized drugs or doses because of variation in patient response to anesthetic agents and the degree of arousing effect of surgery among surgical patients. Enlund’s prospective study of more than 5,000 patients found that no clear conclusion can be drawn regarding the effect of choice of anesthesia on risk of awareness.

Failure to use brain function monitors, when appropriate, is reported to be a risk. However, to date, no anesthesia brain monitor has been adequately validated in the presence of neuromuscular blocking drugs. Therefore, the American Society of Anesthesiologists Task Force on Intraoperative Awareness practice advisory statement recommends the use of a brain function monitor on a case-by-case basis for selected patients who are at risk of awareness.

Intraoperative awareness has been linked to certain types of surgery. Descriptive studies and case reports show an incidence of 0.2 - 0.4% in non-obstetric and non-cardiac surgery, 0.4% in cesarean section and 0.3 – 4.0% in cardiac surgery. Major trauma surgeries have a high incidence of intraoperative awareness due to hypovolemia and hemodynamic instability necessitating light anesthesia. Rigid bronchoscopy and microlaryngeal endoscopic surgery has an increased risk of awareness reported at 1 - 7%.

**Management**

All patients who report intraoperative awareness must be thoroughly evaluated to obtain details of the event and to discuss possible causes. It is particularly important to validate the patient’s experience and to recognize the emotional impact. When an episode of intraoperative awareness has been detected and verified by an adjudication committee, an occurrence report should be completed for the purpose of quality assurance and further follow up. Patients should be offered counseling or psychological support on multiple occasions. Lenmarken et al reported a group of patients who denied any mental problems in the immediate postoperative period but reported moderate to severe symptoms 2 years later. The experience of awareness can cause immediate suffering as well as long-lasting mental symptoms. Furthermore, awareness often leads to anesthesia dissatisfaction and fear of subsequent anesthesia, and general mistrust of the anesthetic care provider. Psychological sequelae can range from mild or no mental problems to the full spectrum of symptoms associated with PTSD. PTSD is a serious psychiatric disease with 6 primary diagnostic criteria. (See Table 2.)
Lennmarken’s study of long-term mental effects of awareness showed that a significant number of patients develop the whole spectrum of diagnostic criteria. Samuelsson et al found that acute emotional responses such as fear, panic and helplessness were significantly related to late psychological symptoms. Professional psychiatric assessment, therapy and follow-up are the standard of practice for patients who report awareness.

**Prevention of Awareness**

There are three stages where measures can be instituted to minimize the risk of intraoperative awareness: the preoperative assessment, the preinduction phase of anesthesia, and during intraoperative management. During preoperative assessment, patients at risk of intraoperative awareness (Table 1) should be identified. The practice advisory statement of the American Society of Anesthesiologists Task Force on Intraoperative Awareness suggests that patients with a significant risk of intraoperative awareness should be informed of the possibility of intraoperative awareness. The patient must also be reassured that all measures will be in place to prevent the complication.

During the preinduction phase, anesthesia personnel must carefully check that the anesthesia delivery system, infusion pumps and properly placed intravenous cannulae are functioning; vaporizers are full
with operational alarm systems; and fresh gas flow is adequate. Prophylactic administration of benzodiazepines has been studied widely. Many anesthesiologists believe that using benzodiazepines such as midazolam in the anesthetic regimen can reduce the risk of awareness. One double-blind randomized clinical trial compared the efficacy of the prophylactic administration of midazolam and a placebo during ambulatory procedure and reported a lower incidence of intraoperative awareness in the midazolam group. Other two randomized clinical trials also reported reduced recall in patients administered midazolam but subsequent intraoperative awareness was not examined. Both studies indicated that midazolam could not be used to reliably produce retrograde amnesia. Thus, the ASA Task Force recommends the use of prophylactic benzodiazepines on a case-by-case basis for selected patients such as patients requiring smaller dosages of anesthetics, with the caveat that delayed emergence might occur.

During the intraoperative period, the patient should be managed with conventional monitoring and brain electrical activity monitoring. Techniques used to assess intraoperative consciousness include observation of purposeful or reflex movement, response to commands, eye opening, presence of eyelash reflex and brisk pupillary responses. When muscle relaxants are not used, inadequate anesthesia can be detected by patient movement and altered or irregular breathing patterns. Typical autonomic physiological responses - e.g. increased blood pressure and heart rate, sweating, tearing, and pupillary responses - can be masked by medications such as beta-blockers and calcium channel blockers. The ‘isolated forearm’ technique has been used to evaluate depth of anesthesia in the presence of neuromuscular blocking drugs. However, this technique is quite cumbersome and has not been widely used. Conventional monitoring includes electrocardiogram, blood pressure, heart rate, pulse oximetry, capnography, and the end-tidal anesthetic analyzer. Correlation studies have shown the association between physiological responses and depth of anesthesia has a prediction probability (Pk) ranging from 0.5 (probability equal to chance) to 0.9 (near perfect association). These findings confirm that clinical techniques and conventional monitoring systems are valuable in the assessment of intraoperative consciousness as long as practitioners are aware of their limitations.

