

General Anesthesia Agents & Procedures

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Learning Objectives:

- Explain the actions, effects and precautions associated with agents used in general anesthesia.
- Describe anesthesia procedures and delivery systems.

Introduction To Anesthesia

Goal of surgical anesthesia

- Achieve lack of sensation with:
 - ◆ Safety
 - ◆ Comfort
 - ◆ Economy
 - ◆ Convenience

Pre-anesthesia procedure

- Preoperative assessment
- Initial cleansing
- Pre-anesthetic medications

Preoperative assessment

- History
 - ◆ cardiopulmonary disease
 - ◆ malignant hyperthermia
- Current conditions
 - ◆ sleep apnea - postoperative risk
 - ◆ coagulopathy
 - ◆ cardiopulmonary disease
 - ◆ infections
 - ◆ renal, hepatic disease
 - ◆ diabetes

Preoperative assessment

- **Current medications**
 - ◆ cardiac medications
 - ◆ anticoagulants
 - ◆ herbals & nutritional supplements
- **Social history - alcohol, tobacco**
- **Physical exam**
 - ◆ cardiopulmonary assessment
 - ◆ evaluate for difficult intubation

FYI - Click for difficult airway evaluation
<http://www.anesth.uiowa.edu/Uploads/LEMONAIRWAYEVAL.htm>

Preoperative assessment

- **Laboratory tests - as indicated**
- **Electrocardiogram (>40 YO)**
- **Cardiac testing; e.g., stress test**
- **Pulmonary function tests??**
- **Radiographs**

FYI - Click for anesthesia risk assessment
<http://www.anesthesiarisk.net/Awaretext.html>

Anesthesia Procedure

- **Induction- initial entry to surgical anesthesia**
- **Maintenance- continuous monitoring and medication**
- **Emergence- resumption of normal CNS function**

Desired effects of general anesthesia

- **Rapid induction**
- **Hypnosis - sleep**
- **Analgesia - lack of pain**
- **Secretion control**
- **Muscle relaxation**
- **Rapid reversal**

Anesthesia stages

- I. **Amnesia**
 - ◆ induction to loss of consciousness
 - ◆ pain sensation intact
- II. **Excitement**
 - ◆ uninhibited response to stimuli
 - ◆ desirable to shorten, bypass this stage

Anesthesia stages

- III. **Surgical anesthesia- planes 1-4**
 - ▲ Gaze central, pupils constricted
 - ▲ Absent somatic & physiologic responses
- IV. **Medullary paralysis (overdose)**
 - ▲ Pupils dilated
 - ▲ Hypotension, circulatory failure

Monitoring during anesthesia

- Vital signs documented every five minutes
- Physical monitoring
 - ◆ pulse
 - ◆ color
 - ◆ chest excursion, breath sounds
 - ◆ reflexes
 - ◆ neuromuscular blockade

Click for information on neuromuscular blockade monitoring
http://www.globalrph.com/neuromuscular.htm#Train_of_four

Monitoring during anesthesia

- Electronic monitoring
 - ◆ Exhaled tidal volume
 - ◆ FIO₂
 - ◆ SPO₂
 - ◆ ETCO₂
 - ◆ ECG
 - ◆ Temperature

Click to see anesthesia monitoring (then, click 'Play')
<http://www.capnography.com/ASA/ASAM.htm>

Monitoring during anesthesia

- Electronic monitoring
 - ◆ Bispectral index (BIS) monitoring - EEG-based monitor for level of consciousness
 - ▶ reduce operative awareness
 - ▶ titrate anesthetic agents

FYI - click for information on BIS monitoring
http://en.wikipedia.org/wiki/Bispectral_index

General Anesthetic Agents

Types of agents for anesthesia

- Pre-anesthetic agents
- Intravenous anesthetics
- Anesthetic gases
- Neuromuscular blockers
- Anticholinesterase agents

Premedications for anesthesia

- Anticholinergics- atropine, rubinol
 - ◆ Reduce vagal response
 - ◆ Reduce pulmonary secretions
 - ◆ Reduce gastric motility
- Analgesics- reduce pain, anxiety
- Tranquilizer (benzodiazepines)- to reduce anxiety
- H₂ antihistamine- to avert emesis

