Rare Preventable Complications in Anesthesiology

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Wrong site surgery: includes surgery on wrong side and on wrong patient; nerve block may also be performed on wrong side; risks include multiple trauma (eg, dressings on one extremity, while procedure planned for opposite side); even patient may be unsure on which limb operation to be performed; spinal surgery may be performed at incorrect level; risk increases when multiple surgical teams operating together; Sexton et al (2006) — found that teamwork culture in operating room (OR) can impede use of surgical checklists; reported that surgeons mostly satisfied with function of team; circulating nurses, anesthesiologists, and residents more commonly reported disenfranchisement; some team members became silently disengaged because of prior experience of being reprimanded; 25% to 45% of nurses reported hesitation to voice concern when witnessing mistakes by physicians; subsequent implementation of time-outs and change in culture have helped improve attitudes; goal must be to engage team members with common commitment to safety; Agency for Healthcare Research and Quality (ahrq.gov) — provides list of risk factors for wrong site surgery; engagement of OR team lessens risk

Fire safety in OR: many fires in hospitals reported in United States, many of which occur in OR; recent study reports decrease over last 40 yr as awareness has grown and use of flammable anesthetic gases has diminished; however, increasing use of alcohol-based surgical preparations in last 15 yr has created new problem; OR burns most commonly occur on patient’s head, face, neck, and upper chest (65% of burns); fire triad — fires require fuel, ignition source, and oxidizing agent (eg, oxygen, nitrous oxide); Anesthesia Patient Safety Foundation (APSF) emphasizes that different providers control different components of fire triad, so communication crucial; surgeons control ignition source; circulating nurses and scrub technicians control fuel (eg, alcohol-based preparations, surgical drapes); anesthesiologists provide oxygen; open air oxygen — use of surgical drapes as “tent” to enhance patient’s oxygen atmosphere creates risk for fire; Culp et al (2013) — devised experimental model to determine flammability of substances in varying oxygen environments; demonstrated that laparotomy sponges slightly more flammable than OR towels (both 100% cotton); measured time to ignition from time of spark; with Fio2 of 21%, ignition time slightly >1.5 sec; with Fio2 of 100%, ignition time 0.1 sec; time to burn entire substance with Fio2 of 21% 22 sec, vs 1 sec with Fio2 of 100%; alcohol-based solutions (eg, Dura-Prep) — manufacturer’s instructions recommended waiting 3 min on hairless skin to allow evaporation; avoid pooling; time to dry on hairy skin can be ≤1 hr

Recommendations of APSF: video available on website; providers should question whether supplemental oxygen necessary and, if so, ideally should control airflow with endotracheal intubation or supraglottic device (to exclude oxygen-enriched environment from surgical field); adhesive surgical drapes not proven to seal surgical field from supplemental oxygen; if open oxygen necessary, advised to use ≤30% concentration by using oxygen blender (wall source cannot deliver such low concentrations); allow alcohol-based preparations to dry; some advocate implementation of fire safety precautions as component of time-out; for procedures involving higher risk, incorporate fire safety precautions in checklist

Management of fires: remove all drapes; turn off all oxygen sources; pour saline over burned areas; rarely necessary to use fire extinguisher directly on patient, but should know extinguisher locations; anticipate high-risk situations and communicate with surgeons and nurses

Preventable errors related to equipment and devices

Falls in OR, anesthetized patient has no ability to brace for fall, and head tends to lead; can be devastating injuries; risk factors — inexperienced nurse who may fail to secure seat belt on operating table or unstrap patient without personnel by patient’s side; combative patient on induction or emergence; lack of vigilance when transferring patient from operating table; operations that require extreme tilt (eg, sliding can occur with steep Trendelenburg position); obesity of patient significantly complicates safety issues; issues with beds and tables — spine tables and hip fracture tables present particular risk (any bed in which patient not on flat surface); tables used in reverse position or arranged so that center of patient not over pedestal of table may create instability (eg, alteration of table to accommodate C-arm fluoroscopy); fulcrum of table different when table unlocked and may cause instability; manufacturers’ instructions dictate that tables should never be moved or unlocked with patient on table; weight limitations of tables invalid when patient in reverse orientation; preventive steps — when setting up table, recommended to grab and wiggle side of bed; excessive lateral play suggests broken bolt; use of air transfer system (eg, HoverMatt) can reduce additional stress on bolts

