جامعة الملك سعود
King Saud University

Slides and 432 team work

General Anesthesia Technique

Objectives:

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

What is Anaesthesia?

"Without sensation"

1846 by Wendell Holmes to describe 'state of sleep from ether'.

Early drugs: opium, alcohol, cocaine

N_2O (1844) & CO_2

Ether (1846, Morton in Boston)

Chloroform (1847, Simpson)

NMBDs (1942)

Halothane (1956)

Thiopental

Propofol

Iso/Sevo/Des-flurane

- **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 in1884.**

Definitions:

Term	Definitions:
General anesthesia	is the state produced when a patient receives medications for amnesia, analgesia, muscle paralysis, and sedation
Inhalation anesthesia	Anesthesia induced by inhalation of drug
Minimum alveolar concentration	MAC is the concentration of a vapour in the lungs that is needed to prevent movement (motor response) in50% of subjects in response to surgical (pain) stimulus. MAC is used to compare the strengths, or potency, of anesthetic vapors.
Analgesia	Stage of decreased awareness of pain sometimes with amnesia
Balanced anesthesia	Anesthesia produced by mixture of drugs, often include both inhaled and intravenous agent

General Anesthesia Goals

Primary goal:

1. Oxygenation
2. Ventilation
3. Monitoring
4. Amnesia: patient should forget any unpleasant feeling.
5. Hypnosis: Unconscious state
6. Analgesia: No pain sensation
7. Autonomic Block: Reflexes blocked
8. Optimal conditions: all the above along with good muscle relaxation.

- **SAFETY AND PATIENT CARE IS THE PRIORITY**

Assessment

- **Planning I:** Monitors **(History, examination & comorbidities)**
- **Planning II:** Drugs
- **Planning III:** Fluids
- **Planning IV:** Airway Management **(LMA (laryngeal mask airway), Endotracheal tube or sedation)**

Process of Anesthesia

- Premedication
- Induction
- Maintenance
- Emergence
- Postoperative care

Preoperative anesthetic evaluation

Physical status classification

- **Class I:** A normal healthy patient.
- **Class II:** A patient with mild systemic disease (no functional limitation)
- **Class III:** A patient with severe systemic disease (some functional limitation) Patients with drug allergies are categorized in this Class
- **Class IV:** A patient with severe systemic disease that is a constant threat to life (functionality incapacitated)
- **Class V:** A moribund patient who is not expected to survive with or without the operation.
- **Class VI:** A brain-dead patient whose organs are being removed for donor purposes
- **Class E:** Emergent procedure

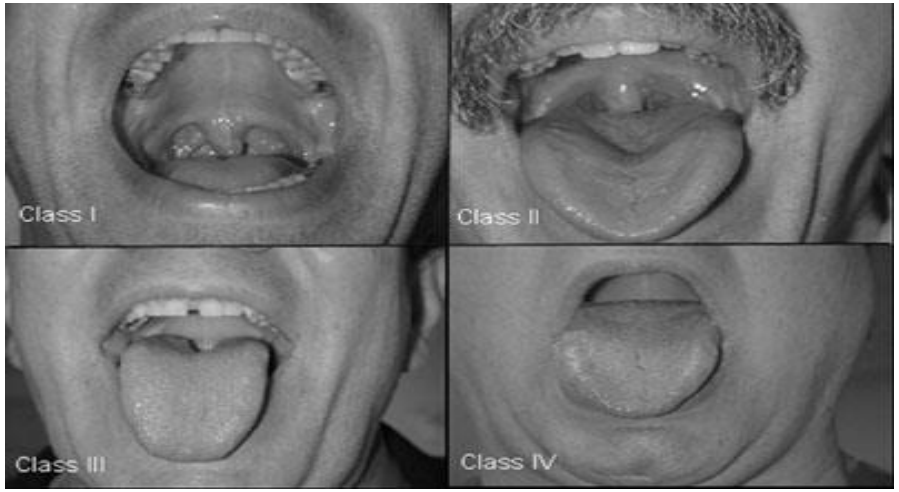
Airway examination
Mallampati classification

Class I: uvula, faucial pillars, soft and hard palate visible (4 structures are visible)

Class II: faucial pillars, soft and hard palate visible (3 structures)

Class III: soft and hard palate visible (2 structures)

