

BTR

DIGITALLY

ANNOTATED

— *by* —

Dr Zainab Vora

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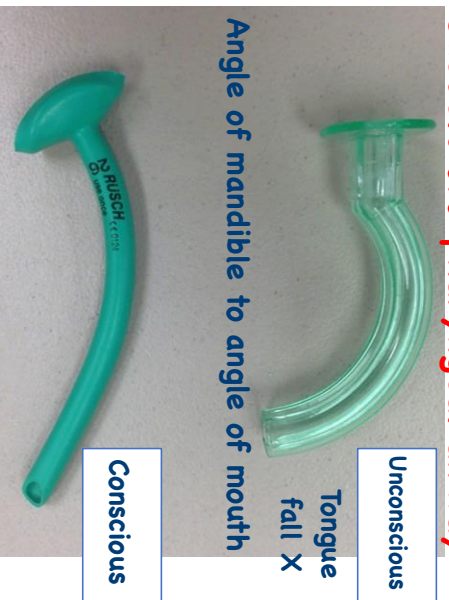
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806

Short Subjects

Anaesthesia

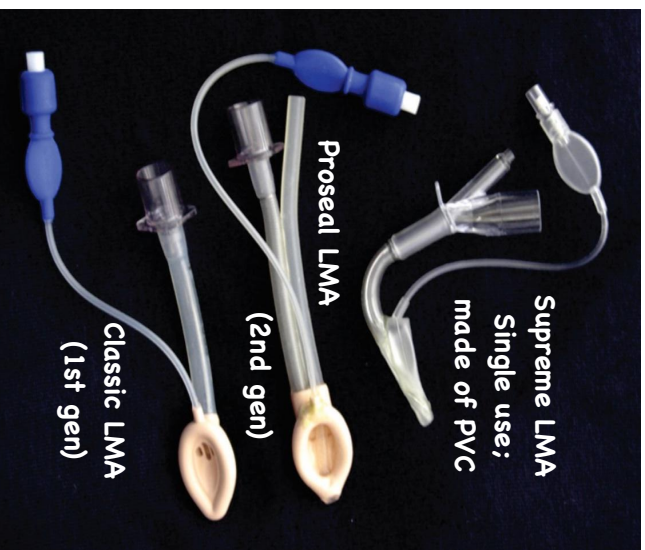
INSTRUMENTS

Guedel's oro-pharyngeal airway



Nasopharyngeal airway

Tip of nose to ear lobule
C/I in base of skull injuries & coagulopathies



SIZE OF LMA	
Child:	3
Female:	4
Male:	5
	3



Intubation & Instruments Needed

Macintosh-Adults



McCoy- Levered blade



Intubation Blades

Miller's- Child

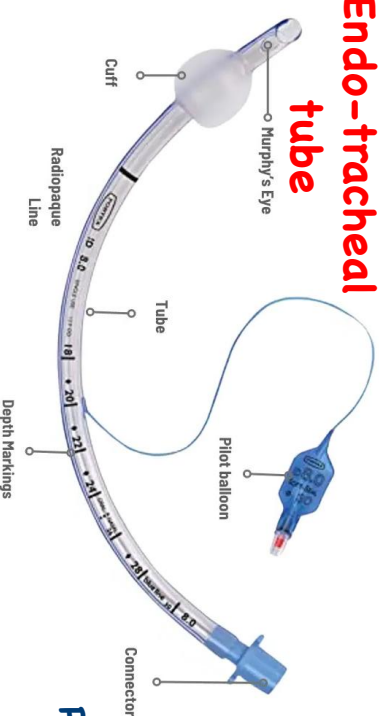


C-Mac Video laryngoscope

- ▶ Preterm- 0
- ▶ Term- 1
- ▶ Children- 2
- ▶ Female- 3
- ▶ Male- 4

- ▶ Hand: Left sided
- ▶ Insert: Right side of mouth
- ▶ Pressure: Forwards & upwards
- ▶ MC injury: Upper central incisions
- ▶ BURP: Backward-Upward-Rightward

Endo-tracheal tube



$$R a \frac{1}{r^4}$$

- ET tube placement:
- CXR
 - Best: EtCO2 = 35-45mmHg

Internal diameter: Resistance

Cuff- Low pressure, High volume

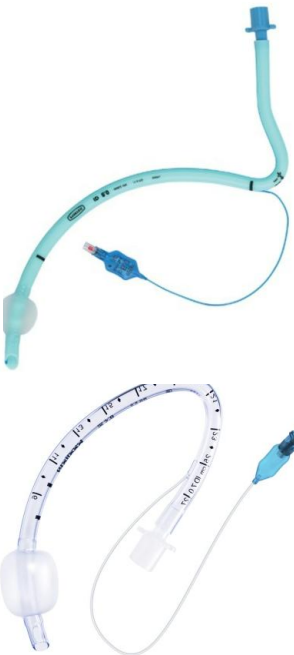
Children: Microcuffed > Uncuffed

Size of ETT-

- <1200g (<28wk): 2.5
- 1200-2200g (29-34wk): 3
- >2200g (>34wk): 3.5
- Child: 3-4
- Female: 7
- Male: 8

Instruments	Formula
ETT(mm) (Uncuffed)	4 + (Age /4)
ETT depth (cm)	3 x ETT
NG Tube/ Foley's (Fr)	2 x ETT
Chest Tube (Fr)	4 x ETT

