

3. General anesthesia techniques

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Anesthesiology



■ From slides ■ Doctor's Notes ■ Team's Notes ■ From the book ■ Important

Role of Anesthetists

- ✓ **Preoperative evaluation and patient preparation** (**Example:** if a patient is going to do a surgery, we don't just admit him/her directly. Preoperative assessment must be done. we check if the patient has uncontrolled comorbidities which needs to be optimized and refer them accordingly to make their condition as optimal as possible for surgery)
- ✓ **Intraoperative management**

General anesthesia

- ✓ **Inhalation anesthesia**
- ✓ **Total IV anesthesia**

Regional anesthesia & pain management

- ✓ **Spinal, epidural & caudal blocks**
- ✓ **Peripheral nerve blocks**
- ✓ **Pain management (acute and chronic pain)**

Post anesthesia care (PACU management) + Anesthesia complication & management

History of Anesthesia: General anesthetics have been used since 1846 when Morton demonstrated the first anesthetic (using ether) in Boston, USA. Local anesthetics arrived later, the first being scientifically described in 1884.

General anesthesia is described as a **reversible state of unconsciousness** with inability to respond to a standardized surgical stimulus. (This basic definition has been used for years)

In modern anesthetic practice, **this involves the triad of: unconsciousness, analgesia (Pain free), muscle relaxation.**

General anesthesia



All this planning must be done before taking the patient to the Operative room

- ✓ Assessment (History ,examination & comorbidities)
- ✓ Planning I: Monitors
- ✓ Planning II: Drugs
- ✓ Planning III: Fluids
- ✓ Planning IV: Airway Management (LMA , Endotracheal tube or sedation)
- ✓ Induction: putting the patient to sleep
- ✓ Maintenance: keeping the Patient is asleep & hemodynamically stable during the surgery
- ✓ Emergence : waking the patient up after the surgery
- ✓ Postoperative care
Example: regular postoperative care unit, HTU or ICU

Objectives of Anesthesia

- Unconsciousness
- Amnesia (the patient should not remember anything during the surgery)
- Analgesia
- Oxygenation
- Ventilation
- Hemostasis
- Airway Management
- Reflex Management
- Muscle Relaxation
- Monitoring

Preoperative anesthetic evaluation

1. Risks of Anaesthesia:

It's important to identify if the patient is at risk of developing intraoperative/postoperative complications or if the patient is bound to be referred to the ICU after surgery

2. Physical status classification (Important!) “ASA = American society of anaesthesiologists “

- **Class I:** A normal healthy patient.
- **Class II:** A patient with mild systemic disease e.g. asthma and don't frequently visit the hospital (**no functional limitation**)
- **Class III:** A patient with severe systemic disease e.g. an obese patient with COPD and feels dyspnic after climbing the stairs (**some functional limitation**)
- **Class IV:** A patient with severe systemic disease that is a constant threat to life e.g. Unstable Angina (**functionality incapacitated**)
- **Class V:** A moribund patient who is not expected to survive with or without the operation they may or may not survive within 24 hours impending ruptured aortic aneurysm with multiple comorbidities. at that time you have to decide whether the surgery is really needed
- **Class VI:** A brain-dead patient whose organs are being removed for donor purposes
- **Class E:** Emergent procedure added after the ASA class if it is an emergency

Patients with drug allergies are categorized in this Class

Example: if a patient with ASA II with controlled bronchial asthma that came with acute appendicitis (emergency) = **ASA II E**

Or a patient with uncontrolled diabetes and comorbidities presented with perianal bleeding (needs urgent intervention) = **ASA IV E**

3. Airway examination - Mallampati classification (Important!)

The patient must be seated and you align your eyes with the level of patient's mouth, and ask the patient to protrude their tongue "without making any sounds"



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

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

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

Class IV: hard palate visible (1 structured) anticipate difficult intubation

4. NPO (Nil per Os) status

All patients undergoing any kind of anesthesia should be NPO

- 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)