Class IV: hard palate visible . (1 structure)



Preoperative anesthetic evaluation

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 should be stopped 6-8 hours before because it is thicker than the mother's milk)
- **Considered as full stomach(cricoid pressure): - Patients in emergency. E.g.**
  - *Trauma patients.*
  - *Pregnant in 3rd trimester.*
  - *Morbid obese patients.*
  - *Diabetic patients Even if they are NPO due to delayed gastric emptying.*

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*

General Anesthesia- Intraoperative

1. Monitor

2. Pre-oxygenation (Important!): 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.

3. Induction: 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.

Including 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:

The cricoid cartilage is the only ring shaped cartilage. When compressing the cricoid by applying pressure, it will result in closing the esophagus, which will prevent any regurge and aspiration of the food contents.

General Anesthesia- Intraoperative

4. **Mask ventilation**
5. **Muscle relaxants**
6. **Intubation & ETT position confirmation General Anesthesia**

How to confirm that the endotracheal tube is in the right place?

A. **Visualizing the tube through vocal cords.** The best clinical method of confirming tracheal intubation.
B. **Chest movements after connecting the tube to the circuit.**
C. **5 point auscultation:** by auscultating the apices, bases of the lungs and the stomach to make sure that the endotracheal tube wasn't inserted through the esophagus (starting with the stomach first)
D. **End Tidal CO2** = 5% (No CO2 is excreted from the stomach, so any CO2 present must be from the lungs Six breaths of CO2 must be seen to confirm tracheal intubation.

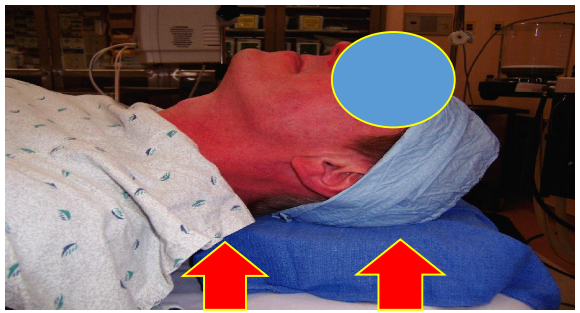
*** Although there are many tests to confirm tracheal intubation, the 'gold standard' is six breaths of end-tidal CO2 with visual confirmation of laryngeal placement of the tube.**

7. **Maintenance**
8. **Emergence**

Difficult BMV- MOANS

1. **MASK SEAL:** mask seal requires normal anatomy, absence of facial hair, lack of interfering substances like vomitus or bleeding & ability of apply mask with pressure.
2. **OBSTRUCTION/ OBESITY:** Obstruction of upper airway, obesity (BMI greater than 26) is an independent marker. Redundant upper airway tissue, chest wall weight & resistance from abdominal contents impede airflow.
3. **AGE:** General loss of elasticity & increased incidence of restrictive /obstructive lung disease with increasing age.
4. **NO THEETH:** Edentulous creates difficulty.
5. **STIFFNESS:** Resistance to ventilation with COPD, Asthma, Pulmonary edema.

Sniffing position (Golden Position)

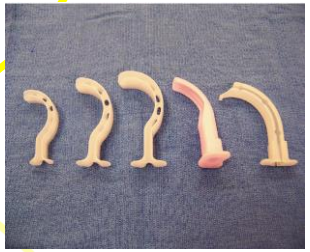


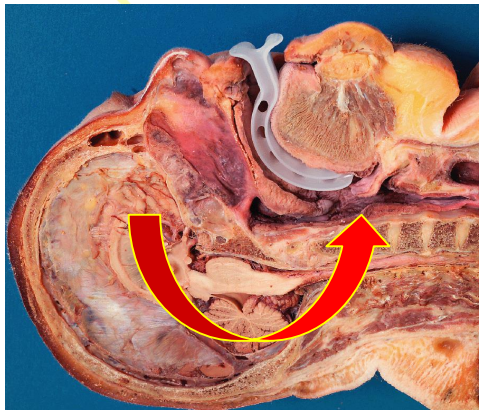
Placing a pillow under the patient's head. Flexion of the neck & Extension of the head at the cervical spine (as if the person is taking a deep breath on a good day) this position will make it easier for doctors to visualize the airway and will become in line