Arm boards: case study — patient in supine position with arms strapped to arm boards; after 2-hr surgery, removal of drapes

Educational Objectives

The goal of this program is to improve anesthetic management of rare preventable complications and thoracic trauma. After hearing and assimilating this program, the clinician will be better able to:

1. Implement measures to reduce the risk for wrong site surgery.
2. Outline key measures to prevent operating room fires.
3. Identify risks for patient falls in operating room.
4. Formulate strategies for the anesthetic management of patients with thoracic trauma.

5. Recognize the clinical role of intraoperative transesophageal echocardiography.

Faculty Disclosure

In adherence to ACCME Standards for Commercial Support, Audio Digest requires all faculty and members of the planning committee to disclose relevant financial relationships within the past 12 months that might create any personal conflicts of interest. Any identified conflicts were resolved to ensure that this educational activity promotes quality in health care and not a proprietary business or commercial interest. For this program, members of the faculty and planning committee reported nothing to disclose.
revealed that arm board had detached from bed frame with full weight of arm and board hanging loosely; high risk for brachial plexus injury; risks — arm boards can be easily dislodged (eg, sheet or drape inadvertently caught in locking mechanism); important to recheck arm board to ensure that board properly secured; C-arm or robotic arms can elevate arm board, resulting in unlocking

Family members present at procedure: most common during insertion of labor epidural catheter; many places do not have policies requiring visitors to be seated, and nurses may engage family members in positioning of patient; case report — husband requested to support patient while labor epidural inserted; upon seeing needle, husband fainted, fell backward, and hit his head on wall; he suffered epidural hematoma and died 24 hr later

Risks of magnetic resonance imaging (MRI): must ensure no metallic objects near mechanism; oxygen tanks brought too close to MRI at risk for being pulled into center of tube; case of 6-yr-old evaluated by MRI for orthopedic injury; underwent general anesthesia and oxygen tank brought too close; tank drawn toward center of machine and acted as projectile, causing death

Pump programming errors and malfunctions: misplaced decimal point on programming of epidural infusion resulted in patient receiving 10-fold increase in dose of medication and permanent neurologic injury; case study — pump composed of 4 prongs that alternately control flow; 1 prong discovered to be faulty, with 1 in 4 chance of patient receiving free flow of medication; patient received free flow of epidural anesthetic

Suggested Reading


Blunt and Penetrating Trauma: Are They the Same?

Blunt thoracic aortic injuries: one of most common cardiovascular injuries; motor vehicle accidents primary cause; 85% of patients die at scene; most common site of injury just distal to left subclavian artery, where ligamentum arteriosum anchors aorta (immobile spot, susceptible to shear stress); computed tomography angiography primary modality for diagnosis; intraoperative phospholothelial angiography (TEE) confirmatory; treatment — traditionally, management options included medical management or open repair; thoracic endovascular aortic repair (TEVAR) — increasingly used; allows repair without need for thoracotomy, single-lung ventilation (with higher risk of acute lung injury), or aortic cross clamping; reduces risk for bleeding, stroke, paraplegia, and mortality; involves placement of catheter to level of ascending aorta with potential for disruption of atheroma and stroke; risk for paralysis dependant on length of graft and number of intercostal arteries covered; anesthetic considerations — focus on standard goals of trauma anesthesia, eg, adequate oxygenation, restoration of blood volume, and treatment of hypothermia and coagulopathy; standard monitoring should be used, ie, arterial line, large bore intravenous (IV) lines, placement of central line (depending on need for resuscitation or infusion of vasoactive drugs); TEE can be useful in guiding catheter-based procedures and checking for atheromas; lumbar drain may be used to decrease cerebral spinal fluid (CSF) pressure and optimize spinal cord perfusion; some institutions utilize neuromonitoring to confirm perfusion of spinal cord; placement of arterial line — aortic graft may obstruct left subclavian artery, which would nullify value of left radial artery; preferred to place arterial line in right radial artery

