



Round : Anesthesia - Lecture 2

Group no : B 8

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Types of anesthesia

▶ Local Anesthesia

Used for minor cut wounds and localized injuries

▶ Regional Anesthesia

- Spinal anesthesia : injected into the spinal fluid Into the CSF
- Epidural anesthesia : outside the spinal column {epidural space}

▶ General Anesthesia

when performing it, the triad of general anesthesia needs to be achieved including:

1. Hypnosis (loss of consciousness). 2. Analgesia. 3. Muscle relaxation (to get rid of reflexes.)

★ In general, Muscle relaxation is not always a goal. Examples, In D&C surgeries, muscle relaxation is not required since it is a short procedure. + In pediatric hernia repair surgeries, abdominal muscles are weak so muscle relaxants are not required. + During delivery, muscle contractions are needed to remain active.

General Anesthesia

- ▶ General anesthesia is a reversible state characterized by loss of reception and perception of stimuli. Important effects seen in general anesthesia are sedation, reduced anxiety, lack of awareness and amnesia, skeletal muscle relaxation, suppression of protective reflexes and analgesia

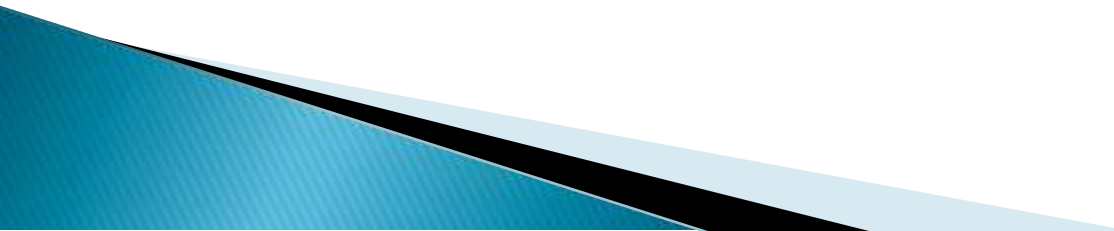
General Anesthesia

Modern **General anesthesia** is based on the ability to provide adequate:

- 1- hypnosis
- 2- analgesia
- 3- muscle relaxation
- 4- amnesia

during **surgical procedures** while maintaining the patient's **normal physiological functions**.

(hemodynamic stability, oxygenation, ventilation, temperature)

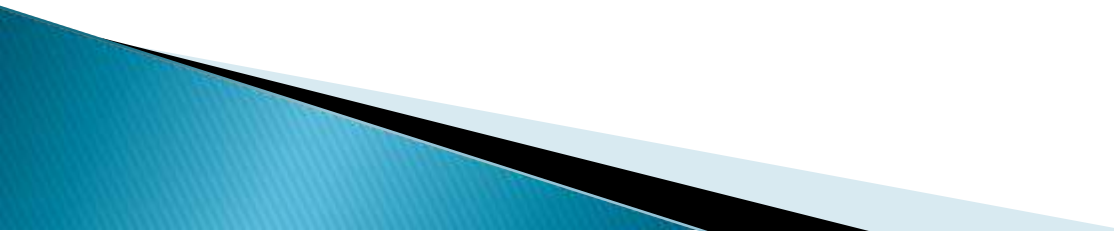


Characteristics of Ideal General Anesthetics

Not a single drug has all the following characteristics so we need to combine multiple drugs together.

- ▶ Rapid onset of action (e.g. propofol will produce unconsciousness in 30 seconds)
- ▶ pleasant odor and **non-irritant** to the respiratory tract.
- ▶ Minimal adverse effects on liver, heart, and other organs
- ▶ Should achieve the triad of anesthesia i.e. induce **unconsciousness**, **analgesia** and preferably some degree of **muscle relaxation**

We need to pay attention to the cost of the drugs too.



MODERN ANESTHESIA IS A COMBINATION OF:

Our choice on which drugs to use depends on the patient's characteristic, for example: if a patient has asthma, which can be triggered by muscle relaxants, we need to choose the safest one of them that causes the least histamine release.

IV and inhaled agents for induction and maintenance of anesthesia

- **IV** : → The most commonly used IV drug Propofol , → Good for asthmatic patients since it causes bronchdilation ketamine , Sodium Thiopental , etomidate , TIVA; total intravenous Anesthesia propofol + Rimefentanil
- **INHALED** : Sevoflurane (most commonly used inhaled agent / works rapidly and recovers rapidly)

2- **Muscle relaxants** (e.g. rocuronium, vecuronium , succinylcholine, cisatracurium/ Nimbix , atracurium).

