

# ANESTHESIA



435

## General anaesthesia technique

{Color index: **Important**★ | **Notes** | **Book** | **433 Notes** | Ex tra | [Editing File](#)}

### Objectives:

- Define General Anesthesia.
- Learn about several equipment, adjuncts and agents used for induction of general anesthesia including intravenous agents, inhalation agents, neuromuscular blocking agents and reversal agents.
- Understand basic advantages and disadvantages of these agents.
- Complications commonly encountered during general anesthesia.

**Done by:** *Nojood Alhaidri & , Dania AlHindawi*

**Revised by:** *Samar AlOtaibi & Dalal AlHuzaimi*



# General anaesthesia technique

## ★ What is anaesthesia?

- “Without sensation” 1846 by Wendell Holmes to describe ‘state of sleep from ether’.
- Early drugs:
  - opium, alcohol, cocaine, N<sub>2</sub>O (1844) & CO<sub>2</sub>, ether (1846, Morton in Boston), chloroform (1847, Simpson), NMBDs (1942), halothane (1956), thiopental, propofol, iso/sevo/des-flurane (we use them nowadays)
- General anesthetics have been used since 1846 when Morton demonstrated the first anesthetic (using ether) on 16th of Oct 1846 in Boston, USA.
- Local anesthetics arrived later, the first being scientifically described in 1884.

## ★ Definitions:

Term	Definition
<b>General anesthesia</b>	<ul style="list-style-type: none"> <li>- A state of reversible unconsciousness, analgesia, and amnesia with skeletal muscle relaxation (neuromuscular blocking agents) and loss of reflexes, which induced by pharmacological agents in a reversible manner.</li> <li>- In orthopedic and peripheral surgeries we don't give muscle relaxant</li> </ul>
<b>Inhalation anesthesia</b>	Anesthesia induced by inhalation of drug.
<b>Minimum alveolar concentration (MAC)</b>	<ul style="list-style-type: none"> <li>- The alveolar concentration required to eliminate the response to standardized painful stimulus in 50% of patients.</li> </ul>
<b>Analgesia (Opioids)</b>	Stage of decreased awareness of pain sometimes with amnesia.
<b>Balanced anesthesia</b>	Anesthesia produced by a mixture of drugs (low doses), often including both inhaled and intravenous agent.

**“An anaesthesiologist is a superman doctor; not just in the operating room”, you can find them in:**

<ul style="list-style-type: none"> <li>- Operating room (hospital, surgicenter)</li> <li>- Other procedural areas</li> <li>- PACU post anaesthesia care unit</li> <li>- Emergency medicine</li> <li>- Respiratory therapy</li> <li>- Administration (operating room, hospital, medical school)</li> <li>- Research</li> </ul>	<ul style="list-style-type: none"> <li>- Labor &amp; delivery suit</li> <li>- Intensive care unit (ICU)</li> <li>- Pain management (acute pain, chronic/cancer pain)</li> <li>- “Code blue” team</li> <li>- Education (health professionals, public)</li> <li>- Managers</li> </ul>
---	---

★ **General Anesthesia Goals: Primary goal:**

- Oxygenation
- Monitoring
- Hypnosis: Unconscious state
- Autonomic Block: Reflexes blocked: All autonomic nervous system functions are retained during anesthesia, such as vasodilation and vasoconstriction, except for skeletal muscle reflexes which are inhibited by muscle relaxant.
- Ventilation: in anesthesia ventilation related to CO2 exhalation.
- Amnesia: patient should forget any unpleasant feeling. (anterograde amnesia) during anesthesia patient should not remember anything happened during surgery, but retain previous memories.
- Analgesia: No pain sensation
- Optimal conditions: all the above along with good muscle relaxation.

**SAFETY AND PATIENT CARE IS THE PRIORITY**

★ **Assessment:**

- Planning I: Monitors
- Planning II: Drugs
- Planning III: Fluids
- Planning IV: Airway Management

★ **Process of Anesthesia:**

- Premedication: Drugs given to the patient before arriving to the theater in the pre-induction period ( 2 hours before surgery) such as lorazepam
- Induction
- Maintenance
- Emergence
- Postoperative care

**Preoperative anesthetic evaluation**

**1-Physical status classification:**

<b>Class I</b>	A normal healthy patient. came only for this surgery, no DM, HTN or asthma
<b>Class II</b>	A patient with mild systemic disease (no functional limitation). very well controlled medical illness such as DM or HTN
<b>Class III</b>	A patient with severe systemic disease (some functional limitation) Patients with drug allergies are categorized in this Class
<b>Class IV</b>	A patient with severe systemic disease that is a constant threat to life (functionality incapacitated)
<b>Class V</b>	A moribund patient who is not expected to survive with or without the operation within 24 hours.
<b>Class VI</b>	A brain-dead patient whose organs are being removed for donor purposes
<b>Class E</b>	Emergent procedure ( we add it to the classification ex. Class II E )

## 2-Airway examination:

Patient is in sitting position, one arm distance from you, eyes to eyes contact, then ask him to open his mouth as widely as possible and protrude the tongue.

