ANAESTHESIA (DAY - I)

INTRODUCTION
MACHINE AND MONITORS
AIRWAY MANAGEMENT
PREOPERATIVE EVALUATION
BASICS OF ANATOMY
PHYSIOLOGY RELATED TO ANESTHESIA
INTRODUCTION TO ANESTHESIA

HISTORY AND ANESTHESIA EQUIPMENTS
HISTORICAL MILESTONES IN ANAESTHESIA

• anaesthesia → ‘No senses’ suggested by ‘Oliver Wendell Holmes’

• N2O & O2 was first synthesized by Priestly (1774).

• 1st clinical use of N20 was done by ‘Horace Wells’

• First public demonstration of ether anesthesia was given by William Thomas Green (WTG) Morton in 1846 on Oct. 16th

• First spinal in human beings was given by August Bier (1898).
  • Cocaine was the first drug.

• anaesthesia machine by Edmund Gaskin Boyle in 1918
Curare – Griffith; sch-bovet
1st local anaesthetic used – cocaine - carl koller
1st spinal in dogs - corning, humans - august bier
ANESTHESIA EQUIPMENTS
• **CYLINDERS**

  • Cylinders are made up of molybdenum steel (to withstand high pressure)
  
  • [New cylinder also have chromium to decrease weight]

  • Aluminum cylinders - MRI compatible

  • **O₂ Cylinders**
  • Pressure - 2000 psi (or 137 kg/cm²)
  • (1 kg/cm² = 14.1 psi)

  • Color - Black body with white shoulders
  • Available in sizes from AA to H
  • Most commonly used cylinder on anaesthesia machine is Type E
Liquid O₂

Advantages
1 ml of liquid oxygen releases 840ml of gas
Can be used away from hospital e.g. in wars, portable low wt., low gas pressure

Special supply reservoirs with refrigeration system are required to store oxygen in liquid form, are used

Liquid O₂ must be stored below its critical temperature of -119°C (critical temperature is the temperature below which a gas can be stored as liquid)
MORE ABOUT OXYGEN

Discovered by Priestly

Colorless, Odorless, Tasteless

Prepared from fractional distillation of air

Body stores of O2 is in lungs in the form of FRC (Functional Residual Capacity)

100% OXYGEN IS TOXIC

1. RESP - ↑capillary perm, ↓Mucociliary transport, Change in surfactant activity
2. CVS - ↑BP, ↓HR, ↓CO
3. Retrolental fibroplasia
4. Denitrogenation (95% in 3 min)
Hypoxia

1. Hypoxic hypoxia M/C during anaesthesia
   Causes:
   a. ↓ FIO2
   b. Diffusion hypoxia
   c. Reduced vent.
   d. Reduced diffusion capacity
   e. Venous admixture

2. Anemic hypoxia
   Causes:
   a. Anemia
   b. CO poisoning
   c. Methaglobenina
   d. Sulphglobenina

3. Stagnant hypoxia- Shock
4. Histotoxic hypoxia - cyanide poisoning
Use:
Poisonings- Carbon monoxide (at 2.5 atm of CO is 19 min while at 1 atm it is 214 min)
Cyanide

Gas bubble disease
Air embolism
Decompression sickness

Infections
Clostridial
Refractory, osteomyelitis
Mucormycosis

Ischemia
Crush injury
Ischemic ulcers
Radiation necrosis
N₂O cylinders

Pressure - 760 psi

Color – blue

Critical temperature of nitrous oxide is 36.5 degree centigrade i.e. above room temperature so it can be stored in liquid form without refrigeration.

Central Supply of O₂ & N₂O

O₂ & N₂O are supplied at 60 psi through central supply.
<table>
<thead>
<tr>
<th>Color of Cylinders</th>
<th>Pressure</th>
<th>Filled as</th>
</tr>
</thead>
<tbody>
<tr>
<td>$O_2$ - Black body with white shoulders</td>
<td>2000psi</td>
<td>Gas</td>
</tr>
<tr>
<td>$N_2O$ – Blue</td>
<td>760psi</td>
<td>liquid</td>
</tr>
<tr>
<td>$CO_2$ – Grey</td>
<td>750psi</td>
<td>liquid</td>
</tr>
<tr>
<td>Cyclopropane – orange</td>
<td>75psi</td>
<td>liquid</td>
</tr>
<tr>
<td>Helium – Brown</td>
<td>1400psi</td>
<td>gas</td>
</tr>
<tr>
<td>Air Grey body with black &amp; white shoulders</td>
<td>2000psi</td>
<td>gas</td>
</tr>
<tr>
<td>Entonox - Blue body with blue &amp; white shoulders</td>
<td>2000psi</td>
<td>gas</td>
</tr>
<tr>
<td>Entonox - Blue body with blue &amp; white shoulders (50% $O_2$ + 50% $N_2O$)</td>
<td>2000psi</td>
<td>gas</td>
</tr>
</tbody>
</table>
PIN INDEX SYSTEM

Oxygen  2,5
N₂O  3,5
Air  1,5
Cyclopropane  3,6
Entonox  7
Carbon dioxide  2,6

It consist of 2 pins 4 mm & 6 mm long on- Yoke of machine to be fitted in the corresponding holes of cylinder valve

This pin index system is to prevent wrong fitting of cylinders

Diameter index safety system (DISS) is intended to prevent wrong fitting of central supply pipes to machine
1. High pressure system
   - Cylinder
   - Pressure regulator (1st stage Pressure reducing valve)
   - Yoke assembly

2. Intermediate Pressure system
   From 2nd pressure reducing valve to flow control valve
   $O_2$ failure alarms
   Pressure reducing valve

3. Low pressure system
   - Downstream to flow control valve
Low pressure system

- Flow control valves are color coded:
  - $O_2$-white
  - $N_2O$ - Blue
  - $CO_2$-Grey
  - Air-black.