3- **Analgesics** (e.g. opioid , fentanyl).



Ketamine Injection

PHASES

- ▶ Induction (stages 1,2)
- ▶ Maintenance (stages 3,4,5)
- ▶ Emergence / Recovery (reverse from 3 to 2 to 1)

STAGES

- ▶ Stage 1 (giving agent- loss of consciousness)
- ▶ Stage 2 (loss of consciousness – regain autonomic stability {temp. BP. Breathing} / Hyper excitable state)
- ▶ Stage 3 (Normal autonomics – drug overdose)
 - 4 planes:
 - eye rolling- fixed
 - Loss of corneal and laryngeal reflexes
 - Pupils dilates
 - Intercostal paralysis / short shallow abnormal respiration
- ▶ Stage 4 (overdose / decrease Breathing. Autonomic instability)
- ▶ Stage 5 (overdose / heart stops)

Stage 1: Conscious sedation (analgesia)

some surgeries are done within this stage when we need to calm the patient. Or used when a patient is anxious and needs to undergo urgent MRI or a stitch.

Stage 2: Hyper-excitability stage (transient)

The patient here shifts from awake stage to sleeping stage, it lasts for a short period of time but it's associated with tachycardia, tachypnea and hypertension.

Stage 3: Surgical anesthesia

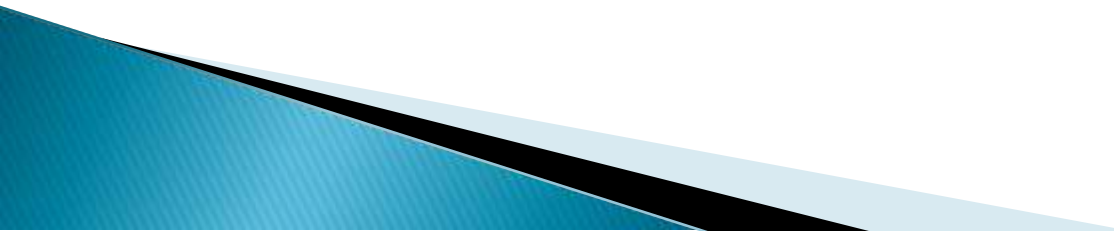
It's the stage we aim to reach with general anesthesia. Here we achieve hypnosis, analgesia and relaxation. In this stage, we might have some degree of respiratory depression but NOT apnea. ★ Apnea only occurs in stage 4

Stage 4: overdose stage

Giving an overdose of anesthesia which causes the respiratory centre to shut and causes apnea.

Stage 5: Cardiac arrest

INDUCTION

- ▶ This phase is between the time of administration of an anesthetic to the development of effective anesthesia[eg;LOC].
 - ▶ Induction of anesthesia with an **intravenous agent** (e.g. propofol will produce unconsciousness in 30 seconds. For achieving the depth of anesthesia, some drugs are added to the anesthetics either by inhalation or intravenous routes. For example, **neuromuscular blockers** like succinylcholine are administered to achieve sufficient **muscle relaxation**.
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INDUCTION

- ▶ Once in circulatory system, they are transported to their biochemical site of action in central and autonomic system, where they exert their pharmacological function.

INDUCTION

- ▶ Induction depends on how fast effective concentrations of the anesthetic drug reach the brain
- ▶ Onset of anaesthesia is faster with intravenous injection than with inhalation, **taking about 10–20 seconds** to induce total unconsciousness. In most cases, IV drugs are used for induction, while inhalational drugs are used for maintenance.
- ▶ Commonly used **intravenous induction agents** include propofol, sodium thiopental, etomidate, and ketamine.

- Although propofol is the most commonly used anesthetic drug, but in patients with hypovolemic shock, day case and stitching after delivery, it is better to use thiopental since it produces less respiratory depression than propofol.
- In patients with hypotension ketamine is better than thiopental and propofol since it elevates the BP.
- In asthmatic patients, we prefer ketamine if not available then propofol.

