

Intraoperative Recall

Risk

- Incidence in USA: 20 million anesthetics annually

Perioperative Risks

- Incidence is approximately 0.1% in general surgical population and increases to approximately 1% in high-risk populations.
- Procedure risk factors include OB surgery, cardiac surgery, trauma, and rigid bronchoscopy.
- Pt risk factors include prior awareness, significant CV disease, COPD, substance abuse, chronic opioid use, and chronic benzodiazepine use.
- Anesthetic risk factors include absent/low benzodiazepine premedication, absent/low halogenated agent, and dense NM blockade.

Worry About

- PTSD is a common sequela (up to 50% incidence).
- Awareness caused a significant fraction of closed claims against anesthesia personnel (1.9–12%).

Assessment Points

| System | Effect | PE | Test |
|--------|--|---|---|
| CV | Htn Tachycardia | | BP ECG |
| RESP | Tachypnea Bronchospasm Decreased compliance | Observation Auscultation | Respiratory rate PIP |
| CNS | Increased sympathetic tone Spontaneous movement | Lacrimation Diaphoresis Observation | Processed EEG, bispectral index End-tidal agent monitoring Postop interview |

Key References: Mashour GA, Avidan M: Intraoperative awareness: controversies and non-controversies, *Br J Anaesth* 115(Suppl 1):i20–i26, 2015; Brice DD, Hetherington RR, Utting JE: A simple study of awareness and dreaming during anesthesia, *Br J Anaesth* 42(6):535–542, 1970.

Perioperative Implications

Preinduction, Induction, and Maintenance

- Counsel all pts about risk of awareness as part of routine consent process.
- Consider benzodiazepine premedication in all pts without contraindication; titrate dose to clinical effect.
- Avoid muscle relaxant if not indicated. If needed, titrate to avoid dense paralysis.

Monitoring

- Consider use of processed EEG monitoring in high-risk pts, especially those receiving total IV anesthesia.
- Keep inhaled agent ≥ 0.7 MAC with audible alarms in high-risk pts.
- Continue to monitor NM blockade.

- Many cases are preventable and identified as attributable to lapses in technique.

Overview

- Explicit recall: Conscious, articulable recollection of events when intended to be unaware.
- Implicit recall: Change in behavior attributable to perception of intraoperative events, but no explicit awareness. Much harder to study.
- Intraoperative awareness: Consciousness during presumed general anesthesia; does not necessarily lead to postoperative recall.
- Hemodynamic changes are neither sensitive nor specific signs of awareness.
- Processed EEG monitoring (such as BIS) may decrease incidence of awareness.
- Maintenance of adequate end-tidal halogenated agent (≥ 0.7 MAC, age adjusted) using audible alarms may decrease incidence of awareness.

Etiology

- Inadvertent awake paralysis usually due to drug labeling or administration error
- Other awareness frequently associated with light anesthesia: Intentional, unintentional, or equipment malfunction

Usual Treatment

- Discuss incident with pt postop.
- Offer psychiatric referral to all pts with recall as screening or treatment for PTSD.
- Preliminary work suggests that glucocorticoids may reduce development of PTSD when administered shortly after a traumatic event; consider administration in PACU if explicit recall is reported there.
- Benzodiazepines are not effective in producing retrograde amnesia; cannot use for rescue of awareness.

General Anesthesia

- Consider redosing induction agent or using inhaled agents if time between induction and securing airway is prolonged.

Regional Anesthesia

- Counsel pts that awareness during regional anesthesia is expected, even with sedation.
- Limit incidental and alarming conversation during surgery with regional or any other anesthetic technique.

Postoperative Period

- Many pts with recall will not spontaneously report recall in the recovery room. Structured interviews

reveal more cases. Serial interviews may improve surveillance further.

- Structured interview for recall:
 - Last thing remembered before sleeping?
 - First thing remembered after awakening?
 - Anything in between?
 - Remember any dreams?
 - Worst thing about anesthetic?

