Al Mustaqbal University

College of Health and Medical Techniques

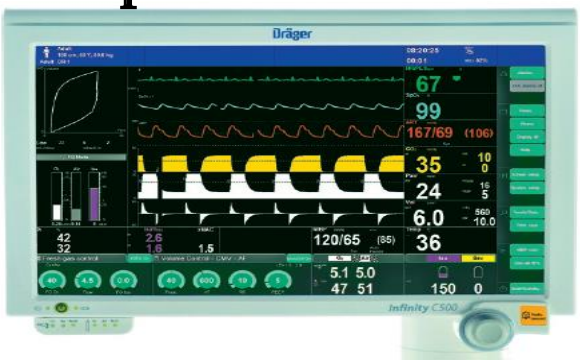
Department of Anesthesia

Practical Anesthesia

Stage Two

Lecture 4

Intraoperative Monitoring



By Lectures

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BSc. Anesthesia & Intensive Care

2023 – 2024

Patient Monitoring Device

People receiving anesthesia must be carefully watched because the medicines used for anesthesia affect the central nervous system cardiovascular system, and respiratory system. Anesthesia suppresses many of the body's normal automatic functions. So it may significantly affect your breathing, heartbeat, blood pressure, and other body functions.

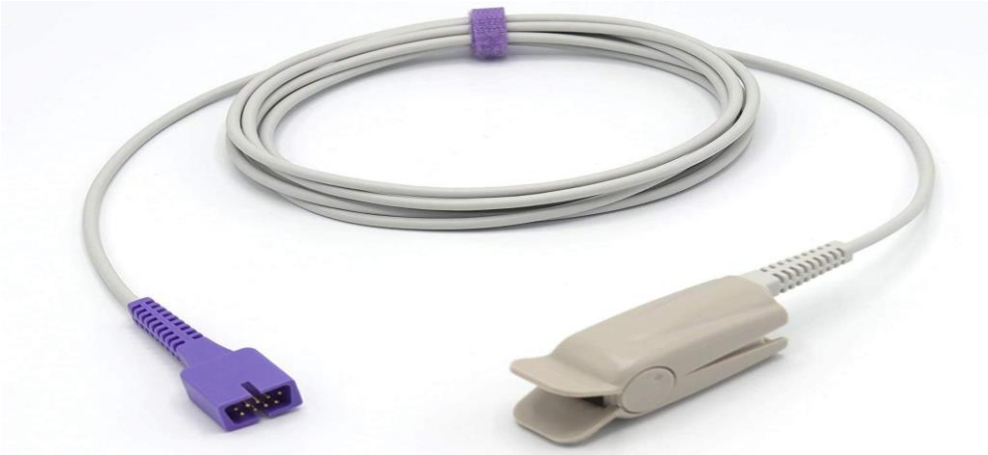
Instruments commonly used for monitoring during anesthesia include:

1. Pulse oximeter (PR).
2. Non-invasive blood pressure (NIBP).
3. Electrocardiogram (ECG).
4. Capnograph.

Pulse Oximeter

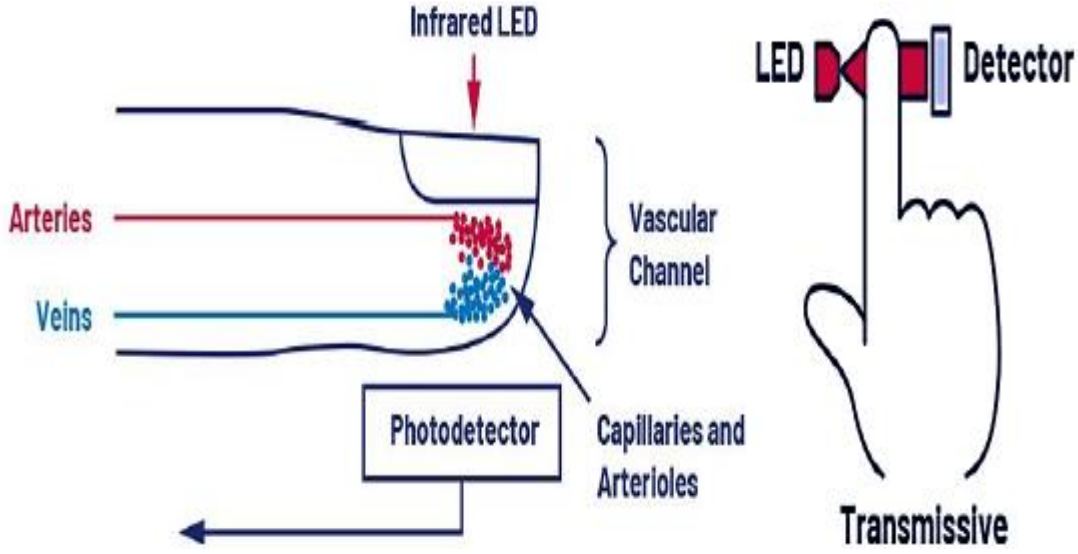
Digital pulse oximetry is a rapid noninvasive test and is used to estimate arterial oxygen saturation. They calculate the amount of oxyhemoglobin (HbO) as a percentage of the total hemoglobin in arterial blood. Pulse oximeters provide a continuous reading of **oxygen saturation** (SpO2) of pulsatile blood. They also indicate the **pulse rate**.

