Principles of Anesthesia

Theoretical Lectures | First Year | Anesthesia Techniques Department
Southern Technical University | Medical Technical Institute-Basra

PACKAGE DESCRIPTION

Course information

TARGET GROUP AND DURATION

- First-year students
- Department of Anesthesia Techniques
- Duration: 15 weeks
- Weekly hours: 3 theory + 6 practical

COURSE INFORMATION

- Course: Principles of Anesthesia
- Year: First Year
- Language: English
- Course type: Specialized
- Units: 9

GENERAL AND SPECIFIC AIMS

Learning outcomes

SPECIFIC AIMS

- Recognize the main methods of anesthesia.
- Understand the proper use and preparation of anesthetic drugs.
- Identify the main anesthesia equipment and systems.
- Apply basic monitoring and safety principles.

GENERAL AIM

- To provide students with the fundamental knowledge and practical skills required to understand anesthesia techniques, anesthetic drugs, equipment, monitoring, and patient safety.

WEEKLY COURSE PLAN — WEEKS 1–5

Theory and practical topics

1	**Theory: Pharmacodynamic Effects**	Practical: Canister: parts, components, mechanism, and practical application.
2	**Theory: Respiratory Physiology Related to Anesthesia**	Practical: IV set and IV fluids: uses and practical application.
3	**Theory: Types of Anesthetic Techniques**	Practical: Magill system: parts, components, mechanism, and application.
4	**Theory: Ideal Anesthetic Agent and Ideal Anesthesia**	Practical: Ayer’s system (pediatric respiration system): parts and application.
5	**Theory: History of Anesthesia**	Practical: Cannula: mechanism of action, types, and practical application.

WEEKLY COURSE PLAN — WEEKS 6–10

Theory and practical topics

6	**Theory: Pharmacokinetic Effects**	
7	**Theory: Steps of Anesthesia**	Practical: Anesthetic machine: components, gas and vapor flow, and application.
8	**Theory: Vital Signs and Anesthesia**	Practical: Anesthetic machine: components, mechanism, and practical application.
9	**Theory: Respiratory Insufficiency and Respiratory Failure**	Practical: ECG: parts, components, and mechanism of action.
10	**Theory: Anesthesia and Shock Syndrome**	Practical: Anesthetic trolley: syringes and airways, types and uses.

Lecture 1

History of Anesthesia

Lecture 1 – Learning Objectives

- Trace the development of anesthesia throughout history
- Identify key figures and discoveries in anesthesia
- Understand how anesthesia evolved from folk practices to a precise science
- Recognize the milestones that shaped modern anesthetic practice

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 1 – Ancient & Medieval Era

- Egyptians, Greeks, and Chinese used opium, mandrake, and cannabis for pain relief
- Hua Tuo (2nd century AD, China): Extracted a compound from cannabis for general anesthesia
- Dioscorides described poppy (opium) in 'Materia Medica'
- Raymond Lully discovered Ether in the 13th century, but it was not used medically
- Paracelsus (16th century): Described ether's effect on chickens (loss of consciousness)

Lecture 1 – The Revolutionary 18th–19th Century

- Joseph Priestley (1772): Discovered nitrous oxide (N_2O) – 'laughing gas'
- Humphry Davy (1800): Suggested N_2O for dental pain relief
- Michael Faraday (1818): Used ether in animal experiments
- Crawford Long (1842): First surgeon to use ether as general anesthesia in America
- William T.G. Morton (1846): First public demonstration of ether anesthesia at Massachusetts General Hospital
- James Simpson (1847): Introduced chloroform for childbirth (Queen Victoria used it in 1853)
- John Snow: 'Father of Modern Anesthesia' – developed anesthesia apparatus and served as Queen Victoria's personal anesthetist

Lecture 1 – 20th & 21st Century Advances

- 1920s–1930s: Discovery of barbiturates (Thiopental Sodium, 1934)
- 1942: Curare introduced as a neuromuscular blocker
- Development of inhalational agents: Halothane (1956), Enflurane, Isoflurane
- Evolution of anesthesia machines: continuous flow, closed-circuit systems
- Local anesthesia: Cocaine (Koller, 1884), Lidocaine, Bupivacaine
- Spinal & Epidural anesthesia techniques refined
- 21st Century: Ultrasound-guided regional anesthesia, TCI, TIVA, AI-assisted monitoring

