

## Vesalius SCALpel™ : Anesthesia

### Risk

ASA (American Society of Anesthesiologists) physiologic status grading

I no systemic disease

II mild/moderate, controlled

III severe, poorly controlled (eg insulin dependent diabetes)

IV life-threatening (eg intubated, end stage renal disease, class IV heart failure)

V moribund

VI organ donor

subheading E = emergency

8w pre-op smoking cessation necessary for benefit

ACC/AHA clinical evaluation for non-cardiac surgery

major risk (need cardiology consult):

unstable coronary syndrome: recent MI with ischemic risk

unstable/severe angina

decompensated CHF

significant arrhythmia

AV block

symptomatic ventricular arrhythmia

supraventricular arrhythmia with uncontrolled ventricular rate

severe valve disease

dobutamine provocative stress test to further stratify cardiac risk

intermediate

mild angina, hx MI (4-6w post MI, base on risk stratification)

compensated/history of CHF

diabetes

renal disease

minor risk

age

abnormal EKG

non-sinus arrhythmia

low functional capacity

hx stroke, incontrolled hypertension

surgical risk factors

high risk/5% risk of MI

emergency major surgery in elderly

long procedure

large fluid shifts and/or major blood loss

peripheral vascular procedures

intermediate/< 5%

carotid endarterectomy

head and neck surgery

intraperitoneal/thoracic  
orthopedic  
prostate  
low risk/ < 1%  
endoscopy  
superficial  
cataract  
breast

### **Beta blockade pre/periop**

decreases heart rate, ischemia  
selective beta 1 block less bronchoconstriction  
target heart rate 55-70  
contraindicated with hi-grade conduction disease, AS, low ejection fraction  
bradycardia most common adverse event  
calcium channel blockers, NTG do not have same protective effect  
AF w rapid vent response: beta block or Ca channel block  
(SVT adenosine)

### **Preemptive local anesthesia:**

prevent afferent pain excitation of CNS  
dramatic change post-op pain profile  
port site benefit, no benefit intraperitoneal  
all local anesthetics block Na currents in nerve fibers  
lidocaine  
onset 2m  
1% (10mg/cc), 3-5mg (0.5cc)/kg (7 with epi), 300mg max, redose 2h  
no epi in digits, penis, nose, ears: risk of ischemia  
IV for ventricular arrhythmias  
side effects: bradycardia, decreased contractility, A-V block, ventricular arrhythmia,  
arrest, decreased respirations (respiratory acidosis, hypoxia), vasovagal, metallic  
taste, tremor, seizure  
marcaine/bupivacaine  
onset 5m, duration 2-4h, 2.5mg (1cc)/kg (max) of 0.25%, (3 w epi)  
seizure, heart block, myocardial depression (more cardiotoxic than lidocaine)  
local anesthetic CNS toxicity  
dose dependent  
tinnitus, dizziness, numbness tongue, circumoral, muscle twitch, visual disturbance,  
seizure, unconsciousness, coma  
respiratory acidosis enhances CNS drug level, exacerbates seizure threshold  
benzodiazepines increase CNS neuronal discharge threshold, protect against seizure  
Rx: supportive measures, ABCs, assist ventilation w O<sub>2</sub>  
atropine for bradycardia, ephedrine for hypotension

## Epidural

avoids higher dose narcotics, less GI dysfunction, mental status changes  
useful in chest trauma, chest surgery, ileus, pancreatitis, intractable angina  
contraindications: coagulopathy, bacteremia/sepsis (fever, elevated WBC alone not  
contraindication), local infection, hypovolemia, hemodynamic instability, cord  
hematoma/compression  
epidural block sympathetic 2 levels above sensation, high (T3) causes bradycardia

## Sedatives/benzodiazepines

diazepam: several active metabolites, mild sedative and amnestic  
effects far beyond half life  
medazolam/versed: rapid onset, short duration (5-10m), few metabolites, incremental dose  
CNS depression, suppress seizures  
only benzodiazepine that can be used as infusion (the rest IV push)  
lorazepam/ativan: slower onset, less prolonged effect, long term ICU sedation  
flumazenil/romazicon: reverse sedative and psychomotor effects of benzodiazepines  
little effect on respiratory depression

