Preadmit Holding Area

Talk to patient
Check name band (identifier)
Check consents - ALWAYS - before sedation
Check if patient is marked
Check with holding are RN if patient is ready to go
Running IV?
Give pre-op sedation

Pre-op Sedation

Only give once consent is confirmed to have been signed

Midazolam	Administered by TBW because of an increased central volume of distribution. Just about all books seem to agree with this. Dosing in this way will prolong the elimination half-life and its duration of effect. In practice, it may cause over sedation in the obese pts who is sensitive to respiratory depressant drugs	
	TBW = total body weight (obese patients could overdose due to larger body weight and thus larger dose)	
	MOA	GABA-A Agonist
		change frequency of channel opening - neuronal hyperpolarization
		most GABA-A agonists increase channel open time, benzos increase open frequency
	Onset	30-60 seconds
	Duration	20-60 min
	Clearance	Liver
	Active Metabolite	1-hydroxymidazolam
	Sedation dose	IV 0.01-0.1 mg/kg

Pre-op Sedation (cont)

Respiratory Effects	minimal but synergistic respiratory depression when combined with other sedatives
CV Effects	minimal
CNS Effects	anterograde amnesia, anticonvulsant properties, anxiolysis, antispasmodic effects *No analgesia*
	~anti spasmodic effects good for spinally mediated skeletal muscle relaxation (useful in CP patients)

Proceed to Operating Room

Transport patient to OR via stretcher or amulation	
Move patient to OR table and **ensure safety strap is secured**	usually placed across thighs 2 inches above the knees over the cover
	arms secured on padded arm boards or tucked
Apply Monitors	record vital signs *at least* every 5 minutes
	-EKG
	-BP
	-Pulse Ox
	-Capnography
	-Temperature

Preoxygenation aka Denitrogenation

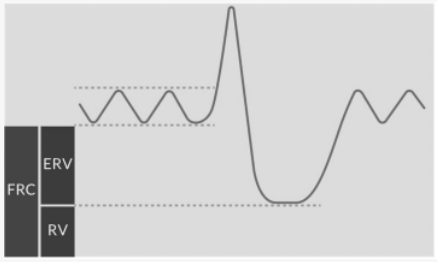
o 1948: Fowler and Comroe demonstrated that inhalation of 100% oxygen (O2) resulted in a very rapid increase of arterial oxyhemoglobin saturation (Sao2) to between 98% and 99%, but that attainment of the last 1% to 2% was a much slower process
o 1950s: Rapid Sequence Induction (RSI) began being utilized in patients at risk for aspiration of gastric contents, preoxygenation became a component of the technique

Preoxygenation extends periods of **safe apnea**

Preoxygenation aka Denitrogenation (cont)

	• defined as the time until a patient reaches a saturation level of 88% - 90%, to allow for the placement of a definitive airway.
	👇 Below this level, oxygen saturation can decrease to critical levels <70% within moments.
Goals of preoxy-genation	👇 Achieve 100% oxygenation saturation prior to procedure
	👇 Denitrogenate the residual capacity of the lungs, maximizing oxygen storage
	👇 Denitrogenate and maximally oxygenate the bloods-tream.
Preoxy-genation techniques	o Tidal volume breathing with 100% O2 for 3-5 minutes
	o 8 deep breaths of 100% O2 for 60 seconds
	o Sit up or reverse Trendelenburg to increase FRC
Nasal oxygen @ 15L during intubation	👇 Preoxygenation and apneic oxygenation are partic-ularly beneficial if manual ventilation after induction of anesthesia is undesirable (eg during rapid sequence induction and intubation RSI), if difficulty with airway management is anticipated and for pts who are expected to desat rapidly
	• Obese • Pregnant • Pediatric • Hypermetabolic pts