5. Anaesthetic plan:

- ✓ **Premeds:** **Example:** if the patient is anxious (anxiolytics)
Patients with bronchial asthma (Ventolin nebulization 30 minutes before the procedure) History of regurgitation (Ranitidine & antiemetic agents)

✓ **Intraoperative management** :

General:

1. Airway management

If patients with (Obese, History of regurgitation, Diabetes or pregnant) they are considered as full stomach even if they are NPO due to delayed gastric emptying

2. Induction

3. Maintenance

4. Muscle relaxation

Monitoring:

1. Positioning (avoid nerve damage according to the patient's position)

2. Fluid management

3. Special technique (Regional block along with GA for pain relief , epidural or central line)

✓ **Postoperative management**

Pain Control:

1. PONV (postop. Nausea and vomiting)

2. Complications anything that can occur in the recovery room e.g.: Hypotension, lung collapse

3. Post-operative ventilation whether you should extubate the patient or kept on mechanical ventilation and shifted to the SICU

4. Hemodynamic monitoring

General anesthesia

1. Monitor

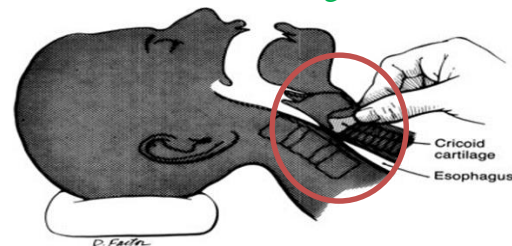
2. Pre-oxygenation(**Important!**): A 100% pure Oxygenated mask on the patient face "slightly away" for 3 minutes or (3 deep breaths) before administering any medication which will help increase the time apnea period (the pause where the patient stops breathing after administering the medication and intubating) the lung will be saturated with oxygen preventing hypoxia during this period

3. Induction : in children: if there is no IV cannulation → 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 apply cricoid pressure + administering medication and preoxygenation 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



Example: If a pregnant patient is scheduled for an elective cesarean section, a cricoid pressure will be inserted. Because of the distended abdomen they have the tendency to regurge and aspirate the food contents

Normal induction & intubation : pre oxygenation → IV Propofol + Fentanyl → ask if the patient is breathing then ventilate the patient by bagging and add on the muscle relaxant to paralyze the muscles → you should keep on ventilating for 3 minutes till the muscle relaxant starts affecting → intubate the patient

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

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

A. by visualizing the tube (Seeing the tracheal tube passing through the vocal cords is the best clinical method of confirming tracheal intubation)

B. after connecting the tube to the circuit the chest will be moving

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)