INDUCTION

- ▶ Thiopental sodium is the barbiturate used for IV induction of **anesthesia** in cardiac surgery. It is **the only ultra-short-acting drug** that is used for induction.
- ▶ SEVOFLURANE is currently the **most commonly used agent for inhalational induction** because of the **rapid onset & recovery** from it Causes no respiratory irritation as it does NOT have a pungent smell.

INDICATIONS OF INHALITONAL INDUCTION

1-Difficult IV access .

2-Difficult Airway to maintain:

- Upper or lower Airway Obstruction (e.g. epiglottitis)
- Bronchopleural fistula
- Empyema.

3-Young children.



In young children, it is very difficult to have an IV access so we use inhalational drugs for both induction and maintenance

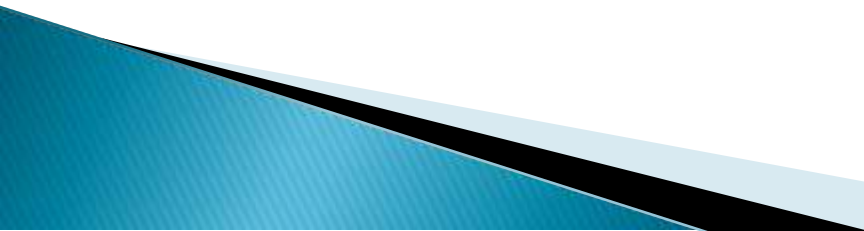
☆ On the other hand, patients who are susceptible to malignant hyperthermia need to use IV drugs for both induction and maintenance.

INHALATION INDUCTION

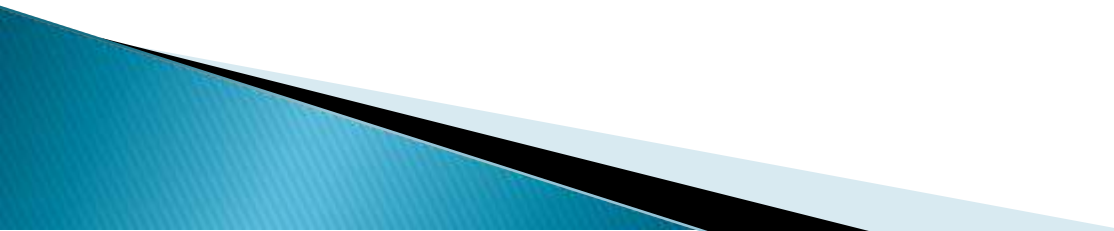
▶ Difficulties and complications :

1. Slow induction of anesthesia.
2. Airway obstruction and bronchospasm.
3. Laryngeal spasm .
4. Environmental pollution.

▶ Advantages over IV agents:

1. The depth of anesthesia can be rapidly altered by changing the concentration of the drug.
 2. **Reversible.**
 3. **Rapidly eliminated by exhalation.**
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Maintenance

- ▶ It includes providing **Continuous and sustained anesthesia**.
 - ▶ INHALITIONAL: A mixture of oxygen, Sevoflurane, and nitrous oxide are commonly used agents for the maintenance of anesthesia.
 - ▶ sevoflurane has some **bronchodilatory** effects that are valuable in preventing bronchospasm
 - ▶ IV infusion: propofol
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MAINTINENCE

1. **Inhalational** agents: Sevoflurane, Isoflurane but also Halothane in a mixture of nitrous oxide 70% in oxygen

Best for neurosurgeries, because it's the least likely to elevate ICP.
High CO_2 in the brain causes elevation in ICP so we aim to reduce it in neurosurgeries by increasing minute ventilation

2. **IV anesthetic** agents. If we use IV drugs for maintenance, we administrate it in doses less than doses used to induce it

3. **IV opioids** (Fentanyl, Alfentanil, Remifentanil)
▶ (alone or combinations) Most commonly used.

Opioids generally cause cardiorespiratory depression

For special conditions :

Ephedrine – increase BP

In cases of hypotension: decrease gases which reduces venodilation, we could give ketamine or give fluids.

Atropine – increase HR In cases of bradycardia

Adrenaline – in case of Asystole

In cases of hypertension: we do the opposite, could give hypertension drugs. Decrease fluids, and stop ketamine if it was given. Sometimes it could be due to pain, so we need to give analgesic.

- Tachycardia could be due to arrhythmias, certain gases, pain and fever.