RAE tubes



Double lumen ET tube



Single lung ventilation

Confirm: Fiberoptic bronchoscope



Combitube



Flexometallic tube



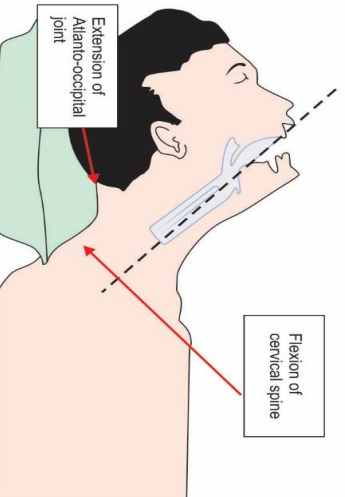
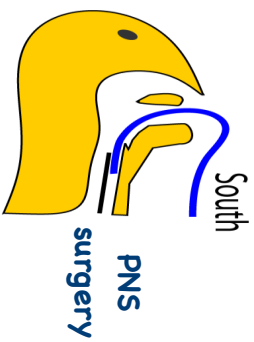
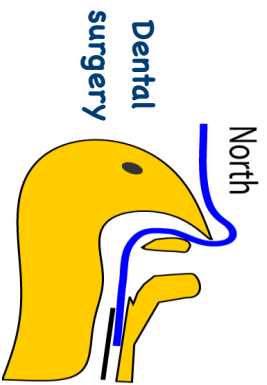
Prone surgery

Stylet

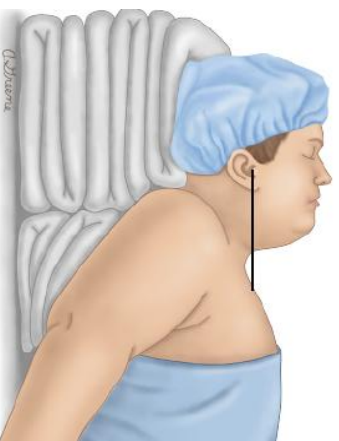


Bougie

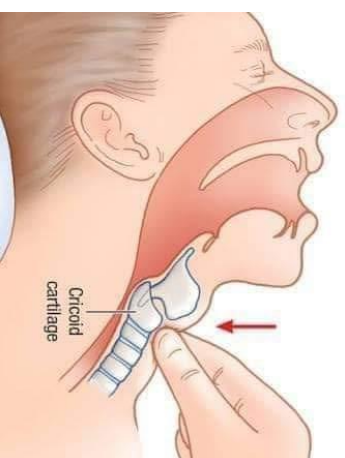
Difficult airway



Sniffing position



RAMP/HELP position
Obese patients



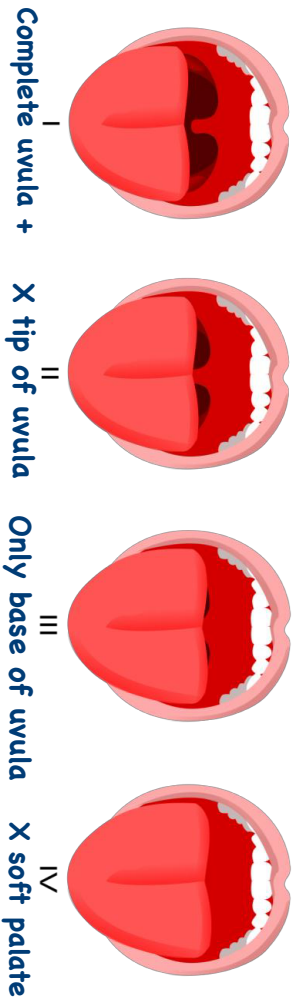
RSI - Selick manoeuvre

5



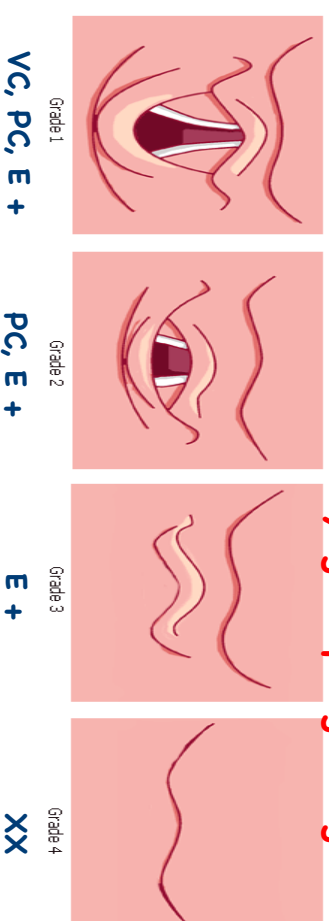
Larson manoeuvre
Reduces r/o Laryngospasm

Difficult Intubation



Mallampati score

Cormack-Lehane Laryngoscopic grading



Difficult Intubation

Plan A:

- Face-mask ventilation & Tracheal intubation
- Direct/ video Laryngoscopy (max. 3 + 1 attempts)

Pre-oxygenation – 3min 100%

Plan B:

- 2nd generation SAD insertion
- Max- 3 attempts

Plan C: Face-mask ventilation

Plan D (CICO): Restricted mouth opening

- Front Of Neck Access (FONA)
- Scalpel Cricothyrotomy

R/F:

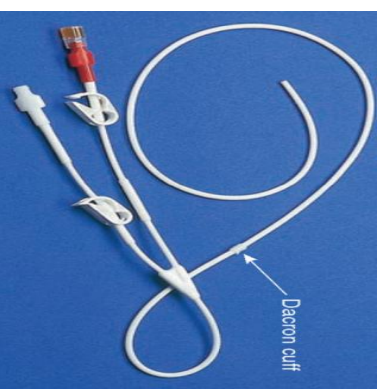
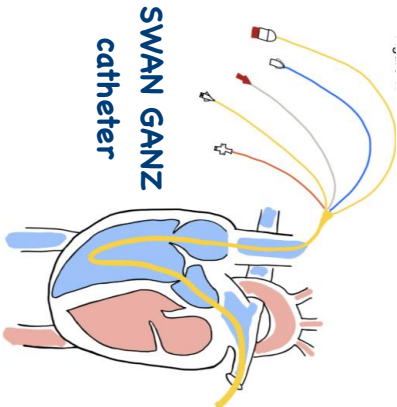
- **Obese**
- **Bearded**
- **Edentulous**
- **Snorer**
- **Elderly**
- **Neck** circumference >40 cm
- ▶ **Finger breadth:TMJ >3 fingers**
- ▶ **Thyro-mental distance- >6.5cm**
- ▶ **Sterno-mental distance- >13cm**
- ▶ **Lip bite test**

