



General Anaesthesia Technique

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Resources: lecture slides, 435teamwork, Book(Julian stone)

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.
- Anesthesia Workstation anesthesia machine structure
- Complications commonly encountered during general anesthesia.

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★ General anaesthesia technique

What is anaesthesia?

“Without sensation” 1846 by Wendell Holmes to describe ‘state of sleep from ether’.

- Early drugs:
 - opium, alcohol, cocaine, N₂O (1844) & CO₂, 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 in 1884.
- **Consciousness: being aware of surroundings and being able to react accordingly. Anesthesia is the opposite.**
- **Amnesia: patient should not recall what happened during the operation.**

Definitions:

Term	Definition
General anesthesia	A state of reversible unconsciousness, analgesia, and amnesia with skeletal muscle relaxation and loss of reflexes. which induced by pharmacological agents in a reversible manner
Inhalation anesthesia	Anesthesia induced by inhalation of drug.
Minimum alveolar concentration (MAC)	The alveolar concentration required to eliminate the response to standardized painful stimulus in 50% of patients.
Analgesia	A stage of decreased awareness of pain sometimes with amnesia
Balanced anesthesia	Anesthesia produced by a mixture of drugs, often including both inhaled and intravenous agent.

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

- Operating room (hospital, surgicenter)
- Other procedural areas
- PACU post anaesthesia care unit
- Emergency medicine
- Respiratory therapy
- Administration (operating room, hospital, medical school)
- Research
- Labor & delivery suite
- Intensive care unit (ICU)
- Pain management (acute pain, chronic/cancer pain)
- “Code blue” team
- Education (health professionals, public)

- Managers

General Anesthesia Goals:

Primary goal:

- Oxygenation
- Ventilation. related to CO2 exhalation.
- Monitoring
- Amnesia: patient should forget any unpleasant feeling.
- Hypnosis: Unconscious state
- Analgesia: No pain sensation
- Autonomic Block: Reflexes blocked
- 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**
- **Induction**
- **Maintenance**
- **Emergence**
- **Postoperative care** (recovery room is an extension of OR).

★ Preoperative anesthetic evaluation

1-Physical status classification:

Class I	A normal healthy patient.
Class II	A patient with mild systemic disease (no functional limitation).very well controlled medical illness such as DM or HTN
Class III	A patient with severe systemic disease (some functional limitation) .Patients with drug allergies are categorized in this Class .patient with disease that's not well controlled
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 within 24 hours.
Class VI	A brain-dead patient whose organs are being removed for donor purpose. we add it to the classification ex. Class II E
Class E	Emergent procedure.

2-Airway examination: (interobserver deviation)

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. The stomach should be free of content, we cant be 100% ure because of gastric secretions but solid food should not be taken
- **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
- Patients in emergency considered as full stomach.

An unconscious patient will aspire, he will not be able to take care of his regurgitation and will aspirate so it is our duty to take care of it.

4-Anesthetic plan

Stages of general anaesthesia (Arthur Ernest Guedel 1937)

Based on inhalation of diethyl Ether

Stage 1	Stage of analgesia start (Joseph Frank Artusio 1954) <ul style="list-style-type: none"> ● <u>Plane 1</u> no amnesia, no analgesia. ● <u>Plane 2</u> amnesia, partial analgesia. ● <u>Plane 3</u> full amnesia and analgesia
Stage 2	Stage of excitement; unconsciousness This stage is dangerous as the patient may injure themselves by pulling away his arms/masks yet he is still unconscious
Stage 3	Stage of surgical anaesthesia This is the stage needed during surgery <ul style="list-style-type: none"> ● <u>Plane¹</u> regular respiration. ● <u>Plane 2</u> eyeball movement. ● <u>Plane 3</u> intercostal muscles paralyzed. ● <u>Plane 4</u> diaphragm.
Stage 4	stage of medullary depression; in the 4th ventricle layer which contains respiration centre

¹Plane or phase

diaphragm paralysis. Patient shouldn't reach this stage there will be no cardiac activity, no breathing. Patient is going into arrest

General anesthesia - INTRAoperative

General Anesthesia

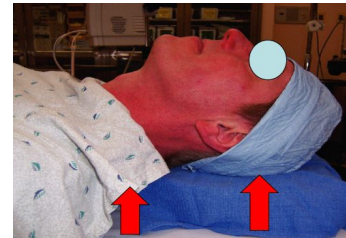
- Monitor
- Pre-oxygenation²
- Induction³ (including RSI⁴ & cricoid pressure)
- Mask ventilation
- Muscle relaxants
- Intubation & ETT (Endotracheal Tube) position confirmation
- Maintenance
- Emergence Extubation. If patient is high risk then keep intubated and take to a high monitoring area (ICU, NICU etc)
- Post operative recovery.