RECOVERY

We turn off the ventilator, it results in increased CO₂, which stimulates the respiratory system. The strongest stimulator of the respiratory system in the brain is CO₂. So we induce hypercapnia for that.

- ▶ This is the time from the **discontinuation of anesthetic until consciousness and reflexes return**.
 - neostigmine + atropine are given together. Atropine mainly is administered to antagonize the cholinergic side effects of neostigmine .
- ▶ The patient is monitored until return of normal physiologic functions.
- ▶ It usually takes about 45 minutes to an hour to **recover completely from anesthesia**. In some cases, this period may be longer depending on medications given during or **after surgery**.
- ▶ **recovery , depends on how fast the anesthetic drug diffuses from the brain**

IV ANESTHETICS

When inducing anesthesia, we give the drug as it is. But when we are performing maintenance, we dilute the drug

A. Advantages:

1. Rapid onset.
2. Depression of pharyngeal reflexes allows early insertion of Laryngeal mask airway (LMA).  Propofol
3. Anti-emetic and anti-convulsive properties.  Thiopental and propofol (status epilepticus)

▶ B. Disadvantages:

1. Venous access required.
2. Risk of hypotension.
3. Apnea common.
4. Loss of airway control.
5.  Anaphylaxis.
 - Propofol contains materials that can induce allergies, and it needs to be used shortly before it becomes chemically altered because then it can cause infections.
 - The most common anesthetic drugs that cause anaphylaxis are muscle relaxants, mainly atracurium. Treat with epinephrine.
 - second most common cause is latex allergy, treat with hydrocortisone.

INHALATIONAL ANESTHETICS

1. Avoids venopuncture.
 2. Respiration is maintained.
 3. Slow loss of protective reflexes.
 4. End-tidal concentration can be measured.
 5. The depth of anesthesia can be rapidly altered by changing the concentration of the drug.
 6. Rapidly eliminated by exhalation.
 7. Upper esophageal sphincter tone maintained.
1. Slow process.
 2. Potential excitement phase.
 3. Irritant and unpleasant, may induce coughing.
 4. Pollution.
 5. May cause a rise in ICP/IOP.

Inhalational Anesthetics

inhalational anesthetics are commonly used as an induction and maintenance agent. The speed of induction of anesthetic effects depends on factors like:

- > **Solubility** ↑ Potent gas
- > **Inspired gas partial pressure** ↑
- > **Ventilation rate** ↑ In pediatric patients mainly
- **Pulmonary blood flow** ↑
- **Keep in mind we can't use inhalational induction if there is any abnormal or obstruction in airway**

- ▶ Induction depends on how fast effective concentrations of the anesthetic drug reach the brain.-
----- **Preoxygenation!!!**
- ▶ While **recovery** , depends on how fast the anesthetic drug diffuses from the
brain.----- **diffusion hypoxia!!!**

▶ **Pre oxygenation** (think about between stage 1 and 2)

- Giving 100% O₂ prior to intubation
- increase lung functional residual capacity
- Main mechanism : **Denitrogenation** (washing Nitrogen out)
 Aim of pre-oxygenation.
- Induction depends on how fast effective concentrations of the anesthetic drug reach the brain
FRC; functional residual capacity in the lungs reaches 100% in order to provide more time for intubation and to make it less likely for the patient to reach a desaturated status quickly.

▶ **Diffusion hypoxia**

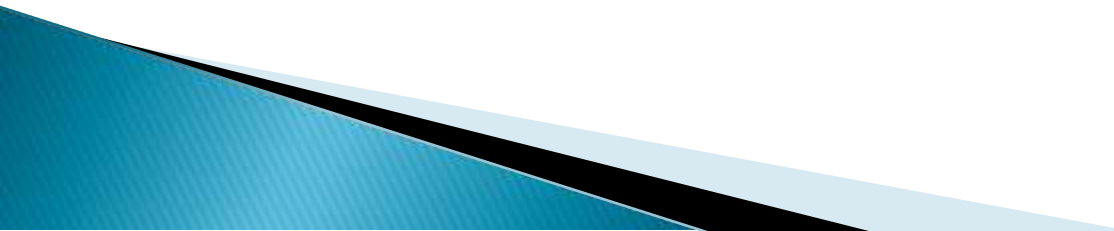
- While recovering from N₂O anaesthesia,
- Large quantities of this gas cross from the blood into the alveolus (down its concentration gradient)
- O₂ and CO₂ in the alveolus are **diluted** by this gas for a short period of time
- Hypoxia