Barbiturate IV Anesthetics

- Rapid-acting
- Short duration
- Agents
 - ◆ Thiopental (pentothol)- previously almost universally used
 - ◆ Suritol NA
 - ◆ Brevital Na

FYI - click for more information on IV anesthetics
<http://anesthesiologyinfo.com/articles/01072002.php>

Non-barbiturate IV Anesthetics

- Etomidate- intubation
 - ◆ rapid-acting
 - ◆ short duration
- Ketamine- intubation
 - ◆ strong analgesia
 - ◆ bronchodilator

Non-barbiturate IV Anesthetics

- Midazolam (Versed)
 - ◆ benzodiazepine
 - ◆ rapid-acting sedative
 - ◆ reversible with flumazenil (Romazicon)

Non-barbiturate IV Anesthetics

- Propofol (Diprivan)- largely replaced thiopental
 - ◆ Hypnotic
 - ◆ Antiemetic
 - ◆ No analgesia
 - ◆ Cardiovascular depression - hypotension
 - ◆ Painful to inject

Anesthetic Gas Kinetics

- Action - probably modify the electrical activity of neurons at a molecular level by modifying functions of ion channels.
- Magnitude of effects are proportional to:
 - ◆ lipid solubility of drug
 - ◆ partial pressure in the brain

Anesthetic Gas Kinetics

- Factors affecting partial pressure
 - ◆ Inspired concentration
 - ◆ Flow rate of anesthetic
 - ◆ Minute volume
 - ▶ increased VE with anesthetic turned on increases uptake
 - ▶ increased VE with anesthetic turned off increases excretion

Anesthetic Gas Kinetics

- Factors affecting partial pressure
 - ◆ Blood gas partition coefficient - rate of exchange of gases between compartments:
 - ▶ alveoli
 - ▶ blood
 - ▶ brain
 - ◆ Tissue perfusion

Inhaled Anesthetics

- Nitrous oxide (N₂O)
 - ◆ weak- used with other medications, gases
 - ◆ safe - does not cause hypotension
 - ◆ adverse effects:
 - ▶ pulmonary hypertension
 - ▶ inhibits hypoxic vasoconstriction
 - ▶ diffuses into ETT cuffs

FYI - link to history of anesthesia
<http://www.mnwelldir.org/docs/history/anesthesia.htm>

Inhaled Anesthetics

- Halogenated volatile liquids
 - ◆ halogen (F, Br) included in molecule
 - ◆ nonflammable
 - ◆ potent- low concentrations as 2nd gas

Inhaled Anesthetics

- Halogenated volatile liquids
 - ◆ adverse effects
 - ▶ hepatotoxicity
 - ▶ nephrotoxicity
 - ▶ CO poisoning - degradation product
 - ▶ congenital anomalies and spontaneous abortions in OR personnel
 - ▶ malignant hyperthermia

Malignant hyperthermia

- A rare life-threatening condition that is triggered by exposure to certain drugs used for general anesthesia
- It also is associated with succinylcholine
- It is genetically predisposed - there is a hyperthermia susceptibility trait

Malignant hyperthermia

- Manifestations
 - ◆ temperature elevation
 - ◆ hypercapnia
 - ◆ tachycardia
 - ◆ tachypnea
 - ◆ hypertension
 - ◆ cardiac dysrhythmias

Malignant hyperthermia

- Manifestations (cont'd)
 - ◆ acidosis
 - ◆ hypoxemia
 - ◆ hyperkalemia
 - ◆ skeletal muscle rigidity
 - ◆ myoglobinuria

Malignant hyperthermia

- Management - operating rooms have malignant hyperthermia boxes
 - ◆ stop administration of triggering agent
 - ◆ dantrolene - muscle relaxant
 - ◆ cooling blanket
 - ◆ fluids

FYI - click to download article on malignant hyperthermia
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1867813/pdf/1750-1172-2-21.pdf>

Adverse effects of general anesthetics

- Depress all components of CNS
- Respiratory depression
- Negative inotropic effects
- Decreased threshold for premature ventricular contractions (PVCs)

Adverse effects of general anesthetics

- Depress all components of CNS
- Respiratory depression
- Negative inotropic effects
- Decreased threshold for premature ventricular contractions (PVCs)
- Peripheral vasodilation (except nitrous oxide)
- Decreased uterine contractions
- Depressed fetal activity ==> hypotonic newborn