FRC Measurement



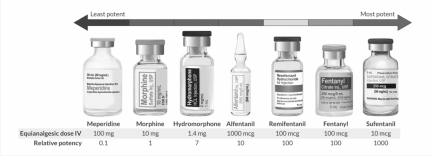
Functional Residual Capacity

FRC	Volume of air in lungs at end of expiration
	o FRC is the reservoir of oxygen that prevents hypoxemia during apnea
	o Diaphragmatic tone and position *also* effect FRC
	o FRC cannot be measured with spirometry because the residual volume cannot be exhaled and RV is a component of FRC
Static equilibrium	*At FRC* the inward elastic recoil of the lungs is balanced by the outward elastic recoil of the chest wall
Normal FRC	35 ml/kg
Indirect FRC measur-ement	Nitrogen washout
	Helium wash in
	Body plethysmography
How will FRC last during apnea?	o We can estimate how long a pt can remain apneic before desaturation if we know the patients FRC and oxygen consumption (VO2)
	o Healthy adult breathing 100% O2 takes 6.9 minutes to desaturate to 90% on pulse oximetry **👇 1 minute if the patient was breathing room air**
Desat formula	time until patient desats = FRC/VO2

Functional Residual Capacity (cont)

Conditions that decrease FRC	*Obesity* • Decreased chest wall compliance • Increased airway collapsibility
	Pregnancy • Diaphragm shifts cephalad due to gravid uterus • First give O2!!! • Decreased chest wall compliance
	Neonates • Less alveoli • Decreased lung compliance • Cartilaginous ribcage prone to collapse during inspiration
Postions that affect FRC	*Decrease* • Supine • Trendelenburg • Lithotomy
	Increase • Prone • Sitting • Lateral- unchanged or increase

Opioid Potency



Opioid Potency Least potent (left) Most Potent (Right)
Meperidine 100mg / 0.1 RP
Morphine 10mg / 1
Hydromorphone 1.4m / 7
Alfentanil 1000mcg / 10
Remifentanil 100mg / 100
Fentanyl 100mcg / 100
Sufentanil 10mcg / 1000

IV Induction Agents - General Anesthesia

Opioids - Fentanyl	**MOA**	mu receptor agonist
	Onset	5 min
	Duration	20-30 min
	Active Metabolite	CYP3A4 (P450)

IV Induction Agents - General Anesthesia (cont)

	Clearance	Liver
	Dosing	*IV* 1-2 mcg/kg *induction* 10 mcg/kg (watch for chest wall or glottis rigidity)
	Resp Effects	respiratory depression
	CV Effects	bradycardia, vasodilation
	CNS Effects	analgesia, N/V
Amine - Lidocaine	**MOA**	**o Local anesthetics bind to alpha-subunit on inside of sodium channel** o When critical number of sodium channels are blocked cell can't be depolarized and action potential cant be propagated
	Adverse Effects	*Mild CNS-related symptoms* • Drowsiness • dizziness • metallic taste • Headache • blurred vision • paresthesia dysarthria • euphoria • Nausea *Larger doses or if given rapidly* • Tinnitus • Tremor • Agitation • Cardiovascular changes are usually minimal with the usual doses

IV Induction Agents - General Anesthesia (cont)

	Uses	o 5% of patients have pain at propofol injection and of these, 1% of them have severe or excruciating pain 👇 40 mg Lidocaine prevents this 👇 Also can mix Lidocaine and Propofol • Propofol and lidocaine= Magic o Add 1 ml of 1 % or 2% lidocaine to a 10 ml syringe of propofol 👇 Place the IV in an antecubital vein (vs the hand). 👇 Pretreat with IV opioids. 👇 If the IV is in the hand, place a tourniquet proximally and pretreat with lidocaine
Propofol most common induction agent	**MOA**	GABA-A agonist (how long the channel stays open) 👇 GABA-A receptor stimulation hyperpolarizes neurons by increasing Cl- conductance. More Cl- inside the cell makes the cell more negative. This reduces resting membrane potential (RMP moves further away from TP)
	Onset	30-60 seconds
	Duration	5-10 min
	Clearance	Liver and extra hepatic metabolism

IV Induction Agents - General Anesthesia (cont)

	Active Metabolite	None
	Induction dose	1.5-2.5 mg/kg IV
	Maintenance dose	25-200 mcg/kg/min
	Resp Effects	decreased resp drive
	CV Effects	decreased BP, SVR, preload, contractility
	CNS Effects	decreased ICP and IOP, no analgesia, +/- seizure activity
Etomidate	**MOA**	GABA-A agonist
	Onset	30-60 seconds
	Duration	5-15 min
	Clearance	Liver & plasma esterases
	Active Metabolite	None
	Induction dose	0.2-0.4 mg/kg IV
	Resp Effects	Mild Resp Depression
	CV Effects	Minimal
	CNS Effects	Decreased ICP, no analgesia

IV Induction Agents - General Anesthesia (cont)