Rota meter is used to measure flow of gases
Flow meters (Thorpe tube) are of variable orifice with smallest diameter at base.

It contains an indicator known as BOBIN which is made of aluminum and the upper level of bobbin indicates the flow.

Oxygen flow meter tube should be most downstream and this is done to prevent delivery of hypoxic mixture if there is any break in flow meter.
• Vaporizers:
  • To deliver to inhalational agents.

  • Agent specific, color code strip for each agent, (red - halothane, purple - isoflurane, yellow - sevoflurane, orange - desflurane)

  • (Aladin cassette vaporizer is the latest vaporizer which can be used to deliver all inhalational agents.
  • It just requires insertion of color coded cassette of each agent)

- Temperature compensated
• Breathing Systems

• Open

• Semi closed

• Closed

1. Open - By putting mask or gauge piece directly over nose & mouth previously used for ether, chloroform. A special mask schimmelbusch mask is used for ether.
2. Semi closed - Described by Mapleson. Mapleson A system —> also K/a Magill circuit

Mapleson A

Mapleson B

Mapleson C

Mapleson D

Mapleson E

"Mapleson F"

FG = Fresh gas  P = Patient
• Best for spontaneous respiration

• Fresh gas flow should be Equal to minute volume to prevent rebreathing when patient is on spontaneous respiration. It is >3 times the minute volume (and inspite of rebreathing may not be prevented) when patient is on controlled ventilation.

• Lack circuit- modification of Type A system

  Type B - Obsolete circuit, no more used

  Type C - Obsolete circuit, no more used (functionally B, C -equally effective for spontaneous and CV)
• Type D

- Most commonly used circuit is Bain’s (modification of Mapleson D system)

- Length of tubing is 1.5 mtrs

- Bain’s circuit is best for controlled ventilation

- Fresh gas flow should be 1.6 times of minute volume (or 70-100ml/kg if RR is high) to prevent rebreathing on controlled ventilation.

- It is 2.5 times of minutes

• volume when patient is on spontaneous ventilation
• Mapleson E (Also K/a Ayres T piece)

• Mapleson F

• It is Jackson Rees modification of T piece (Mapleson E) system

• Used for children usually < 6 yrs. of age or < 20 kg

• FGF = 1.5-2xMV for CV, i.5xMV for spontaneous

• Newer circuits: Humphry ADE, PENLON, MERA-F, LACKS (all these are co-axial circuits)
CLOSED CIRCUIT - It is the circle system in which CO2 is absorbed by soda lime from exhaled gases & exhaled gases can be reused.
Soda lime composition

Ca (OH)₂ - 94%
NaOH - 5%
KOH - 1%

Silica is added to make it hard so that minimum powdered dust is formed

Indicator color changes

<table>
<thead>
<tr>
<th>Phenolphthalein</th>
<th>Fresh</th>
<th>Exhausted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl violet</td>
<td>White</td>
<td>pink</td>
</tr>
<tr>
<td>Mimosa Z</td>
<td>Red</td>
<td>white</td>
</tr>
<tr>
<td>Duraorb</td>
<td>pink</td>
<td>white</td>
</tr>
</tbody>
</table>
Size of soda lime granules = 4-8 mesh
- Air ip tee in canister=53%
- Hardness->75
- Humidity should be >50%
- Max amount of CO2 that can be absorbed by 100 g ms of sodalime 26L
  - 13,700 calories are produced for 1 mole of CO2 absorbed
• **BARYLIME**
  
  - Ca(OH)$_2$ - 80%
  - Ba(OH)$_2$ = 20%

  • Baryline it does not require silica for hardness (water of crystallization is sufficient to keep barylime hard)

• **AMSORB** (also called as calcium hydroxide lime) is a new CO$_2$ absorber which doesn’t produce compound A with sevoflurane and CO with desflurane Universal F (univent) is a single limb closed circuit
Semi closed (Mapleson system)  
**Advantages**  
1. Light weight easy to carry  
2. Due to light weight chances of accidental extubation is not high  
3. Work of breathing is less  
4. Danger of hypercapnia is less  
5. No such accumulations  
6. Can be used safely  

**Disadvantages**  

Closed (circle system)  

**Advantages**  
1. Low fresh gas flow required so economical  
2. Low pollution  
3. Humidity is preserved 40-100% can be achieved  

**Disadvantages**  
1. High flows are required  
2. Scavenging is difficult; high theatre pollution  
3. Not well preserved  

6. Use with Trielene C/T - reaction with soda lime produces Dichloro acetylene which is neurotoxic (encephalitis) & Phosgene which causes ARDS  
- sevoflurane produces compound A  
- Desiccated soda lime as well as barylime produces carbon monoxide (CO) with desflurane > enflurane > isoflurane > halothane = sevoflurane - desiccated soda lime can produces hydrogen fluoride with sevoflurane which can cause burns of respiratory mucosa
• Static current - generated by flow of gases, Methods to prevent: antistatic material (adding carbon), cotton clothes, humidity > 50%