Fibreoptic intubation

Instruments



CLAI: S.epidermidis/CONS



- MC vein for central line: Internal Jugular Vein
- MC vein for TPN: Subclavian vein
- Max risk of pneumothorax: Subclavian vein
- Max risk of infection: Femoral vein
- Max risk of thrombosis: Femoral vein

- ▶ **Total Parenteral Nutrition (TPN):**
- ▶ 20:30:50 Protein:Fat:Carbs
- ▶ >1kg/day weight gain: Fluid overload
- ▶ Weight gain after: >6days
- ▶ Refeeding syndrome: Hypo-K/Mg/P
- ▶ Zn, B12 deficiency
- ▶ MC metabolic complication: Insulin resistance

Instruments



18G needle

Minimum G in ATLS(Trauma)



18Fr Foley's catheter



14Fr NG tube

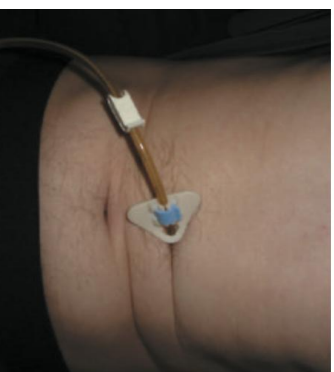
CI: Skull base #
Esophageal stricture

Length of NG tube:
NEX (Nose-Ear-Xiphoid) - Adults
NEMU (Nose-Ear-Midpt. b/w Xiphoid & Umbilicus) - children

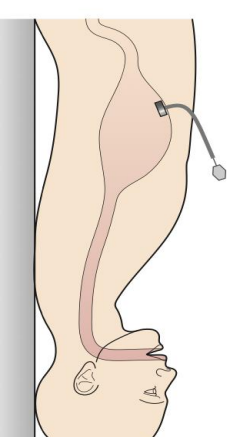
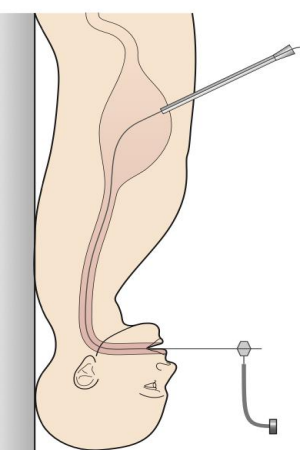
Colour Code	Size	Flow rate
Orange	14G	270
Gray	16G	210
White	17G	130
Green	18G	80
Pink	20G	50
Blue	22G	30
Yellow	24G	20
Violet	26G	10

GORRY from Punjab

Color Code	French
Green	14 1Fr = 0.3mm
Orange	16
Red	18
Yellow	20
Purple	22
Blue	24



PEG tube (Percutaneous Endoscopic Gastrostomy)



Day Care Anesthesia

Criteria

- Surgery < 2hrs
- Low risk of significant immediate postoperative complications
- Patient able to eat, drink postoperatively
- Post-op pain managed by oral painkillers in conjunction with LA/ Peripheral block
- Patient able to mobilise postoperatively
- BMI (to avoid respiratory distress) <38

Contra-Indications

- Unstable ASA 3
- ASA 4, 5
- Any poorly controlled comorbidity

Preferred anesthesia: TIVA → Propofol

Preferred opioid: Remifentanyl [shortest acting] → Pseudocholinestrase

Preferred MR: Sch/Rocuronium > Mivacurium

Leading cause of re-admission: PONV; Hemorrhage

— discharge

Aldrete score: Activity/ BP/ Consciousness / Respiration/ o2 saturation

Monitoring during Anesthesia

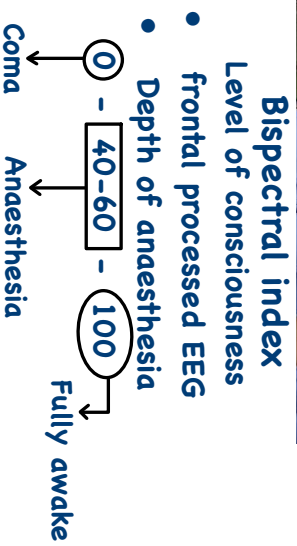


MR

No drug	Nondepolarizing block	Depolarizing block	
		Phase I	Phase II
Train-of-four TOF-R = 1.0	Fade TOF-R = 0.4	Constant but diminished TOF-R = 1.0	Fade TOF-R = 0.4

>5mg/kg

- MC nerve: Ulnar nerve - adductor pollicis
- 2nd MC nerve: Facial nerve - orbicularis oculi
- MC stimulus: ToF[2Hz]
- Tetanic stimulation: 50Hz
- Extubation TOF: >0.9 - clinical sign → lifts head > 5s



Pulse oximetry

Beer Lambert law

OxyHb: IR light

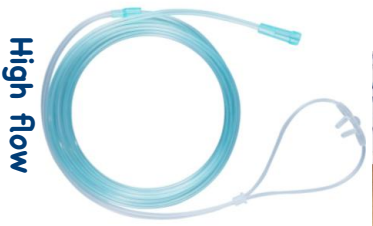
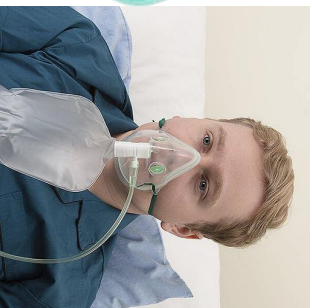
DeOxyHb: Red light

False low (~85%) = Meth-Hb

False high (~100%) = CO-Hb

Detect via Co-oximetry

Oxygen Delivery Devices



- B W O Y R Gf**
- Blue 24% 4L/min
 - White 28% 4L/min
 - Orange 31% 6L/min
 - Yellow 35% 8L/min
 - Red 40% 8L/min
 - Green 60% 12L/min

