

## **A DISCUSSION OF ANESTHESIA**

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A. Respiratory

1. Airway obstruction

2. Respiratory depression

3. Hypoxemia

4. **Sore throat**

B. Neurologic

1. Muscle weakness (recurarization)

2. **Pain**

3. Over-sedation

C. Cardiovascular

1. Hypertension

2. Hypotension

3. Dysrhythmias

4. Hypothermia

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1. **Nausea/Vomiting**

**V. FOR MORE INFORMATION**

**A DISCUSSION OF ANESTHESIA**

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## **INTRODUCTION**

Anesthesia facilitates a patient's ability to tolerate surgery and other procedures, and so it serves a vital function in health care. Anesthesia is provided by physicians, dentists, and nurse anesthetists, and is essential for the over 26 million surgeries performed in the United States each year. There are approximately 30,000 anesthesiologists and 30,000 CRNAs in the United States.

Anesthesia has become a complex and fascinating area of health care, but is often not well understood by practitioners outside the field. The goal of this discussion is to provide a general introduction to the subject of anesthesia for nurses, nursing students, and other interested audiences.

There are numerous approaches to administering anesthesia for any given patient and for any given surgery. The variation in anesthesia is due to the individual differences in patients and patient's preferences, the requirements of the surgery, the large selection of anesthetic agents to choose from, and the preference of the anesthesia provider.

## **I. TYPES OF ANESTHESIA**

### **A. General Anesthesia**

A general anesthetic is performed by rendering a patient unconscious using intravenous and/or inhalation agents, voluntary and reflex motor responses are diminished or absent and the patient no longer has any sensation (hence the term anesthesia). General anesthesia can be instituted with a large variety of medications (see section on anesthetic agents) with various means of airway control (see below).

#### 1. Goals of general anesthesia

- Analgesia: lack of pain
- Anesthesia: lack of sensation
- Amnesia: lack of memory (immediate perioperative events)
- Areflexia: lack of reflexes
- Anxiolysis: lack of anxiety
- Antiemesis: lack of emesis
- Muscle relaxation
- Physiologic stability: hemodynamic, respiratory, hepatic, renal, etc.

The anesthesia provider has intentionally produced a coma, and is now responsible for all aspects of the patient's well-being, from the most basic physical functions to autonomy.

#### 2. Levels of General Anesthesia (Guedel's signs: Originally defined for ether anesthetic)

Stage One: Amnesia and analgesia

- From amnesia and analgesia to loss of consciousness.
- Respirations present and quiet, reflexes intact.

Stage Two: Excitement or delirium

- From loss of consciousness to onset of total anesthesia.
- Respirations irregular, increased muscle tone, involuntary movements, dilated pupils; disconjugate gaze, increased risk of vomiting, aspiration, laryngospasm, and bronchospasm; best not to stimulate the patient at this time.

Stage Three: Surgical anesthesia

- Divided into four planes:
- 1 and 2: From total loss of consciousness with regular respirations, decreased muscle tone, absent cough, absent swallow or gag reflexes, pupils normal size and reactive;
- 3 and 4: Onset of total muscle relaxation, non-reactive pupils, and cessation of spontaneous respirations.

Stage Four: Anesthetic overdose

- Pupils fixed and dilated, cardiac arrest imminent, no respirations.
- Requires immediate cessation of all anesthetics, ventilation with 100% oxygen, supportive measures.

### 3. Airway Management

. a. Endotracheal intubation

- An endotracheal tube (ETT) can be placed direct or blind, awake or asleep, oral or nasal.
- Uses: Any case that requires general anesthesia and positive pressure ventilation, particularly those that require paralytic muscle relaxants, such as cardiothoracic cases, intracranial cases, upper abdominal cases, and cases in which any movement by the patient would be deleterious to patient.
- Surgeries greater than 2-4 hours
- Patients at risk for aspiration (pregnant, h/o GERD, hiatal hernia, NPO < 8 hrs)
- Pros: secured airway, decreased aspiration risk
- Cons: noxious stimuli = more anesthetic required, larger CV response at insertion if anesthesia is light, laryngospasm, bronchospasm, risk of dental or soft tissue (lips, pharynx, larynx, vocal cords, trachea, mediastinum) damage during placement, postoperative sore throat.

b. Laryngeal mask airway (LMA)

- Placed at level of larynx, designed for use with spontaneous respirations.
- Uses: general anesthetic cases particularly those that do not require muscle

relaxation such as extremity surgeries, plastic surgery (for example, rhinoplasty, breast augmentations, abdominoplasty, etc.), deep/large biopsies, and relatively short cases. Patient must not be at risk for aspiration.