	Side Effects	o Myoclonus (not a seizure) o Does not cause seizures if the patient does not have a history of seizures o Suppression of adrenocortical function for up to 24 hrs. It should be avoided in sepsis and acute adrenal failure o N&V (greater than any other induction agent) o Acute intermittent porphyria
Ketamine	**MOA**	NMDA antagonist (creates dissociated state)
	MOA secondary	Many 2nd receptor targets including opioid, MAO, serotonin, NE, muscarinic, and NA channels
	Onset IV	30-60 seconds
	Onset IM	2-4 minutes
	Onset PO	variable
	Duration	10-20 minutes (can last 60-90 min to return to full orientation)
	Clearance	Liver
	Active Metabolite	Norketamine
	Induction Doses	IV 1-2 mg/kg IM 4-8 mg/kg PO 10mg/kg
	Opioid Sparing Dose	0.1-0.5 mg/kg or 1-3 mcg/kg/min

IV Induction Agents - General Anesthesia (cont)

Resp Effects	maintains resp drive, increased oral secretions (DROOL EVERYWHERE, GIVE GLYCO)
CV Effects	Increased SNS tone, SVR, HR, and CO
CNS Effects	Increased ICP, IOP, nystagmus and analgesia causes emergence delirium and lowers seizure threshold, can also treat severe depression

Food Allergies & Propofol

Overseen by the American Academy of Allergy, Asthma and Immunology. They state:	o Propofol can cause anaphylactic reactions, the cause of these reactions is unclear and appears not to be related to soy or egg allergy.
o Egg allergy	👇 Patients with soy, peanut allergy or egg allergy can receive propofol without any special precautions. – Probably safe 👇 Most people with egg allergies are allergic to the albumin egg whites. Egg lecithin found in propofol is derived from the YOLK
o Soy	👇 Any soy proteins that are capable of producing an immune response are removed during the refining process 👇 Prop is safe to use in pts with soy allergy

Food Allergies & Propofol (cont)

o Peanut	👎 Like soy peanuts are a type of legume. Some have speculated the potential of cross sensitivity between peanuts and soy (and thus propofol) although there is no evidence to support this 👎 Prop is safe to use in pts with a peanut allergy
o Increased Risk of Bacterial Contamination	👎 Propofol syringes must be discarded within 6 hrs 👎 Infusions (and the tubing) must be discarded within 12 hrs

LBW vs TBW

TBW	Total body weight **Maintenence**
	• Weight when individual steps on scale
IBW	Describes the BMI associated with the lowest risk of body weight related comorbidities. We can estimate the ideal body weight with the following formulas:
	o Men (kg)= height (cm) – 100 o Women (Kg)= Height (cm) - 105
LBW	Lean body weight
	👎 LBW = 1.3 X IBW

Drug	Dose	Recommendation
Propofol	Induction Maintenance	LBW TBW
Succinylcholine	Intubation	TBW
Rocuronium Vecuronium	Intubation Maintenance	LBW LBW
Cisatracurium Atracurium	Intubation Maintenance	TBW TBWvsLBW

LBW vs TBW (cont)

Fentanyl ((nl))Sufentanil	Loading Maintenance	TBW LBW
Remifentanil	Loading Maintenance	LBW LBW
Midazolam	Loading (not preop) Maintenance	TBW TBW
Epidural Local		75% of normal dose

Guedel's Stages of Anesthesia

Stage 1 - Analgesia or Disorientation	o Can be initiated in a preoperative holding area o Patient is given medication and may begin to feel its effects but has not yet become unconscious
o Induction stage	👎 Patients are sedated but conversational 👎 Breathing is slow and regular 👎 Patient progresses from analgesia free of amnesia to analgesia with concurrent amnesia 👎 This stage comes to an end with the loss of consciousness.