- fixed O2 %
- COPD
- O2 toxicity

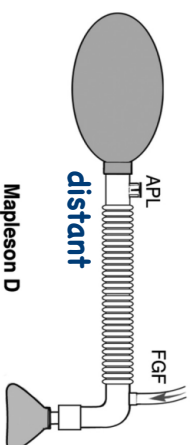
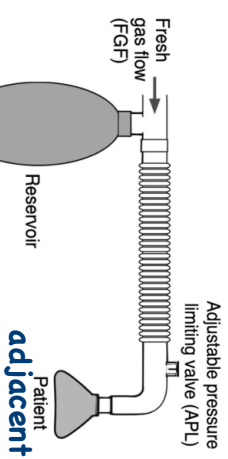


↓ NP dead space
Humidification, PEEP+
May delay intubation

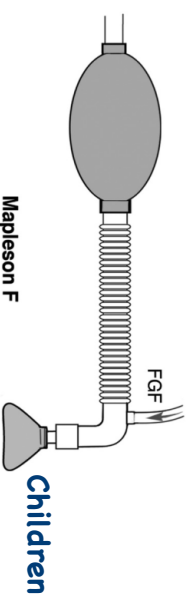
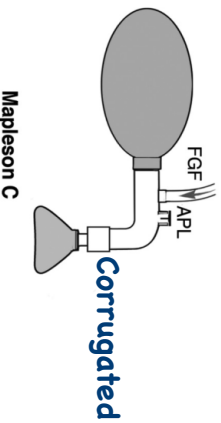
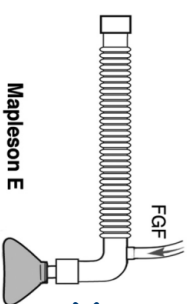
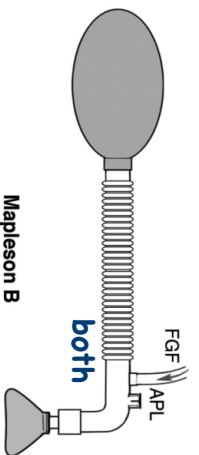
- Prerequisites for NIV:
- Conscious
 - Empty stomach

Device	Nasal Cannula	Hudson mask	Venturi device	NRBM	HFNC	NIV[CPAP]
Max Flow Rate (L/min)	5	10	15	15	60	No limit
Max Saturation (%)	40	60	60	85-90	100	100

Mapleson circuits (Semi-closed)



MC circuit in spontaneous: FGF = MV
 Mapleson A - Magill's circuit; Lack's Coaxial circuit
 MC circuit in controlled: FGF = 1.6 x MV
 Mapleson D - Bain's coaxial circuit

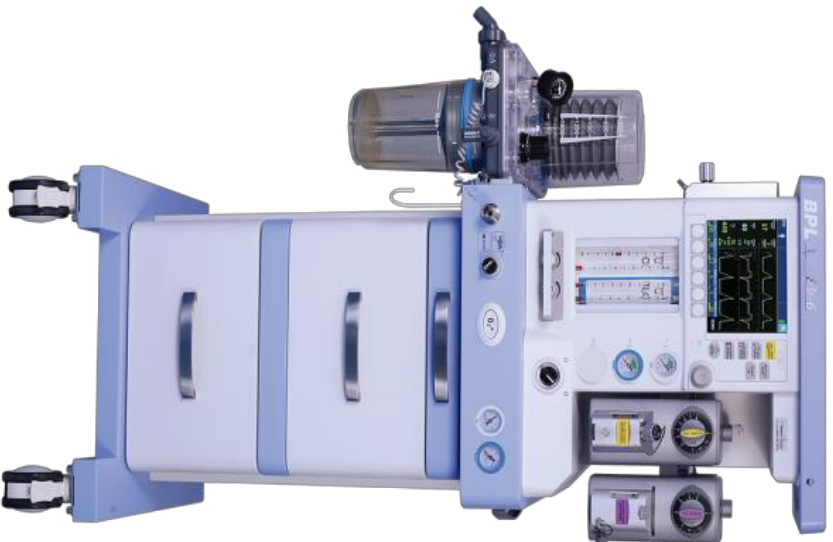


AMBU bag (Artificial Manual Breathing Unit)
 Pop-off valve: 30-40 cm H₂O



BAIN'S circuit

Anesthesia Workstation (Boyle)



High-pressure system:

N₂O → 760psi

- Gas cylinders + Yokes
- Size: **A** – H MC size: **E** Material: Mb-steel MR compatible:
 - Aluminium
 - Titanium
- Pressure: **2000psi** – O₂/air/entnox
- Cylinder pressure regulators
- Cylinder pressure gauges

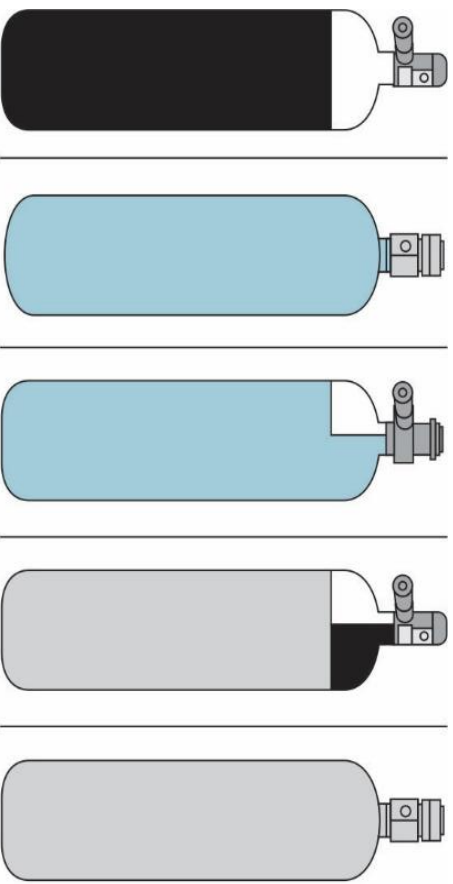
Intermediate-pressure system:

60psi

- Pipeline gas inlets
- Pipeline pressure gauges
- Oxygen fail safe valve
- Flowmeter valves
- Oxygen flush valve