Lumbar drain: when signal on neuromonitor lost, recommended to increase mean arterial pressure and drain CSF; large radicular artery (artery of Adamkiewicz) usually located ≈T9 to T11; when stent reaches this area, patient at increased risk for injury to spinal cord; most common protocol for use of lumbar drains involves placement of catheter, monitoring of pressure (set at 10 mm Hg), and drainage of 10 mL of CSF/hr; if signals lost or if patient in ICU becomes symptomatic, can drain 20 mL/hr with goal of restoring neuromonitoring signals; complications of lumbar draining — excessive drainage risks herniation

Blunt cardiac trauma: patients usually sick with multigorgan injury and cardiac trauma commonly overlooked; right ventricle most anterior chamber so most commonly injured; arrhythmias most common presentation (primarily premature ventricular contractions); ST changes may occur and when present should raise suspicion for blunt cardiac injury; one-third of patients with ventricular rupture also have pericardial rupture and exsanguination into thorax; management — supportive care indicated for arrhythmias and ST changes; structural injuries of myocardium require surgery

Pulmonary contusion and flail chest: account for one-third of blunt chest trauma; associated with increased risk for pneumonia, acute respiratory distress syndrome, and long-term respiratory dysfunction; typically manifest in OR as V/Q mismatch; treatment supportive, with utilization of acute lung injury protocol (eg, lower tidal volumes [6 mL/kg], high positive end-expiratory pressure, and permissive hypercarbia); when removed from ventilator may benefit from epidural analgesia

Penetrating chest trauma: right ventricle most commonly injured chamber of heart; puncture injuries of ventricles tend to spontaneously seal because of thickness of wall, in contrast to injuries of atria, which require repair because of thinner walls; tamponade most common presentation; ≈20% require coronary artery bypass graft because of coronary artery injury; anesthetic plan — apply standard monitors; arterial line; large-bore IV catheters; tamponade limits stroke volume, and preservation of cardiac output achieved by increased heart rate; therefore, speaker advocates administration of epinephrine to maintain high heart rate; give adequate IV fluids to ensure adequate intravascular volume; induction best done with goal of maintaining spontaneous respiration because positive pressure can cause fall in preload and hemodynamic instability; for patient in extremis, may be best to drain fluid before induction of general anesthesia; once pericardium opened, blood pressure tends to rebound

Ballistic injuries: unpredictable because of “weird” trajectory; injuries may be extensive; intraoperative TEE useful to exclude structural damage (blunt cardiac injuries may be present)

Emergency department thoracotomy: outcomes dismal; best reserved for isolated penetrating cardiac injuries; in this setting, survival rate 20% to 30%

Other injuries: airway injuries — presence of chest trauma should raise suspicion for airway injury; carina relatively fixed

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point and susceptible to shear injuries; neck injuries — stabilization of airway main priority

Airway management: indications for intubation include mental status changes and Glasgow Coma Scale score of 8; recommended to electively intubate patients with chest and abdominal penetrating trauma because of potential for rapid destabilization; airway algorithm — rapid-sequence intubation; in-line stabilization; cricoid pressure; low threshold for surgical airway, ie, consider after 3 attempts at nonsurgical airway (especially if one attempt by airway expert); video laryngoscopy has revolutionized management