## Total intravenous anesthesia (TIVA)

propofol/dexmedetomidine: sedative/hypnotic for induction and maintenance  
extremely short half life, effects stop almost immediately after IV stopped  
dexmedetomidine: little respiratory depression, rare allergic reaction  
propofol: causes respiratory depression  
ideal transition from long-term sedation in preparation for extubation  
less post-op nausea and vomiting than inhalational  
IV Rx for post-op N/V  
dose-related hypotension, more in elderly (16-30% decrease MAP 1<sup>st</sup> 10m)  
peripheral vasodilatation, myocardial depression  
bradycardia 4% with opioids or long term beta blockers  
transient, moderated by slow administration  
caution with movement disorders (Parkinson's)  
propofol infusion syndrome:  
children, pts w acute neurologic illness, sepsis susceptible  
rare, with prolonged hi dose  
systemic cytokine catechol and glucocorticoid activation  
cardiac and peripheral neuromuscular dysfunction  
rapid, marked bradycardia to asystole  
rhabdomyolysis, renal failure  
limit dose to 5mg/kg/h, less than 48h  
etomidate: minimal cardiovascular effects v other rapid onset induction agents  
ketamine  
IV rapid dissociative state, useful for induction  
sympathetic effect: 25% increase BP, tachycardia

- bronchodilatation
- myocardial depression
- contraindicated in head injury: increased cerebral blood flow and O<sub>2</sub> consumption and metabolic rate
  - contraindicated with increased ICP
- with max adrenergic tone in traumatic hypovolemia, ketamine can drop BP
- halucinogen, emergence delirium
- droperidol/inapsine
  - neuroleptic, antiemetic, antianxiety
  - contraindications: prolonged Q-T (enhances), not used with other CNS depressants
- methohexital & thiopental
  - significant cardiovascular depression
- opoids
  - demerol poor choice: metabolite normeperidine causes convulsions
    - long half life
    - lowers seizure threshold
    - cumulative after multiple doses, esp with renal failure
    - occasional use to decrease shivering
    - contraindicated with MAO inhibitors
  - morphine
    - 1-2h half life
    - IV .08-.12mg/kg over 10-15m loading dose
    - maintenance 4-6mg/h
    - affects central and peripheral mu, kappa and delta receptors
    - arteriolar and venous dilatation (release of histamine from mast and other cells)
    - increases venous capacitance > arterial, relieve CHF
    - least lipophilic of opoids, slow onset, long duration
    - more effective than fentanyl and demerol which are lipid soluble and rapidly absorbed
    - more rostral spread in epidural, spinal
    - no incompatibility with local
    - cirrhosis, renal disease prolong half life
    - MS & phenothiazine can ppt pheo crisis
  - fentanyl/sublimaze: does not release histamine, choice in pts with bronchospasm
    - rapid onset and clearance, decreased nausea and vomiting
  - addiction: compulsive maladaptive behavior
  - naloxone/narcan: reverses opioid sedation and respiratory depression
  - tolerance: need for increasing doses, can occur without dependence
  - dependence: withdrawal symptoms (after tolerance develops)

## MAC

- minimal alveolar concentration of anesthesia at 1 atm. that prevents movement in 50% of pts in responsive to pain
- threshold increased by chronic alcohol abuse, hyperthermia, cocaine
- threshold decreased by hypoxia, acute intoxication, hypothermia

beta blockade makes hard to evaluate

## Muscle relaxants

both kinds of muscle relaxants most common OR cause of anaphylactic reaction (latex 2<sup>nd</sup>)  
signs of anaphylaxis: bronchospasm, angioedema, cardiovascular collapse  
(antibiotics, contrast most common causes of anaphylaxis outside OR)

### depolarizing

succinyl choline (1mg/kg): 2 Ach molecules linked end to end

mimics acetylcholine

only depolarizing agent still in use

short-acting depolarization at myoneural junction

fasciculation

irreversible

5-7m return of spontaneous respiration

side effects: bradycardia, hypotension, dysrhythmias, hyperkalemia, myalgia,  
increased intracranial pressure, malignant hyperthermia

increases K by 1mEq within minutes, can be profound with burns and maj trauma

contraindicated in ophthalmologic surgery (increased intraocular pressure) and closed  
head injury (increases intracranial pressure)

para/quadrilegics and burns have upregulated muscle endplate receptors: standard  
dose of succ can cause massive depolarization, acute life-threatening  
hyperkalemia

contraindicated in end-stage liver disease (impaired metabolism prolongs duration),  
renal insufficiency (decreased excretion) make pt susceptible to rapid changes  
in K, arrhythmias