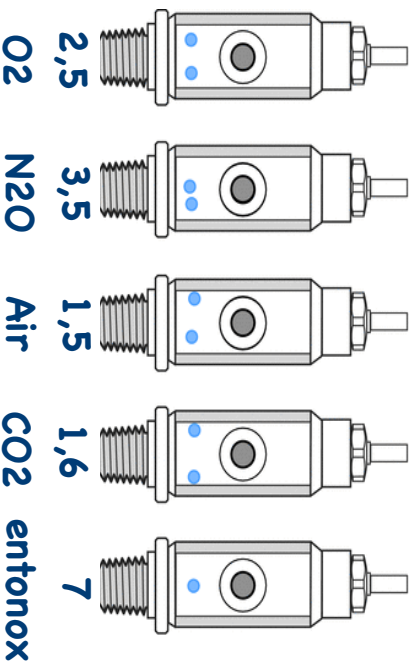
Low-pressure system:

- Flowmeters (rotameters)
- Vaporizers
- Common gas outlet

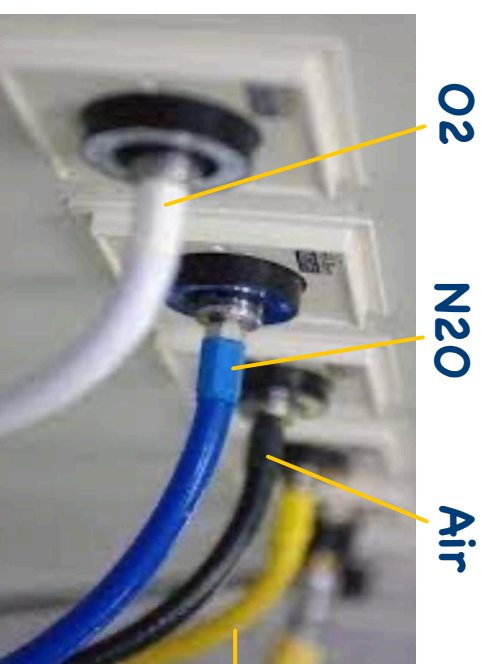


PISS [Pin Index Safety System]

O2 2,5
 N2O 3,5
 N2O+O2 (antiox) 7
 Air 1,5
 CO2 1,6 - >7.5%
 2,6 - <7.5%



Orange: Cyclopropane [3,6]
Brown: Heliox(79% Helium + 21% Oxygen) - airway obstruction



DISS [Diameter index Safety system]
pipelines : int. pressure

Inhalational anesthetics

	MAC α 1/potency	BLOOD GAS SOLUBILITY α 1/speed
Methoxyflurane	0.2	12
Halothane	0.75	2.5
Isoflurane	1	1
Sevoflurane	2	0.65
Desflurane	6	0.45 (Xenon min)
N2O	104	0.47

N2O
 Concentration effect
 Second gas effect
 Diffusion hypoxia
 B12 deficiency

C/I: Intestinal obstructn;
 Middle ear sx



Sevoflurane

Compound A
 Fruity odour
 Best for
 Asthma
 Day care Sx
 Liver D



Isoflurane

Best for
 cardiac Sx



Halothane

Min MAC
 Max bronchdil
 Al hepatitis
 Max ICP rise
 Sensitises heart
 to epin

arrhythmia



Desflurane

Tec-6 vaporizer
 Irritant X induction
 CO with dessicated
 soda lime
 Maintenance agent of
 choice
 Best for Renal D,
 Obese

ALL Inhalational agents:
 -Cerebral metabolic O2 ↓
 -CBF/ICP ↓
 -CVS, HR ↓
 -Respiratory drive ↓

ALL IV agents:
 -Cerebral metabolic O2 ↓
 -CBF/ICP ↓ **Except KETAMINE**
 -CVS,HR ↓
 -Respiratory drive ↓

IV anesthetics

(TIVA)

DOC for Day care/ Liver/ Kidney/ NeuroSx/ TIVA/ Malignant Hyperthermia/ Porphyria/Antiemetic : **PROPOFOL**

Infusion syndrome (acidosis, green urine), Painful injection- Soyabean oil, Egg lecithin : **PROPOFOL**

NMDA antagonist, Dissociative anesthesia, DOC in Asthma/ COPD, Cyanotic HD, Shock : **KETAMINE**

C/I in Hypertension / Epilepsy/ Glaucoma : **KETAMINE**

DOC in Cardiac surgery, S/E- Adrenal suppressant (11 β -hydroxylase) : **ETOMIDATE**

DOC in Hyperthyroidism, Seizures, Narcoanalysis, Redistribution S/E- **Intra-arterial vasospasm**: **THIOPENTONE**

Rx: Papaverine injection

Muscle relaxants

Depolarising MR: Sch

Best for RSI, Shortest acting

S/e: Myalgia (MC), Hyperkalemia, Bradycardia, Intragastric pressure high

Non-depolarising MR:

Aminosteroid compounds: Rocuronium, Vecuronium, Pancuronium

Longer duration, metabolized in liver & kidneys

Benzylisoquinolinium compounds: Atracurium, Mivacurium

Shorter duration of action

Hofmann elimination & ester hydrolysis- safe in RF/ LF/ pediatrics Atracurium

May cause more histamine release

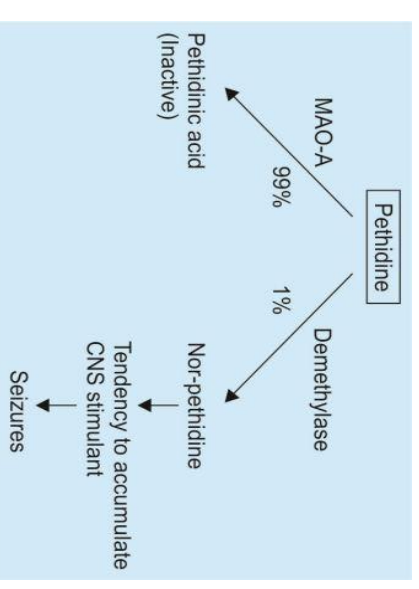
By-product of Atracurium: Laudanosine- seizure (cis-atracurium preferred)

- ▶ Most cardiostable, neuroSx (Biliary excretion) :Vecuronium
- ▶ Shortest acting NDMR:Gantacurium(X FDA approved) > Mivacurium
- Dibucaine No. <30: Atypical pseudocholinesterase
- Prolonged paralysis after giving **Succinylcholine & Mivacurium**
- ▶ Reversal : NDMR → Neostigmine + Atropine
- ▶ Sugammadex : Cyclodextrin → for Ve/Rocuronium [C/I in Liver ds.]