- Pros: less noxious than ETT = better tolerated with light anesthesia, less CV response, rapid/smooth emergence, less sore throat; no muscle relaxant needed, frees hands of anesthesia provider as opposed to mask ventilation. Part of difficult airway algorithm, relatively easy to place.
- Cons: does not protect airway from aspiration (therefore contraindicated in patients at risk), increased risk of gastric insufflation, when not seated correctly it may result in partial airway obstruction. LMA position may change if patient becomes light due to laryngeal tightening.

c. Mask

- Placed over nose and mouth with tight mask seal.
- Uses: Initial means of assisted ventilation before placement of ETT or LMA.
- Good for really short cases not involving the airway (ex. PETs, EUA).
- Pros: least noxious, well tolerated.
- Cons: increased aspiration/gastric insufflation risk, increased operating room pollution with inhalation agents, increased risk of injury to cornea and facial nerves, anesthesia provider hand fatigue.

**B. Sedation: “Monitored Anesthesia Care” (MAC)**

1. Provision of sedation during surgeries performed with local anesthetic infiltration.
2. Uses: Eye surgeries, breast biopsies, small plastics cases, hernia repair
3. Pros: Less anesthetic required, faster turn-around time
4. Cons: A continuum which may border on general anesthesia if patient requires large amounts of local anesthesia. Provider must be able to manage airway.

**C. Regional Anesthesia**

1. Spinal

- Small volume (1-3cc) of local anesthetic and/or narcotic injected into subarachnoid space, i.e, into the cerebrospinal fluid (CSF).
- Placed with a spinal needle (21-26g) and sterile technique,
- Usually as a single injection, although a catheter can be placed for repeated or continuous medication.
- This results in the interruption of sensory, motor and sympathetic nervous system conduction below the level of the injection.
- The neural blockade may spread upward to some degree, depending on the patient position and whether of the medication is more or less dense than the CSF (which can be adjusted by the addition of either 8% dextrose or water to the medication).
- Usually provided with some sedation (except expectant mothers).
- Can be combined with epidural or general anesthesia.
- Uses: Lower extremity or lower abdominal cases (cesarean section, BTL, ankle fracture, knee arthroscopy, TURP).

- Pros: Avoids airway manipulation, maintains consciousness, provides excellent analgesia/anesthesia and relaxation of affected extremity.
- Cons: Limited duration of anesthetic effect, postdural puncture headache, Hypotension (fluid bolus and pressors may be necessary), failure to produce desired level/depth of anesthetic block which may result in conversion general anesthesia, nausea, urinary retention, and high spinal.
- Contraindications: patient refusal, use of anticoagulants or coagulopathy, systemic infection or infection on back near site of injection, uncooperative or uncommunicative patient.

## 2. Epidural

- Larger volume (5-20 cc) of local anesthetic and/or narcotic injected into epidural space, not into spinal fluid.
- Placed with use of large hollow bore needle (17g) and usually a small indwelling catheter.
- An indwelling catheter can be injected repeatedly or continuously.
- This produces a segmental neural blockade, i.e., the blockade spreads both up and down from the point of injection. The blockade can be more (anesthetic) or less (analgesic) dense, depending on the amount and concentration of the medication.
- Can be combined with general anesthesia or sedation.
- Uses: same as spinal and more (longer surgeries and postop pain control)
- Pros: as above but not limited by time if catheter placed.
- Cons: as above but not limited by time, technically more difficult than spinal since needle is larger and risk of dural puncture exists, large volume of medication.
- Contraindications: Same as spinal

## 3. Peripheral nerve block

- Local anesthetic injected into areas surrounding nerve trunks/roots.
- Good for extremity surgery. Multiple types of blocks can be performed:
  - Cervical plexus: good for carotid endarterectomies
  - Upper extremity blocks: brachial plexus (interscalene, supraclavicular, and axillary), median, radial, and ulnar nerve blocks.
  - Lower extremity: sciatic, femoral, obturator and ankle blocks.
  - Thoracic and abdominal nerve blocks.
- Pros: Less risk than central block. Can supplement general or regional anesthesia and decrease post-op pain and narcotic use.
- Cons: Can be technically difficult, limited time of action, nerve damage.

## 4. Bier block (intravenous regional anesthesia)

- Local anesthetic is injected into the vessel after the vessels have been exsanguinated with esmarch and a proximal tourniquet has been inflated.

- Good for short, soft tissue surgeries of upper and lower extremities such as ganglion cyst removal, carpal tunnel release, contracture/tendon release.
- Pros: as above, technically easy.
- Cons: Limited by time and may not provide enough anesthesia for bone pain.

