Introduction to Anesthesiology

Meaning of Anesthesia:

Greek word an- “without”, and, aesthesis “sensation”, refers to the inhibition of sensation.
Oxford dictionary definition: insensitivity to pain, especially as artificially induced by the administration of gases or the injection of drugs before surgical operations.
Note: “Anesthesia” in American English, “Anaesthesia” in British English.

Primitive Anesthesia:

In ancient civilizations: opium poppy, coca leaves, mandrake root and alcohol are used to induce anesthesia.
Regional anesthesia in ancient times was by compression of nerve trunks or the application of cold (cryo-analgesia).

Middle Ages and Renaissance:

Years 1200 - 1500 A.D. in England: a potion called dwale was used as an anesthetic. contained bile, opium, lettuce, bryony, and hemlock.
In19th Century: Crawford Long-1842: employed *ether* as a general anesthetic for limb amputations and parturition.
World Anesthesia Day: On 16 October 1846, John Collins Warren removed a tumor from the neck of a local printer, Edward Gilbert Abbott.
Local anesthesia: chewed coca leaves and spat saliva.

The evolution of modern anesthesia:

First: with inhalational anesthesia => local and regional anesthesia => finally: intravenous anesthesia.
Birth of modern Anesthesia:
-In 1913, Chevalier Jackson used a direct laryngoscopy as a means to intubate the trachea. Sodium thiopental (an intravenous anesthetic agent) used for first time in humans on 8th of March/ 1934 by Ralph M. Waters.
-General anesthesia;
Is a medically induced state of unconsciousness with loss of protective reflexes, resulting from the administration of one or more general anesthetic agents. It is carried out to allow medical procedures that would otherwise be intolerably painful for the patient; or where the nature of the procedure itself precludes the patient being awake.
A variety of medications may be administered, with the overall aim of ensuring unconsciousness, amnesia, analgesia, loss of reflexes of the autonomic nervous system, and in some cases paralysis of skeletal muscles. The optimal combination of drugs for any given patient and procedure is typically selected by an anesthetist, or another provider such as an Operating Department Practitioner, Anesthetist Practitioner, physician assistant or nurse anesthetist (depending on local practice), in consultation with the patient and the surgeon, dentist, or other practitioner performing the operative procedure.
Purpose of general anesthesia:
General anesthesia has many purposes, including:

1. Unconsciousness.
2. Analgesia (loss of response to pain).
3. Amnesia (loss of memory).
4. Immobility (loss of motor reflexes).
5. Paralysis (skeletal muscle relaxation).

-Preanesthetic evaluation

Prior to a planned procedure, the anesthetist reviews medical records and/or interviews the patient to determine the best combination of drugs and dosages and the degree to which monitoring will be required to ensure a safe and effective procedure.

-Key factors in this evaluation are the patient's age, body mass index, medical and surgical history, current medications, and fasting time. Thorough and accurate answering of the questions is important so that the anesthetist can select the proper drugs and procedures.

An important aspect of pre-anesthetic evaluation is an assessment of the patient's airway, involving inspection of the mouth opening and visualization of the soft tissues of the pharynx. The condition of teeth and location of dental crowns are checked, and neck flexibility and head extension are observed.

Fasting times:

It is important for patient undergoing general anesthesia to stop eating and drinking before the operation, as a full stomach can cause vomiting (an active reflex that moving gastric contents into the pharynx) or regurgitation (a passive movement of gastric contents into the pharynx under the force of gravity), For the unconscious patient, the danger lies in the fact that the epiglottis is disabled which leads to aspiration (movement of these contents from the pharynx into the lungs).

Diet	Minimal duration of fasting (all age)
Beverages (plain water, fruit juice, carbonated drinks, tea, coffee)	2 hours
Breastmilk	4 hours
Formula milk	6 hours
Milk other than breastmilk	6 hours
Snacks (toast + drinks) amount and type need to be noted	6 hours

-Premedication

Prior to administration of a general anesthetic, the anesthetist may administer one or more drugs that complement or improve the quality or safety of the anesthesia. Example of anesthetic premedication is the preoperative administration of beta adrenergic antagonists to reduce the incidence of postoperative hypertension, cardiac dysrhythmia, or myocardial infarction. Anesthesiologists may administer an antiemetic agent such as ondansetron, droperidol, or dexamethasone to prevent postoperative nausea and vomiting, or subcutaneous heparin or enoxaparin to reduce the incidence of deep vein thrombosis. Other commonly used premedication

agents include opioids such as fentanyl or sufentanil, gastrokinetic agents such as metoclopramide, and histamine antagonists such as famotidine.

Stages of general anesthesia

Stage 1:
Also known as the stage of *induction*, is the period between the administration of induction agents and loss of consciousness. During this stage, the patient progresses from analgesia without amnesia to analgesia with amnesia. Patients can carry on a conversation at this time.
Stage 2:
Also known as the stage of *excitement*, is the period following loss of consciousness and marked by excited and delirious activity. During this stage, the patient's respiration and heart rate may become irregular. In addition, there may be uncontrolled movements, vomiting, suspension of breathing, and pupillary dilation. Because the combination of spastic movements, vomiting, and irregular respiration may compromise the patient's airway, rapidly acting drugs are used to minimize time in this stage and reach Stage 3 as fast as possible.
Stage 3:
Also known as the stage of *surgical anesthesia*, the skeletal muscles relax (but the diaphragm muscle should not be paralyzed completely unless due to using of a muscle relaxant), vomiting stops, respiratory depression occurs, and eye movements slow and then stop. The patient is unconscious and ready for surgery. This stage is divided into four planes:
Plane 1: The eyes roll, then become fixed;
Plane 2: Corneal and laryngeal reflexes are lost;
Plane 3: The pupils dilate and light reflex is lost;
Plane 4: Intercostal paralysis and shallow abdominal respiration occur.
Stage 4:
Also known as the stage of *overdose*, occurs when too much anesthetic medication is given relative to the amount of surgical stimulation and the patient has severe brainstem or medullary depression, resulting in a cessation of respiration and potential cardiovascular collapse. This stage is lethal without cardiovascular and respiratory support.