• Sterilisation of anesthesia equipment

• Metallic instruments can be autoclaved

• Other for all instruments ethylene oxide gas sterilization is best
  • 2nd choice = 2% gluteraldehyde
  • 3rd Choice = ethyl alcohol 70%
Face Masks

Available in sizes 00 —> 4

Dead space and chances of aspiration is significantly increased by mask ventilation
Airways

Most commonly used airway – Guedel
Length of airway = Distance between tip of nose & tragus + 1 inch
Laryngeal mask airway
Available in sizes 1-4

USES

- Emergency airway
- Difficult intubations
- Elective procedure for minor surgeries
- To assist intubations (intubating LMA)

Advantages:

- Easy to insert (Even paramedical staff can insert)
- Can be used in cervical instability
- No laryngoscopy required
- No muscle relaxants required (Can be used in awake pat)
• Disadvantages:

- Does not prevent aspiration
- Laryngospasm

• Other type of LMA
• Intubating LMA
• Proseal LMA (suction port for stomach decompression)
• Laryngoscope

• Commonly used laryngoscope - Macintosh (curved blade) for neonates - straight blade (magill)

• Head & neck position for laryngoscope - extension at Atianto-occipital joint & flexion at cervical spine

• Teeth most vulnerable to damage - upper Incisors
• Cuff to be filled with air, pressure should be less than 25mmHg (15=25)

• In small children uncuffed tube should be used (<10 yrs)

• Confirmation of position! chest movements, mist in tube, auscultation (Important point for auscultation => Lt Lower base) but - Surest sign of intubation => capnography
• Red Rubber
• 1 Reusable
• 2 Non transparent
• 3 Radiolucent
• 4 Absent
• 6 Cuff = low volume, high

• Pressure

• ↑Chances of tracheal injury  ↓chances of tracheal injury
Size of ET tube
Adult:
Male - 8.5/9 no.
Female = 7.5/8 no.

<6 years = Age (years)/3 + 3.5
> 6 years - Age/4 + 4.5

**Length of tube**

For oral intubation Age/2 + 12 cms

For nasal intubation add 3 cms to oral length

Reflex response to Intubation: CV-tachyarrhythmia, hypertension
Laryngeal-larynospasm CNS - ↑ ICT
HORMONAL ↑ cortisol and catecholamines
Methods to inhibit xylocard iv\xylocaine spray\ opioids\ beta blockers

Other tubes:
→ RAE preformed tube (oxford) - oral and dental surgeries like cleft lip and palate

→ Spiral embedded tube (flexometallic\armoured - head and neck

→ Robert Shaw & Carlen's tube - double lumen for thoracic surgery i.e. for one lung ventilation
**Indications:** absolute- to prevent spillage of pus, blood, malignant cells
- bronchopleural lavage
- massive BP fistula

Relative- surgical

Confirmation is with bronchoscopy and major problem is hypoxia due to
- malposition (incidence is less with broncoscopy)
- \( V/Q \) mismatch (now considered as most common cause)

**Nasal Intubation Indications**

(i) Oral surgery
(ii) Fracture mandible
(iii) Inadequate mouth opening
(iv) Awake Intubation
(v) Elective tube is to be kept for prolonged periods (max, time is 3 weeks)
• **Advantage**
  - better tolerated by awake patients
  - Oral hygiene can be maintained

• **Disadvantages**
  - bleeding
  - infection (sinusitis)
  - nasal deformity

• **Contraindication**
  - Basal skull fracture
  - CSF rhinorhea
  - Nasal mass
  - Adenoids
  - Coagulopathy

• C/I for both oral and nasal intubation:
  - Laryngeal edema
  - Epiglottitis
  - Laryngotracheobronchitis
• **Oxygen delivery devices**

• **High flow systems**: - These are fixed performance device so delivers accurate oxygen (error is only ± 2%) and therefore possible to regulate oxygen delivery.

• These include venture mask, special nebulizers, and high air flow blenders.

• **Low flow system**- Nasal cannula, Oxygen mask, tent, hood-variable performance devices so inaccurate and not possible to regulate oxygen delivery

• **Reservoir Bag (breathing bag)**
  • For neonates - 250 ml
  • For infant & small children - 500 ml
  • For adolescents - 1000 ml
  • For adults - 2000 ml
**AMBUBAG**

- Artificial manual breathing unit (capacity 1200 ml)
- Max. O2 that can be given by AMBU Bag - 100%

**Instruments to preserve Humidity**

Complete cessation of mucociliary activity occurs < 22 mg/L (<50 %)
Various methods to preserve humidity are:
1. Heat and moisture exchanger (also called as artificial nose)
2. Humidifiers
3. Nebulizers (optimal size 0.5.-5microns)

**Scavenging system** system used to eliminate the excessive anesthetic gases most important for N2O (greenhouse effect)
MONITORING

- CNS
- CVS
- RESPIRATORY
- NEURO MUSCULAR
- TEMPERATURE
- RENAL
Signs of light anaesthesia

1. Movement response (not possible with NM blocking drugs)
2. ↑ BP, Tachycardia, sweating, lacrimation
3. Tachypnea, breath holding, coughing, laryngospasm
4. Eye movements, eye lash response
5. Patent reflexes (but may be preserved with ketamine)
• Electrophysiological measures:
  • EEG- p waves
  • Persistent evoked responses
  • Bispectral Index is 1\textsuperscript{ST} scientifically validated and commercially available monitor to see the depth of anesthesia.