Guedel's Stages of Anesthesia (cont)	
o Loss of Consciousness	👇 Count backwards from 100, the patient typically loses consciousness between 80 to 90, i.e. stops counting – the old way 👇 Blinking increases, and nystagmus may appear 👇 Eyes eventually fix in the midline as the lids close • GENTLE 👇 Patient becomes unresponsive, atonic, apneic, and the oculocephalic (or more precisely vestibular-oculocephalic) and corneal reflexes are lost 👇 Call patients name 👇 Eyelash reflex 👇 Tape eyes- as soon as you lose consciousness • If you struggle to ventilate they you could hurt their eyes • Not on sedation cases • Don't tape in endo watch the L eye
o Eye Protection after Loss of Consciousness	👇 Tape eyes horizontally after loss of consciousness 👇 Eyes should be protected before instrumenting the air way

Guedel's Stages of Anesthesia (cont)	
Stage 2 - Excitement	o There is a higher risk of laryngospasm (involuntary tonic closure of vocal cords) at this stage, which may be aggravated by any airway manipulation o The combination of spastic movements, vomiting, and rapid, irregular respirations can compromise the patient's airway.] o Fast-acting agents help reduce the time spent in stage 2 as much as possible and facilitate entry to stage 3. o NEVER EXTUBATE AT THIS TIME
	o If you are using gas induction no muscle relaxation- you can really see this 👇 Its really short with IV induction 👇 FOR KIDS • Laryngospasm • Don't touch them too soon
Stage 3 - Deep	o *Surgical Anesthesia targeted anesthetic level for procedures requiring general anesthesia* o Ceased eye movements and respiratory depression are the hallmarks of this stage. o Airway manipulation is safe at this level
	4 planes in stage

Guedel's Stages of Anesthesia (cont)

Plane 1, there is still regular spontaneous breathing, constricted pupils, and central gaze
• eyelid, conjunctival, and swallow reflexes usually disappear in this plane
• Just gazing

Plane 2, there are intermittent cessations of respiration along with the loss of corneal and laryngeal reflexes. Halted ocular movements and increased lacrimation may also occur.

Plane 3 is marked by complete relaxation of the intercostal and abdominal muscles and loss of the pupillary light reflex. This plane is referred to as "true surgical anesthesia" because it is ideal for most surgeries.

Plane 4 is marked by irregular respiration, paradoxical rib cage movement, and full diaphragm paralysis resulting in apnea.

Mask Ventilation

One hand	o C o E o If you are struggling put in oral airway
Two hands	o Get it less than 20 o Two people approach
Non- Invasive Airway Maneuvers	• Chin lift • Not usually in induction • Jaw Thrust

Mask Ventilation (cont)

Placement of LMA if unable to ventilate	• LMA • Difficult supraglottic airway placement o Restricted mouth opening o Obstruction o Distorted airway o Stiff lungs or C spine
Upper Airway Patency	• Pharynx • Collapsible tube inside box • Box is formed: o Tongue o Soft palate o Pharyngeal tissue o Cervical spine
During inspiration a negative gradient draws air into lungs	• Tendency to make airway collapse • In awake state o Counteracted by three sets of dilator muscle
If able to ventilate give muscle Relaxant	• Upper airway consists of the cartilaginous and bony structures of the nose and mouth, followed by the soft tissue of the oropharynx and laryngopharynx, and ending in the rigid trachea • Soft tissue of the pharynx is prone to collapse in the unconscious, or anesthetized, patient and may be further compromised by obesity, a large tongue, airway edema, large neck circumference, external compression, and many other factors

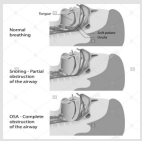
Mask Ventilation (cont)

Controversy

- When placing an endotracheal tube after induction o Historically been instructed to refrain from administering muscle relaxation until adequate mask ventilation in the anesthetized patient was confirmed in order to both avoid
  - Critical hypoxemic event
  - Ensure an attempt at an escape wake up.
- o There is little published evidence to support this practice, and the administration of muscle relaxation before ensuring adequate BVM ventilation remains controversial
- o Neuromuscular Blockade and the Airway
  - Regarding Mask Ventilate- There is evidence that paralysis of the upper airway musculature improves ability to ventilate
  - A recent study published data indicating that NMB using rocuronium facilitated bag-mask ventilation in anesthetized patients

Oral Airways

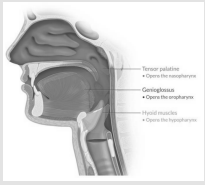
Airway Obstruction



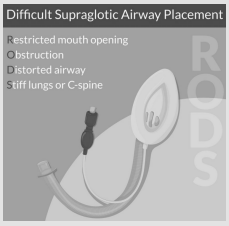
Difficult Ventilation Mnemonic

Ventilate Patient with mask after loss of consciousness

Upper Airway Patency



Mneumonic for Difficult LMA Placement



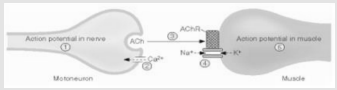
Why Neuromuscular Blockades (NMB)?