Opioids

- Full agonist: Morphine, Pethidine, Heroin, Meperidine, Methadone, Codeine, Fentanyl
- Partial agonist: Buprenorphine
- Mixed agonist/antagonist: Nalbuphine, Pentazocine, Butorphanol
- Antagonist: Naloxone, Naltrexone

- Avoid Opioids in- Head injury, Biliary obstruction – SOD dysfunction, asthma
- Mydriasis: Meperidine
- Pruritus: Histamine release – vasodilation, hypotension
- No tolerance to: Constipation, Miosis
- Serotonin syndrome: TRAMADOL(μ R_c action + Serotonin R_c)
- Wooden chest syndrome: Fentanyl
- Prolonged QTc: Methadone
- Shortest acting (Day care): Remifentanyl



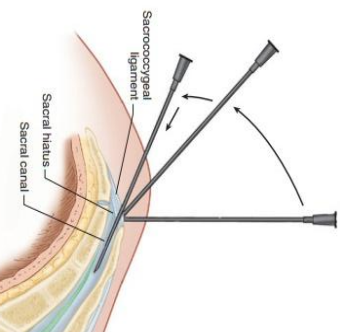
Regional Anesthesia



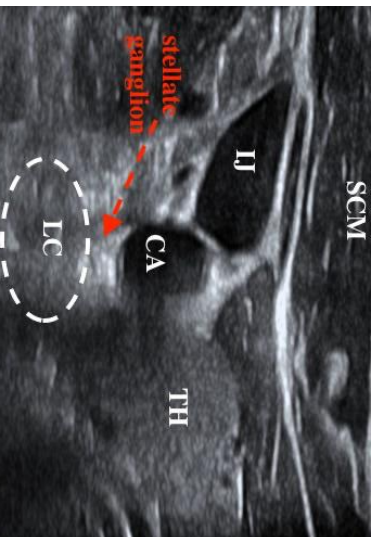
Anterior ethmoidal nerve



Nasociliary n. block



Caudal anesthesia (<8yrs)
Sacral hiatus open
S3-S4 lvl



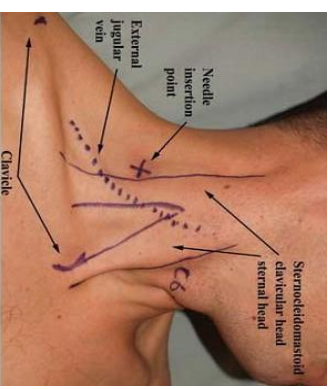
- C6 - Stellate ganglion block**
Done for: Raynaud's; Vasospasm;
PTSD
Signs:
- Horner's - Ptosis[1st]
 - Guttman sign - nasal mucosal congestion

Supraclavicular block

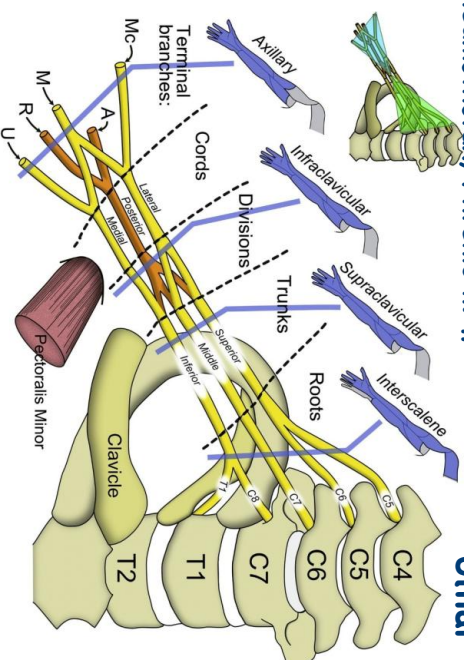


Upper arm surgery; R/O Pneumothorax, Phrenic n. #

Interscalene block

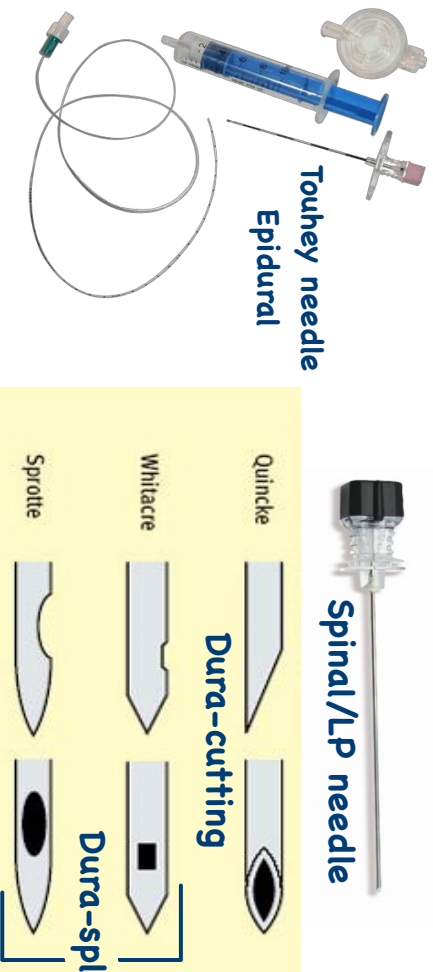


Shoulder & upper arm
Ulnar n. spared



Neuraxial block autonomic/motor/sensory

Epidural Anesthesia (EA)	Spinal Anesthesia (SA)
Larger dose of drug	Smaller dose of drug
Anywhere	L3-L4 MC Tuffier's line ~ iliac crest[L4-5]
Not as good as SA	Better quality of anesthesia
Adjustable, prolonged action via a catheter	Single-shot injection; action for ~3hrs Umbilicus