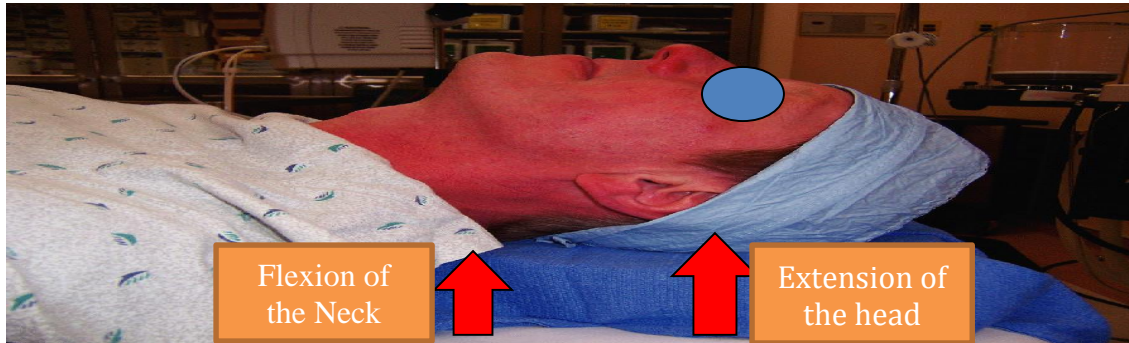
D. End Tidal CO₂ = 5%

Six breaths of CO₂ must be seen to confirm tracheal intubation

7. Maintenance
8. Emergence

Sniffing position (Golden Position) MCQ

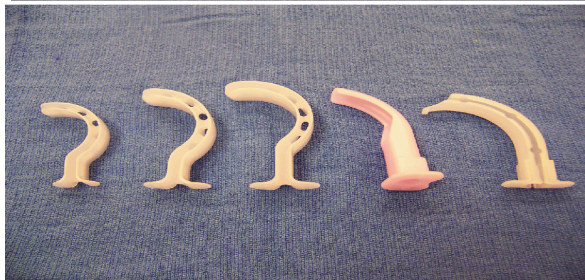
Placing a pillow under the patient's head. Flexion of the neck & Extension of the head at the cervical spine (as if the person is taking a deep breath on a good day☺) this position will make it easier for doctors to visualize the airway and will become in line



Mask and airway tools

Function: to make the airway patent

Airway Mask



Oropharyngeal airways: is used in unconscious patients to avoid tongue swallowing

Mask ventilation: 2 Techniques
Size Measuring: from the angle of the mouth and the mandible

Nasopharyngeal airway: used in partially conscious patients with intact gag reflexes that will not tolerate oropharyngeal airways

Size measuring: from the nostril to the tragus of the ear

Mask ventilation and intubation

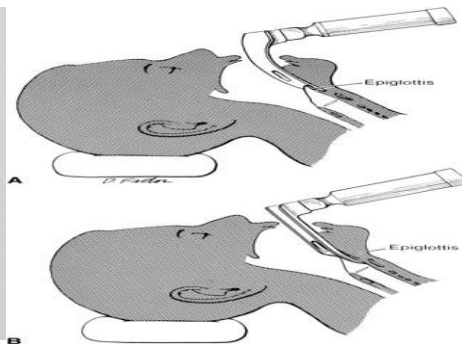


2. **Single handed** : by making a C shape with the thumb and index on the mask and E shape on the jaw with the remaining 3 fingers

1. **Double handed** : Using both hands place the thumb on the mask by pushing and lifting the jaw forward to open the airway

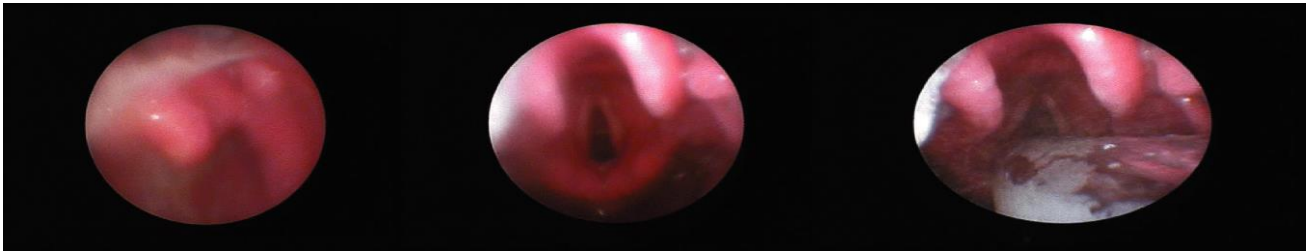
Intubation: is done in 2 ways

Different types of blades (they will not ask about it)