• It utilizes many parameters like multiple ESQ signals, eye blink etc, to calculate a score,
• A score of 45-60 is considered as adequate depth (score of 100 is for fully awake state and 0 for completely silent brain).

• Entropy: other monitor
• **Cardio Vascular**
  - Pulse rate
  - Blood pressure- non-invasive
    - Invasive

• For invasive BP radial A is most commonly cannulated but ALLEN’S test is mandatory

• Normal value of Allen test <7sec;
  - 7-14 borderline
  - >15 sec abnormal

• ECG-(lead II for arrhythmias & lead V5 for ischemia is preferred)
• Central venous pressure

• Preferred vein - internal Jugular Vein

• Normal CVP 6-8 mm Hg

• Pulm. A catheterization (Swan ganz catheter is used)

• Cardiac chambers pressure monitoring of
  • (i) RA-0.8 mm Hg
  • (ii) RV-15-30 / 0-8 mm Hg
  • (iii) PA-15-30 / 5-15 mm Hg
  • (iv) PCWP- 4-12 mmHg
• left atria failure pulmonary edema develops if PCWP >25 mmHg
• (v) LA-4-12 mmHg
• 2. → for temperature monitoring
• 3. → for mixed venous oxygen saturation- best indicator of tissue perfusion (cardiac output)
• 4. → For Cardiac output. Cardiac index
• 5. fluid titration → CVP

• Tran esophageal echocardiography
  - Most sensitive for wall motion abnormality (ischemia) and air embolism
RESPIRATORY

- Oxygen saturation measured by **pulse oximeter** (normal 97-98%)
- Limitations: abnormal Hb, cold, shivering, anemia (severe), nail polish, hyperpigmentation, shock

- Expired $CO_2$ expired $CO_2$ -32-42 mm Hg measured by **Capnography**

- **Uses of capnography**
  1) Surest sign of intubation
  2) To diagnose intra operative displacement and disconnection of endotracheal tube
  3) Diagnosing cardiac arrest
  4) Diagnosis of embolism
  5) Diagnosis of malignant hyperthermia, exhausted soda lime
•-(ABG )ARTERIAL BLOOD GAS ANALYSIS

• Apnea monitoring:

  • intubated patients - capnography,
  • non intubated pts - Impedence plethysmography or Transthoracic impedance pulmonometry (also knowg as electrical impedance pulmonometery) (simplest and most commonly used method to detect apnea in a non intubated patient).

• Pulse oximeters can detect apnea in both intubated and non intubated patients.
• Neuromuscular
  • Single twitch stimulation
  • Train of four (2 Hz stimuli every 0.5 sec. repeated after 10-12 sec.)
  • Most useful for maintenance and differentiate between depolarizing and non-depolarizing block
  • Ratio of 0.9 for successful reversal
  • Tetanic stimulation (50Hz for 5 sec.)
Neuromuscular Blockade

No Block | Depolarizing* | Non-Depolarizing
---|---|---

**Tetany**

Train of Four (TOF)

Double-burst stimulation (DBS)

Post-tetanic potentiation

*Phase I depolarizing block. Phase II blockade behaves like a non-depolarizing block.

TOF ratio = B/A

Common Monitoring Sites

**Ulnar nerve**
Adductor pollicis
Adducts thumb

**Facial nerve (CN VII)**
Orbicularis occuli
Closes eyelid
Corrugator supercili
Furrows brow

**Posterior tibial nerve**
Flexor hallucis brevis
Flexes big toe
NM monitoring

Muscles

- Adductor pollicis supplied by ulnar N is most commonly chosen muscle. Other muscle which can be used is Orbicularis oculi supplied by facial nerve (ideal muscle for monitoring because response in orbicularis oculi corresponds with laryngeal muscles) but monitoring is technically very difficult so it is not frequently used.

Stimuli

- Train of four is most commonly used modality.
To conclude- fading and post tetanic facilitation is characteristic of non depolarizers.
FADING is characteristics of non-depolarizers
- Other like Tetanic stimulation (sustained stimulus of 50 - 100 Hz) or Post tetanic facilitation:

(A stimulus is given just after tetanic stimulation, uniylion depolarizers wiili exhibit facilitation) Or Double burst stimulation (two sets 3 stimuli are given, similar to other responses non depolarizers will exhibit fading).
• **TEMPERATURE**: mandatory → hypothermia is common thermal abnormality
  • during anesthesia

• Reasons:
  • A) Because of vasodilatation by anesthetics heat transfer from core to skin
  • b) Evaporation
  • c) ↓Room temp. (Ideal OT temp. 21°C adults & 28°C children.)
  • d) Cold fluids

• Effect of hypothermia
  • CVS ↓C.O vent irritability <28°C.
  • Resp - ↓MV (Resp arrest i 23 °C).
  • Blood - ↑viscosity
  • ↓Tissue perfusion
  • Metabolic acidosis
Core temp. > rectal temp > surface temp

Sites for core temp.
- Pulmonary artery (most accurate)
- Tympanic membrane (most accurate for brain temp)
- Nasopharynx (best for brain temp)
- Lower esophagus (most commonly used site and best)
- Oral cavity
- Axilla - less reliable of core temp
- Rectal
- Bladder
- Skin temperature

Uses of hypothermia
- Induced hypothermia
  - Oxygen consumption & BMRI ↓ 7% with °C ↓ in temperature
  - 1. Brain protection
  - 2. Protection against tissue ischemia during cardiac surgery
PRINCIPLES OF ADMINISTRATION OF GENERAL ANESTHESIA