Induction

Most general anesthetics are induced either intravenously or by inhalation. Intravenous injection works faster than inhalation, taking about 10–20 seconds to induce total unconsciousness. This minimizes the excitatory phase (Stage 2) and thus reduces complications related to the induction of anesthesia. Commonly used intravenous induction agents include propofol, sodium thiopental, etomidate, and ketamine. Inhalational anesthesia may be chosen when intravenous access is difficult to obtain (e.g., children), when difficulty maintaining the airway is anticipated, or when the patient prefers it. Sevoflurane is the most commonly used agent for inhalational induction, because it is less irritating to the tracheobronchial tree than

other agents.

Physiologic monitoring

Several monitoring technologies allow for a controlled induction of, maintenance of, and emergence from general anesthesia.

1) Continuous electrocardiography (ECG or EKG): Electrodes are placed on the patient's skin to monitor heart rate and rhythm. This may also help the anesthesiologist to identify early signs of heart ischemia.

2) Continuous pulse oximetry (SpO2): A device that placed, usually on a finger, to allow for early detection of a fall in a patient's hemoglobin saturation with oxygen (hypoxemia).

3) Blood pressure monitoring: There are two methods of measuring the patient's blood pressure. (invasive and noninvasive)

4) Agent concentration measurement: anesthetic machines typically have monitors to measure the percentage of inhalational anesthetic agents used as well as exhalation concentrations.

5) Oxygen measurement: Almost all circuits have an alarm in case oxygen delivery to the patient is compromised. The alarm goes off if the fraction of inspired oxygen drops below a set threshold.

6) Circuit disconnection alarm or low pressure alarm indicates failure of the circuit to achieve a given pressure during mechanical ventilation.

7) Capnography measures the amount of carbon dioxide exhaled by the patient in (percentage or mmHg) allowing the anesthesiologist to assess the adequacy of ventilation.

8) Temperature measurement to discern hypothermia or fever, and to allow early detection of malignant hyperthermia.

9) Electroencephalography, entropy monitoring, or other systems may be used to verify the depth of anesthesia. This reduces the likelihood of anesthesia awareness and of overdose.

Airway management

Anesthetized patients lose protective airway reflexes (such as coughing), airway patency, and sometimes a regular breathing pattern due to the effects of anesthetics, opioids, or muscle relaxants. To maintain an open airway and regulate breathing, some form of breathing tube is inserted after the patient is unconscious. To enable mechanical ventilation, an endotracheal tube is often used, although there are alternative devices that can assist respiration, such as face masks or laryngeal mask airways. Generally, full mechanical ventilation is only used if a very deep state of general anesthesia is to be induced for a major procedure, and/or with a profoundly ill or injured patient. That said, induction of general anesthesia usually results in apnea and requires ventilation until the drugs wear off and spontaneous breathing starts.

Neuromuscular blockade

Paralysis, or temporary muscle relaxation with a neuromuscular blocker (muscle relaxant), is an integral part of modern anesthesia. The first drug used for this purpose was curare, introduced in the 1940s, which has now been superseded by drugs with fewer side effects and, generally, shorter duration of action. Muscle relaxation allows surgery within major body cavities, such as the abdomen and

thorax, without the need for very deep anesthesia, and also facilitates endotracheal intubation.

Maintenance

The duration of action of intravenous induction agents is generally 5 to 10 minutes, after which spontaneous recovery of consciousness will occur. In order to prolong unconsciousness for the required duration (usually the duration of surgery), anesthesia must be maintained. This is achieved by allowing the patient to breathe a carefully controlled mixture of oxygen, nitrous oxide, and a volatile anesthetic agent, or by administering medication (usually propofol).

Recovery

Emergence is the return to baseline physiologic function of all organ systems after the cessation of general anesthetics. This stage may be accompanied by temporary neurologic phenomena, such as agitated emergence (acute mental confusion), aphasia (impaired production or comprehension of speech), or focal impairment in sensory or motor function.

Postoperative care

Anesthesia should conclude with a pain-free awakening and a management plan for postoperative pain relief. This may be in the form of regional analgesia or oral, transdermal, or parenteral medication.

-The differences between general anesthesia and local anesthesia

Features	General anesthesia	Local anesthesia
1-Site of action	CNS	Peripheral nerve
2-Area of body involve	Whole body	Restricted area
3-Consciousness	unconscious	conscious
4-Care of vital signs	Essential	Usually less important than in general anesthesia
5-Poor health patient	risky	safe
6-Given to uncooperative patient	possible	Not possible
7-Major surgery	preferred	Not preferred
8-Minor surgery	Not preferred	preferred