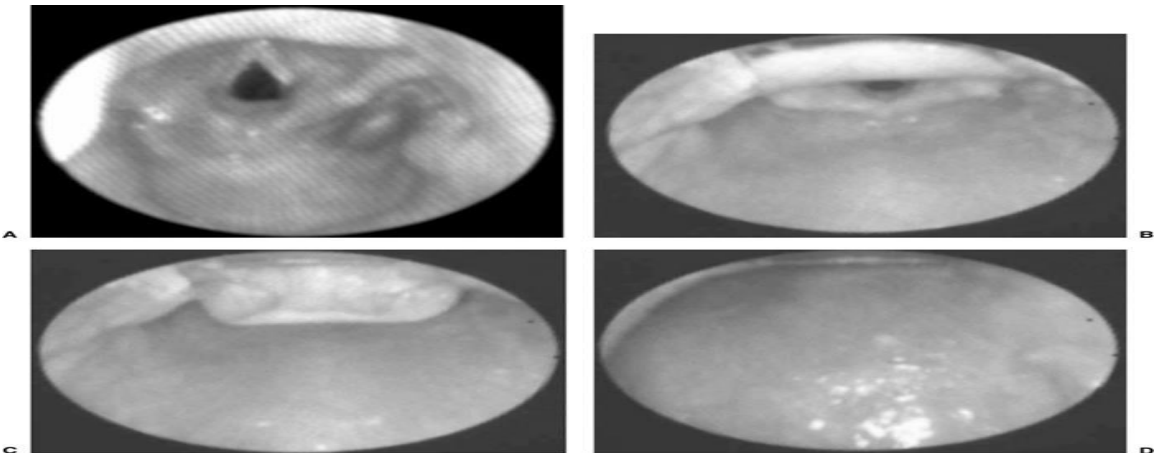


- A. **Regular laryngoscope:** by Holding the Laryngoscope with the left hand go from the right side of the mouth with the laryngoscope blade pushing the tongue to the left side → going deeper the epiglottis will be visualised at the back of the tongue. at this point lift your handle and up you will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

Laryngeal opening (the upper one is the trachea and the lower is the esophagus)



Laryngeal view scoring system (Cormack-Lehane grading system)



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

} Anticipated Mallampati III or IV

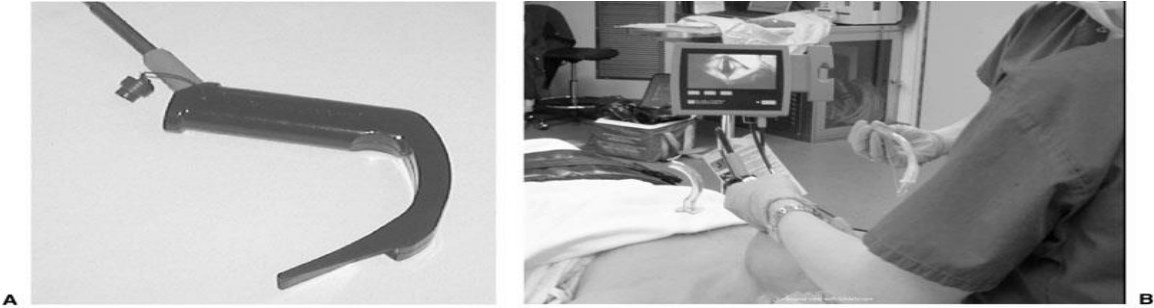
Difficult airway

This is an obese patient with no head extension or neck flexion



Example: Morbid obesity you place a wedge under the shoulder to create a thyromental distance ($\geq 6.5\text{cm}$) + Sternomental distance (≥ 12.5) to have an ample space for intubation

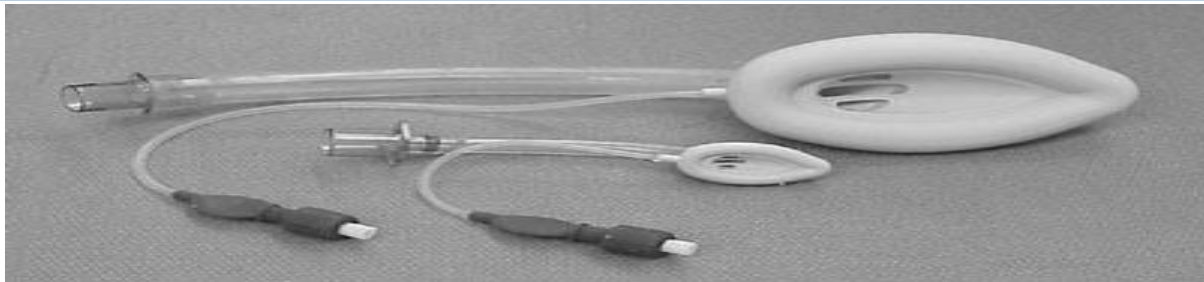
Glidescope



Has a blade like the laryngoscope. It is connected to a video screen to see the glottic opening. Under vision you're able to 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