1. Adult spinal cord-Lower border of L1
2. Spinal cords in infants-Upper border of L3
3. A/D/Subarachnoid space-Lower border of S2

CI: Raised ICP; Papilledema; Coagulopathy; Shock; Local infection

Layers punctured for LP:

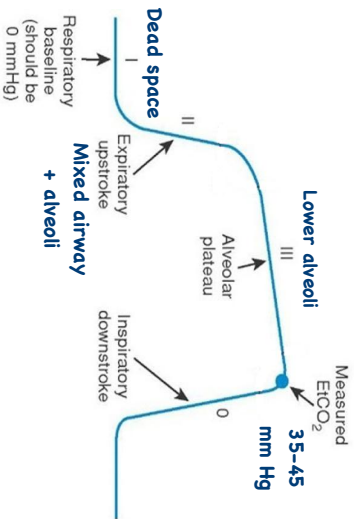
Skin → subcutaneous fat → supraspinous lig → interspinous lig → Ligamentum flavum → Dura → Arachnoid

Post-dural puncture headache:
 •TOC: iv Fluids + bed rest -x-> Autologous blood patch
MC Intra-op complication: Hypotension
DOC: Phenylephrine
MC post-op complication: Urinary retention

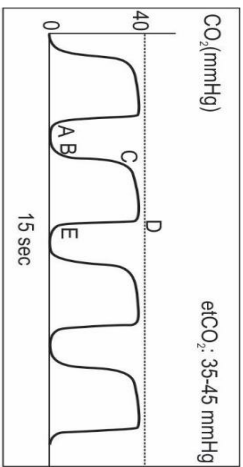
PDPH: increases in pregnancy & on ambulation; reduces on supine position

PIH, Heart ds in pregnancy: Epidural / GA
Except CoA/ Eisenmenger/ Uncorrected TOF: GA

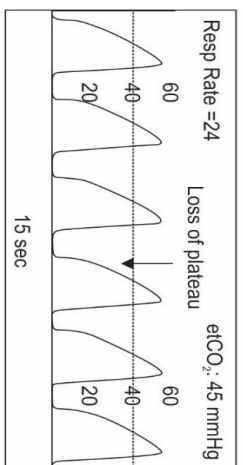
Capnography



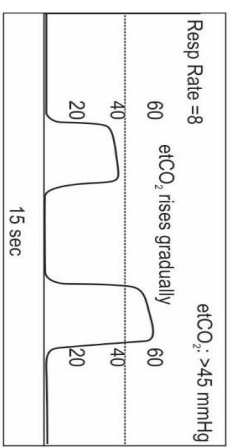
Infrared spectroscopy



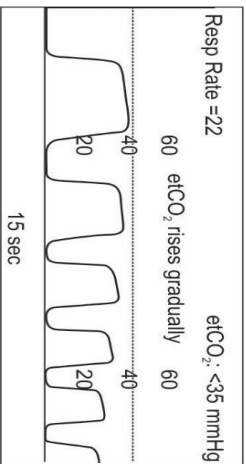
Normal



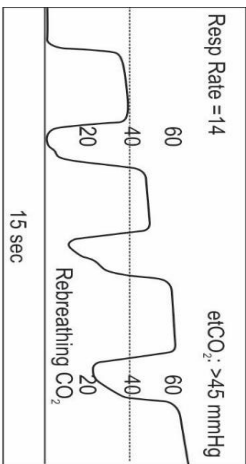
**Shark Finn - COPD
airway obstruction**



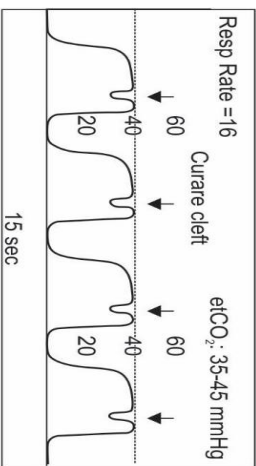
Hypoventilation



Hyperventilation



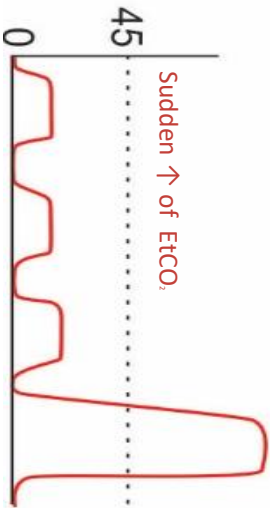
Extinguished soda lime



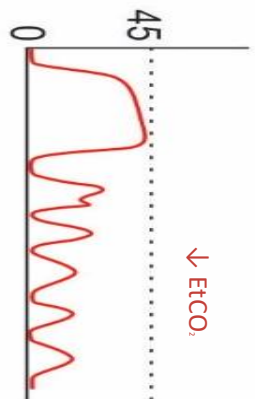
Resp. effort ++



Stepladder



Esophageal intubation



Malignant hyperthermia

- Sch, Lignocaine, Inhalational agents
- Tachycardia + Rigidity
- Earliest sign- EtCO₂ ↑
- Late sign- Hyperthermia
- RYR/DHPR (Chr 19)-AD
- DOC- Dantrolene sodium



- Circuit disconnect
- Cardiac arrest
- Venous air embolism

R/F: Neurosurgery/
Laparoscopy/ Sitting posture/
Fowler's position/ Neck
surgery

Next: DURANT position
[Lt.lateral decubitus +
Trendelenberg] → Aspirate



EtCO₂ > 10-20mm
↓
Adequate Chest compression
↓
Intra-arterial DBP >20mm

Pre-Op Assessment

Pre-op drug DOC to reduce anxiety: Midazolam
 Pre-op drug DOC to reduce secretions: Glycopyrrolate
 Pre-op Antibiotic time: 30min - 1hr prior to incision - Cefazolin
 MC nerve injured intra-op- Ulnar nerve
 MC intra-ophthalmic complication- Corneal abrasions
 PONV DOC: Ondansetron
 POVL MCC: Ischemic optic N
 MCC of intra-op anaphylaxis: Antibiotics > MR
 Min acceptable Hb: 8mg/dL (elective)
 Min acceptable platelet: 1 lakh