• They allow for easy airway and operative field manipu-lation	o Good for specific types of surgery o No single agent is ideal for every situation
• What is the Neurom-uscular Junction? (NMJ)	o The neuromuscular junction is a synapse that develops between a motor neuron and a muscle fiber o Made up of several components: the presynaptic nerve terminal, the postsynaptic muscle membrane, and the intervening cleft (or gap) o End Plate Acetylcholine is hydrolyzed rapidly by the enzyme acetylcholinesterase in the synaptic cleft Not all acetylcholine that is released reaches the endplate, some is hydrolyzed en route.

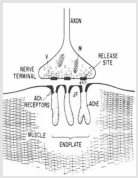
Why Neuromuscular Blockades (NMB)? (cont)

• Muscle Relaxants	o Disrupts the physiological sequence of neuromuscular transmission. o Provides NO ANALGESIA or AMNESIA o Used to optimize surgical condition and facilitate intubations. o Mechanism of action occurs at the neuromuscular junction (NMJ) o Post junction nicotinic receptors are composed of five subunits o Lined up circumferentially around ion conducting core o Two alpha subunits

Neuromuscular junction



Muscle Relaxants



End Plate

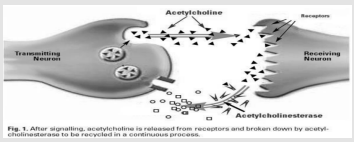
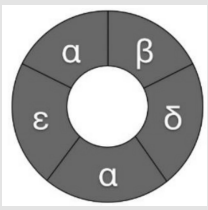


Fig. 1. After signalling, acetylcholine is released from receptors and broken down by acetylcholinesterase to be recycled in a continuous process.

Post Junction Nicotinic Receptors



o Post junction nicotinic receptors are composed of five subunits
o Lined up circumferentially around ion conducting core
o Two alpha subunits

Depolarizing NMB

Succinylcholine chloride (Anectine, Quelicin)	o Depolarizing neuromuscular blockers act as **agonists** at postsynaptic nicotinic acetylcholine receptors and cause prolonged membrane depolarization resulting in neuromuscular blockade.
	• Resemble ACH bind to ACH receptors • generating an action potential ....**depolarization**. • Sodium channels are **open** as a result of depolarization, then **close** in a resting state and muscle relaxation occurs.
	• Ach binds to subunit-allows channel to open -*depolarization occurs* • Depolarizing neuro muscular blockers – Bind to alpha subunits – Cause Channel to remain open- mimics Ach – Prolonged depolarization occurs
	Chemical formula: C14H30N2O4

Depolarizing NMB (cont)

MOA	agonists at postsynaptic nicotinic acetylcholine receptors and cause prolonged membrane depolarization resulting in neuromuscular blockade
Onset	IV 60-90 sec IM 2-3 min
Duration	5 min
Reversal	None
Dose	**IV 0.5-1.5 mg/kg** Ped IV 4-5 mg/kg Laryngospasm: 1-.5 mg/kg/IV or 4-6mg/kg IM
Metabolism	Psuedocholinesterase
Adverse Effects	👎 Hyperkalemia 👎 Malignant Hyperthermia 👎 Apnea

Non-Depolarizing NMB

o NDMR compete with acetylcholine for the active binding sites at the postsynaptic nicotinic acetylcholine receptor

o Resemble ACH enough to **bind to the ACH receptor**, but **fail to activate** the receptor, thus blocking its action (paralyzing the muscle transmission)

o *"The key fits but won't open the door."*

o Competitive Antagonist – compete with ACH

👎 SO THEY CAN BE REVERSED

o The bond is very tight depending upon the drug, it will last from 20 to 90 minutes.