LMA (Laryngeal mask airway): comes in various sizes and shapes



Indicated when you are not able to intubate or for short procedures (1:30 -2 Hours)

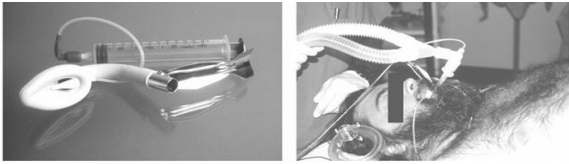
Example: A patient with bronchial asthma scheduled for a hand surgery or removal of foreign body (short procedure)

Not used in emergencies or laparoscopic surgeries like laparoscopic cholecystectomy because the abdomen will be distended so there is high chance of regurgitation and aspiration

✓ **Advantages:**
Avoids trauma to the trachea

✓ **Disadvantages:**
Aspirations and regurgitation. Because it lies over the laryngeal opening not inside the trachea

✓ Fast track LMA



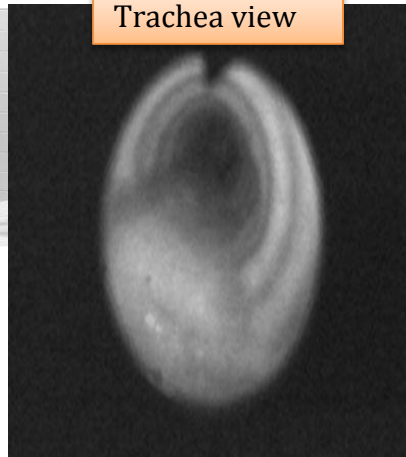
It is made in such shape to be able to slide an endotracheal tube through the hole in between. There is a flap and once you put the ETT the flap goes up → No risk of Aspiration



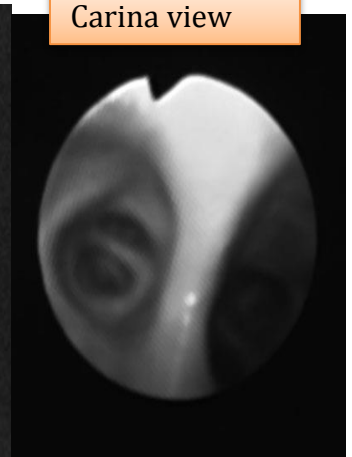
Fiberoptic intubation (They will not ask about it)



Trachea view



Carina view



It is used when there is a 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 fiberoptic 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)

Induction agents (in a separate pharmacology lecture)

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.

Induction - **Propofol** (mostly used), **Thiopental** and **Etomidate** (Etomidate is used in hemodynamically unstable patients & in patients with cardiac diseases. because It prevents hypotension) all are IV induction agent

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

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

Mainly used in the maintenance phase

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)

General anesthesia

- Reversible loss of consciousness
- Analgesia
- Amnesia
- Some degree of muscle relaxation

Intraoperative management

- Maintenance : the aim is to achieve a balanced anesthesia

Inhalation agents: N₂O (No Longer used) Used O₂ 40% and air 60%, Sevoflurane, Desflurane, Isoflurane

TVA (Total IV agents): Propofol (when you don't use inhalation agents!!)

Opioids: Fentanyl, Morphine

Muscle relaxants

Balance anesthesia

- Monitoring depending on the patient's condition (ECG ,End tidal CO₂, pulse oximeter , Blood pressure cuff , urine output , temperature measurement & blood loss measurement)
- 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
 - 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:

Minor procedures 1-3ml/kg/hr.

Major procedures 4-6ml/kg/hr.