Lecture 1 – Summary

- Anesthesia evolved from ancient herbal remedies to a precise scientific discipline
- Morton's 1846 public demonstration marks the birth of modern anesthesia
- John Snow is considered the father of modern anesthesia
- Continuous technological and pharmacological advances define current practice

ACTIVITY AND ASSESSMENT — LECTURE 1

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 2

Respiratory Physiology Related to Anesthesia

Lecture 2 – Learning Objectives

- Understand the anatomy and function of the respiratory system
- Learn lung volumes and capacities relevant to anesthesia
- Understand the mechanism of breathing and gas exchange
- Know the effects of anesthesia on respiration

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 2 – Anatomy of the Respiratory System

- Upper airway: Nose, pharynx, larynx (vocal cords)
- Lower airway: Trachea, bronchi, bronchioles, alveoli
- Diaphragm: The primary muscle of respiration
- Alveolar membrane: Only 0.5 microns thick – site of gas exchange
- Pleura: Visceral and parietal layers with pleural cavity

Lecture 2 – Lung Volumes & Capacities

- Tidal Volume (TV): ~500 mL – air inhaled/exhaled during normal quiet breathing
- Inspiratory Reserve Volume (IRV): ~3000 mL – additional air that can be inhaled
- Expiratory Reserve Volume (ERV): ~1100 mL – additional air that can be exhaled
- Residual Volume (RV): ~1200 mL – air remaining after maximal exhalation
- Vital Capacity (VC) = TV + IRV + ERV ≈ 4600 mL
- Functional Residual Capacity (FRC) = ERV + RV ≈ 2300 mL
- Total Lung Capacity (TLC) = VC + RV ≈ 5800 mL

Lecture 2 – Mechanism of Breathing

- Inspiration: Diaphragm and intercostal muscles contract → thoracic volume increases → intrathoracic pressure drops (-1 to -2 mmHg) → air flows in
- Expiration: Muscles relax → positive pressure (+1 mmHg) → passive air outflow
- Dalton's Law: Partial pressure = Total pressure × Gas fraction
- Henry's Law: Amount of dissolved gas $\propto$ Partial pressure
- Atmospheric PO_2 = 150 mmHg (21% of 760 mmHg)
- Diffusion occurs across the alveolar-capillary membrane

Lecture 2 – Anesthetic Effects on the Respiratory System

- Central respiratory depression: Anesthetics suppress the medulla oblongata; reduced response to CO_2
- Opioids cause severe respiratory depression
- Neuromuscular blockers prevent diaphragm contraction
- General anesthesia reduces pharyngeal muscle tone → airway obstruction
- Loss of laryngeal reflexes → aspiration risk
- FRC decreases by 15–20% during general anesthesia
- V/Q mismatch increases; atelectasis may develop
- HPV (Hypoxic Pulmonary Vasoconstriction) may be inhibited by some anesthetics

Lecture 2 – Blood Gas Values

- Arterial blood: PaO_2 95–100 mmHg, $PaCO_2$ 35–45 mmHg, SaO_2 95–98%
- Venous blood: PaO_2 ~40 mmHg, $PaCO_2$ ~46 mmHg, SaO_2 ~75%
- Expired air: PO_2 ~100 mmHg, PCO_2 ~27 mmHg
- Normal V/Q ratio = 0.8
- Anesthesia causes V/Q mismatch and potential atelectasis

Lecture 2 – Summary

- Understanding respiratory physiology is vital for safe anesthesia
- Anesthetics affect respiratory centers, respiratory muscles, airways, and gas exchange
- FRC reduction and V/Q mismatch are key concerns during general anesthesia