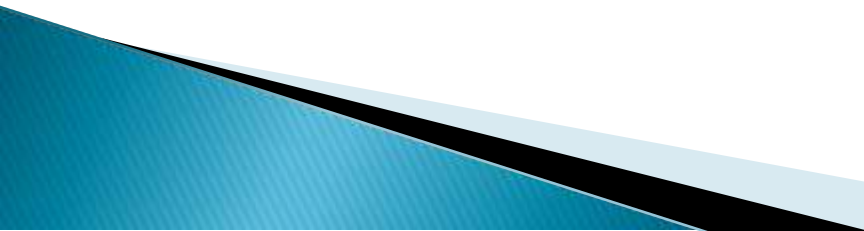
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PROCEDURE

It's important to administrate anxiolytics prior to the intervention to relax the patient. Mainly we use midazolam since it also results in anterograde amnesia. (inhalational drugs result in it too). If the patient is relaxed then we eliminate the chances of having stress-induced hypertension.

- ▶ The mask or hand is introduced gradually to the face from the side.
 - ▶ While talking to the patient & encouraging him to breathe deeply the anesthetist adjusts the mixture of gas flow & observes the patient's reaction.
 - ▶ initially N₂O 70% in O₂ is used.
 - ▶ immediate 8% sevoflurane in 70% nitrous oxide in oxygen.
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PROCEDURE

5. Anesthesia deepened by gradual introduction of a **volatile agent**. (e.g. halothane 1-3%).
 6. A single breath technique for patients who are able to cooperate.
 7. Observe the color of patient's skin, pattern of ventilation, palpate peripheral pulses, monitor ECG & spO₂.
 8. Insertion of an **oropharyngeal airway**, a **laryngeal mask airway** or **tracheal tube** may be considered when anesthesia has been established
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In young Children;

- ▶ Allow them to play with mask before connecting anesthetic tube.
- ▶ Delivery tube may be preferred.



➤ Difficulties and Complications:

1. **Airway obstruction**

2. **Laryngeal spasm**

- Recurrent laryngeal nerve is what provokes laryngospasm and bronchospasm, often due to saliva.

➤ **Cause: stimulation during light Anesthesia.**

➤ **Treatment: stop stimulation, gently deepen anesthesia >> 100%O₂ is applied with face mask.** + open airway with jaw thrust.

If non worked then give succinylcholine (last option)

➤ **If severe >> 100%O₂ is applied with face mask, I.V. *suxamethonium* .**

→ ☆ (Scoline), it is the drug of choice for the rapid sequence induction

➤ **suxamethonium :succinylcholine, used to cause short-term paralysis as part of general anesthesia ,It is given either by **injection** into a vein or muscle.**

3. Bronchospasm

- ▶ **Cause:** Allergy, smokers, Irritants, upper respiratory infection
- ▶ **Treatment:** increasing the depth of anesthesia with additional induction agent or volatile agent, or by administering IV or endotracheal lidocaine (local anesthetic) 1-2 mg/kg. **warming of gases, bronchodilators.**

4. Malignant hyperthermia:

Patients who are susceptible of having malignant hyperthermia are given TIVA drugs

- ▶ **Cause:** volatile Anesthetics(halothan, suxamethonium and local anesthetics are triggering substances). All gases except nitrous oxide, results in hyper-metabolic status
First sign of it is high tidal CO₂
- ▶ **Treatment:** Dantrolene IV(muscle relaxant that decrease excitation-contraction of muscles)
- ▶ **5. Raised intracranial pressure(Inhalational to IV)**

Airway maintenance delivery of inhalation agents



1. Face Mask:

2. Laryngeal Mask (LMA)



Doesnt give positive pressure in COPD patients,, cause it goes to the stomach if the pressure is high