Flexion o the neck and extension of the head

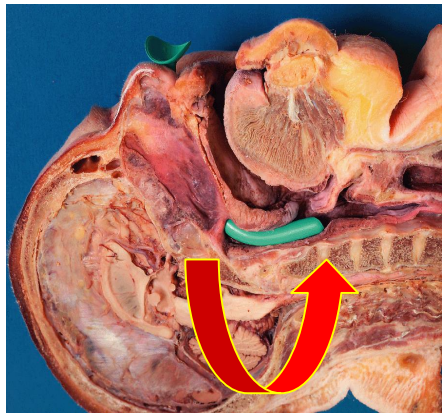
Mask and airway tools

Mask airway
Function: to make the airway patent.





Oropharyngeal airways: is used in unconscious patients to avoid tongue swallowing. Size Measuring: from the angle of the mouth to the angle of the jaw.



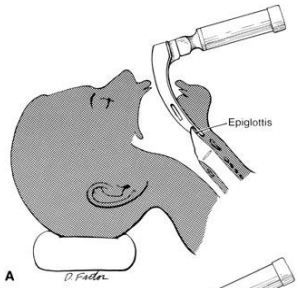
Nasopharyngeal airway: used in partially conscious patients with intact gag reflexes that will not tolerate oropharyngeal airways. Or Maxillofacial procedure patient b/c the jaw is wired, when you want to extubate him put nasopharyngeal airway to support the tongue or in locked jaw. Size measuring: from the nostril to the tragus of the ear.

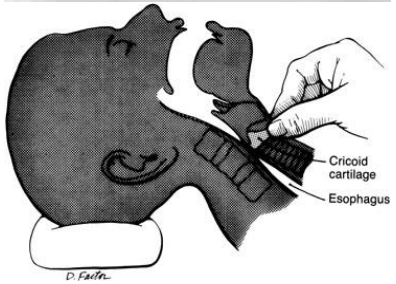
Mask ventilation: 2 Techniques

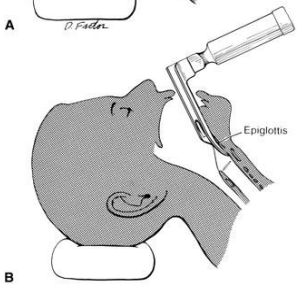
1. Single handed: by making a C shape with the thumb and index on the mask and E shape on the jaw with the remaining 3 fingers

2. 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.

Intubation





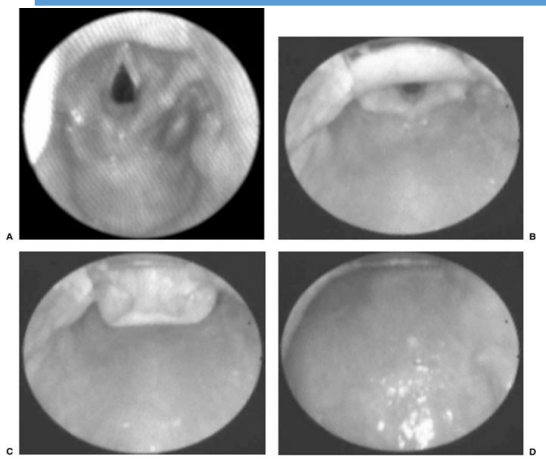


Intubation is done in 2 ways:

1. **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
2. **Glidescope.**

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

Laryngeal view scoring system (Cormack-Lehane grading system)



A. **Grade I:** you can see the epiglottis at the top and the glottic opening (Full view of glottis). Easy intubation
B. **Grade II:** the Posterior edge of the epiglottis (posterior commissure of the glotic opening)
C. **Grade III:** only the tip epiglottis. Difficult intubation
D. **Grade IV:** no structure can be seen. Difficult intubation.