ACTIVITY AND ASSESSMENT — LECTURE 2

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 3

Types of Anesthetic Techniques

Lecture 3 – Learning Objectives

- Classify the types of anesthesia
- Understand the principle, indications, and contraindications of each type
- Distinguish between local and general anesthesia

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 3 – Classification of Anesthesia

- General Anesthesia: Complete loss of consciousness, sensation, movement, and memory
- • IV Anesthesia (Propofol, Thiopental, Ketamine, Etomidate)
- • Inhalational Anesthesia (Isoflurane, Sevoflurane, Desflurane, N_2O)
- • Balanced Anesthesia (combination approach)
- Local/Regional Anesthesia: Loss of sensation in a specific area with preserved consciousness
- • Topical, Infiltration, Peripheral Nerve Block
- • Spinal Anesthesia, Epidural Anesthesia
- Monitored Anesthesia Care (MAC): Local anesthesia + light sedation

Lecture 3 – General Anesthesia

- Requires: Hypnotic + Analgesic + Muscle Relaxant + Mechanical ventilation
- Inhalational agents: Rapid control of depth, rapid emergence; but airway irritation and environmental pollution
- IV agents: Fast onset, no respiratory irritation; but accumulation in fat and difficult depth control
- Balanced Anesthesia: Small doses from each class to minimize side effects
- Example: Propofol + Remifentanil + Rocuronium + O_2/Air

Lecture 3 – Local/Regional Anesthesia

- Topical: On skin or mucous membranes (Lidocaine gel, EMLA cream, Benzocaine spray)
- Infiltration: Injection into tissues (Lidocaine 1–2%, Bupivacaine 0.25–0.5%)
- Peripheral Nerve Block: Around a peripheral nerve (Bier's block, Axillary block, Femoral block)
- Spinal Anesthesia: Injection into subarachnoid space (L3–L4); used for C-sections, pelvic and lower limb surgery
- Epidural Anesthesia: Injection into epidural space; catheter can be left for continuous anesthesia/analgesia
- Commonly used in labor (Epidural analgesia)

Lecture 3 – Comparison: General vs. Local Anesthesia

- Consciousness: Lost in general, preserved in local
- Airway protection: Required in general, not always in local
- Ventilation: Mechanical in general, spontaneous in local
- Recovery: Slower in general, faster in local
- Nausea/Vomiting: Common in general, rare in local
- Use: Major surgery (general) vs. minor/moderate surgery (local)

Lecture 3 – Summary

- Choice of anesthesia depends on: type of surgery, patient condition, surgeon preference, anesthetist expertise
- No single technique is ideal for all situations
- Balanced anesthesia represents the modern standard for general anesthesia

ACTIVITY AND ASSESSMENT — LECTURE 4

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 4

Ideal Anesthetic Agent & Ideal Anesthesia

Lecture 4 – Learning Objectives

- Know the properties of an ideal anesthetic agent
- Understand the concept of ideal anesthesia
- Evaluate current drugs against ideal criteria

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 4 – Properties of an Ideal Anesthetic Agent

- Physical/Chemical: Liquid at room temperature, chemically stable, non-flammable, non-corrosive, compatible with rubber
- Pharmacological: High potency, rapid onset, easy depth control, rapid emergence, no accumulation, no tolerance
- Physiological: No cardiac depression, no respiratory depression, no airway irritation, organ protection, no PONV, no seizures, no allergic reactions
- Clinical: Patient satisfaction, wide safety margin (high LD_{50}/ED_{50} ratio), no metabolic interference

Lecture 4 – Does an Ideal Agent Exist?