• Preoperative Assessment
• Premedication &
• Monitoring
GENERAL ANAESTHESIA

Triad of anesthesia
1. Narcosis (and amnesia)
2. Analgesia
3. Relaxation

Balanced Anaesthesia - Analgesia + Amnesia + muscle relaxation + unconsciousness + Abolition of reflex+ maintenance of hemodynamics\hemostasis of body

**General protocol:** premedication with BZs
Preoxygen with 100% O2 for 3 minutes

Induction with \text{\textit{l}}\text{\textbackslash v} agents followed by suxamethonium→ intubation→maintenance with oxygen 33%+ N_20 66% + inhalational agent + non depolarizer muscle relaxant

Reversal with cholinesterase inhibitors→ extubation
<table>
<thead>
<tr>
<th>Stage</th>
<th>Respiration</th>
<th>Tidal volume</th>
<th>Pupils</th>
<th>Eye position</th>
<th>Reflexes affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I (Stage of Analgesia) from analgesia to loss of consciousness</td>
<td>Irregular</td>
<td>Small</td>
<td>Constricted</td>
<td>Divergent</td>
<td>NIL</td>
</tr>
<tr>
<td>Stage II (Excitement) loss of consciousness to rhythmical respiration</td>
<td>Irregular</td>
<td>Large</td>
<td>Dilated (Reflex dilatation due to symp. +)</td>
<td>Divergent</td>
<td>Eyelash</td>
</tr>
<tr>
<td>Stage III (Surgical Anaesthesia) Plane 1 (Rhythmical respiration to cessation of eye movement)</td>
<td>Regular</td>
<td>Large</td>
<td>Constricted (Roving eye balls)</td>
<td>Divergent</td>
<td>Pharyngeal Skin Conjunctive</td>
</tr>
<tr>
<td>Plane 2 (cessation of eye movement to start of respiration, paresis) (excluding diaphragm)</td>
<td>Regular</td>
<td>Medium</td>
<td>V4 Dilated</td>
<td>Fixed centrally</td>
<td>Corneal</td>
</tr>
<tr>
<td>Plane 3 (resp. paresis to paralysis)</td>
<td>Regular</td>
<td>Small</td>
<td>Vt dilated</td>
<td>Fixed centrally</td>
<td>Laryngeal</td>
</tr>
<tr>
<td>Plane 4 (Diaphragmatic paralysis)</td>
<td>Jerky</td>
<td>Small</td>
<td>Fully dilated</td>
<td>Fixed centrally</td>
<td>Cranial Anal sphincter</td>
</tr>
<tr>
<td>Stage IV Medullary paralysis</td>
<td>APNEA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• PRE OPERATIVE ASSESSMENT

• PREOPERATIVE ASSESSMENT AND PREMEDICATION

• Includes complete history, general physical examination and systemic examination

• PULMONARY FUNCTION TEST

• Bed side test
  • 1. Match test; match stick to be blown off from 15 cm distance
  • 2. Auscultation over trachea during forced expiration if breath sounds are audible > 6 sec. airway obstruction is present
  • 3. Able to blow a balloon
    • Breath holding time: normal > 25 seconds
    • 15 -25 -borderline
    • < 15 sec – significant
• ASA grading

• I- Normal healthy patient
• II- Mild systemic disease with no functional limitations
• III- Moderate systemic disease with functional limitations
• IV- Severe systemic disease which is constant threat to life and make patient incapacitating
• V- Moribund patient who is not expected to survive >24 hrs
• VI- Brain dead patient
Management of preexisting drug therapy

• Patient on MAO inhibitors - discontinued before 3 weeks

• Levodopa - should be continued

• Oral hypoglycaemic - for minor surgery (<20 min) continue, omitting morning dose
  • For major surgery - switch over to insulin 48 hrs before surgery

• Oral anticoagulants - To be stopped 4 days before and switch over to LMWH, which is stopped 12-24 (depending on dose) before surgery.

• Oral contraceptives - estrogens containing pills to be stopped 4 wks before

• Only progesterone pills need not be stopped
• Antihypertensive: to be continued and morning dose to be taken except ACE inhibitors and Angiotensin II antagonist

• Antianginal-> All to be continued including aspirin (except for retinal and plastic surgery where it is stopped 48 hours prior) except

• Clopidogrel (plavis) be stopped 7 days prior,
• ticlopidine should be stopped 14 days prior,
• abciximab 2 days prior and
• eptifibatide 8 hours, prior to surgery,

• Antithyroid drugs and thyroxine: to be continued
• Lithium: To be stopped 48-72 hrs before surgery

• Steroid: if patient has taken steroid for more than 1 wk in last 1 yr (by any route) - intraoperative steroid replacement is necessary

• Smoking: to be stopped 8 wks before (complete ciliary recovery)

• Antitubercular drugs: To be continued but assessment of liver function tests is mandatory

• Herbal medicines effect drug metabolism, bleeding profile and neuronal functions.
• So they have to be stopped 1 weeks prior to surgery
PREMEDICATION

AIM: To
1. Relieve anxiety
2. Induce sedation
3. Promote hemodynamic stability
4. Reduce Chances of aspiration
5. Provide analgesia
6. Prevent post op. N. & V (nausea & Vomiting)
7. Control infection
8. Control of secretions
9. Amnesia
• **Relieve anxiety**
  • 1. Non-pharmacological measures
    • - Assurance
    • - Relaxation
  • 2. Pharmacological
    • - Diazepam / Lorazepam

• **To ↓ the secretions**
  • - Atropine
  • - Glycopyrolate
  • - Scopolamine
  • -> NOT INDICATED

ROUTINELY
• Chances of aspiration
  - Fasting recommendations
  - For food & unclear fluids 8 hrs.
  - clear fluids 2-3 hrs. Fasting is enough
  - Children 6-8 hours for solid, 2-3 hours for clear fluids.
  - Infants - 4 hours for milk, 2 hours for water.