The LEMON Approach

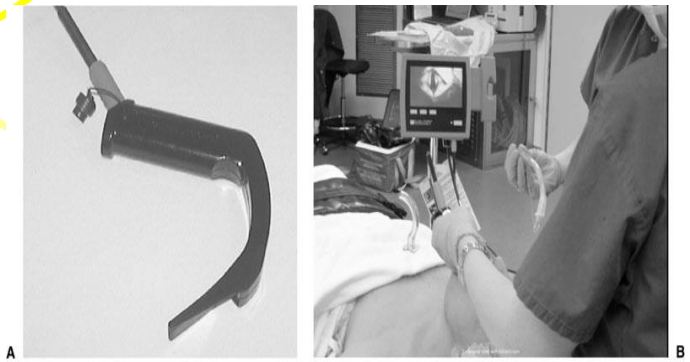
For difficult intubation (Done pre-op)

1. **LOOK EXTERNALLY:** Abnormal facies, unusual anatomy or facial Trauma.
2. **EVALUATE (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.
3. **MALLAMPATTI SCORE:** III predicts difficulty and IV predicts extreme difficulty.
4. **OBSTRUCTION/ OBESITY.**
5. **NECK MOBILITY**. (If patient can't move his neck he won't be able to do sniff position)

Difficult airway

This is a 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.

Glidescope

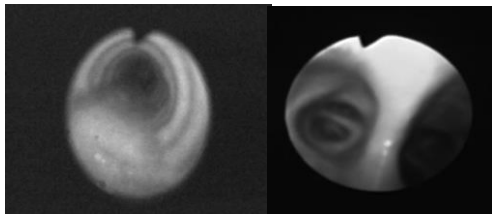


Has a blade like the laryngoscope. It is connected to a video screen to see the glotic opening. Under vision you're able insert the scope from the center to visualize the structures and easily intubate unlike the laryngoscope It is very beneficial for patients with anticipated difficult intubation e.g. obese patients and patients with cervical injury → no neck mobilization

Fiberoptic intubation

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)

Trachea view **Carina view**



Anesthesia Machine

Anesthesia is delivered via a machine from the main gas supply to the patient.

FUNCTIONS OF ANAESTHESIA MACHINE:

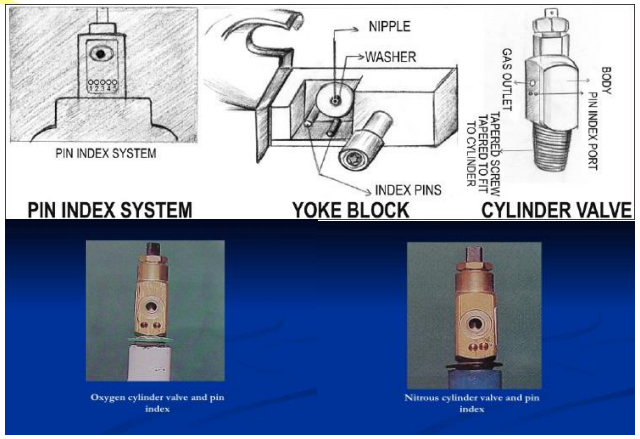
The machine performs four essential functions:

1. Provides O2,
2. Accurately mixes anaesthetic gases and vapours,
3. Enables patient ventilation and
4. Minimises anaesthesia related risks to patients and staff.

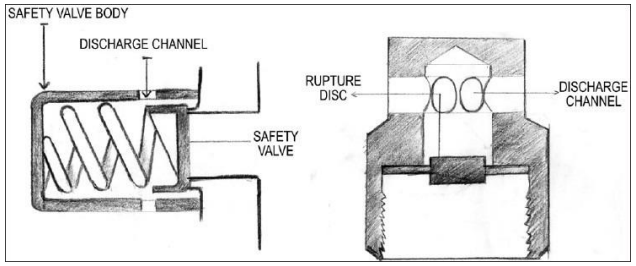
- **Gas supplies:** From the central pipeline to the machine as well as cylinders.
- **Flow meters.**
- **Vaporizers.**
- **Fresh gas delivery:** Breathing systems and ventilators.
- **Scavenging.**
- **Monitoring.**