-The problem with this classification is the interindividual variation, a doctor may say it is class I but the another one consider it as class II.

### Others in examination:

- ★ Check the inter-incisor gap which should be at least 3 fingers, jaw restriction may cause difficult introduction of laryngoscope and the ETT.
- ★ Gliding movement: normally the upper teeth are in front of the lower teeth, if the patient can bring the lower jaw in front of the upper jaw > most likely very easy intubation.
- ★ Thyromental and sternomental distance.
- ★ Observe for neck swelling, restricted neck movement and neck circumference (heavy neck such in obese patient may considered as difficult to intubate)

### Mallampati classification ★



**Class I:** uvula, faucial pillars, soft and hard palate visible



**Class II:** faucial pillars, soft and hard palate visible



**Class III:** soft and hard palate visible



**Class IV:** hard palate visible

## 3-NPO status:

- **NPO**, Nil Per Os, means nothing by mouth.
- **Solid food:** 8 hrs before induction.
- **Liquid:** 4 hrs before induction.
- **Clear water:** 2 hrs before induction.
- **Pediatrics:** stop breast milk feeding 4 hrs before induction (formula milk considered solid food, thicker than the mother's milk)
- Patients in emergency considered as full stomach.

## 4-Anesthetic plan

- **Premed**
- **Intraop. management**
  - General, Airway Management, Induction, Maintenance, Muscle relaxation, Monitoring, Positioning, Fluid management, Special techniques
- **Postop. management**
  - Pain control, PONV(postop. Nausea and vomiting), Complications, postop. ventilation, Hemodynamic mont

## Stages of general anaesthesia (Arthur Ernest Guedel 1937) MCQs

It is very important to know that these stages were introduced in 1937 where there was no IV medication available. So it based on volatile analgesic only!! (diethyl ether or “simply” ether) .

<b>Stage 1</b>	Stage of analgesia start (Joseph Frank Artusio 1954) <ul style="list-style-type: none"><li>❑ <u>Plane 1</u> <b>no</b> amnesia, <b>no</b> analgesia.</li><li>❑ <u>Plane 2</u> amnesia, partial analgesia.</li><li>❑ <u>Plane 3</u> full amnesia and analgesia</li></ul>
<b>Stage 2</b>	Stage of excitement; <b>start from</b> unconsciousness, <b>patient is very agitated</b> , he may have jerky movement, blood pressure up and down, irregular breathing, and sometimes vomiting, stool or urine passage. “Don’t do any painful stimulation in this stage pt will go to laryngeal spasm”
<b>Stage 3</b>	Stage of <b>surgical anaesthesia</b> , this what we need regular breathing and blood pressure <ul style="list-style-type: none"><li>❑ <u>Plane<sup>1</sup> 1</u> <b>regular respiration.</b></li><li>❑ <u>Plane 2</u> eyeball movement, <b>during anesthesia eyeball move lateral and vertical and this stage it rolls around (initially).</b></li><li>❑ <u>Plane 3</u> intercostal muscles <b>paralyzed.</b></li><li>❑ <u>Plane 4</u> diaphragm.</li></ul>
<b>Stage 4</b>	stage of medullary depression; diaphragm paralysis ,4th stage started when the diaphragm become paralyzed, we never want this. It happens when all upper centers (respiratory, cardiac and brain stem) are completely inhibited, pupils fully dilated, no pulse, no BP, no respiration.

## General anaesthesia - INTRAoperative

### ★ General Anesthesia

1. Monitor
2. **Pre-oxygenation<sup>2</sup>**
3. Induction<sup>3</sup> ( including RSI<sup>4</sup> & cricoid pressure)
4. Mask ventilation
5. Muscle relaxants
6. Intubation & ETT position confirmation
7. Maintenance, **continue with oxygen and volatile anesthesia.**
8. Emergence: **awake the patient, do suctioning and extubation**

---

<sup>1</sup> Plane or phase

<sup>2</sup> Before induction the patient must breathe 100% oxygen for at least 3 minutes from a suitable breathing circuit. This will help increase the time apnea period (the pause where the patient stops breathing after administering the medication and intubating). There is now a greater reservoir of oxygen in the lungs to utilize before hypoxia occurs

<sup>3</sup> In children: if there is no IV cannula → inhalation induction is used (sevoflurane). In adults or if there is an IV line → induction is by IV anesthetics.