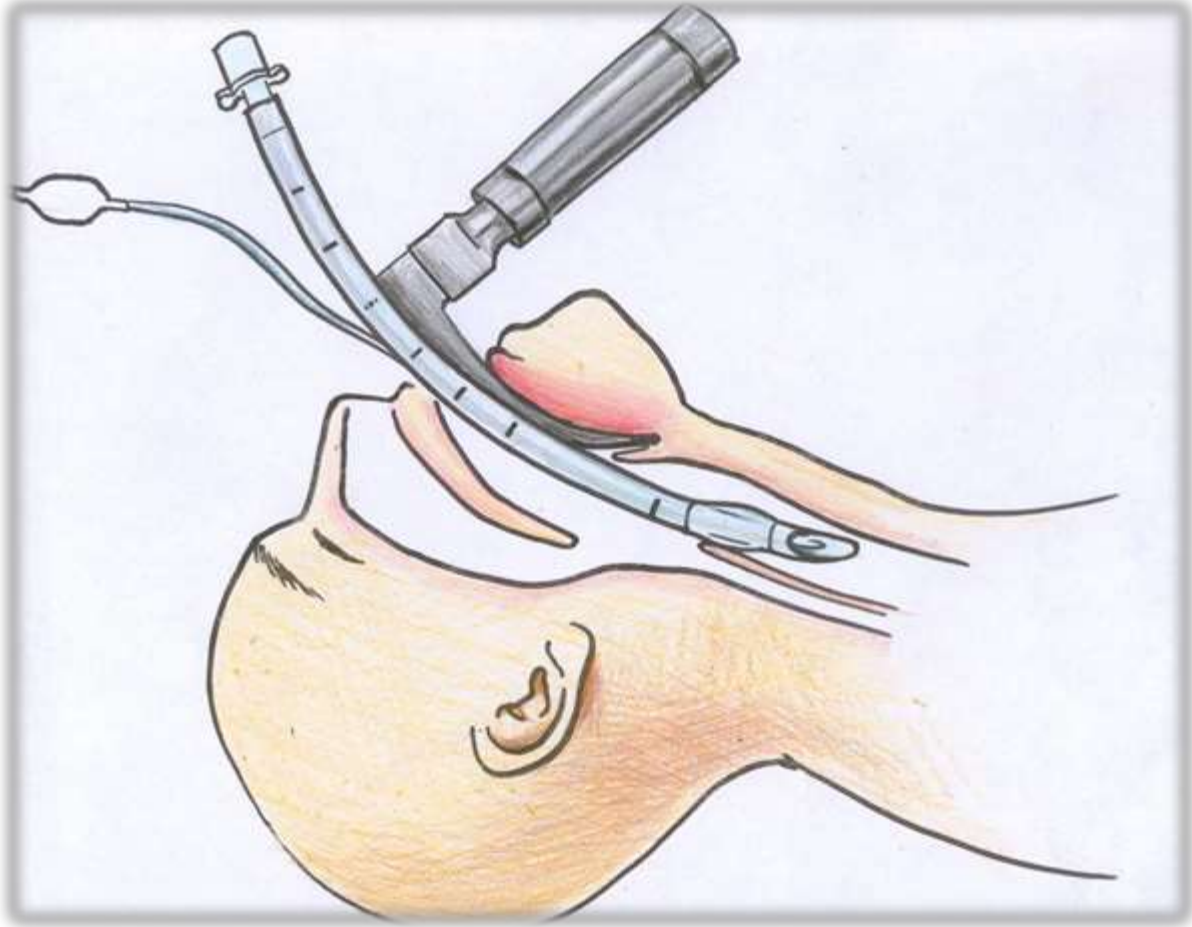
Indications of LMA:

- a. Provide clear airway without the need to support a mask.
- b. Avoid the use of tracheal intubation during spontaneous ventilation.
- c. In a case of difficult intubation , to facilitate subsequent insertion of a tracheal tube

Contraindications of LMA:

- a. Full stomach or any condition lead to delayed gastric emptying.
 - b. Possible regurgitation .
 - c. Surgical access is Impeded By the cuff of the LMA .
 - d. Thoracic surgery.
 - e. an unusual position (Prone
- 

3. tracheal intubation.



➤ Preparation:

1. The anesthetist must check the availability and function of the necessary equipment.
2. should have a dedicated and experienced assistant.
3. laryngoscopes of the correct size are chosen.
4. patency of tracheal tube is checked.

— extubation is the most critical, since there is a high chance of spasms.

So we remove the tube either while the patient is in a deep sleep, or fully awake.

Indications:

1. Provision of a clear airway .
2. Surgical procedures in which the anesthesiologist cannot easily control the airway (e.g., prone, sitting, or lateral decubitus procedures).
3. Head and neck operation (nasotracheal tube).
4. Protecting the respiratory tract from aspiration of gastric contents
5. Suction of the respiratory tract.