Safety Features

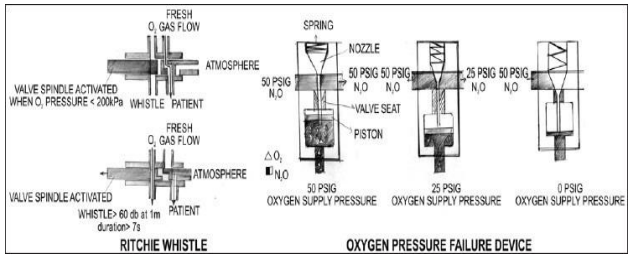
Pin Index safety system



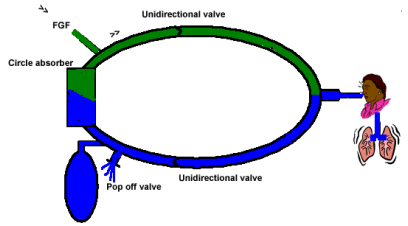
Pressure Regulators

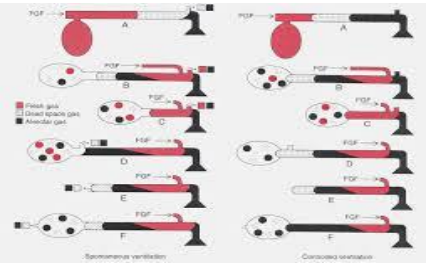


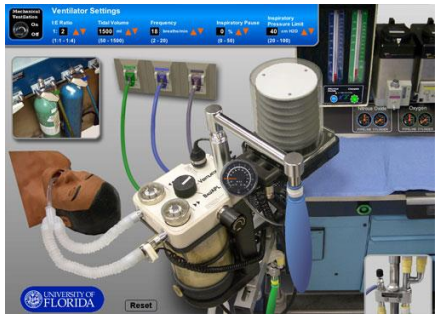
Oxygen Failures device



DISS safety connections Non-interchangeable screw thread







Induction agents (in a separate pharmacology lecture)

1. **Opioids:** fentanyl (to reduce the requirement of anesthetic induction and inhalation agents) If used in high dose it will result in chest wall rigidity hence difficulty ventilating the patient.
2. **Induction:**

   IV: Propofol (mostly used, causes hypotension), Thiopental and Etomidate (Etomidate is used in hemodynamically unstable patients & in patients with cardiac diseases. because It prevents hypotension).

   Inhalational: we use it in patients where we suspect difficult ventilation or in pediatric patients who don't have cannulas.
3. **Muscle relaxants:**

   Depolarizing – Succinycholine used in Rapid sequence induction & Pregnant ladies (No reversal Agent).

   Nondepolarizing → Antagonist: Neostigmine

   - Long Acting
   - Intermediate acting: takes 3-5 minutes to start affecting Rocuronium.

   If given in high doses (from 0.6 to 1.1 you can intubate the patient in 1 minute) Rocuronium

   Antagonist: Sugammadex

   - Short acting: Optimal Condition for intubation:

   Patient is not moving - Sleeping - Muscles are relaxed

Induction agents (in a separate pharmacology lecture)

Induction

- **IV induction** used in most patients.
- **Inhalation induction:** Isoflurane, sevoflurane (mainly used), Desoflurane (Pungent smell causing spasms) & Halothane not used anymore due to Hepatotoxicity

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.

Therefore you must keep the patient in a much physiological state as possible →make him/her sleep with an inhalational agent and intubate without using muscle relaxants)

Intraoperative management

- **Maintenance:** the aim is to achieve a balanced anesthesia
  - Inhalation agents: N2O (No Longer used) Used O2 40% and air60%, Sevoflurane, Desflurane, Isoflurane
  - TVA (Total IV agents): Propofol (when you don't use inhalation agents!!) In case of spine surgery and the surgeon doesn't want you to use any muscle relaxant because they need to check the nerve stimulation to the muscles, you use Total IV agents. You don't use inhalational b/c it affects their readings.
  - Opioids: Fentanyl, Morphine(long acting). Muscle relaxants
  - Aim: Balanced anesthesia

- **Monitoring** 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.

- **Position** – supine, lateral, prone, sitting or lithotomy (in Lithotomy position all the structures will go up which might cause some lung injuries if not careful)

- **Fluid management** - Crystalloid vs colloid (for every 1ml of blood loss you give 3ml Crystalloid Or for every 1ml of blood loss you give 1ml colloid)

Intraoperative management

- **NPO fluid replacement: (MCQ) 4, 2, 1 Rule formula**
  - 1st 10kg weight: 4ml/kg/hr.
  - 2nd 10kg weight: 2ml/kg/hr, and 1ml/kg/hr thereafter.
- **Intraoperative fluid replacement** (Once the surgeon starts):
- **Add on maintenance**
  - Minor procedures 1-3ml/kg/hr. e.g.: Laparoscopic procedure
  - Major procedures 4-6ml/kg/hr.
  - Major abdominal procedures 7-10/kg/ml
- Example: A patient is 40kg. The 1st 10kg = 10X4 = 40ml/hr 2nd 10kg = 10X2 = 20ml/hr . 3rd 20kg = 20X1 = 20ml/hr
- So the maintenance = 40+20+20= 80 ml/hr. You have to add insensible loss, urine output & blood loss.
- A 5kg pediatric patient's fluid replacement will be: 5X4 = 20 ml/hr