- Answer: NO. Every anesthetic agent has advantages and disadvantages
- Propofol: Rapid but causes hypotension
- Sevoflurane: Rapid but expensive and potential renal effects with barbiturates
- Isoflurane: Good but causes vasodilation and coronary steal
- N_2O: Safe but weak and can expand air-filled spaces
- Therefore, we use balanced anesthesia to approximate the ideal

Lecture 4 – The Concept of Ideal Anesthesia

- Smooth induction: No pain or anxiety
- Stable maintenance: Appropriate depth throughout surgery
- Protected airway: No aspiration or obstruction
- Adequate ventilation: Normal PaO_2 and $PaCO_2$
- Hemodynamic stability: Stable BP and HR
- Rapid emergence: Full consciousness after surgery
- Effective analgesia: Complete pain relief
- No complications: No nausea, vomiting, or headache

Lecture 4 – The Triad of Anesthesia

- The Classic Triad:
- 1. Hypnosis (loss of consciousness)
- 2. Analgesia (loss of pain sensation)
- 3. Muscle Relaxation (skeletal muscle relaxation)
-
- Modern Addition:
- 4. Homeostasis (physiological stability)
-
- Balanced Anesthesia uses multiple drugs in small doses to achieve all four components

Lecture 4 – Summary

- No ideal anesthetic agent exists, but balanced anesthesia approximates the ideal
- The four components of anesthesia are: Hypnosis, Analgesia, Muscle Relaxation, and Homeostasis
- Proper drug selection and close monitoring lead to near-ideal anesthesia

ACTIVITY AND ASSESSMENT — LECTURE 5

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 5

Pharmacodynamic Effects

Lecture 5 – Learning Objectives

- Understand the concept of pharmacodynamics
- Know the effects of anesthetic drugs on different body systems
- Understand mechanisms of action at cellular and molecular levels

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 5 – Definition & Mechanisms

- Pharmacodynamics: Study of the effect of the drug on the body (vs. pharmacokinetics: effect of body on drug)
- Mechanism theories:
    - Lipid Theory: Anesthetics dissolve in neuronal lipids and alter cell properties
    - Protein Theory: Anesthetics bind to membrane proteins (GABA-A, NMDA, Nicotinic receptors)
    - Membrane Theory: Alteration of cell membrane properties

Lecture 5 – Effects on the Central Nervous System

- Cerebral cortex suppression → Loss of consciousness
- Limbic system suppression → Amnesia (loss of memory)
- Autonomic system suppression → Loss of emotional response
- EEG changes: Slow waves → increased amplitude → burst suppression → flat line
- Spinal cord: Inhibition of ascending and descending pathways; reduced reflex responses

Lecture 5 – Cardiovascular Effects

- Propofol: ↓ Contractility, ↓ SVR, ↓↓↓ BP (significant hypotension)
- Thiopental: ↓ Contractility, ↓ SVR, ↓↓ BP; histamine release
- Ketamine: ↑ HR, ↑ Contractility, ↑ SVR, ↑↑ BP (sympathomimetic)
- Etomidate: Minimal cardiac depression; safest for cardiac patients
- Halothane: ↓↓ Contractility, ↓↓ SVR, ↓↓ BP; arrhythmogenic
- Isoflurane: ↓ Contractility, ↓↓ SVR, ↓↓ BP; coronary steal phenomenon
- SVR = Systemic Vascular Resistance

Lecture 5 – Respiratory & Other System Effects

- Respiratory: Depression of respiratory center (reduced CO_2 response), suppression of airway reflexes, bronchodilation (Halothane, Sevoflurane)
- GI: Reduced esophageal motility, decreased gastric emptying, ↓ LES tone → aspiration risk
- Renal: Reduced renal perfusion (↓ GFR), decreased urine output
- Hepatic: Most anesthetics metabolized in liver; Halothane hepatitis (rare); fluoride compounds from Enflurane/Sevoflurane
- Autonomic: Sympathetic suppression, reduced catecholamine secretion

Lecture 5 – Summary

- Pharmacodynamics explains how anesthetics affect body functions
- Understanding cardiovascular, respiratory, and CNS effects is essential to prevent complications
- Drug selection must consider the patient's comorbidities and the surgical procedure

ACTIVITY AND ASSESSMENT — LECTURE 6

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 6

Pharmacokinetic Effects

Lecture 6 – Learning Objectives

- Understand the concept of pharmacokinetics
- Know the ADME phases (Absorption, Distribution, Metabolism, Excretion)
- Understand how anesthesia affects drug distribution and elimination

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 6 – Definition & Absorption