• Drugs NOT RECOMMENDED ROUTINELY
  - Ranitidine (given night before surgery)
  - Sodium citrate (just before surgery)
  - Omeprazole
  - Metoclopramide
• **Provide analgesia**

• **Opioids**

• Not recommended routinely

• - To be given in preop. Room. Not in ward, only used to attenuate cardiovascular response to intubation

• -

• **To reduce infection**

• Antibiotics are to usually given intravenously 5-10 min. before skin incision.
• Nausea & vomiting
  •  - Droperidol
  •  - Metoclorpramide
  •  - Ondnnsteron 4-8 mg
  - NOT INDICATED ROUTINELY

• Dexamethasone
POSITIONING UNDER ANAESTHESIA
COMPLICATIONS FOR DIFFERENT POSITIONS

↓ In vital capacity with position

Lithotomy  ↓ by 18%
Trendelenburg ↓ by 14%
Rt. Lateral  ↓ by 12%
Lt Lateral  ↓ by 10%
Prone  ↓ by 10%

Most common N, injured during anaesthesia is

- Ulnar (34%)
- Brachial (24%)
- Lumbosacral nerve root (16%)
LITHOTOMY:

1) Nerve injuries
   - Peroneal N. injury (compressed b/w head of fibula; & bar)
   - Saphenous N. injury (pressure over medial condyle)
     - Femoral N. injury (angulation of thigh)
   - Obturator N. injury (angulation of thigh)

2) Muscle injury
   - Compartment syndrome of leg (extreme tightening of straps)
   - Compartment syndrome of hand (compressed between buttocks & table)
   - Chemical burns

3) ↑Venous return-↑cardiac load

4) Respiration-↓FRC
Lateral & Lateral oblique

1. Transient Homer syndrome
2. Brachial plexus injury!
3. Radial & ulnar N.; injuries
4. Compartment syndrome of hand
5. Extreme flexion of neck can compromise spinal blood flow
6. Breast injury
7. Genitalia injury
1. ↑CVP, ↑ICP, ↑IOP:
2. Cardiac load (↑V.R)
3. ↓FRC
4. Cerebral H’age
5. Venous congestion in face- swelling of face, conjunctiva, eyelids Lingual & buccal neuropathy

SITTING

1. Extreme flexion of neck—>Spinal Cord ischemia
2. Brachial plexus injury (weight of armi GA stretched brachial plexus) .
3. Femoral & obturator N. injury
4. Sciatic N. injury
5. VENOUS AIR EMBOLISM: commonly seen in posterior fossa surgery (usually IGGml. of air is considered significant, although death can occur with 5ml)
Diagnosis of venous air embolism: → most sensitive tool is transesophageal echocardiography (TEE) (can detect 0.2 ml of air)
—Doppler —capnography - end tidal nitrogen (very sensitive)

Treatment: pack the area
Stop nitrous oxide
Aspirate through CVP catheter
Control any arrhythmia
Left lateral position (only if suspected ASD/VSD)

EYE COMPLICATIONS

- Exposure keratitis- very common complication
- Blindness - ischemic optic neuropathy is most common cause
AIRWAY MANAGEMENT

AIR WAY ASSESSMENT
INTUBATION
DIFFICULT
ALGORITHMS
DIFFICULT AIRWAY

ASA definition of difficult airway:

“The clinical situation in which a conventionally trained anaesthetist experiences difficulty with mask ventilation, difficulty with tracheal intubation or both.”

DIFFICULT VENTILATION

The inability of a trained anesthetist to maintain the oxygen saturation > 90% using a face mask for ventilation and 100% inspired oxygen, provided that the pre-ventilation oxygen saturation level was within the normal range.

- More than 3 attempts
- Longer than 10 minutes
- Failure of optimal best attempt
Predictors of difficulty to face mask ventilate (OBESE)

1. The **Obese** (body mass index > 26 kg/m²)
2. The **Bearded**
3. The **Elderly** (older than 55 y)
4. The **Snorers**
5. The **Edentulous**
History
- Patient/notes/chart/medic-alert/spam letter
  - Difficulty
  - Surgery/burns
  - Concurrent disease
  - Reflux/recent meals

General examination
- Do they just look difficult?
  - Dentition (prominent upper incisors, receding chin)
  - Distortion (edema, blood, vomits, tumor, infection)
  - Disproportion (short chin-to-larynx distance, bull neck, large tongue, small mouth)
  - Dyssmobility (TMJ and cervical spine)
- Massively obese or pregnant
- Beards +/- tubes

Specific tests

Investigations.
- Nasoendoscopy
- X-ray, CT/MRI Flow volume loop
• AIRWAY ASSESSMENT

Sensitivity: 44% - 81%
Specificity: 60% - 80%

• Mallampati scoring

• Class I  faucial pillar’s, soft palate, uvula
• Class II  faucial pillars, soft palate, and no uvula
• Class III  only soft palate
• Class IV  only hard palate (modified Sampson and Young)

• Thyro mental distance  Normal > 6.5cms

• Sterno mental distance  > 13 cms
Thyromental distance

- Measure from upper edge of thyroid cartilage to chin with the head fully extended.
  - Normal is approx 7cm
    - Sensitivity: 90.9%     Specificity: 81.5%
Atlanto-occipital movement

- The patient is asked to hold head erect, facing directly to the front, then he is asked to extend the head maximally and the examiner estimates the angle traversed by the occlusal surface of upper teeth.