Emergence: "Waking the patient up"

1. **Turn off the agent.** (inhalation or IV agents)
2. **Reverse the muscle relaxants.** (For non depolarizing muscle relaxant) Neostigmine (anticholinesterase) -> SE: bradycardia which could be treated by Atropine.
3. **Return to spontaneous ventilation with adequate ventilation and oxygenation.**
4. **Suction upper airway.**
5. **Wait for patient to wake up and follow command.**
6. **Hemodynamically stable.**

General anesthesia- Complications

1. **Respiratory complications**
   - o Aspiration o Airway obstruction and pneumonia
   - o Bronchospasm
   - o Atelectasis → if the endotracheal tube was inserted in the right bronchus and you missed it, the left lung's alveoli will eventually stop functioning resulting in atelectasis (collapse) of the left lung
   - o Hypoventilation →central nervous system or analgesia wasn't adequate over dosage of competitive relaxants or cholinesterase deficiency
2. **Cardiovascular complications**
   - o Hypertension and hypotension
   - o Arrhythmia
   - o Myocardial ischemia and infarction → especially with diabetic patients that cannot tolerate the surgical stress
   - o Cardiac arrest
3. **Neurological complications**
   - o Slow wake-up (The cause could be Hypothermia -> reduced metabolic rate -> slow down medications elimination)
   - o Stroke
4. **Malignant hyperthermia:** a rare life-threatening condition that is usually triggered by exposure to certain drugs used for general anesthesia, specifically the volatile anesthetic agents and the neuromuscular blocking agent, succinylcholine. Resulting in an sudden unexplained rise of the temperature (Hyperpyrexia) 1-2 o per hour + ↑End tidal CO_2 although ventilating (60-65) the normal=45 usually patients don't survive . Treatment : dantrolene

❑ **Remember! Nobody dies because you can't intubate but patients die because you can't ventilate. (Ventilation is the key of anesthesia)– Dr.Sadia**

Postoperative management the recovery room

Post-anesthesia care unit (PACU)

- o Oxygen supplement
- o Pain control
- o Nausea and vomiting
- o Hypertension and hypotension
- o Agitation

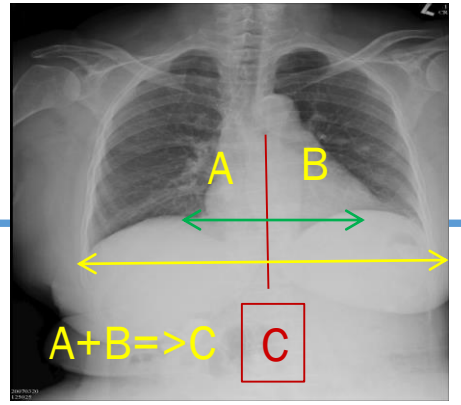
Surgical intensive care unit (SICU)

- o Mechanical ventilation
- o Hemodynamic monitoring

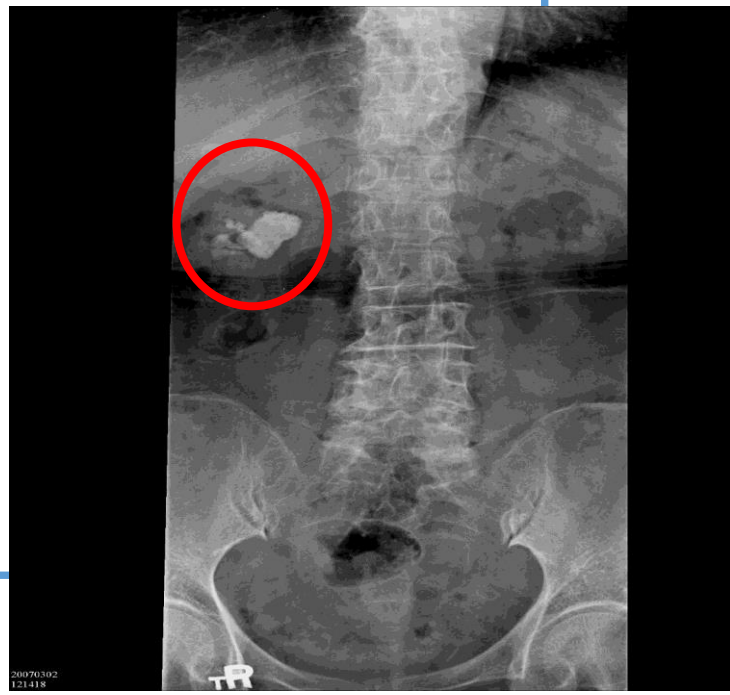
Case Report - Arterial oxygen desaturation following PCNL (Percutaneous nephrolithotomy)