Anticipated Problems/Concerns

- High risk of serious psychiatric sequelae

Jaundice

Maggie Lesley | Aliaksei Pustavoitau | William T. Merritt

Risk

- Chronic liver disease consistently the ninth most common cause of death in USA
- Male to female ratio: 2:1
- African American to Caucasian ratio: 2:1

Perioperative Risks

- Jaundice per se poses no special risks; at least 25% present with severe pruritus.
- Risks are associated with coexisting or underlying conditions.
- Use of regional anesthesia limited by coagulopathy and ascites.

Worry About

- Biliary obstruction

- Chronic liver disease:
 - Hepatopulmonary syndrome and hypoxemia
 - Portopulmonary Htn
 - Hepatorenal syndrome
 - CV dysfunction (cirrhotic, alcohol)
 - Infection, protein-malnutrition
 - Encephalopathy (hepatic and alcoholic); cerebral edema
 - Portal Htn:
 - Esophageal varices (incompetent lower esophageal sphincter)
 - Ascites; renal dysfunction
 - Low systemic vascular resistance and hyperdynamic circulation
 - Bleeding
 - Inability to extubate at end of surgery

- Altered drug pharmacodynamics and pharmacokinetics
- Renal impairment
- Universal precautions
- Invasive monitoring

Overview

- Mostly unconjugated-excess production:
 - Hemolytic anemias (e.g., sickle cell anemia, β -thalassemia major)
 - Extravascular hemolysis (tissue infarction, large hematoma, hemorrhage into tissue, postoperative jaundice)
 - Ineffective erythropoiesis: Decreased hepatic uptake
 - Drugs (e.g., flavaspidic acid, novobiocin, some cholecystographic dyes)
 - Severe, prolonged fasting: Decreased conjugation

- Neonate: Physiologic jaundice of the newborn, breast milk jaundice, hypothyroidism, galactosemia
- Sepsis
- Acquired transferase deficiency: Drug inhibition (e.g., pregnanediol, chloramphenicol), hepatocellular disease (cirrhosis, hepatitis)
- Gilbert disease: Decreased glucuronyl transferase; usually mild but can transiently worsen during periods of stress
- Crigler-Najjar I (absent) and II (partial decrease) in glucuronyl transferase
- Mostly conjugated-decreased hepatic/extrahepatic excretion:
 - Hereditary and/or familial: Dubin-Johnson, Rotor syndromes, recurrent intrahepatic cholestasis

- (benign), gestational cholestatic jaundice (approximately 1:13,000 deliveries; third trimester; pre-eclampsia, nulliparity; twin; decreased plt)
- Acquired: Sepsis; hepatocellular disease (drug- and viral-induced hepatitis), postoperative jaundice (pigment overload [transfusions, resorption of hematomas, hemolysis]), hepatocellular damage [drugs, including halothane; shock], benign postoperative jaundice, drug-induced cholestasis (e.g., oral contraceptives, methyltestosterone)
 - Extrahepatic biliary obstruction (e.g., mechanical, from stones, stricture, tumor, pancreatitis)
- Pseudojaundice:
 - Dietary carotenoids (primarily infants; excessive intake of vegetables, such as

- carrots and tomatoes), TPN-associated liver dysfunction
- Poisoning (picric acid)

Usual Treatment

- No specific treatment outside of newborn period.
- For neonates: fluids, phototherapy, exchange transfusion, albumin, tin mesoporphyrin, and IV immunoglobulin Rx have been shown to decrease the level of unconjugated bilirubin below levels regarded to be toxic to the neonatal brain. The smaller and sicker the premature infant, the more aggressive the therapy needed.