Sniffing position (Golden Position):

Base of skull condyle, 1st vertebral joint, Under occiput. These 3 come in one line and superimpose this = makes intubation easy. This position also helps pass ETT very easily.

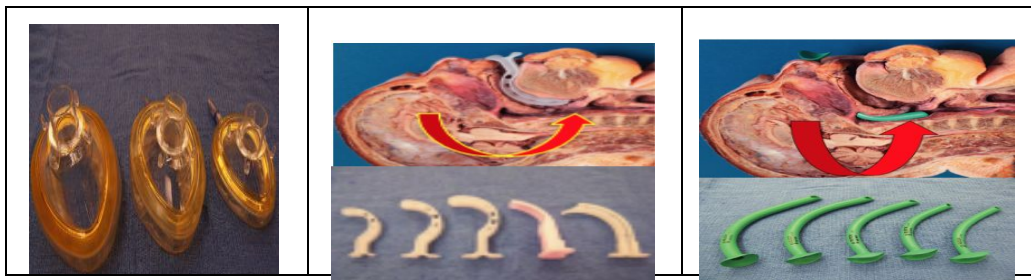
Flexion of cervical joints.

Extension of A-O joint.



Mask and airway tools:

If the tongue falls back it may cover the epiglottis and so we use nasopharyngeal



² 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 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.

⁴ **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.

Mask ventilation and intubation⁵

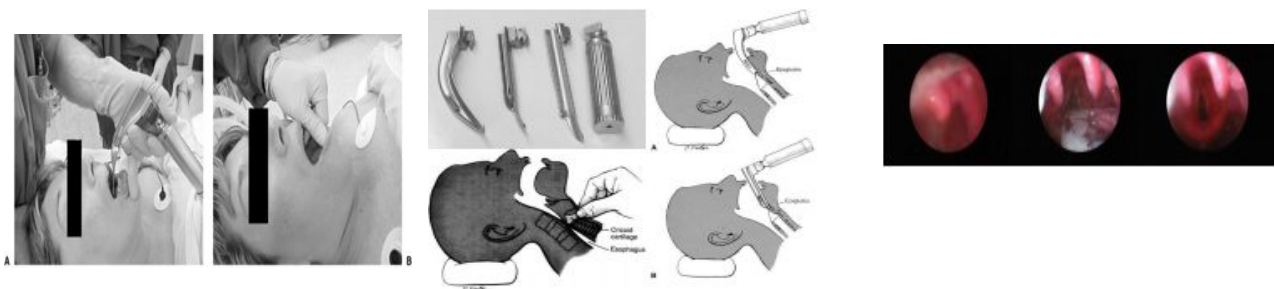
Double handed intubation. Single E and C technique.
You hold the ramus of the mandible and lift it up lifting the tongue away from the tract and applying a downward force to give you a seal so theres no leak. You then attach it to a mechanical ventilator or manually ventilate. Also make sure that the neck is extended.



Difficult BMV⁶ - MOANS

M	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.
O	obstruction/obesity	Obstruction of upper airway, obesity ⁷ (BMI greater than 26) is an independent marker. Redundant upper airway tissue, chest wall weight & resistance from abdominal contents impede airflow.
A	Age	General loss of elasticity & increased incidence of restrictive /obstructive lung disease with increasing age.
N	No teeth	Edentulous creates difficulty
S	Stiffness	Resistance to ventilation with COPD, Asthma, Pulmonary edema.

Intubation



⁵ OSCE: it has 2 Techniques:

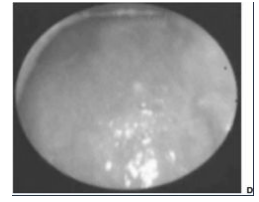
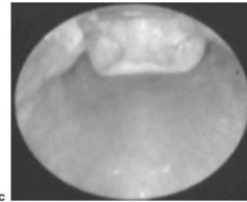
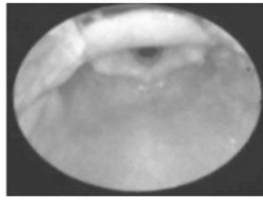
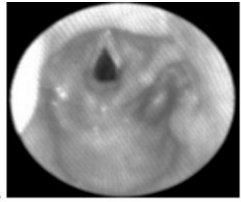
Single handed: by making a C shape with the thumb and index on the mask and E shape on the jaw with the remaining 3 fingers.