Brain function monitoring has been advocated to recognize ongoing intraoperative awareness. The monitoring systems can be subdivided into two groups; those that process spontaneous electroencephalographic (EEG) and electromyographic activity, and those that acquire evoked responses to auditory stimuli (AEPs). Both spontaneous EEG and AEP provide information about the hypnotic state of the patient. Because the raw waveforms are too complicated to interpret on a continuous basis, they are processed by computer to form a dimensionless parameter.
Table 3. Comparison of cerebral monitors

<table>
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<tr>
<th>Monitor</th>
<th>Description</th>
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<tr>
<td><strong>BIS</strong></td>
<td>Converts a single channel of frontal EEG into an index of hypnotic level.</td>
</tr>
<tr>
<td>Entropy</td>
<td>Describes irregularity, complexity or unpredictability characteristics of a signal. Algorithm is public domain.</td>
</tr>
<tr>
<td>Narcotrend®</td>
<td>Derived from a system developed for the visual classification of the EEG patterns associated with stages of sleep.</td>
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<tr>
<td>Patient State Analyzer</td>
<td>Derived from a 4 channel EEG.</td>
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<tr>
<td>SNAP index</td>
<td>Calculates a SNAL index from a single channel EEG. Spectral analysis and burst suppression algorithms.</td>
</tr>
<tr>
<td>Cerebral State Monitor</td>
<td>Handheld device to analyze a single channel EEG. Provides EEG suppression percentage and EMG activity.</td>
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Bispectral index (BIS®, Aspect Medical Systems, Natick, MA), Entropy® (GE Healthcare Technologies, Waukesha, WI), Narcotrend®, (MonitorTechnik, Bad Branstedt, Germany), Patient State Index (PSI, Physiometrix, North Billerica, MA), SNAP index (Everest Biomedical Instruments, Chesterfield, MO) and Cerebral State Index (Danmeter A/S, Odense, Denmark) are scaled from 0 (deeply anesthetized) to 100 (awake). AEPs are the electrical responses of the brainstem, a part of the brain which is relatively insensitive to anesthetics. In contrast, early cortical responses, known as the middle-latency AEPs (MLAEPs) change predictably with increasing concentrations of both volatile and intravenous anesthetics by increasing latency and decreasing amplitude of the various waveform components.

BIS® values in the range of 40 to 60 are reported to reflect a low probability of consciousness under general anesthesia. However, two case reports revealed patients experiencing intraoperative awareness despite monitored values that indicated an adequate depth of anesthesia. Some case reports suggest that certain intraoperative events (e.g. cerebral hypoperfusion, gas embolism) and patient conditions can affect BIS® values. A multicenter, double-blind, randomized trial - known as the B-Aware Trial - reported two cases of intraoperative awareness in a group although it showed an overall risk reduction of 82% (p=0.022) when the BIS®-guided was compared to a routine care group.

A Cochrane review also indicated reduction of recall when BIS®-guided anesthesia was implemented. A study of 2,000 patients randomly assigned to BIS®- guided anesthesia (40 - 60) or anesthetic gas monitoring (0.7-1.3 MAC) showed no difference in incidence of awareness. Use of either BIS® or PSI as a guide during administration of anesthetic drugs requires caution to avoid awareness. A recent small study also noted caution with the use of Narcotrend®-guided general anesthesia in the presence of neuromuscular blockade. All anesthesia brain monitors should be adequately validated before being used as guides for administration of anesthetic agents for individual patients. At present, brain
function monitors are not supported by sufficient research to be included as a standard of practice to
reduce the occurrence of intraoperative awareness in high-risk patients undergoing general
anesthesia. The ASA Task Force recommended that the decision to use a brain function monitor
should be made on a case-by-case basis by the individual practitioner for selected patients.

A recent study examined the use of single use paraffin wax earplugs to reduce the risk of awareness
and affect the requirement for propofol. Although no sparing effect in the dose of propofol was
found, the incidence of awareness was reduced in patients undergoing spinal anesthesia.