<sup>4</sup> **Important from airway management lecture:** RSI (Rapid sequence induction): Used in emergencies or with patients who are considered as “full stomach” by applying cricoid pressure + administering medication and pre-oxygenation all at once without bagging to immediately intubate within (30-60 seconds)

Cricoid pressure.

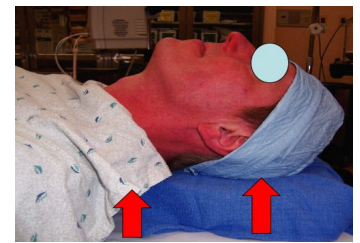
★ **Difficult BMV<sup>5</sup> - MOANS**

<b>M</b>	<b>Mask seal</b>	mask seal requires normal anatomy, absence of facial hair, lack of interfering substances like vomitus or bleeding & ability of apply mask with pressure.
<b>O</b>	<b>obstruction/obesity</b>	Obstruction of upper airway, <b>obesity<sup>6</sup></b> (BMI greater than 26) is an independent marker. Redundant upper airway tissue, chest wall weight & resistance from abdominal contents impede airflow.
<b>A</b>	<b>Age</b>	General loss of elasticity & increased incidence of restrictive /obstructive lung disease with increasing age.
<b>N</b>	<b>No teeth</b>	Edentulous creates difficulty
<b>S</b>	<b>Stiffness</b>	Resistance to ventilation with COPD, Asthma, Pulmonary edema.



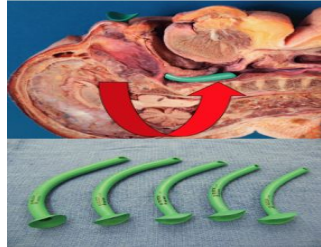
-Maneuvers can help in case of difficult ventilation: chin lift and jaw thrust

★ **Sniffing position (Golden Position):**

The ideal position, Placing a pillow under the patient's head > flexion at cervical spine and extension at The atlanto-occipital joint, with this position all the three axes (oral, pharyngeal and laryngeal axis) become in one line > easier intubation



★ **Mask and airway tools:**

		
Face Mask	oropharyngeal airway (guedel pattern airway) tube like, has a hollow inside - used in unconscious patients to avoid tongue swallowing	nasopharyngeal airways - used in partially conscious patients with intact gag reflexes that will not tolerate oropharyngeal airways.

<sup>5</sup> Bag-Mask Ventilation

<sup>6</sup>In morbid obese (definition of morbid obesity BMI>40) patient with no head extension or neck flexion Nowadays for obese patients: we raise the head to improve the ventilation and we use glidescope for intubation.

## ★ Mask ventilation and intubation<sup>7</sup>

Ventilation techniques: C and E or bimanual technique.

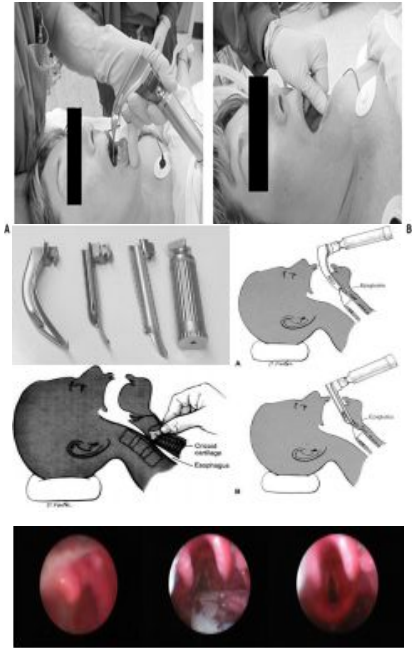
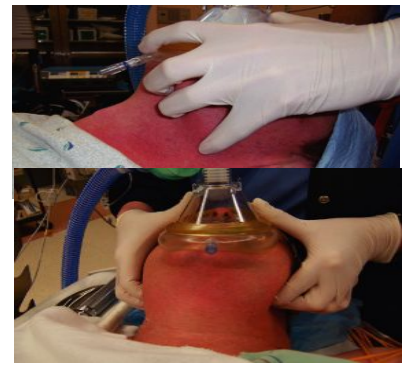
## ★ Intubation

-There are 2 techniques to open the mouth: pressing on the mandible or finger technique.