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.

⁶ Bag-Mask Ventilation

⁷In 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.

Laryngeal view scoring system (Cormack-Lehane grading system)



Difficult airway: If for example they are obese, have a thick neck etc..



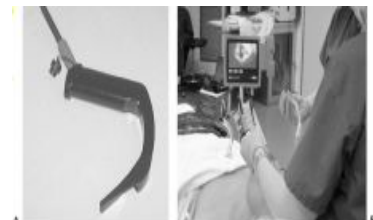
The LEMON approach⁸

L	Look externally	Abnormal facies, unusual anatomy or facial Trauma.
E	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.
M	Mallampati score	III predicts difficulty and IV predicts extreme difficulty.
O	Obstruction / Obesity	-
N	Neck mobility	(If patient can't move his neck he won't be able to do sniff position)

Difficult airway management:

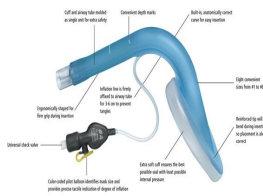
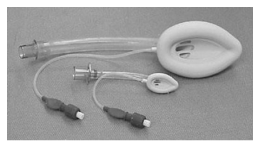
- **Glidescope:** A monitor that helps watch the structures as you go inside.

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.



⁸ For difficult intubation (Done pre-op)

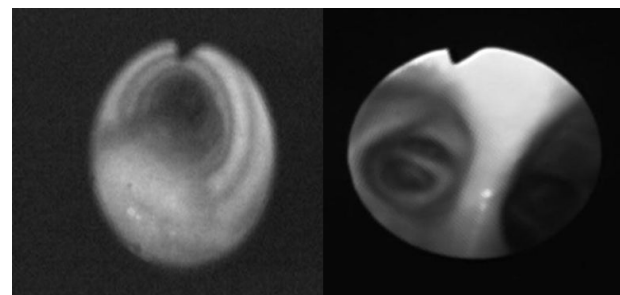
● **LMA⁹:**



● **Fast track LMA**



- **Fiberoptic intubation¹⁰:** with the help of a monitor one person can do it alone.
- **USually** in very difficult airway or when patient can't move.



Trachea view

Carina view

To help differentiate: The esophagus is a muscular tube whereas the trachea has muscles and cartilage and you'll see rings.

★ **Anesthesia Machine**

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

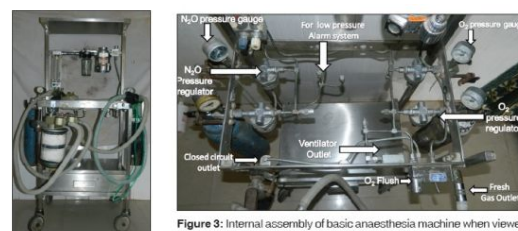


Figure 3: Internal assembly of basic anaesthesia machine when viewed from above with covering plate removed

⁹ Laryngeal mask airway

¹⁰ 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)

Anesthesia Workstation

Previously called “Machine” the difference is the workstation includes ALL equipment: the machine, monitor, laryngoscope, suction etc. They’re all things we need for an anesthetic operation.

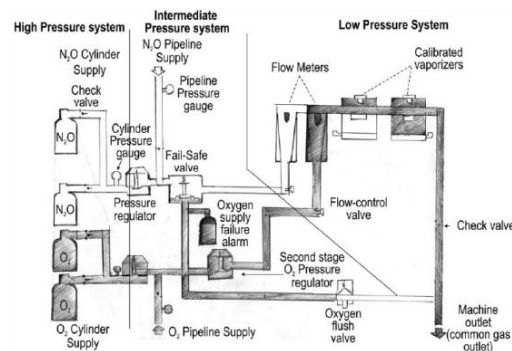


Functions of anesthesia machine: “4 essential functions”

- Provides O₂.
- Accurately mixes anaesthetic gases and vapours.
- Enables patient ventilation.
- Minimises anaesthesia related risks to patients and staff. Using the machine you can control the pollution, it will throw the waste outside and will reduce the pollution risk.