Anesthetic management: start of operation should not be delayed to establish IV access or other preparations; definitive repair by surgeon and anesthetic management can be performed simultaneously; some authorities recommend permissive hypotension; thromboelastometry techniques have helped to decrease utilization of blood products

Use of TEE: can be of great value intraoperatively (eg, diagnosis of tamponade [100% sensitivity and 99.3% specificity]); disadvantages include need for trained individual; limited in patients with cervical spine or esophageal injury; complications rare; if resistance met upon insertion, should not force probe; beneficial to have second anesthesia provider to care for patient during TEE; contraindicated if esophageal pathology present; indications for basic TEE — chest wall injuries; noncardiac surgery when cardiovascular pathology may affect outcome; catheter-based procedures (eg, TEVAR); closures of

Acknowledgments

Drs. McAllister and Wilson spoke at the Annual Meeting of the Texas Society of Anesthesiologists, held on September 10-13, 2015, in San Antonio. For information on upcoming CME meetings from the Texas Society of Anesthesiologists, please go to tsa.org, or visit our website, Audiodigest.org, and click on “Upcoming Meetings.” The Audio Digest Foundation thanks the speakers and the sponsors for their cooperation in the production of this program.
1. In a study by Sexton et al of teamwork culture in the operating room (OR), which of the following groups was most likely to report satisfaction?
   (A) Surgeons  
   (B) Anesthesiologists  
   (C) Circulating nurses  
   (D) Residents

2. According to the Agency for Healthcare Research and Quality, which of the following reduces risk for wrong site surgery?
   (A) Presence of dressings on extremity  
   (B) Confirmation of site by patient  
   (C) Presence of multiple surgical teams  
   (D) Engagement of all members of OR team

3. Alcohol-based surgical preparations (eg, DuraPrep) may take _______ to fully dry on hairy skin areas.
   (A) ≤10 min  
   (B) 30 min  
   (C) 45 min  
   (D) 1 hr

4. Recommendations from the Anesthesia Patient Safety Foundation for preventing fires in the OR include all the following, EXCEPT:
   (A) Endotracheal intubation when supplemental oxygen is used  
   (B) Use of oxygen blender  
   (C) Use of adhesive surgical drapes  
   (D) Full drying of alcohol-based skin preparations

5. Which of the following statements about the risk for patient falls from OR tables is true?
   (A) Weight capacities are unchanged when tables are used in reverse position  
   (B) Unlocking a table does not significantly change the center of gravity  
   (C) Modern tables are designed to maintain stability when center of patient not over pedestal  
   (D) Use of air transfer system (eg, HoverMatt) decreases stress on table bolts

6. All the following are acceptable in patients undergoing thoracic aortic repair, EXCEPT:
   (A) Placing arterial line in left radial artery  
   (B) Use of central venous catheter  
   (C) Transesophageal echocardiography  
   (D) Neuromonitoring of spinal cord

7. In a patient who becomes symptomatic from spinal cord ischemia, it is recommended to drain _______ from a lumbar drain.
   (A) 5 mL/hr  
   (B) 10 mL/hr  
   (C) 20 mL/hr  
   (D) 30 mL/hr

8. Which of the following is the most common manifestation of blunt cardiac trauma?
   (A) Arrhythmias  
   (B) Murmur  
   (C) Congestive heart failure  
   (D) Hypotension

9. Which of the following is the most common manifestation of penetrating cardiac trauma?
   (A) Arrhythmias  
   (B) Tamponade  
   (C) Hemorrhage  
   (D) Air embolism

10. Appropriate anesthetic management in patients with pericardial tamponade includes which of the following?
    (A) Vasoactive agents to maintain high heart rate  
    (B) Inotropic agents to increase stroke volume  
    (C) Rapid-sequence intubation  
    (D) All the above

Answers to Audio Digest Anesthesiology Volume 58, Issue 13: 1-B, 2-B, 3-A, 4-C, 5-C, 6-D, 7-A, 8-D, 9-B, 10-D