## **II. PERIOPERATIVE SEQUENCE AND ANESTHETIC AGENTS**

### **A. Preoperative Period**

The goals of the anesthesia provider's preoperative visit are as follows:

1. **Assessment:** To obtain pertinent information about the patient, and design an anesthetic plan suitable for this patient and the surgical procedure (more on this later).
  - Demographics: Identification, type and site of surgery, consent.
  - History: Allergies. Social history. Medications. HPI. PMH/ROS. PSH. Past and family anesthetic history.
  - Focused physical exam: Airway. Cardiovascular. Lungs. Neurologic. Surgical site. Local or regional anesthetic site.
  - Review of appropriate labs, tests, and imaging.
2. **Rapport:** To establish a relationship, and build trust with the patient (this is a very important goal as studies have shown that a patient's perioperative course is influenced by his/her perceptions, attitudes and feelings toward the healthcare providers).
3. **Premedication:** Such as antibiotics, anxiolytics (e.g. midazolam), antiemetics (e.g. droperidol, ondansetron, dexamethasone, metoclopramide), and antacids (e.g. Bicitra, famotidine). To the OR!

### **B. Induction of Anesthesia**

The induction of anesthesia follows once the patient is moved to the operating room table, monitors (EKG, NIBP and pulse oximeter) are placed, and oxygen by mask is provided. Typical induction agents for a general anesthetic include:

#### 1. Narcotics

Provide analgesia, and blunt the sympathetic response to endotracheal intubation and surgical incision. Examples of commonly used narcotics are:

- Fentanyl (Sublimaze): 100x more potent than MSO<sub>4</sub>, duration: 30-45 min.
- Alfentanil (Alfenta): 10x more potent than MSO<sub>4</sub>, duration: 10-15 min.
- Sufentanil (Sufenta): 1000x more potent than MSO<sub>4</sub>, duration: 60 min.
- Meperidine (Demerol): 1/10th potency of MSO<sub>4</sub>, duration: 2-3 hrs.
- Morphine sulfate: The analgesic standard, duration: 2-4 hrs.

#### 2. Sedative/Hypnotics (aka induction agents)

Cause unconsciousness and are given in preparation for endotracheal intubation. Induction agents cause amnesia, but most have no analgesic properties. The following is a list of commonly used induction agents. They all have a rapid onset (10-60 sec) and similar mode of metabolism (85-99% hepatic metabolism). The decision to use one over the other is determined by cost, patient profile, provider preference and drug side effects (good and bad).

- Propofol (Diprivan): Onset 40sec. Duration 5-10min. Easy titration and rapid emergence. Short elimination half-life (30min-1 hr) means no hangover. The only induction agent with antiemetic properties. It has become the most commonly used induction agent.
- Thiopental (Pentothal): Onset 10-20sec. Duration 5-15min. Long elimination half-life (11 hrs) results in hangover effect. pH 10.5: May cause problems with extravasation. Releases histamine: May cause bronchospasm. Exacerbates porphyrias. Reliable, inexpensive, and was the main drug used until propofol.
- Ketamine (Ketalar): Onset 30sec. Duration 5-15min. Maintains BP well, and in small doses maintains spontaneous respiration. Powerful analgesic. Good bronchodilator. Increased salivation. Emergence delirium, which may be prevented by giving sedation.
- Etomidate (Amidate): Onset 30-60sec. Duration 3-10min. Maintains cardiac output well, so good for trauma cases or where hypotension at induction is likely. Increased muscle tone and involuntary movement. May depress adrenal function for up to 24 hours even after single dose.
- Methohexital (Brevital): Onset 20-40sec. Duration 5-10min. Ultra-short acting barbiturate. Higher rate of post-op nausea.

### 3. Muscle Relaxants

#### a. Depolarizing Agents

- Succinylcholine (Anectine): Onset 30-60sec. Duration 4-6min. Causes fasciculations which may result in hyperkalemia; postop myalgias; increased intraocular, intracranial and intra-abdominal pressures. Implicated in malignant hyperthermia. Good for rapid sequence inductions and/or general anesthetics requiring intubation and no muscle relaxation. Contraindicated if history of burn injury: severe hyperkalemia may result

#### b. Nondepolarizing Agents

- Short acting: Mivacurium (Mivacron): Onset 2min. Duration 5-15min. Good for short cases such as direct laryngoscopies, endoscopies, exam under anesthesia.
- Intermediate acting: Rocuronium (Zemuron). Vecuronium (Norcuron). Atracurium (Tracrium). Cisatracurium (Nimbex). All with similar onsets (2 min) and durations (30-60min).
- Advantage of cisatracurium is Hoffman elimination: Spontaneous breakdown of the drug without hepatic or renal metabolism, so good for use in patients with renal or hepatic insufficiency.
- Long acting: Pancuronium (Pavulon): Slow onset, long duration of action, inexpensive, causes tachycardia, good for long cases with narcotic drip.