Major abdominal procedures 7-10ml/kg/hr

Example: A patient is **40kg**. The 1st 10kg = 10X4 = 40ml/hr

2nd 10kg = 10X2 = 20ml/hr 3rd 10kg = 10X1 = 10ml/hr 4th 10kg = 10X1 = 10ml/hr

A 5kg pediatric patient's fluid replacement will be: 5X4 = 20 ml/hr

Intraoperative management – Emergence “waking the patient up”

1. Turn off the agent (inhalation or IV agents)
2. Reverse the muscle relaxants
3. Return to spontaneous ventilation with adequate ventilation and oxygenation
4. Suction upper airway when the patient response to you and reverse muscle relaxant
→ **Neostigmine**
5. Wait for patient to wake up and follow command
6. Hemodynamically stable
7. Then you can extubate the patient and shift them to the post anesthesia care unit or the HDU “High dependency unit” or you can keep the patient intubated and lessen the agent’s concentration without reversing or antagonizing the muscles relaxant
→ shift them to the SICU intubated/ventilated (e.g. craniotomy ending up with respiratory depression of any surgical complication) → Usually planned beforehand
8. Postoperative management the recovery room
If the patient was shifted to ICU he/she is no longer your problem
9. Post-anesthesia care unit (PACU)
 - Oxygen supplement
 - Pain control
 - Nausea and vomiting
 - Hypertension and hypotension
 - Agitation
10. Surgical intensive care unit (SICU)
 - Mechanical ventilation
 - Hemodynamic monitoring

General Anesthesia - Complications

- **Respiratory complications**
 - Aspiration – airway obstruction and pneumonia
 - Bronchospasm
 - **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
 - Hypoventilation → central nervous system or analgesia wasn’t adequate over dosage of competitive relaxants or cholinesterase deficiency

- **Cardiovascular complications**
 - Hypertension and hypotension
 - Arrhythmia
 - Myocardial ischemia and infarction → especially with diabetic patients that cannot tolerate the surgical stress
 - Cardiac arrest
- **Neurological complications**
 - Slow wake-up
 - Stroke
- **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 unexplained rise of the temperature (Hyperpyrexia) 1-2° per hour + ↑End tidal CO₂ although ventilating (60-65) the normal=45 usually patients don't survive **treatment : dantrolene**

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) **ASAM**

3. Pre-anesthetic Assessment

EKG: Normal sinus rhythm

CXR: Borderline cardiomegaly & tortuous aorta

Lab data: Hb 10.5 / Hct 33.2

Within the normal range

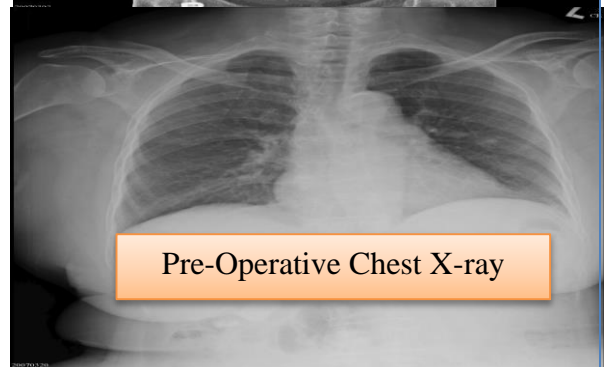
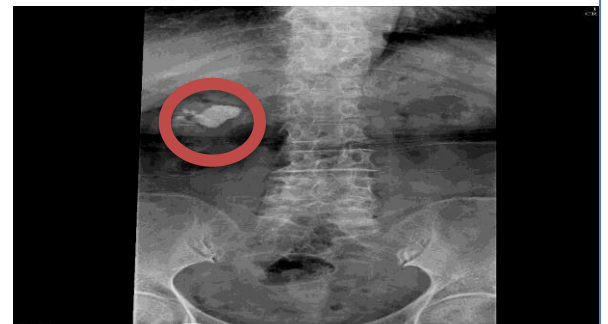
{ BUN 24 / Creatinine 1.1
GOT 14
PT, aPTT WNL

4. Anaesthetic Technique

2. Preoperative diagnosis: Right renal stone (3.2 cm)

Operation planned: Right PCNL

(Percutaneous nephrolithotomy)



Pre-Operative Chest X-ray

General anesthesia with endotracheal intubation. Standard monitoring apparatus for ETGA