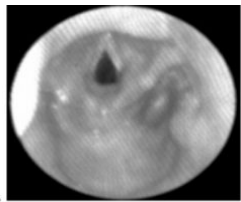
**Regular laryngoscope:** by Holding the Laryngoscope with the left hand go from the right side of the mouth with the laryngoscope blade pushing the tongue to the left side → going deeper, the epiglottis will be visualized at the back of the tongue. At this point lift your handle and up you will see the glottic opening and you will be able to intubate.

- ★ cricoid cartilage is a circular cartilage at the level of C6 vertebral body, when we apply pressure on the cartilage (in RSI) , **it occlude the esophagus therefore prevent aspiration.**

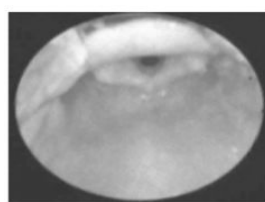
- **Laryngeal View:** (this is the view you come across while doing the intubation).



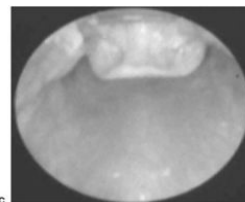
### Laryngeal view scoring system (Cormack-Lehane grading system) ★



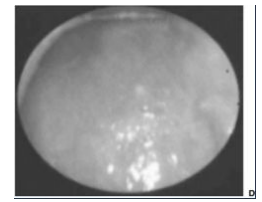
**Grade I:** you can see the epiglottis at the top and the glottic opening (Full view of glottis). Easy intubation.



**Grade II:** the Posterior edge of the epiglottis (posterior commissure of the glottic opening)



**Grade III:** only the tip epiglottis. Difficult intubation.



**Grade IV:** no structure can be seen. Difficult intubation.

<sup>7</sup> OSCE: it has 2 Techniques:

Single handed: by making a C shape with the thumb and index on the mask and E shape on the jaw with the remaining 3 fingers.

Double handed: Using both hands, place the thumb on the mask by pushing and lifting the jaw forward to open the airway. If your hands are small or for obese patients.



## ★ The LEMON approach<sup>8</sup>

<b>L</b>	<b>Look externally</b>	Abnormal facies, unusual anatomy or facial Trauma.
<b>E</b>	<b>Evaluate</b>	(3-3-2 rule): 3 fingers between the incisors, 3 fingers along the floor of the mandible b/w the mentum and the neck mandible junction (If thyromental distance > 6.5cm 3 fingers, the patient will not have difficult intubations) & 2 fingers in the superior laryngeal notch. This predicts difficulty in visualizing the glottis.
<b>M</b>	<b>Mallampati score</b>	III predicts difficulty and IV predicts extreme difficulty.
<b>O</b>	<b>Obstruction / Obesity</b>	-
<b>N</b>	<b>Neck mobility</b>	(If patient can't move his neck he won't be able to do sniff position)

## ★ Difficult airway management:

### → Glidescope:

A blade connected to a video screen to see the glottic opening. Used in: e.g. obese patients and patients with cervical injury → no neck mobilization.

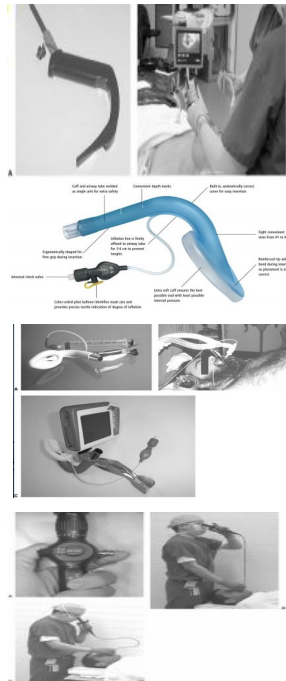
### → LMA<sup>9</sup>:

laryngeal mask airway there are many different types and sizes, used in case of difficult intubation (facial trauma)

### → Fast track LMA

### → Fiberoptic intubation<sup>10</sup>:

video passed, we can see through the eyepiece, one operator can intubate alone.



## Anesthesia Machine

Anesthesia is delivered via a machine from the main gas supply to the patient. Anesthesia workstation: it is the place where they keep the anesthesia machine and all related tube, monitor, suctioning catheter, laryngoscope, and everything related to anesthesia.