- Pharmacokinetics: Study of the effect of the body on the drug
- Routes of administration:
- • Inhalation: Via alveoli (gases and vapors)
- • Intravenous: Directly into circulation
- • Oral/IM/SC/Topical: Less common in anesthesia
- Inhalation absorption depends on:
- • Vapor pressure (higher = more absorption)
- • Blood/Gas partition coefficient (lower = faster: Desflurane 0.42, N_2O 0.47, Sevoflurane 0.65)
- • Fat/Blood partition coefficient (higher = more accumulation in fat)

Lecture 6 – Distribution

- Volume of Distribution (Vd) = Dose / Plasma Concentration
- Multi-compartment model:
- • Central compartment: Blood, brain, heart, liver, kidneys (highly perfused)
- • Peripheral compartment: Muscles, skin (moderately perfused)
- • Deep compartment: Fat (poorly perfused)
- Induction: Drug goes to brain first (central compartment)
- Maintenance: Distributes to muscles (peripheral)
- Recovery: Leaves brain → fat → then metabolized/excreted
- Second Gas Effect: N_2O increases absorption of other inhalational agents

Lecture 6 – Metabolism & Excretion

- Metabolism (primarily liver):
- • Phase I: Oxidation (Cytochrome P450)
- • Phase II: Conjugation (Glucuronidation, Sulfation)
- • Halothane: 20% metabolized in liver → trifluoroacetic acid
- • Propofol: Metabolized in liver → inactive metabolites
- Excretion:
- • Kidneys: Most drugs and metabolites excreted renally
- • Lungs: Inhalational agents excreted unchanged via ventilation
- • Factors affecting pulmonary excretion: Ventilation rate, cardiac output, blood/gas partition coefficient

Lecture 6 – Half-Life & Context-Sensitive Half-Time

- Context-sensitive half-time: Time for 50% concentration decrease after stopping infusion
- Propofol: 30–60 min (minimal accumulation)
- Thiopental: 3–8 hours (accumulates in fat)
- Etomidate: 2–5 hours (minimal accumulation)
- Ketamine: 2–3 hours (some accumulation)
- Remifentanil: 3–4 minutes (metabolized in blood by esterases; no accumulation)

Lecture 6 – Summary

- Pharmacokinetics explains how the body handles anesthetic drugs
- ADME phases determine onset, duration, and recovery from anesthesia
- Context-sensitive half-time is more clinically relevant than standard half-life for IV infusions

ACTIVITY AND ASSESSMENT — LECTURE 8

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 7

Steps of Anesthesia

Lecture 7 – Learning Objectives

- Know the different phases of anesthesia
- Understand the requirements of each phase
- Recognize potential complications at each stage

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 7 – Phases of General Anesthesia

- Pre-operative → Pre-induction → Induction → Maintenance → Reversal → Recovery
-
- Each phase has specific goals, monitoring requirements, and potential complications

Lecture 7 – Pre-operative Phase

- Pre-anesthetic assessment: Medical history, surgical history, drug history, allergies, family history
- ASA Physical Status Classification: I (healthy) to VI (brain-dead)
- Laboratory tests: CBC, renal function, liver function, coagulation, ECG, Chest X-ray
- Pre-operative instructions: NPO (6–8 hours solids, 2 hours clear fluids)
- Premedication: Benzodiazepines (anxiety), Anticholinergics (secretions), Antacids (aspiration prophylaxis), Opioids (pre-emptive analgesia), Antiemetics

Lecture 7 – Pre-induction & Induction

- Pre-induction:
- • Patient identification, procedure verification, site marking
- • Monitoring: ECG, BP, SpO_2, $EtCO_2$
- • IV access (18G or 16G)
- • Pre-oxygenation: 100% O_2 for 3 minutes
- • Sniffing position for intubation
- Induction:
- • Opioid (Fentanyl 1–2 mcg/kg) → Induction agent (Propofol 1.5–2.5 mg/kg)
- • Bag-mask ventilation with O_2
- • Muscle relaxant (Rocuronium 0.6 mg/kg or Succinylcholine 1–1.5 mg/kg)
- • Intubation after 60–90 seconds