Inhaled Anesthetics

- Halogenated volatile liquids
 - ◆ Halothane (Fluothane)
 - ◆ Enflurane (Ethrane)
 - ◆ Isoflurane (Forane)
 - ◆ Desflurane (Suprane)
 - ◆ Sevoflurane (Ultane)
 - ◆ Methoxyflurane (Penthrane)

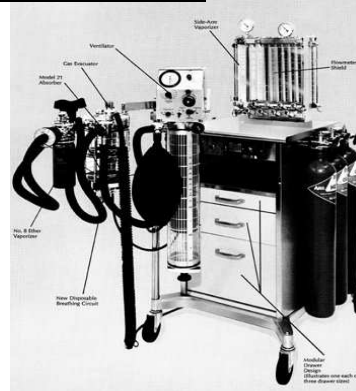
Anesthesia machine

- Ventilator, anesthesia bag
- Gas cylinders- O₂, N₂O
- Precision flowmeters
- Calibrated vaporizer- for liquid anesthetics
- CO₂ absorber
- Rebreathing bag
- Tubing
- Gas scavenging system

Anesthesia machine

Click for virtual anesthesia machine; next, Click educational animations; then, click deliver a virtual anesthetic. Follow menu from there.
<http://www.simanest.org/vfgs3.html>

Anesthesia machine



Anesthesia machine

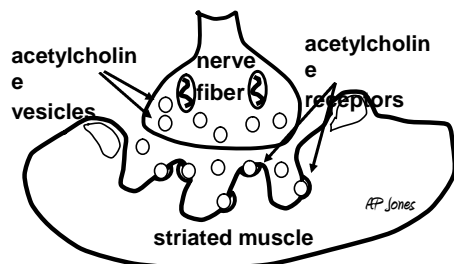
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Neuromuscular Blocking Agents

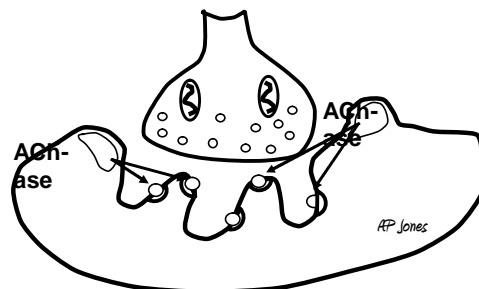
Neuromuscular junction

Nerve stimulation ==> ACh secretion ==> binds to ACh receptor ==> contraction



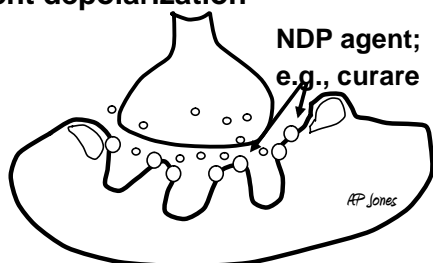
Neuromuscular junction

ACh-ase secreted ==> ACh hydrolyzed ==> muscular relaxation

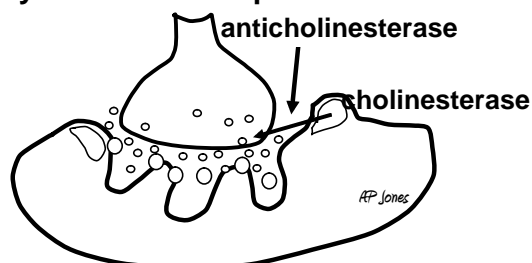


Action of non-depolarizing agents (curariform)

Occupy Ach receptor sites ==> prevent depolarization



Reversal of non-depolarizing agents
 anticholinesterase hydrolyzes
 cholinesterase ==> increase
 acetylcholine ==> depolarization



Indications for neuromuscular blockers

- Muscular relaxation for:
 - ◆ intubation
 - ◆ surgical procedures
- Controlled ventilation; e.g.,
 - ◆ oscillators
 - ◆ inverse ratio ventilation
 - ◆ independent lung ventilation
 - ◆ increased intracranial pressure

Neuromuscular blockers - history

- Amazon natives
 - ◆ curare, Tubocurarine
 - ◆ poison for blowgun darts
 - ◆ potency - trees monkeys could climb