  - Visual assessment or using a goniometer.
    - Grade I >35 degrees
    - Grade II 22-34 degrees
    - Grade III 12–21 degrees
    - Grade IV <12 degrees
Further assessments

- Sterno-mental distance
  - A sternomental distance of 12.5cm predicts a difficult intubation.

- Mandibular protrusion
  - If the patient is able to protrude the lower teeth beyond the upper incisors intubation is usually straightforward
  - If the patient cannot get the upper and lower incisors into alignment intubation is likely to be difficult.
## Wilson’s risk score

<table>
<thead>
<tr>
<th></th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight</strong></td>
<td>0=&lt;90kg</td>
</tr>
<tr>
<td></td>
<td>1=&gt;90kg</td>
</tr>
<tr>
<td></td>
<td>2=&gt;110kg</td>
</tr>
<tr>
<td><strong>Head and neck movement</strong></td>
<td>0=Above 90 degrees</td>
</tr>
<tr>
<td></td>
<td>1=About 90 degrees</td>
</tr>
<tr>
<td></td>
<td>2=Below 90 degrees</td>
</tr>
<tr>
<td><strong>Jaw movement</strong></td>
<td>0=IG&gt;5cm or SLux &gt;0</td>
</tr>
<tr>
<td></td>
<td>1=IG&lt;5cm and SLux = 0</td>
</tr>
<tr>
<td></td>
<td>2=IG&lt;5cm and SLux&lt;0</td>
</tr>
<tr>
<td><strong>Receding mandible</strong></td>
<td>0=Normal</td>
</tr>
<tr>
<td></td>
<td>1=Moderate</td>
</tr>
<tr>
<td></td>
<td>2=Severe</td>
</tr>
<tr>
<td><strong>Buck teeth</strong></td>
<td>0=Normal</td>
</tr>
<tr>
<td></td>
<td>1=Moderate</td>
</tr>
<tr>
<td></td>
<td>2=Severe</td>
</tr>
</tbody>
</table>

- Head movement assessed with pencil taped to a patient’s forehead.
- IG = Interincisor gap measured with mouth fully open.
- SLux = Maximal forward protrusion of the lower incisors beyond the upper incisors.
Indications for Intubation

• Is there failure of airway maintenance?
• Is there failure of airway protection?
• Is there failure of oxygenation or ventilation?
• What is the anticipated clinical course? (i.e., expected deterioration, long transport, long time in radiology, etc.)
Clinical Signs of Airway Compromise: Threatened Patency

- Inspiratory stridor
- Snoring (pharyngeal obstruction)
- Gurgling (blood/secretions)
- Drooling (epiglottitis)
- Hoarseness (laryngeal edema/vocal cord paralysis)
- Paradoxical chest wall movement
- Tracheal tug
- Mass - abscess, hematoma, angioedema
Clinical Signs of Airway Compromise: Inadequate Protection

- Blood in upper airway
- Pus in upper airway
- Persistent vomiting
- Loss of protective airway reflexes
  - swallowing reflex is superior to gag reflex
Clinical Signs of Airway Compromise: Oxygenation and Ventilation

- Central cyanosis
- Obtundation and diaphoresis
- Rapid shallow respirations
- Accessory muscle use
- Retractions
- Abdominal paradox
Intubation

• Equipment
  ◦ TRAINED ASSISTANT
  ◦ Laryngoscopes with a selection of blades
  ◦ Variety of endotracheal tubes
  ◦ Introducers for endotracheal tubes (stylets or flexible bougies)
  ◦ Oral and nasal airways
  ◦ A cricothyroid puncture kit
  ◦ Reliable suction equipment
  ◦ Laryngeal mask airways, sizes 3 AND 4

• Intubation is attempted by optimal direct laryngoscopy;
  ◦ optimal head and neck positioning
  ◦ optimal muscle relaxation
  ◦ optimal laryngoscope blade
  ◦ optimal external laryngeal manipulation
  ◦ optimal use of the bougie
• After intubation correct placement of the tube should be confirmed by:
  – Observing the tube pass through the cords
  – Successful inflation of the chest on manual ventilation
  – Auscultation over both lung fields in the axillae
  – Capnograph
  – If in doubt – take it out
Technique of Laryngoscopy

- “Sniffing” position to align oral-pharyngeal-laryngeal axis
- Flex neck by placing pillow beneath occiput (raise 10 cm)
- Extend head maximally
- With laryngoscope
  - open mouth fully
  - push tongue to left out of view
  - pull upward at 45 degrees
Adducted vocal cords
Plan A: Initial tracheal intubation plan

Direct laryngoscopy succeeded → Tracheal intubation

failed intubation

Plan B: Secondary tracheal intubation plan

ILMA™ or LMA™ succeeded → Confirm then fiberoptic tracheal intubation through ILMA™ or LMA™

failed oxygenation

Plan C: Maintenance of oxygenation, ventilation, postponement of surgery and awakening