### non-depolarizing

longer onset than succ

competitive inhibition of Ach

reversed by acetylcholinesterase inhibitors

short acting: mivacurium (histamine release)

intermediate: rocuronium, cisatracurium, vecuronium

usual agents for intubation

effects last 30-45m

long acting: pavulon, curare

neostigmine: anticholinesterase, decreased breakdown of ach, reverse block

## General anesthesia

loss of consciousness

shorter acting agents are less lipid-soluble

isoflurane, desflurane, sevoflurane (less airway irritation)

N<sub>2</sub>O decreases necessary dose of second agent decreasing toxicity and facilitating  
emergence

contraindications: small bowel obstruction, pneumothorax

diffuses into closed spaces faster than N diffuses out  
halothane and enflurane replaced by newer agents with less side effects  
halothane sensitizes myocardium to catechols, rare fulminant hepatitis (middle aged obese women)  
enflurane: nephrotoxic fluoride ion, brain toxicity, seizure

### **Pneumoperitoneum/laparoscopic surgery**

increase mean arterial pressure (sympathetic response), systemic vascular resistance, afterload, decrease cardiac filling (decreased cardiac index), tachycardia  
CO<sub>2</sub> hypercarbia, increased ETCO<sub>2</sub> : increase minute ventilation  
air or CO<sub>2</sub> embolus put pt in left lateral decubitus  
bone is the largest CO<sub>2</sub> reservoir  
rapid pneumoperitoneum can cause vasovagal effect: atropine  
increased pressure causes decreased femoral venous flow, decreased renal flow and GFR  
IVC flow is not affected until pressure of 20mm  
reverse Trendelenberg: decreased venous return decreases cardiac output  
load pts with fluid (1-2L) to prevent asystole (especially obese)  
effects accentuated with beta blockade, ace inhibitors, renin-angiotensin block  
CO<sub>2</sub> absorption increases cerebral blood flow, cerebral pressure (risk in head injury)  
lung: FRC & compliance decreased  
heat does not trigger visceral pain  
intraperitoneal local little effect, beneficial @ port sites

### **Malignant hyperthermia**

autosomal dominant, several mutations  
muscle membrane disorder  
ryanodine receptor (calcium release channel) abnormality  
abnormal function of calcium release channel in sarcoplasmic reticulum  
massive build-up of calcium in myoplasm  
succinylcholine: generalized skeletal muscle contraction  
potent halogenated inhalational agents trigger: halothane, isoflurane, desflurane, devoflurane  
change integrity of myolemma  
other triggers: infectious disease, neuroleptics, severe exercise in heat  
not triggered by local or spinal, propofol or narcotics  
manifestations:  
early sign masseter contraction  
abrupt increase end tidal CO<sub>2</sub>, hot anesthesia cannister early  
signs in order of occurrence: increased ET CO<sub>2</sub>, then tachycardia, then PVCs  
violent sustained muscle contraction  
unexpected cardiac arrest or arrhythmia (PVCs) after induction (increased Ca<sup>++</sup>, K<sup>+</sup>)  
increased temp, arrhythmia (tachycardia), acidosis, muscle rigidity, increase creatinine kinase, myoglobinuria

mixed respiratory and metabolic acidosis  
similar to heat stroke, neuroleptic malignant syndrome  
confirm with muscle biopsy, caffeine-halothane contraction test  
aggressive Rx with dantrolene, reduces mortality from 70-5%  
1-2mg/kg doses IV push repeated up to total 10mg/kg  
dantrolene causes muscle relaxation beyond the myoneural junction, possibly  
interfering with the release of  $Ca^{++}$  from the sarcoplasmic reticulum  
dantrolene causes muscle weakness, GI upset  
aggressive cooling  
pretreat with dantrolene if suspect

### **Antiemetics**

ondansteron: serotonin receptor antagonist, non-sedating, few side effects  
droperidol/butyrophenone: effective, cheap; Torsades, Q-T prolongation, need EKG  
monitor, anxiety  
metoclopramide/reglan: limited prophylactic antiemetic, short half life, contraindicated in  
Parkinsons (acts on dopamine receptors)  
promethazine: very sedating, effective

### **Hypothermia**

shivering leads to increased  $O_2$  consumption  
L shift oxyhemoglobin dissociation curve  
inhibits coagulation

### **Latex allergy**

immediate massive vasodilation, bronchoconstriction  
Rx: IV epi, steroid, antihistamine, D/C anesthesia, large volume resuscitation

**Aspiration:** lung injury pH < 2.5, volume > 0.5cc/kg  
no food or cloudy drink 6-8h pre-op  
no water 2h pre-op

### **pulse ox**

measures only on pulsatile flow  
NTG causes metHb  
CO poisoning: need to measure direct arterial  $O_2$  saturation