Induction: Fentanyl 1ug/kg

Propofol 2mg/kg

Succinylcholine 80 mg

Atracurium 25 mg

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](#)

5. Intra-operative Events

Stable hemodynamics

Abnormal findings 30 minutes after surgery started

Increased airway pressure 35~40 mmHg (normal. 18-20mmHg)

SpO2 dropped to 90~95% (suspect that the ventilator cannot push air because there is an obstruction e.g. Bronchospasm, one lung ventilation)

Bilateral breathing sounds were still audible then

Management: Solu-cortef 100 mg IV stat

Aminophylline 250 mg IV drip

Bricanyl 5 mg inhalation

Bronchodilators
assuming that the
patient suffered from
bronchospasm

ABG data:

pH	7.2
PaO ₂	90.5
PaCO ₂	No(45)66.8
HCO ₃ ⁻	26.0
BE	-2.4
Na ⁺	143.0
K ⁺	4.0
Ca ²⁺	1.1
Hb/Hct	11.4/36.1

6. Post-operative Course

The patient's condition continued until the end of surgery

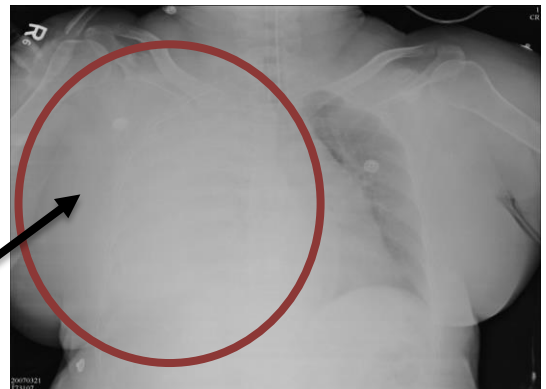
SpO2 90~92% after the patient was placed in the supine position again with diminished breathing sound over right lower lung

The patient was transferred to SICU for further care (*)

Chest X-ray was followed in SICU

Postoperative Course:

Immediate post-operative
Heamothorax



Pigtail drainage in SICU

Pleural effusion: bloody

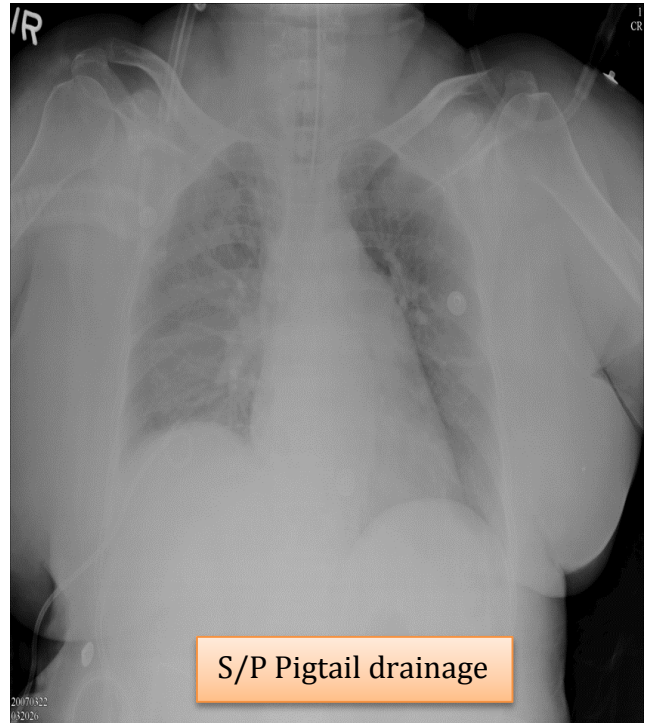
RBC numerous

WBC 7800 (Seg 94%)

Gram stain (-)

Impression: Right hydrothorax and hemothorax

- ✓ Extubation and transfer to ordinary ward
- ✓ Pigtail removed



Remember! Patients die from improper ventilation not faulty intubation – Dr.Sadia