Revert to face mask Oxygenate & ventilate succeeded → Postpone surgery Awaken patient

failed oxygenation

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation

LMA™ succeeded → Awaken patient

improved oxygenation

Increasing hypoxaemia → Cannula cricothyroidotomy or Surgical cricothyroidotomy

fail
PERIOPERATIVE (Intraoperative + postoperative) COMPLICATIONS OF GA

- Maximum no. of complications occur during maintenance period necessitating the significance of vigilance

- Most anaesthetic complications occur because of human errors
1. Pulmonary Aspiration of gastric contents (Preventable complication)

Predisposing factors
- Depressed consciousness
- Full stomach
- Conditions ↓ lower oesophageal sphincter tone
  - Pregnancy (Progesterone relaxes LES, impaired gastroesophageal angle)
    - Hiatus hernia
    - Nasogastric tubes
    - Obesity
- Atropine, glycopyrolate
- Dopamine
- Sodium nitroprusside
- Halothane
- Thiopentone
- Opoids
- Ganglion blockers
Condition ↓ gastric emptying
DM
Hypothyroidism
Narcotics
Anxiety, pain

Risk factors
- Gastric content >25ml
- pH <2.5
- Type of gastric aspirate - Liquid less dangerous than solids)
High pH less dangerous low pH

Signs & symptoms
- Tachycardia
- Tachypnea
- Coughing
- Wheezing
- Cyanosis’ Hypoxia - most reliable in GA Pulmonary edema
Prevention:

- Nil orally
- Antacids + metoclopramide + H2 blockers
- Regional preferred over GA

GA: Rapid sequence induction (RSI)

Preoxygenation —> Induction - Ketamine/thiopentone —> Suxamethonium - Bag & mask ventilation C/I and Sellick’s manoeuvre (cricoid pressure)
• **Indication for RSI or C/I for B & M vent**
• Full stomach
• Pregnancy
• Intestinal obstruction
• Obesity
• Abdominal tumour / ascites
• Diabetes
• Hiatus hernia
• N-m disease
• Diaphragmatic hernia
• Tracheoesophgeal fistula
• Meconium aspiration syndrome
• Pyloric stenosis
Awake extubation
2. Hypoxia
Causes
i. Airway obstruction - most common cause is tongue fall Rx
   - Backward head tilt & anterior mandible displacement
   - Airways
   - Assisted ventilation
   - Intubation

ii. Low FIO2- decreased supply

iii. Hypoventilation
   - Drugs (CNS sedatives)
   - Inadequate reversal
   - Pain
   - Obesity
   - Gastric dilatation

Rx: treat the cause
iv. V/Q mismatch
- Atelectasis - most common respiratory complication and most common cause of atelectasis is secretions

v. Pulmonary edema

vi. Diffusion hypoxia

vii. Pneumothorax

viii. LARNGOSPASM - most common cause is secretions

Treatment -
- IPPV
- Suxamethonium

ix. Hypercarbia and hypocarbia
CARDIOVASCULAR
1. Hypotension

Cause -
   i. Blood loss

To prevent: DELIBRATEMNDEDXCONTROLLED HYPOTENTION (Reduction of systolic BP to 80-90 mm Hg or mean arterial pressure to 50-65 mm Hg or reduction of BP by 1/3 of its preoperative value)

Techniques
   1. Spinal & epidural
   2. Inhaled anaesthetics
      Halothane
      Isoflurane
      Enflurane
   3. Vasodilators
Sodium nitroprusside acts on arterioles very dangerous S/E cyanide poisoning

Rx sodium nitrite
Sodium thiosulfate

—> Nitroglycerine act on veins-can cause methhemoglobinemia

Sodium nitroprusside & NTG are most commonly as infusions.

4. Ganglion blockers
5. \( \alpha \) Blockers
6. \( \beta \) Blockers
7. Calcium channel blockers
8. POE I
9. \( \alpha+\beta \) Blockers (Labetalol):

Systemic effects: No organ dysfunction occurs if systolic BP is maintain at 80mm Hg & map at 50 mm Hg & MAP at 50-65 mm Hg

ii. Inadequate volume replacement
iii. Septicaemia
iv. ↓ C.O
2. Hypertension
Causes -
- Pain
- inadequate depth of anaesthesia
- Hypoxia
- Hypercapnia
- Pre-existing HT
- increase Fluids

3. Arrhythmias
Most common is TACHYCARDIA
Most common cause of tachycardia in intraoperative period is inadequate depth of anaesthesia while in post operative period it is most commonly due to pain and anxiety.

4. Myocardial ischemia

5. Cardiac arrest (82% has been reported to occur during induction)
• NEUROLOGICAL

• Convulsions

• -hypoxia
• - Drugs
  • methohexitone
  • enflurane
  • sevoflurane
  • atracurium
  • local anaesthetics
• Awareness- most common auditory
• Prevention
  • - Benzodiazepines
  • - Inhalational agents
Delayed recovery

Causes:
- Sedatives
- Inadequate reversal
- Electrolyte imbalance
- Hypoglycaemia
- Blood gas abnormality
- i.e. H’ge
GIT

Nausea & vomiting - Most common post op. complication

ANAPHYLATIC REACTIONS

-Most common cause of anaphylaxis in perioperative period is antibiotics
  - Among anaesthetic agents 60-70% of anaphylactic reactions are because of muscle relaxants.
  - Anaphylactic reactions does not occur with inhalational agents

Thermal

Hypothermia is very common thermal abnormality during anaesthesia
Hyperthermia – rare