We can give drugs through the tube if a patient came to the ER but IV access is not possible, these drugs are:

1. Atropine
2. Naloxone
3. Vasopressin
4. Epinephrine.
5. Oxygen

} Give double the IV dose + 10 cc of normal saline

* In pediatrics, we could give lung surfactant through the tube.

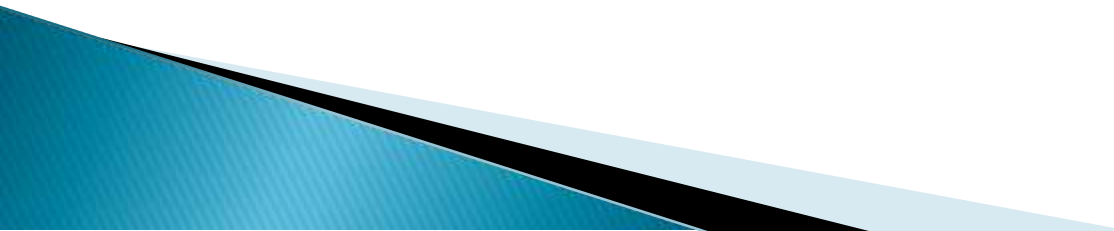
6. Surgical procedures within the cranium, chest or abdomen.
 7. Protecting a healthy lung from a diseased lung to ensure its continued performance (e.g. hemoptysis, empyema & pulmonary abscess).
 8. Severe pulmonary and multisystem injury associated with respiratory failure (e.g., severe sepsis, airway obstruction, hypoxemia).
 9. Positive-pressure ventilation Even in COPD patients
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Table 2. Methods of Supporting the Airway

	Bag and Mask	Laryngeal Mask Airway (LMA)	Endotracheal Tube (ETT)
Advantages/ Indications	• Basic • Non-invasive • Readily available	• Easy to insert • Less airway trauma/irritation than ETT • Frees up hands (vs. face mask) • Primarily used in spontaneously ventilating patient	"The 5 P's" • Ensures airway Patency • Protects against aspiration • Allows Positive pressure ventilation • Allows suctioning i.e. "Pulmonary toilet" • A route for Pharmacological administration
Disadvantages/ Contraindications	• Risk of aspiration if ↓ LOC • Cannot ensure airway patency • Inability to deliver precise tidal volume • Operator fatigue	• Risk of gastric aspiration • PPV > 20 cm H₂O needed • Limited TMJ mobility • C-spine or laryngeal cartilage fracture • Oropharyngeal, retropharyngeal pathology or foreign body	• Insertion can be difficult • Muscle relaxant usually needed • Laryngospasm may occur on failed intubation or extubation • Sympathetic stress due to intubation
Other	• Facilitate airway patency with jaw thrust and chin lift • Can use oropharyngeal/nasopharyngeal airway	• Does NOT protect against laryngospasm or gastric aspiration • Sizing (approx): 40-50 kg: 3 50-70 kg: 4 70-100 kg: 5	• Auscultate to avoid endobronchial intubation • Sizing (approx): Male: 8.0-9.0 mm Female: 7.0-8.0 mm Pediatric: (age/4) + 4 mm

Monitoring of anesthesia

A) Routine monitoring technologies :

- 1- Continuous Electrocardiography (ECG): monitor Heart **rate** and **rhythm** + The effect of the drugs we administrated on the cardiac system
- 2- Continuous pulse oximetry (SpO₂): early detection of a fall in a patient's hemoglobin saturation with oxygen (**hypoxemia**) It relays on red and infra-red light

★ It is the most important monitor

The most common cause of the pulse oximeter indicating desturation is when the pulse oximetre is not detecting correctly (it couldve been moved by the surgeon, lights are affecting it), other causes are that the patient is asthmatic, has anemia, a smoker or has an upper airway problem, cuff pressure is still applied, accidental extubation, hypothermia (peripheral vasoconstriction). Or that the tube is inserted too much; mostly to the right since it is more in line with the trachea, shorter and wider.

3- Blood Pressure Monitoring (NIBP):

Non-invasive blood pressure regularly during the surgery.