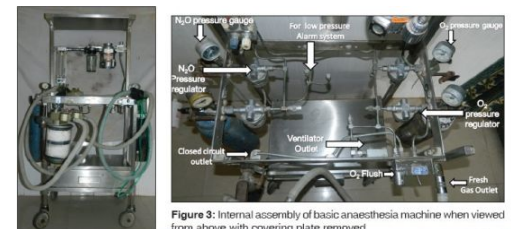


Figure 3: Internal assembly of basic anaesthesia machine when viewed from above with covering plate removed

<sup>8</sup> For difficult intubation (Done pre-op)

<sup>9</sup> Laryngeal mask airway

<sup>10</sup> It is used when there is pathology in the airway and difficult intubation. The patient is in an awake state. Using local anesthesia, insert the apparatus and ask the patient to swallow like a nasogastric tube and it will go through the trachea. There is a camera attached at the end of the fiber optic bands which allows the anesthetic to visualize the tracheal & carina. It is used in one lung ventilation & in masses located in the mediastinum (if the patient stops breathing after administering the medication. The mass will compress the trachea)



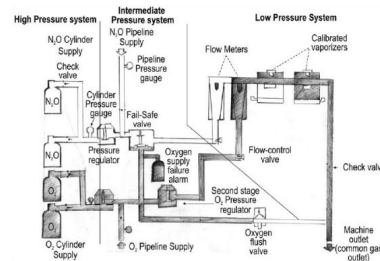
## ★ Functions of anesthesia machine: “4 essential functions”

- Provides O<sub>2</sub>.
- Accurately mixes anaesthetic gases and vapours.
- Enables patient ventilation.
- Minimises anaesthesia related risks to patients and staff.

## ★ Machine basic structures:

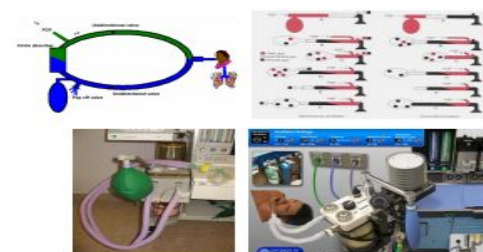
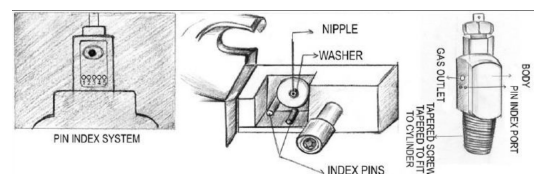
- Gas supplies: From the central pipeline (used in KKUH) to the machine as well as cylinders.
- Flow meters. The flow meter measures and indicates the rate of flow of gases and allows precise control of O<sub>2</sub> or N<sub>2</sub>O delivery to the vaporizer/common gas outlet. **Nitric oxide not used anymore in KKUH.**
- Vaporizers: devices that convert liquid volatile anesthetic to gases, these gases go to our lung to be absorbed > circulation > brain to inhibit it > unconsciousness. (هو العلية اللي نحط فيها السيفوفلورانس)
- Fresh gas delivery: Breathing systems and ventilators. **common gas outlet**
- Scavenging: For the excreted waste products (سألت دكتور بالاور قالي هو الجهاز اللي يطلع التلوث برا غرفة العمليات زي الفلتر)
- Monitoring.

## - Diagram of Anesthesia Machine:



## ★ Safety Features:

- Pin Index safety system (PISS): available in the cylinders, it only fit in certain position, so O<sub>2</sub> cylinder pin index will not fit in the N<sub>2</sub>O cylinder.
- Pressure Regulators:(pressure regulators valve) it lowers the gas pressure (which is 4-5 kiloPascal in the cylinder or central pipeline) to the normal pressure that is compatible with us (which is 1 kiloPascal = 1 atmosphere= 760 mmhg), bc if we use high pressure the patient may have barotrauma (rupture of the lung) and pneumothorax.
- DISS safety connections Non-interchangeable screw thread: (diameter index safety system) is a gas station outlet system used in the hospital setting for the supply of medical gases. DISS connectors are threaded and have a unique diameter for each type of gas to prevent erroneous connection. **This is only with central pipeline. (Used to prevent incorrect connection of gas pipeline to the machine inlet)**
- Oxygen Failures device



## ★ Breathing circuit ⇒


**Induction agents:** in a separate pharmacology lecture,

- **IV induction** (used in most patients.)
- **Inhalation induction**

the patient will sleep within 3-4 sec


<b>Analgesics</b>	- Opioids – <b>Fentanyl</b> , Sufentanyl, Remifentanyl
<b>Induction of unconscious</b>	- <b>Propofol</b> , Thiopental and Etomidate, Benzodiazepines - <b>IV induction</b> , IV drugs lead to complete airway obstruction due to loss of muscle tone. - <b>Inhalation induction<sup>11</sup></b> , we cannot give volatile anesthetic for patient susceptible to have malignant hyperthermia, all volatile agents will trigger it so we use TIVA for them which is total IV anesthesia. we encourage the patient to breath spontaneously, so the patient does not lose airway patency.
<b>Muscle relaxants</b>	- <b>Depolarizing – Succinylcholine</b> (used in Rapid sequence induction & Pregnant ladies (No reversal Agent)). - Non-depolarizing