Lecture 7 – Maintenance & Reversal

- Maintenance:
- • Inhalational: 0.5–2 MAC of Isoflurane/Sevoflurane
- • IV: Propofol infusion (TCI)
- • Analgesia: Fentanyl, Remifentanil infusion
- • Muscle relaxation: Rocuronium, Atracurium
- • Monitoring: ECG, BP, SpO_2, $EtCO_2$, Temperature, Urine Output, BIS, TOF
- Reversal:
- • Neuromuscular reversal: Neostigmine 0.05 mg/kg + Atropine 0.02 mg/kg
- • OR Sugammadex 2–4 mg/kg (for rocuronium)
- • Opioid reversal: Naloxone 0.04 mg (rare; may cause pain)
- • Benzodiazepine reversal: Flumazenil 0.2 mg (rare)

Lecture 7 – Recovery Phase

- Early Recovery:
- • Stop anesthetics; patient begins spontaneous breathing and movement
- • Extubation criteria: TOF ratio > 0.9, spontaneous breathing, eye opening, following commands, SpO_2 > 95% on room air
- Late Recovery (PACU – Post-Anesthesia Care Unit):
- • Monitoring: BP, HR, SpO_2, pain, nausea, temperature
- • Aldrete Score for discharge (≥ 9): Activity, Respiration, Circulation, Consciousness, SpO_2

Lecture 7 – Summary

- Anesthesia requires meticulous planning and continuous monitoring
- Each phase has specific requirements and challenges
- Safe extubation and PACU monitoring are critical for patient safety

ACTIVITY AND ASSESSMENT — LECTURE 10

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 8

Vital Signs and Anesthesia

Lecture 8 – Learning Objectives

- Understand the importance of vital sign monitoring during anesthesia
- Know the devices used for monitoring
- Understand how to interpret data and make decisions

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 8 – Importance of Monitoring

- 'You cannot manage what you do not monitor'
- Continuous monitoring is essential for early detection of changes
- ASA Standards for Basic Anesthetic Monitoring must be followed
- All monitors provide complementary information about patient status

Lecture 8 – Blood Pressure Monitoring

- Non-invasive (NIBP): Cuff on arm, oscillometric method, measured every 3–5 minutes
- Invasive (Arterial Line): Catheter in radial artery, continuous reading; used in major surgery
- Normal values: Systolic 90–140, Diastolic 60–90, MAP 65–105 mmHg
- Goal during anesthesia: MAP > 65 mmHg

Lecture 8 – Heart Rate, SpO_2 & $EtCO_2$

- Heart Rate: ECG Lead II; Normal 60–100 bpm
- • Bradycardia < 60 bpm → Atropine 0.5 mg
- • Tachycardia > 100 bpm → Esmolol or Labetalol
- Oxygen Saturation (SpO_2): Pulse oximetry; Normal 95–100%
- • < 90% = Hypoxemia → Increase FiO_2, check airway
- End-tidal CO_2 ($EtCO_2$): Capnography; Normal 35–45 mmHg
- • > 45 = Hypoventilation or Malignant Hyperthermia
- • < 35 = Hyperventilation
- • = 0 = Disconnected tube or Cardiac arrest

Lecture 8 – Temperature, ABG & Urine Output

- Temperature: Esophageal or ear probe; Normal 36.5–37.5°C
- • Hypothermia < 36°C: Common in anesthesia; causes delayed emergence, bleeding, infection
- • Prevention: Warm blankets, fluid warmers, forced air warming
- ABG: pH 7.35–7.45, PaO_2 80–100, $PaCO_2$ 35–45, HCO_3^- 22–26, BE ±2
- Urine Output: Foley catheter; Goal > 0.5 mL/kg/hr

Lecture 8 – Depth of Anesthesia Monitoring

- BIS (Bispectral Index): EEG-based monitor; 0 (flat) to 100 (awake)
- • 40–60 = Good anesthetic depth
- • < 40 = Too deep (risk of awareness)
- • > 60 = Too light (risk of awareness)
- MAC (Minimum Alveolar Concentration): Concentration preventing movement in 50% of patients
- • 1 MAC = Surgical anesthesia
- • 0.3 MAC = Analgesia with sedation
- Train of Four (TOF): Monitors neuromuscular blockade
- • 4/4 = No block; 1/4 = Complete block; Extubation requires TOF ≥ 0.9