### C. **Maintenance of Anesthesia**

This is the period of time in which surgery is being performed. Typically general anesthesia is maintained with inhalation agents, but can also be maintained with IV infusion. Usually supplemented with narcotics and muscle relaxants. Crystalloids, colloids, and blood products



are given as needed. Hemodynamic and other medications may be required.

1. Inhalation agents: Mechanism of action is not understood: Discover it and win the Nobel Prize! The partial pressure in the alveoli is directly related to the effect on the brain, because they are not very soluble in the blood (i.e., they have low blood:gas solubility).

- Isoflurane (Forane): Intermediate action of induction and emergence, inexpensive.
- Sevoflurane (Ultane): Rapid action, no pungent smell so great for mask inductions, lower blood:gas solubility makes it easier to titrate than isoflurane.
- Desflurane (Suprane): Very rapid action, has lowest blood:gas solubility, highly pungent, not good for mask induction.

2. Intravenous agents: May be single agent, or combinations.

- Propofol: See induction section, very titratable and short-acting agent.
- Ketamine: See induction section.
- Narcotics: e.g., fentanyl or sufentanil.
- Benzodiazepines: e.g., midazolam or lorazepam (Ativan).

#### **D. Emergence**

Period of time that maintenance agent is discontinued, patient begins to wake up, spontaneous respirations resume, airway reflexes return, and the patient is prepared for extubation and transport to recovery room. Medications may be given to control pain, decrease or prevent nausea, and to reverse the effects of nondepolarizing muscle relaxants:

1. Anticholinesterase: Neostigmine, edrophonium. Increases the amount of circulating acetylcholine so that skeletal muscles can function again.
2. Anticholinergics: Glycopyrrolate, atropine. Given along with anticholinesterases to reduce the severity of cholinergic (muscarinic) response to the increased levels of acetylcholine (bradycardia, bronchospasm, salivation, lacrimation, urination, defecation, myosis, and diaphoresis).

### **III. ANESTHESIA RED FLAGS**

A focused history and physical of the patient is performed preoperatively, with attention to airway, previous anesthetic experiences, and underlying medical conditions.

#### **A. Airway**

1. History: Difficult or prolonged intubations, cervical spine instability, radiation to or around the neck area, airway tumor, obstructive sleep apnea, or rheumatoid arthritis.
2. Exam: Recessed chin, short neck, poor dentition, poor Mallampati score, morbid obesity. These patients may be difficult intubations, and one should consider alternative plans for airway management (awake fiberoptic, LMA, tracheostomy)

#### **B. Past Medical History**

1. Genetic: malignant hyperthermia, porphyria, atypical pseudocholinesterase, down syndrome, other congenital metabolic or developmental syndromes.
2. Cardiovascular: Exercise intolerance, hypertension, CHF, CAD, valve disease,

- cardiomyopathy, angina, peripheral vascular disease, dysrhythmia, pacemaker/ICD, blood dyscrasia.
3. Pulmonary: asthma, tuberculosis, current/recent URI, dyspnea on exertion
  4. Endocrine: diabetes, hyperthyroid, adrenal tumor (pheochromocytoma), steroid dependency (supplement peri-op), morbid obesity.
  5. Neurologic: Carotid artery disease, CVA/TIA, seizure, chronic pain, motor or sensory loss.

#### **IV. POSTOPERATIVE PROBLEMS** (most common in **bold**)

##### **A. Respiratory**

1. Airway obstruction
2. Respiratory depression
3. Hypoxemia
- 4. Sore throat**

##### **B. Neurologic**

1. Muscle weakness (recurarization)
- 2. Pain**
3. Over-sedation

##### **C. Cardiovascular**

1. Hypertension
2. Hypotension
3. Dysrhythmias
4. Hypothermia

##### **D. GI**

- 1. Nausea/Vomiting**

#### **V. FOR MORE INFORMATION**

American Association of Nurse Anesthetists: [www.aana.com](http://www.aana.com)

California Association of Nurse Anesthetists: [www.canainc.org](http://www.canainc.org)

California BRN Statement on Practice of the Nurse Anesthetist:  
<http://www.rn.ca.gov/practice/pdf/npr-b-10.pdf>