## Intraoperative management :

<b>Maintenance</b>	- Inhalation agents: N <sub>2</sub> O, Sevoflurane, Desflurane, Isoflurane. - Total IV agents: Propofol - Opioids: Fentanyl, Morphine - Muscle relaxants - <b>Balance anesthesia</b>
<b>Monitoring</b>	Depends on the patient's condition (ECG, Capnograph, pulse oximeter, Blood pressure cuff, temperature measurement, urine output & blood loss measurement) in all patients + nerve stimulator if you give muscle relaxant.
<b>Positioning during surgery</b>	<ul style="list-style-type: none"> <li>• <b>Supine</b></li> <li>• <b>Lateral</b></li> <li>• <b>Prone</b></li> <li>• <b>Sitting</b></li> <li>• <b>Lithotomy</b> <ul style="list-style-type: none"> <li>• When you position the patient you have to take care of the airway and Iv lines.</li> <li>• Proper position is important to prevent pressure necrosis on pressure area such the occiput (may cause alopecia), elbow and the heels.</li> <li>• <b>Reverse Trendelenburg supine position:</b> the head elevated so there will be pooling of blood in the lower limbs &gt; reduce the venous return to the heart, low BP &gt; low cerebral perfusion pressure.</li> </ul> </li> </ul> 

<sup>11</sup> Inhalation induction Indication:

1. Pediatrics without IV lines
2. Patients with anticipated cessation of breathing (Patient with tracheal stenosis if you give them IV induction and Muscle relaxants the trachea will be more stenosed.

	<ul style="list-style-type: none"> <li>● <b>Prone Position:</b> such in <u>colorectal procedure</u> where they want to bring <b>abdominal content toward the diaphragm</b> to have more space&gt; the diaphragm will have little space for expanding, this is called diaphragm excursion&gt; might have respiratory depress, patient head is down, all blood goes toward the cranium&gt; increase ICP and intraocular pressure which may exaggerate glaucoma. Tongue edema may also occur.</li> <li>● <b>Sitting Position:</b> such in <u>neurosurgical procedures</u> to <b>allow access to the posterior fossa</b>. Increase the risk of venous air embolism if the cranial veins (sagittal, transverse sinus) did not collapse, because they are at higher level from the heart when they are open air will suck into them.</li> <li>● <b>Lithotomy position:</b> such in <u>urology or gynecological procedures</u>. patient is supine but legs are up. Could be low, high, or standard lithotomy. Increase the risk of compartment syndrome.</li> <li>● <b>Lateral position:</b> such in <u>neurosurgical procedures</u>, increase the risk of breathing problems such pneumothorax.</li> </ul> 
<p><b>Fluid management</b></p>	<ul style="list-style-type: none"> <li>- Crystalloid vs colloid</li> <li>- <b>NPO fluid replacement:</b> <ul style="list-style-type: none"> <li>- 1st 10kg weight-4ml/kg/hr,</li> <li>- 2nd 10kg weight-2ml/kg/hr</li> <li>- 1ml/kg/hr thereafter</li> </ul> </li> <li>- Intraoperative fluid replacement: <ul style="list-style-type: none"> <li>- minor procedures 1-3ml/kg/hr</li> <li>- major procedures 4-6ml/kg/hr</li> <li>- major abdominal procedures 7-10ml/kg/hr</li> </ul> </li> </ul>

### ★ Intraoperative Management and Recovery:

Waking up is a crucial time where there is short period when the patient is aware of emergence without a full return to consciousness.

- Turn off the agent (inhalation or IV agents)
- Reverse the muscle relaxants
- Return to spontaneous ventilation with adequate ventilation and oxygenation
- Suction upper airway, **make sure that upper airway reflexes return such as gagging and cough.**
- Wait for patient to wake up and follow command
- Hemodynamically stable

## Postoperative management :

<p><b>Post-anesthesia care unit (PACU)</b> even if the patient is 100% normal, there are some bad effect of anesthesia.</p>	<ul style="list-style-type: none"> <li>- Oxygen supplement</li> <li>- Pain control</li> <li>- Nausea and vomiting</li> <li>- Hypertension and hypotension</li> <li>- Agitation</li> </ul>
<p><b>Surgical intensive care unit (SICU)</b> Respiratory exercise for high risk patient before and after the surgery.</p>	<ul style="list-style-type: none"> <li>- Mechanical ventilation</li> <li>- Hemodynamic monitoring</li> </ul> <p>There are conditions where the patient needs more care such after cardiac surgery so we move them to critical areas such HDU (high dependency unit), SICU, MICU&gt; sometimes they do not extubate these patients.</p>