Prevention of anesthesia awareness necessitates the application of clinical techniques, conventional
monitoring systems, and brain function monitoring, when appropriate. Vigilance, improved training,
and supervision cannot be overemphasized. Patients’ understanding of the anesthetic technique must
be validated. As many as 45% of all patients do not comprehend the meaning of terms used by the
anesthesiologist. While both the ASA and the American Association of Nurse Anesthetists have
developed guidelines and practice advisories for prevention of intraoperative awareness, the Joint
Commission recommends that individual hospitals and departments of anesthesia develop and
implement their own policies.

**Management of the Case Presented**

During the preanesthetic interview, the patient reported that she was fearful of being anesthetized. A
review of the previous anesthetic record indicated that the patient had become mildly hypoxic
following propofol administration. A decision was made to intubate the patient and succinylcholine
was given followed by sevoflurane. Midazolam was not added.

The anesthesiologist validated that patient experience of explicit recall from the previous anesthesia,
and carefully explained to the patient that the incidence of this complication in general anesthesia is
rare. It was noted that the previous anesthesiologist evaluated her declining oxygen and decided to
quickly secure her airway. For this reason, the plan for the present procedure was general anesthesia
with intubation. Airway assessment was made and determined to be uncomplicated. Antacid
prophylaxis was given. After application of standard monitors and placement of a BIS® device, 4 mg
midazolam and 50 ug fentanyl were given intravenously. Rapid sequence intubation was planned. The
patient was induced with intravenous propofol at a dose of 1.5 mg/kg after a 2nd dose of fentanyl,
50ug. Succinylcholine 0.8mg/kg was used for paralysis. The trachea was intubated and anesthesia was
maintained with air, O₂ and sevoflurane and vecuronium for muscle relaxation. BIS® values were
recorded every 15 minutes and maintained at < 70.

The patient’s experience was evaluated by a structured interview on three occasions -- before the
PACU discharge, at first postoperative day, and a phone call follow-up after 10 days. The patient
reported no incidence of intraoperative awareness. She was discharged home on the 2nd
postoperative day and stated diminished fear for any future anesthetics.
REFERENCES


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**Post-test**

1. **Which of the following describes intraoperative awareness?**
   a. An implicit memory
   b. An explicit memory
   c. A dream during general anesthesia
   d. Tachycardia

2. **To best diagnose awareness, an interview should be:**
   a. Appropriately structured
   b. Performed just prior to discharge from the PACU
   c. Performed up to two weeks after anesthesia
   d. All of the above

3. **Patient risk factors identified for awareness include all of the following EXCEPT:**
   a. Obesity
   b. Female gender
   c. Advanced age
   d. Poor hemodynamic reserve

4. **Surgery that is most commonly related to intraoperative awareness includes:**
   a. Caesarean section
   b. Trauma surgery
   c. Cardiac surgery
   d. All of the above

5. **Which of the following is a correct statement regarding the psychological sequelae of awareness?**
   a. A patient who denies awareness at the first interview is not likely to develop PTSD.
   b. Fear, panic and helplessness are typical of late psychological symptoms.
   c. A professional psychiatric consultation should only be offered when requested by the patient.
   d. Awareness does not cause any type of immediate psychological suffering.
6. **Proper management of a patient who reports intraoperative awareness includes:**
   
   a. Explaining to the patient that the incidence of awareness is very rare, and the experience is likely a dream.
   
   b. Psychiatric therapy if the symptoms of post-traumatic stress disorder (PTSD) persist more than 1 month.
   
   c. A thorough evaluation of the patient to obtain details and to discuss possible causes of the occurrence.
   
   d. Validation of potential causes of the event by a psychiatrist.

7. **Preoperatively, a patient with a history of awareness requires:**
   
   a. A thorough assessment of risk factors for awareness
   
   b. An evaluation of emotional and psychological impact
   
   c. Reassurance that measures will be taken to prevent awareness in the future
   
   d. All of the above

8. **Which of the following is not an effective measure for minimizing the risk of awareness during the intraoperative period?**
   
   a. Administration of muscle relaxants
   
   b. Observation of purposeful or reflex movement
   
   c. Capnography
   
   d. Brain function monitoring

9. **Which statement is true regarding brain function monitors?**
   
   a. Brain monitors should be validated before implementation as a preventive measure.
   
   b. The combination of BIS® and PSI detects awareness in all cases.
   
   c. BIS® monitors reliably indicate adequate depth of anesthesia in all cases.
   
   d. Brain function monitors are the standard of care to prevent intraoperative awareness.

10. **What is the most common cause of intraoperative awareness?**
    
    a. Failure to use a brain function monitor
    
    b. Use of intravenous anesthetics as the primary technique
    
    c. Insufficient knowledge of awareness by the anesthetic care team
    
    d. Light anesthesia