Assessment Points

| System | Effect | Assessment by Hx | PE | Test |
|------------|--|---|---|--|
| HEENT | | Duration | Yellow sclerae | |
| CV | Hyperdynamic Poss decreased SVR | General symptoms | Increased HR, decreased BP | |
| RESP | Cirrhosis have 6x increase in pulm Htn | Severe dyspnea, hypoxia, clubbing | Clubbing Cyanosis | ECHO; right-sided heart cath if indicated, usually for PAS ≥50 |
| GI | Severe dysfunction Prolonged effects of most anesthesia drugs | General symptoms, reflux, ascites, varices, edema | Signs of chronic liver disease | LFTs Coagulation time Hgb, plt |
| ENDO/METAB | Decreased synthetic function, increased enzymes, decreases albumin, decreased hepatic coagulation factors; decreased clearance of toxins | General malaise symptoms Easy bruising and bleeding | Jaundice Ecchymoses Hematoma Ascites | LFTs Coagulation time NH ₃ , lactate |
| HEME | Decreased plt | Easy bruising and bleeding | Ecchymoses, hematoma | |
| DERM | | Duration, evidence of bleeding | Yellow color | |
| RENAL | Decreased function Higher risk of postop renal impairment | | Edema May be hypovolemic in obstructive jaundice | BUN, Cr; Cr may be spuriously lower with high bilirubin |
| CNS | Recurrent encephalopathy in cirrhosis Cerebral edema in fulminant hepatic failure Autonomic dysfunction | Mental status Duration of illness Abnormal autonomic function | Normal to encephalopathy/ comatose Orthostatic BP changes | Bilirubin interferes with cerebral near-infrared oximetry |

Key References: Yang LQ, Song JC, Irwin MG, et al.: A clinical prospective comparison of anesthetics sensitivity and hemodynamic effect among patients with or without obstructive jaundice, *Acta Anaesthesiol Scand* 54(7):871–877, 2010; Vaja R, Barker RC: Drugs and the liver, *Anaesth Intensive Care Med* 13:71–74, 2011.

Perioperative Implications

- Drug: Decreased protein production leads to decreased albumin binding and more active drug.
 - Cimetidine and/or ranitidine: Clearance reduced, especially in pts with ascites, hypoproteinemia, and encephalopathy.
 - Benzodiazepines: Clearance of oxidative pathway markedly decreased; glucuronidation path (e.g., lorazepam) not greatly altered; excessive sedation in severe liver disease.
 - Narcotics: Meperidine clearance is severely affected; adverse affects of morphine can be increased.
 - Neuromuscular blockade: Succinylcholine activity may be prolonged somewhat because of decreased levels of pseudocholinesterase; decreased metabolism of vecuronium and rocuronium.
 - Miscellaneous: Phenobarbital and lidocaine have reduced clearance; diuretics may have reduced natriuretic efficacy.

- Halogenated agents: Halothane should be avoided; association of enflurane with hepatic toxicity is less clear; isoflurane and sevoflurane are preferred agents in setting of liver disease and best preserves liver hemodynamics; reports of hepatic toxicity for both are rare.
- Pregnancy: Jaundice may signal HELLP syndrome and pregnancy-induced Htn.
- Cardiac surgery: Jaundice occurs in approximately 20% post-CPB pts; risk factor for mortality.

Preoperative Preparation

- Hydration should be adequate; if chronic liver failure, may be total body fluid increased but intravascularly decreased.

Monitoring

- NMB: Dose muscle relaxants to effect and consider path of elimination.
- Invasive CV monitoring: Important for some procedures.

Airway

- May have bleeding disorder.

Induction

- Avoid benzodiazepines.
- Consider cricoid pressure if varices present.

Maintenance

- Be mindful of metabolic clearance paths.
- When practical, use drugs cleared chiefly by nonhepatic paths.

Extubation

- May have delay in awakening

Anticipated Problems/Concerns

- Inability to extubate immediately postoperatively due to prolonged action of NMB and sedative/hypnotic/narcotic medications

Jehovah's Witness Patient

Meg A. Rosenblatt | Alopi Patel

Risk

- More than 8 million members worldwide
- Headquarters in Brooklyn, New York; new world headquarters under construction in Warwick, New York

Perioperative Risks

- Possible morbidity and/or mortality from massive hemorrhage secondary to religious dogma banning members from accepting blood transfusions.

- Appropriate blood conservation measures (i.e., autologous blood salvage, normovolemic hemodilution, reduction of intraoperative and iatrogenic blood loss) in pts who do not accept autologous blood transfusions results in similar or better outcomes compared