### ★ General Anesthesia Complications:

<p><b>Respiratory complications</b></p>	<ul style="list-style-type: none"> <li>- Aspiration -airway obstruction and pneumonia</li> <li>- Bronchospasm</li> <li>- <b>Atelectasis</b></li> <li>- Hypoventilation (central nervous system or analgesia wasn't adequate over dosage of competitive relaxants or cholinesterase deficiency)</li> </ul>
<p><b>Cardiovascular complications</b></p>	<ul style="list-style-type: none"> <li>- <b>Hypertension and hypotension</b></li> <li>- Arrhythmia</li> <li>- <b>Myocardial ischemia and infarction</b></li> <li>- Cardiac arrest</li> </ul>
<p><b>Neurological complications</b></p>	<ul style="list-style-type: none"> <li>- Slow recovery from anesthesia.</li> <li>- Stroke</li> </ul>
<p><b>Malignant hyperthermia</b></p>	<p>-It is very rare but it can happen, triggered by <b>succinylcholine and all volatile anesthetic agents.</b>          -hypermetabolic syndrome, related to release of Ca &gt; contraction of the muscle&gt; heat production          -high morbidity and mortality in the past, but now it is controlled by drugs such dantrolene sodium.          - Confirmed malignant hyperthermia is by: 1- Genetic testing or 2- Muscle biopsy قال مب اي مسل بايويسي نوع خاص بس ما قال اسمه          - In known cases: We avoid the triggers (Volatile and Succinyl)</p>
<p><b>Hypothermia</b></p>	<ul style="list-style-type: none"> <li>- Definition 35 C</li> <li>- Classification:             <ul style="list-style-type: none"> <li>- Mild 35-32 C</li> <li>- Moderate 32-28 C</li> <li>- Severe 28-20 C</li> </ul> </li> <li>- Mechanism:</li> </ul>

- Heat loss: Anaesthesia inhibit our thermoregulatory system. Behavioral changes (when we are conscious we can react to the internal and external changes. if I feel cold I will wear more clothes, drink hot tea ....)
- Radiation 40%: Transfer of electromagnetic energy between two bodies of different temperature.

Volatile anesthetic are vasodilators > the patient will lose heat in the form of radiation waves, which flow from high to low gradient (our body temperature is 37 °C but the room 20°C)

- Convection 30%: Energy transfer will be greater if the air immediately adjacent to a patient's skin is repeatedly disturbed
- Evaporation 25%: As water becomes vapour, heat energy is lost as latent heat of vaporization. This type of heat loss will be increased if a large surface is exposed to evaporation, e.g. loops of bowel during a laparotomy. Surgical skin prep increases heat loss in this way. 10% is lost via respiratory water vapour

External humidifiers to compensate for the lack of natural humidification mechanisms when the upper airway is bypassed, this only available in the SICU bc they are intubated for long time.

- Conduction 5%: Transfer of heat energy by direct contact between two objects of differing temperatures, e.g. a patient being in direct contact with the operating table. A patient lying in a pool of fluid or wet sheets will lose an increased amount of heat via conduction

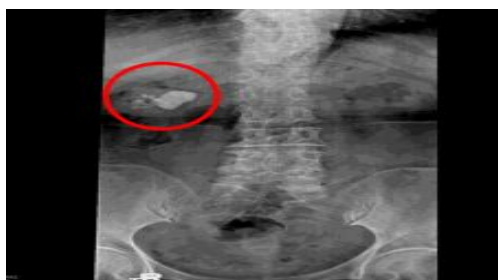
- Therapeutic vs Accidental Hypothermia

Example of therapeutic hypothermia: patient with cardiac arrest after resuscitating we move the patient to ICU and keep his temperature low to protect the heart. Similarly during cardiac surgery to decrease the metabolisms

- Adverse effects:
  - 1-Slow drug metabolism: due to body enzymes inhibition, so the patient may need ICU, delayed hospital discharge.
  - 2-Infection ( surgical site infection): bc it inhibit our immune systems.
  - 3-Hyperglycemia and brain depression
- Prevention: increase theater temperature and give warm IV fluid
- Treatment

★ Not mentioned by the doctor!!