1. **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) ASAII
2. **Preoperative diagnosis:** Right renal stone (3.2 cm)
   Operation planned: Right PCNL
3. **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



Pre-op CXR



(Percutaneous nephrolithotomy)

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

7. Anaesthetic Technique

General anesthesia with endotracheal intubation. Standard monitoring apparatus for ETGA.

Induction:

- o Fentanyl 1ug/kg
- o Propofol 2mg/kg
- o Succinylcholine 80 mg
- o 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 O2 0.5 L/min
- ✓ **Position:** prone
- ✓ **Blood loss:** 300 mL → PRBC 2U

8. Intra-operative Events

- ✓ **Stable hemodynamics.** Abnormal findings 30 minutes after surgery started.
- ✓ **Increased airway pressure** 35~40 mmHg (normal.18- 20mmHg) **SpO_2 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. *(Bronchodilators assuming that the patient suffered from bronchospasm)*
  - o Hydrocartisone 100 mg IV stat.
  - o Aminophylline 250 mg IV drip.
  - o Bricanyl 5 mg inhalation as nebulization.

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

9. Post-operative Course

- The patient's condition continued until the end of surgery. SpO2 90~92% after the patient was placed in the supine position again with diminished breathing sound over right lower
- The patient was transferred to SICU for further care*
- Chest X-ray was followed in SICU

10. Postoperative Course:

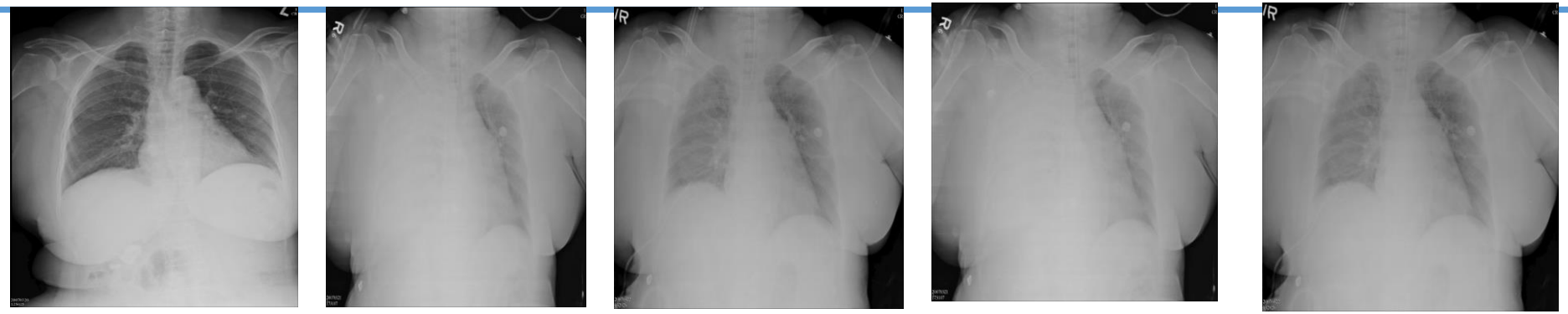
Pigtail drainage in SICU.

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**

جامعة الملك سعود
King Saud University

Done by:

- **Falwah Alharthi**

Reviewed by

- **Sara Alkharashi**

Leader

- **Yasmine Alshehri**

Color reference:
Black-slids
Green-Notes
Blue-Book
Red-important

Contact us:
Anesthesia433@gmail.com