Anesthesia machine

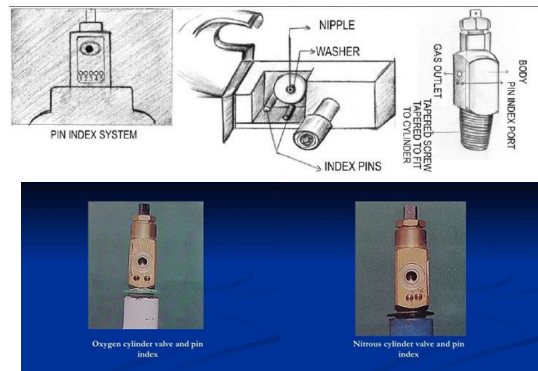
- Gas supplies: From the central pipeline to the machine as well as cylinders.
 - **Flow meters.** The flow meter measures and indicates the rate of flow of gases and allows precise control of O₂ or N₂O delivery to the vaporizer/common gas outlet.
 - Vaporizers.
 - Fresh gas delivery: Breathing systems and ventilators.
 - Scavenging.
 - Monitoring.
- **Diagram of Anesthesia Machine:**



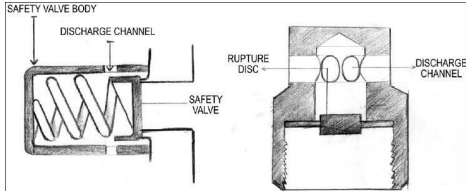
When the low pressure is introduced to the patient its at a normal pressure. The valves regulate the pressure and revert it from high to normal.

Safety Features:

- Pin Index safety system (PISS): previously instead of using O₂ you might introduce NO and so the patient will die. Here the pin is like a USB cord, you have 2 sides and it'll help avoid giving NO. if you want to give O₂ theres a specific type of pin that is specific only to O₂ (for ex the diameters are different to help differentiate)



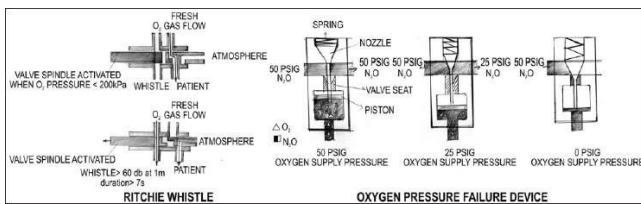
- Pressure Regulators:



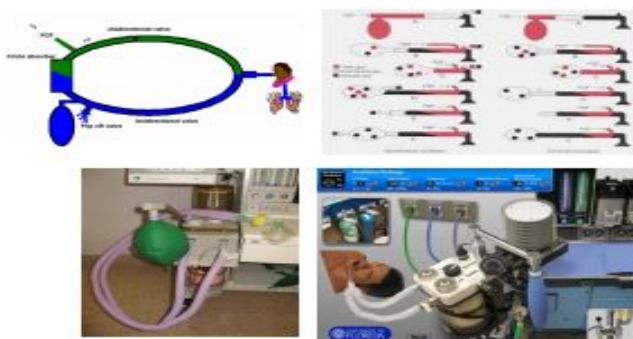
- DISS safety connections Non-interchangeable screw thread: is a gas station outlet system used in the hospital setting for the supply of medical gases. DISS connectors are threaded and have a unique diameter for each type of gas to prevent erroneous connection.



- Oxygen Failures device



Breathing circuit



Most imp to us is the circle system, when you reach an equilibrium it goes around around.

★ Induction agents:

- **IV induction** used most of the time
- Inhalation induction used in children or patients with partial airway obstruction because it keeps the airway patent and open so we don't lose airway control.

Analgesics	<ul style="list-style-type: none"> ● Opioids – Fentanyl, Sufentanyl, Remifentanyl These drugs are used depending on operators personal preference and what's suitable for the patient.
Induction of unconscious	<ul style="list-style-type: none"> ● Propofol more hypotension, Thiopental and Etomidate has more cardiac stability so if the pt has heart dis give this, Benzodiazepines
Muscle relaxants	<ul style="list-style-type: none"> ● Depolarizing – Succinylcholine (used in Rapid sequence induction & Pregnant ladies (No reversal Agent). ● Non-depolarizing

★ Intraoperative management:

Maintenance	<ul style="list-style-type: none"> ● Inhalation agents: N2O, Sevoflurane, Desflurane, Isoflurane. ● Total IV agents: Propofol ● Opioids: Fentanyl, Morphine ● Muscle relaxants ● Balance 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.
Positioning during surgery	<ul style="list-style-type: none"> ● Supine ● Lateral ● Prone ● Sitting ● Lithotomy
Fluid management	<ul style="list-style-type: none"> ● Crystalloid vs colloid ● NPO fluid replacement: <ul style="list-style-type: none"> ○ 1st 10kg weight-4ml/kg/hr, ○ 2nd 10kg weight-2ml/kg/hr ○ 1ml/kg/hr thereafter ● Intraoperative fluid replacement: <ul style="list-style-type: none"> ■ minor procedures 1-3ml/kg/hr ■ major procedures 4-6ml/kg/hr ■ major abdominal procedures 7-10ml/kg/hr

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 :

Post-anesthesia care unit (PACU) Some go to high dependency area or specific management like cardiac ICU etc.	<ul style="list-style-type: none"> ● Oxygen supplement ● Pain control ● Nausea and vomiting give antiemetic during surgery ● Hypertension and hypotension ● Agitation
Surgical intensive care unit (SICU)	<ul style="list-style-type: none"> ● Mechanical ventilation ● Hemodynamic monitoring

General Anesthesia Complications:

Respiratory complications	<ul style="list-style-type: none"> ● Aspiration- airway obstruction and pneumonia ● Bronchospasm ● Atelectasis ● Hypoventilation due to the opioids the respiratory rate is decrease and tidal volume is increased (central nervous system or analgesia wasn't adequate over dosage of competitive relaxants or cholinesterase deficiency)
Cardiovascular complications	<ul style="list-style-type: none"> ● Hypertension and hypotension ● Arrhythmia ● Myocardial ischemia and infarction ● Cardiac arrest
Neurological	<ul style="list-style-type: none"> ● Slow recovery from anesthesia. Not waking up after surgery

complications	<ul style="list-style-type: none"> Stroke using anesthesia for longer periods of time causes ruptures of vessels due to cerebral pressure but this is very rare
Malignant hyperthermia	<p>Sensitive to depolarizing agents; triggered by succinylcholine and all volatile anesthetic agents. This used to have a high mortality rate. We give dantrolene sodium before surgery to prevent malignant hyperthermia.</p>
Hypothermia VERY common	<ul style="list-style-type: none"> Definition 35 C or less (core temperature) Classification: <ul style="list-style-type: none"> Mild 35-32 C Moderate 32-28 C Severe 28-20 C Mechanism: Depress the hypothalamus at the temp regulatory centre. <ul style="list-style-type: none"> Heat loss <ul style="list-style-type: none"> Radiation Convection Evaporation Conduction Therapeutic vs Accidental Hypothermia (Therapeutic: sometimes given during cardiac surgery to decrease the temp so the patient consumes little O₂ and it preserves its function. Accidental: like alcohol, you get vasodilation and a lot of heat is lost) Adverse effects (more time in hospital) Prevention: You increase the temp of your surroundings (single most important factor), or use floor warmers Treatment: Rewarming

Practice Questions:

Q1: Stages of general anesthesia described by Arthur Ernest Guedel in 1937 are based on which of the following?

- Intravenous Ketamine
- Inhalational Desflurane
- Inhalation of Diethyl ether
- Intravenous Propofol

Q2: which of the following is the sequence of phases for administering general anesthesia?

- Extubation, induction, intubation, and maintenance
- Induction, intubation, maintenance, and emergence
- Intubation, maintenance, emergence, and induction
- Intubation, extubation, emergence, and maintenance

Q3: which of the following is a common position if the patient during majority of the surgeries?

- A. Supine
- B. Lateral decubitus position
- C. Lithotomy
- D. Prone

Q4: Following multiple trials of laryngoscopy, the anesthetist realized that he cannot ventilate. Which of the following is appropriate ?

- A. Awake the patient and cancel the case
- B. Call for expert anesthetist
- C. Use fiber optic bronchoscope
- D. Tracheostomy

Q5: A 67-year-old female patient booked for hysterectomy under combined spinal epidural. Which of the following is the time duration to hold food intake before surgery ?

- A. 1-3 hours
- B. 4-5 hours
- C. 6-8 hours
- D. 10-12 hours

Q6: Which of the following time periods is considered intra-operative ?

- A. Leaving floor to OR
- B. Entering OR to recovery room
- C. Leaving recovery room till time of follow up
- D. Leaving the hospital for discharge

Q7: 21-year-old patient morbidly obese booked for laproscopic sleeve gasterectomy under general anesthesia, on airway assessment showed soft palate and hard palate. Which of the following is the Malampati class for this patient ?

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

Answers:

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