Mendelson syndrome Aspirin + pregnancy
 NPO heavy meal: 8hr
 Light/semi-solid meal/ Formula: 6hr
 Breastmilk: 4hr
 Clear liquids: 2hr

Goldman Grading system
 risk assessment

Stop Drugs before surgery

Clopidogrel: 7d Warfarin: 5d LMWH: 24h UFH: 4-6h Li: 48hr SGLT2: 24hr
 ACEi/ ARB/ OHG/ Insulin/ Diuretic (except thiazide): omit morning dose
 OCP: r/o DVT (immobilisation/obese) - 4-6wks
 Smoking: 4-6wks

r/o Euglycaemic ketoacidosis

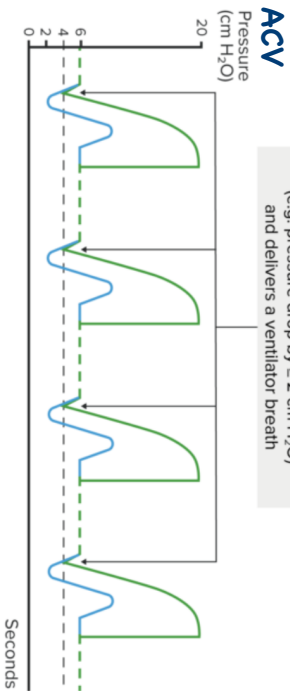
ASA classification

ASA PS	Definition	Examples (including, but not limited to):
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use
ASA II	A patient with mild systemic disease	Current smoker, social alcohol drinker, pregnancy, obesity (BMI 30–40), well-controlled DM/HTN, mild lung disease
ASA III	A patient with severe systemic disease	Poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥ 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA < 60 weeks History (>3 months) of MI, CVA, TIA, or CAD/stents
ASA IV	A patient with severe systemic disease that is a constant threat to life	Recent (<3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD, or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology, or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	Organ donor (brain-dead patient)

Mechanical ventilation modes

Volume-controlled	<ul style="list-style-type: none"> Controlled mechanical ventilation (CMV): Breaths all triggered by ventilator, predefined rate and volume set Assist-controlled ventilation (ACV): Breath triggered by patient's effort, if no patient breath per unit time, ventilator triggered; predefined tidal volume set Synchronized intermittent mandatory ventilation (SIMV): Spontaneous breathing permitted with no ventilator assist; predefined tidal volume set.
Pressure-controlled	<ul style="list-style-type: none"> Pressure support ventilation (PSV): Triggered by patients inspiration only; assist with pressure limitation provided.
Mixed	<ul style="list-style-type: none"> PS/SIMV: Ensures spontaneous breaths permitted in SIMV receive pressure assist

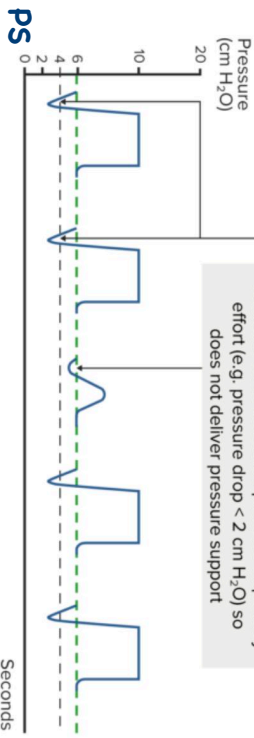
Modes of Mechanical Ventilation



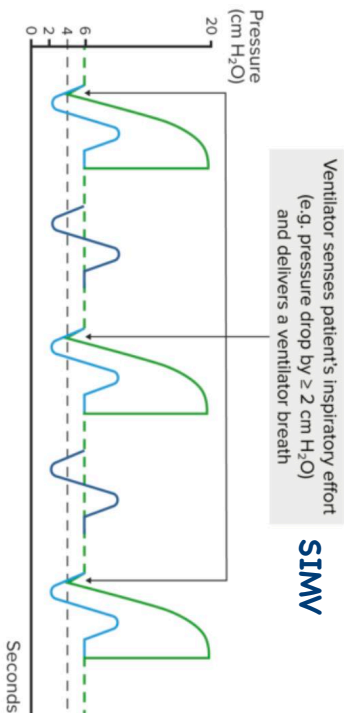
Assist control ventilation (ACV) Ventilator breaths do not occur at regular intervals and are triggered by patient breaths (all patient breaths are assisted) **r/o Hyperventilation**

Ventilator senses patient's inspiratory effort (e.g. pressure drop by ≥ 2 cm H₂O) and delivers a ventilator breath

Ventilator does not sense patient's inspiratory effort (e.g. pressure drop < 2 cm H₂O) so does not deliver pressure support



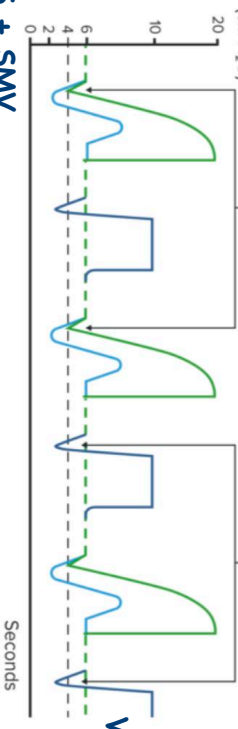
Pressure support (PS) All sensed patient breaths are supported by pressure



Synchronized Intermittent mandatory ventilation (SIMV) Ventilator breaths occur at regular intervals but are triggered by patient breaths (only some patient breaths are assisted)

Ventilator senses patient's inspiratory effort (e.g. pressure drop by ≥ 2 cm H₂O) and delivers a ventilator breath

Ventilator senses patient's inspiratory effort (e.g. pressure drop by ≥ 2 cm H₂O) and delivers pressure support



PS + SMV Synchronized Intermittent mandatory ventilation (SIMV) + pressure support (PS) Ventilator breaths occur at regular intervals but are triggered by patient breaths (only some patient breaths are assisted) + unassisted breaths are supported by pressure

Weaning