Lecture 8 – Documentation

- Record BP, HR, SpO_2, $EtCO_2$ every 5 minutes minimum
- Record special events: Induction, Intubation, Incision, Extubation
- Record all drugs given with doses and times
- Record fluids (input) and blood loss/urine (output)
- Accurate documentation is a medico-legal requirement

Lecture 8 – Summary

- Vital sign monitoring is the cornerstone of safe anesthesia
- Each monitor provides critical information about patient status
- BIS and TOF add objective measures to clinical assessment

ACTIVITY AND ASSESSMENT — LECTURE 11

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 9

Anesthesia and Respiratory Insufficiency / Failure

Lecture 9 – Learning Objectives

- Understand definitions of respiratory insufficiency and failure
- Know the causes of respiratory failure during anesthesia
- Understand diagnosis and treatment

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 9 – Definitions

- Respiratory Insufficiency: Inability to maintain normal PaO_2 and $PaCO_2$
- - Type I (Hypoxemic): $PaO_2 < 60$ mmHg with normal or low $PaCO_2$
- - Type II (Hypercapnic): $PaCO_2 > 45$ mmHg with low PaO_2
- Respiratory Failure: Life-threatening respiratory insufficiency requiring ventilatory support

Lecture 9 – Causes of Respiratory Failure

- Before Induction: Airway obstruction, aspiration, pneumothorax, pulmonary edema
- During Maintenance: Disconnected tube, circuit obstruction, anesthetic overdose, malignant hyperthermia, anaphylaxis
- After Extubation: Laryngospasm, vocal cord paralysis, atelectasis, pneumonia, pulmonary embolism
- Anesthetic-related: Suppressed respiratory drive, muscle relaxation, loss of airway reflexes

Lecture 9 – Diagnosis

- Clinical: Cyanosis, tachypnea/bradypnea, use of accessory muscles, altered consciousness, agitation or somnolence
- Monitoring: $SpO_2 < 90\%$, $EtCO_2 > 45$ or < 20, elevated peak airway pressure
- ABG: Type I ($PaO_2 < 60$, $PaCO_2$ normal/low) or Type II ($PaO_2 < 60$, $PaCO_2 > 45$)
- Imaging: Chest X-ray for atelectasis, pneumonia, pneumothorax

Lecture 9 – Treatment

- General: A (Airway) – Chin lift, jaw thrust, OPA/NPA; B (Breathing) – 100% O_2, bag-mask ventilation; C (Circulation) – fluids, vasopressors
- Specific causes:
- • Laryngospasm: CPAP, Propofol, Succinylcholine
- • Bronchospasm: Salbutamol nebulizer, Hydrocortisone, Epinephrine
- • Pneumothorax: Needle decompression, chest tube
- • Aspiration: Suction, bronchoscopy, antibiotics, steroids
- • Atelectasis: Recruitment maneuvers, PEEP, physiotherapy
- • Pulmonary edema: Diuretics, morphine, PEEP

Lecture 9 – Mechanical Ventilation

- Indications: PaO_2 < 60 on 100% O_2, $PaCO_2$ > 60 with acidosis, RR > 35 or < 8, loss of consciousness
- Modes: Volume Control (VC), Pressure Control (PC), SIMV, PSV, CPAP, BiPAP
- Prevention: Good pre-oxygenation, rapid sequence induction in aspiration-risk patients, proper positioning, aspiration prophylaxis, early post-op mobilization

Lecture 9 – Summary

- Respiratory failure is one of the most dangerous anesthesia complications
- Early diagnosis and rapid treatment save lives
- Prevention through proper technique and monitoring is paramount

ACTIVITY AND ASSESSMENT — LECTURE 13

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

Lecture 10

Anesthesia and Shock Syndrome

Lecture 10 – Learning Objectives

- Understand the definition and types of shock
- Know the effect of anesthesia on shock
- Understand management of the shocked patient under anesthesia

TEACHING RESOURCES

Required educational materials

- Classroom, laptop, and data projector.
- Whiteboard and teaching aids.
- Anesthesia machine and accessories.
- Breathing systems and suction devices.
- Mechanical ventilator.
- ECG monitor and defibrillator.
- Models and simulation equipment for practical training.