Non-depolarizing agents

- Adverse effects
 - ◆ histamine release ==>
 - ▶ flushing
 - ▶ bronchospasm
 - ▶ anaphylaxis

FYI - click for video of flushing
http://www.youtube.com/watch?v=WofFb_eOxxA

Non-depolarizing agents

- Side effects
 - ◆ histamine release ==>
 - ▶ flushing
 - ▶ bronchospasm
 - ▶ anaphylaxis
 - ◆ vagolysis ==> tachycardia, hypertension
 - ◆ hypoventilation, apnea
 - ◆ aspiration

Non-depolarizing agents

- **Contraindications**
 - ◆ myasthenia gravis
 - ◆ asthma
 - ◆ electrolyte disturbance
- **Interaction- potentiated by**
 - ◆ aminoglycosides; e.g., gentamycin
 - ◆ tetracyclines

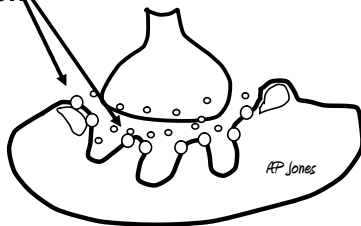
Specific NDP agents

- Tubocurarine Cl- prototype agent
- Pancuronium Br (Pavulon) - long acting
- Atracurium besylate (Tracrium)
- Vecuronium Br (Norcuron)
- Doxacurium (Nuromax)
- Cisatracium (Nimbex)
- Rocuronium (Zemuron)

FYI - Link to properties of specific NDP agents
http://en.wikipedia.org/wiki/Neuromuscular-blocking_drugs

Depolarizing agent (succinylcholine)

Drug attaches to Ach receptor ==> depolarizes muscle ==> inhibits repolarization

**Succinylcholine**

- **Very short-acting**
- **Not reversible with drugs**
- **Pseudocholinesterase deficiency ==> slow hydrolysis of agent ==> prolonged action**

Succinylcholine

- **Side effects**
 - ◆ fasciculation ==> muscle soreness
 - ◆ hyperkalemia
 - ◆ increased ocular pressure
 - ◆ increased intracranial pressure
 - ◆ malignant hyperthermia

Succinylcholine (Anectine, Sucostrin)

- **Onset.....1 min**
- **Duration.....4-6 min**
- **Perfect for intubations**

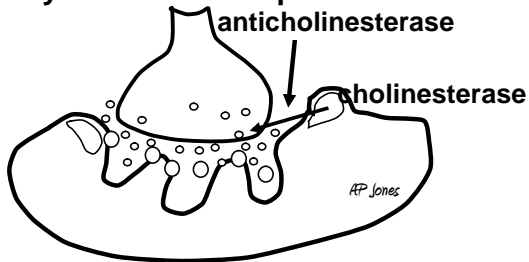
Anticholinesterase Agents

Anticholinesterase agents

- Action- inhibit ACh-ase ==> increase ACh at NM junction ==> permit depolarization
- Indications
 - ◆ reverse curariform paralysis
 - ◆ diagnose and treat myasthenia gravis

Reversal of non-depolarizing agents

anticholinesterase hydrolyzes cholinesterase ==> increase acetylcholine ==> depolarization



Anticholinesterase agents

- Side effects- increase acetylcholine at muscarinic receptors ==> cholinergic crisis
 - ◆ bradycardia
 - ◆ secretion
 - ◆ bronchospasm
- Cholinergic crisis treated with atropine

Anticholinesterase agents

Edrophonium CI (Tensilon)

Onset < 1 min

Duration 2-10 min

Routes IV, IM

Indications Reverse NDPs, diagnose MG (Tensilon test)

Click for video of positive Tensilon test
<http://www.youtube.com/watch?v=k7YX9kuWrxA>

Anticholinesterase agents

Agents for myasthenia gravis:

- ◆ Pyridostigmine (Mestinon)
- ◆ Ambenonium CI (Mytelase)
- ◆ Neostigmine (Prostigmin)

Summary & Review

- Preoperative evaluation
- Balanced anesthesia- for safety, comfort and convenience.
- Four stages of anesthesia
- Intraoperative monitoring

Summary & Review

- Pre-anesthetic medications
- Intravenous general anesthetics
- Inhaled general anesthetics
- Anesthesia machine
- Neuromuscular blockers- NDP & DP
- Anticholinesterase agents

END

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