Invasive one is used in major surgeries and unstable cases



4 - Agent concentration measurement

- ▶ Common anesthetic machines have monitors to **measure the percent of inhalational anesthetic** agent used (e.g. sevoflurane, isoflurane, desflurane, halothane etc.).
- ▶ The monitors also usually measure nitrous oxide and oxygen percentages.

5- Carbon dioxide measurement ★ The most important method to insure a correct intubation

(capnography): measures the amount of

 **carbon dioxide** expired by the patient's lungs in percent or mmHg, mmHg is usually used to allow the anesthesia provider to see more subtle changes in CO₂. It allows the anesthetist to assess the **adequacy of ventilation.**

Extra important in orthopedic surgeries to detect PE. (First sign is a drop in CO₂ since there is ventilation but no perfusion and exchange. If CO₂ level is zero on the capnography, then it indicates a cardiac arrest)

6- Temperature measurement:

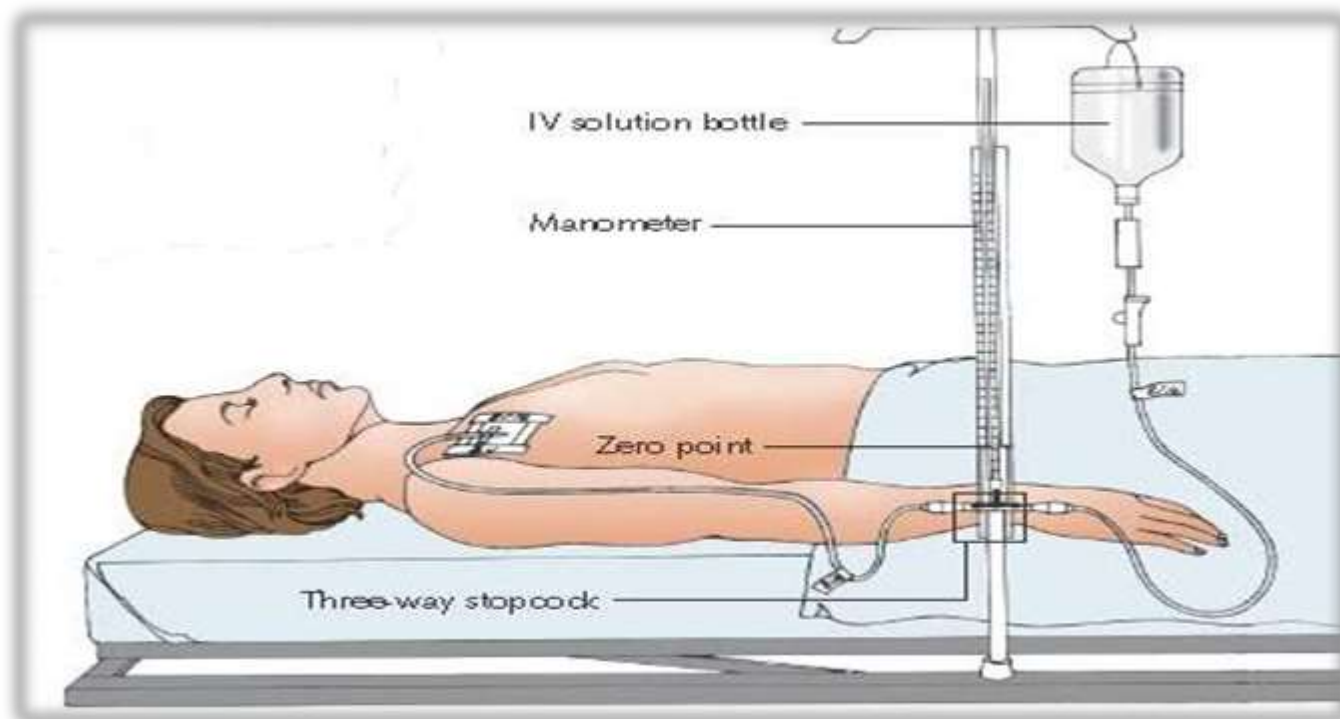
to discern **hypothermia** or **fever**, and to aid **early detection of malignant hyperthermia.**

 Can indicate the presence of any infections + reduces the activity of some drugs mainly muscle relaxants.

 Very bad, can cause coagulation problems + results in cardiac arrhythmias
Also increases the risk of infections.

**Central Venous Pressure monitoring (CVPM)

Monitors the preload (venous return)



THANK YOU