Lecture 10 – Definition & Types of Shock

- Shock: State of inadequate tissue perfusion leading to O_2 deficiency, lactate accumulation, acidosis, and multi-organ dysfunction
- Types:
- • Hypovolemic: Blood loss, dehydration, burns
- • Cardiogenic: MI, arrhythmias, cardiomyopathy
- • Distributive: Sepsis, anaphylaxis, neurogenic
- • Obstructive: Tamponade, tension pneumothorax, pulmonary embolism

Lecture 10 – Anesthesia and Shock

- Most anesthetics cause vasodilation → worsening hypotension
- Cardiac suppression → worsening cardiogenic shock
- Autonomic suppression → worsening neurogenic shock
- Elective surgery is contraindicated in shock; anesthesia is only for life-saving procedures

Lecture 10 – Management of Shock Under Anesthesia

- Assessment: HR, BP, MAP, SpO_2, Urine Output, Lactate, Base Deficit, CVP
- Resuscitation before anesthesia:
- • Airway & Breathing: O_2 100%, intubation if needed
- • Circulation: Wide-bore IV access, Crystalloids (Lactated Ringer's, NS), Colloids, Blood products (PRBC, FFP, Platelets), Vasopressors (Norepinephrine, Epinephrine, Dopamine), Inotropes (Dobutamine)

Lecture 10 – Anesthetic Choice in Shock

- Hypovolemic shock: Etomidate (safest – minimal cardiac depression) or Ketamine (maintains BP); avoid Propofol and Thiopental
- Cardiogenic shock: Etomidate + Fentanyl; avoid Ketamine (increases myocardial O_2 demand)
- Septic shock: Etomidate or Ketamine + aggressive fluid resuscitation + antibiotics within first hour
- Anaphylactic shock: Epinephrine 0.5–1 mg IM (1:1000) + fluids + steroids + antihistamines + airway protection

Lecture 10 – Monitoring in Shock

- Arterial line (continuous BP)
- Central line (CVP, $ScvO_2$)
- Urine Output (goal > 0.5 mL/kg/hr)
- Serial ABG and lactate measurements
- Temperature monitoring

Lecture 10 – Anesthetic Shock-like States

- Malignant Hyperthermia (MH):
- • Genetic disorder (RYR1 gene mutation)
- • Triggered by volatile anesthetics and Succinylcholine
- • Symptoms: Hyperthermia > 38.8°C, tachycardia, tachypnea, muscle rigidity, hyperkalemia, metabolic acidosis, myoglobinuria
- • Treatment: Dantrolene 2.5 mg/kg IV (up to 10 mg/kg), cooling, bicarbonate, mannitol
- Anaphylaxis:
- • Hypotension, bronchospasm, urticaria, angioedema
- • Treatment: Epinephrine, fluids, steroids, antihistamines

Lecture 10 – Summary

- Shock under anesthesia requires aggressive resuscitation and safe drug selection
- Etomidate and Ketamine are the safest in shock
- Close monitoring is essential; treat the underlying cause

ACTIVITY AND ASSESSMENT — LECTURE 15

Student-centered learning

QUICK QUIZ

- List three key points from the lecture.
- Explain the clinical importance of the topic.
- Discuss one application question with your group.

INDIVIDUAL ACTIVITY

- Define key terms from the lecture.
- Label the main parts of the relevant equipment.
- Write one important safety precaution.

THANK YOU

DO YOU HAVE ANY QUESTIONS?

Principles of Anesthesia

End of Course

Principles of Anesthesia – Theoretical Lectures
First Year | Anesthesia Techniques Department