Non-Depolarizing NMB (cont)

o Competitive Antagonist	👎 Two alpha subunits are binding sites for Ach 👎 Sites occupied by nondepolarizing neuro muscular blockers 👎 Cause channel to remain closed 👎 Ion flow to produce depolarization can't occur	
Rocuronium	👎 Rocuronium is the most widely used nondepolarizing relaxant in the United States. 👎 Can be used for rapid sequence induction (RSI) when succinylcholine is contraindicated.	
	MOA	o Resemble ACH enough to bind to the ACH receptor, but fail to activate the receptor, thus blocking its action (paralyzing the muscle transmission) o Competitive Antagonist – compete with ACH
	Onset	1-2 min
	Duration	20-35 min
	Dose	**IV 0.6 - 1.2 mg/kg** Infusion 5-12 mcg/kg/min Pretreatment 5mg *no reconstitution*
	Reversal	Sugammadex Neostigmine (less effective)

Non-Depolarizing NMB (cont)

	Metabolism	some de-acetylation
Vecuronium	**MOA**	
	Onset	3-5 min
	Duration	20-35 min
	Metabolism	Liver
	Dose	**IV: .08 - .12 mg/kg** Infusion: 1-2 mcg/kg/min
		• To shorten the onset time, the priming principle involves the administration of a small dose of rocuronium usually 3 minutes prior to induction • The optimal priming dose which is the largest dose that it is given that will not produce weakness in an awake patient is very small • Priming dose is given prior to succinylcholine rapid sequence induction to decrease the myalgias (5 mg)

Rapid Sequence Induction

Indicators

o Patient at risk for regurgitation and aspiration who require GA History of
o Recent vomiting or recent meal
o Pregnancy
- Over 18 weeks
- Full stomach
- Loose spincter

o Increased intra-abdominal pressure
o Abdominal distension
o Poorly controlled GE reflux
o Decreased level of consciousness
o Gastroparesis
o Bowel Obstruction
- GOP1

Rapid Sequence Induction (cont)

Rapid Sequence Induction Method

o Preoxygenation is critical
o Suction and airway alternatives available
o Use adjuvant drugs to control BP, HR response: midazolam, narcotics, lidocaine, ketamine, etc
o Explain and rehearse use of cricoid pressure with the patient.
o Optimize position of upper airway.
o Identify person to do cricoid pressure
o Apply Cricoid while patient is awake
- Conscious 20N (2 kg)
- If you cant see they are pushing too hard
- Tell them to keep holding pressure until you them to let go

o Propofol 1.5-2.5 mg/kg
o asleep 40N (4 kg) of pressure
o **Succinylcholine 0.5 to 1.5 mg/kg** or **Rocuronium 1.2 mg/kg**
o Loss of consciousness-fasciculations
o Eye Protection
o Intubate
o Hold cricoid until endotracheal tube cuff is inflated and placement is confirmed

Modified Rapid Sequence

o Same steps but with ventilation
o Gentle IPPV (Paw 10-15 cm H2O) with 100% O2 until relaxant has peak effect.
o If you cant see vent until glide scope

General Anesthesia - Inhalation Induction

Indications	Difficult IV access Developmentally delayed adult Pediatrics Potential airway obstruction e.g. epiglottitis Kids or special need, Sevo dilates vein- if you cant get IV
Contraindications	Aspiration risk Active bleeding in airway (risk of cough, laryngospasm)
Inhalation Induction Technique	Prime circuit with anesthesia agent from vaporizer at maximum setting Oxygen at 8L/min Pop off valve open and patient end of circuit occluded. Have patient exhale maximally, then apply face mask to patient and inhale maximally from primed circuit. Expect prompt onset of sleep (60 seconds) followed by transient apnea, then pattern of rapid shallow respirations. They are crying then go dominate Then you put the IV in and tube them Need the pop up valve OPEN

General Anesthesia - Inhalation Induction (cont)

Inhalation Induction Technique #2	Prime circuit with N2O 70%, FGF at 8L/min Pop off valve open and patient end of circuit occluded. When patient is comfortable with situation, begin volatile agent increasing vaporizer setting by 0.5% every 3 or 4 breaths Reassure patient with calm voice encouraging a regular smooth breathing pattern. Use of a deep breathing pattern here may lead to premature onset of apnea with prolonged phase. Expect several minutes to fall asleep. Assist ventilation Don't use N2O if you are trying to get pregnant- spont miscarriage For adults or special needs

General Anesthesia - LMA Induction Sequence

Induction	Pre-Oxygenate Lidocaine Propofol Loss of consciousness Eye protection **Usually don't ventilate** Open mouth insert LMA When you take it out don't deflate cough- all the secretions go right in the airway
Fentanyl LMA	Many anesthesia providers do not give fentanyl on induction Wait for return of spontaneous respiration Others give small dose