Case Report - Arterial oxygen desaturation following PCNL  
(Percutaneous nephrolithotomy) (433 Team)



(Percutaneous nephrolithotomy)



Pre-op CXR

★ **Patient:**

- 73 y/o Female (BW 68 kg, BH 145 cm (BMI 32→ Obese))
- Chief complaint: Right flank pain (stabbing, frequent attacks) General malaise and fatigue
- Past history: Hypertension under regular control+ Senile dementia (mild) ASAI

★ **Preoperative diagnosis:**

- Right renal stone (3.2 cm)
- Operation planned: Right PCNL

★ **Pre-anesthetic Assessment**

- EKG: Normal sinus rhythm
- CXR: Borderline cardiomegaly & tortuous aorta
- Lab data: Within the normal range
  - Hb 10.5 / Hct 33.2 BUN 24 / Creatinine 1.1 GOT 14 PT, aPTT WNL

★ **Anaesthetic Technique**

- General anesthesia with endotracheal intubation. Standard monitoring apparatus for ETGA.
- Induction:
  - Fentanyl 1ug/kg
  - Propofol 2mg/kg
  - Succinylcholine 80 mg
  - Atracurium 25 mg
  - (In those patients we try to reduce the dose)
  - Endotracheal tube reinforced (ID 7.0-mm) @ 19cm
  - Maintenance: Isoflurane 2~3% in O<sub>2</sub> 0.5 L/min
  - Position: prone
  - Blood loss: 300 mL → PRBC 2U

**8. Intraoperative Events**

- Stable hemodynamics. Abnormal findings 30 minutes after surgery started.
- Increased airway pressure 35~40 mmHg (normal.18- 20mmHg) SpO<sub>2</sub> dropped from 100% to 95% and then kept falling till it reached 90%
- Bilateral breathing sounds were still audible then
- Management:100% Oxygen, increasing the depth of anesthesia. Hydrocortisone 100 mg IV stat.
- Aminophylline 250 mg IV drip.
- Bricanyl 5 mg inhalation as nebulization

**9. Postoperative Course**

- The patient's condition continued until the end of surgery. The patient was transferred to SICU for further care\*
- Chest X-ray was followed in SICU

**10. Postoperative Course:**

- Pigtail drainage in SICU.
- Pleural effusion: bloody RBC numerous WBC 7800 (Seg 94%)
- Gram stain(-) Impression: right hydrothorax and hemothorax
- Extubation and transfer to ordinary ward
- Pigtail removed



Before



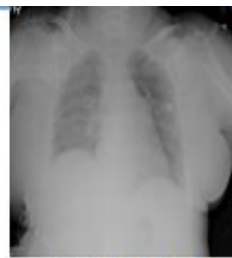
In SICU



Post fluid drainage by  
pigtail catheter



Immed.  
Postop



s/p pigtail



435

**Q1. Which of the following is the indication for cricoid pressure?**

- A. To prevent vomiting
- B. To improve viewing of the glottis
- C. To increase tone of the lower esophageal sphincter
- D. To prevent aspiration of gastric contents

**Q2. 75-year-old patient presents with signs and symptoms of uncontrolled hypertension and diabetes mellitus type 2. He underwent prostatectomy. Which one of the following is ASA classification for this patient?**

- A. I
- B. II
- C. III
- D. IV

**Q3. Which one of the following is the most significant predictor of difficult airway during preoperative assessment?**

- A. Past history of difficult intubation
- B. Mallampati grade III
- C. Missing teeth
- D. Morbid obesity

**Q4: What is the consequence of hypothermia perioperatively?**

- A. Reduce Oxygen demand
- B. Reduce hospital stay
- C. Improve oxygenation
- D. Increase incidence of infection

**Q5: In safety features of anesthesia machine, the pin index system is used to prevent which of the following?**

- A. Incorrect connection of gas pipeline to the machine inlet
- B. The incorrect cylinder connection
- C. Barotrauma
- D. Mixing of two inhalational anesthesia agents

**Q6: What is the WHO guideline for post-operative analgesia?**

- A. Oral medications
- B. Transdermal medication
- C. Prescribe analgesia PRN
- D. Start with higher dose of analgesia.



**Q7: A 20 y/o male patient post had PNS excision was transferred to PACU, what is the first thing to check?**

- A. BP
- B. oxygenation
- C. pulse rate
- D. temperature

**Q8: a 40 Y/O female patient scheduled for right breast fibroadenoma excision under general anaesthesia , which is the appropriate laryngeal mask for her?**

- A. size 2
- B. size 3
- C. size 4
- D. size 5

**Q1: D | Q2: C | Q3: A|Q4: D| Q5: A| Q6:A| Q7: B| Q8: B**