Pulse oximetry has proved to be a powerful monitoring tool in the room, recovery wards, intensive care units, general wards, and when transporting critically ill patients. It is considered the greatest technical advance in monitoring of the last decade.



Components:

1. A **probe** is positioned on the finger, toe, ear lobe, or nose. Two or three (LEDs) produce beams at red and infrared frequencies (660 nm and 940 nm respectively) on one side.
2. A **sensitive photodetector** on the other side.
3. The **case houses** the microprocessor. There is a display of the oxygen saturation, pulse rate, and a plethysmographic waveform of the pulse. Alarm limits can be set for a low saturation value and both high and low pulse rates.



Non Invasive Blood Pressure

Oscillometry is the most common method used to measure arterial blood pressure non-invasively during anesthesia. The **systolic**, **diastolic,** and **mean arterial pressures** are measured, calculated, and displayed. These devices give reliable trend information about the blood pressure. They are less reliable in circumstances where a sudden change in blood pressure is anticipated, or where a minimal change in blood pressure is clinically relevant.

Components:

1. A cuff with a tube is used for inflation and deflation.
2. The case where the microprocessor, pressure transducer, and solenoid valve which controls the deflation of the arm cuff are housed. It contains a display and a timing mechanism that adjusts the frequency of measurements. Alarm limits can be set for both high and low values.

Electrocardiogram

This monitors the electrical activity of the heart with electrical potentials of 0.5–2 mV at the skin surface. Different groups of cells in the heart are depolarized at different times during the cardiac cycle, and an electrical wave travels through the myocardium. This wave can be detected at the skin surface and displayed as an electrocardiograph (ECG). The ECG is therefore a graph of myocardial electrical potential against time. Continuous ECG monitoring is considered essential during the administration of any general anesthetic or sedation, and also in critical care areas.

Components:

1. Skin electrodes detect the electrical activity of the heart, 0.5–2 mV at the skin surface.
2. Color-coded cables transmit the polarization signal from electrodes to the monitor. Cables are available in 3- and 5-lead versions as snap or grabber designs and with a variety of lengths.
3. The ECG signal is then boosted using an amplifier. The amplifier covers a frequency range of 0.05–150 Hz. The amplifier has ECG filters that are used to remove the noise/artifacts from ECG and produce a 'clean' signal.
4. An oscilloscope displays the amplified ECG signal.

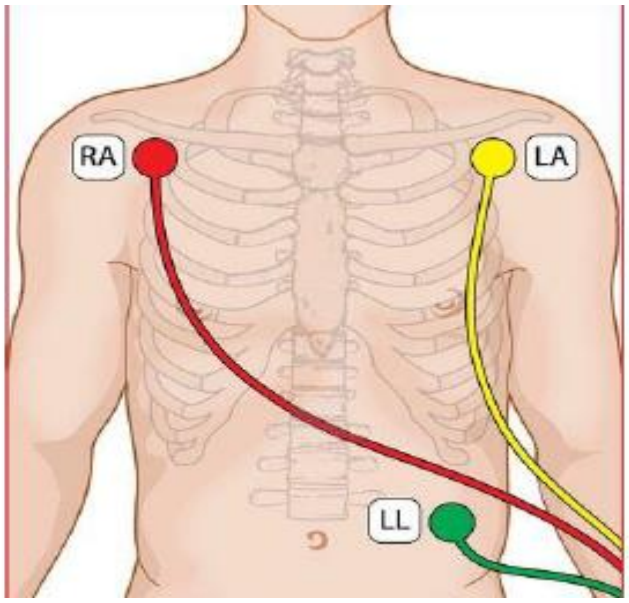
Notes:

- ✓ The ECG monitor can have two modes:

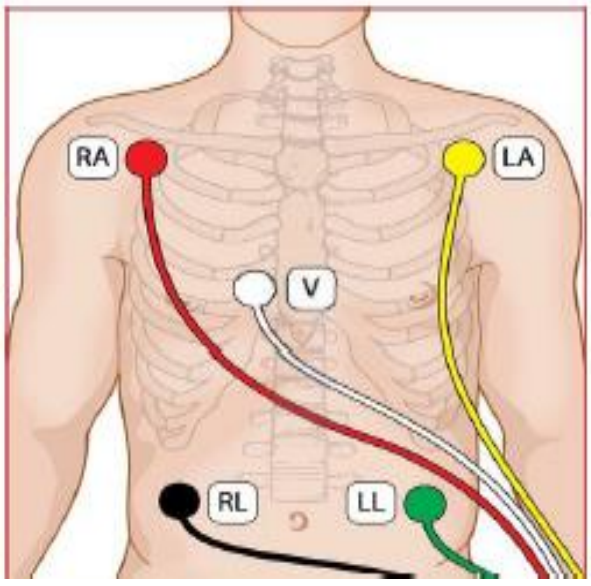
The monitoring mode (frequency range 0.5–40 Hz).

The diagnostic mode (frequency range 0.05–150 Hz).

- ✓ Usually during anesthesia, **three skin electrodes** are used (right arm, left arm, and indifferent leads). The three limb leads used include two that are 'active' and one that is 'inactive' (earth). The red electrode is placed on the right arm, yellow on the left arm, and green on the left leg.



- ✓ Sometimes **five electrodes** are used. RA, LA, and LL electrodes are used plus a ground electrode, and a single chest electrode instead of C1–C6. The 5-electrode ECG allows continuous monitoring of more than the standard three leads.

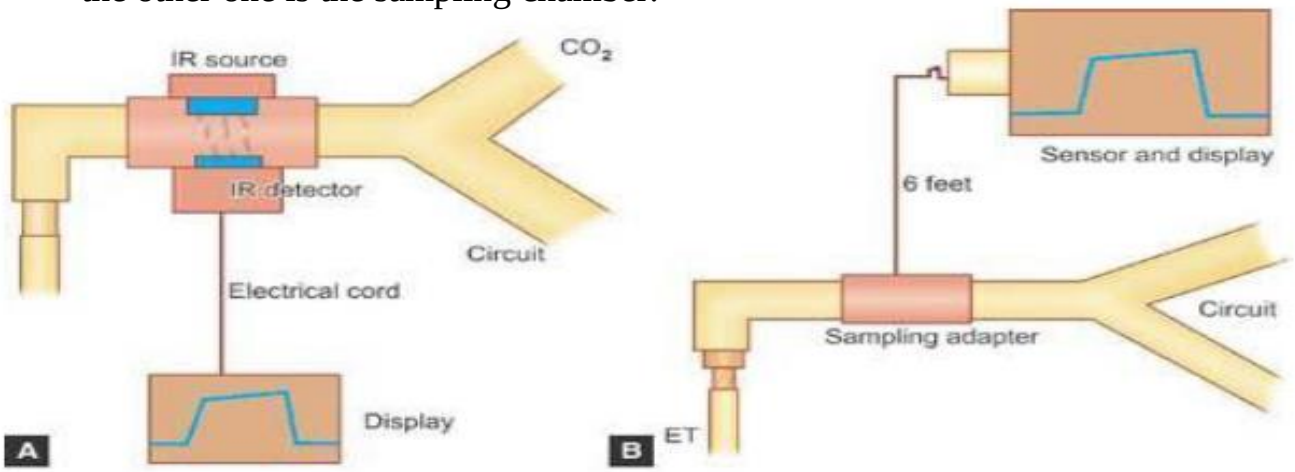


- ✓ A **12-lead** ECG is a more sensitive indicator of **rhythm**, **axis**, **ischemic changes,** and **small electrical abnormalities** and is used before noncardiac surgery, and in all patients with known cardiovascular disease, significant arrhythmia, or significant structural heart disease.

Capnograph

Capnograph: is the device that records and shows the graphical display of the waveform of CO2 measured in kPa or mmHg.

1. The sampling chamber can either be positioned within the patient's gas stream (main-stream version) or connected to the distal end of the breathing system via a sampling tube (side-stream version).
2. A photodetector measures light reaching it from a light source at the correct infrared wavelength after passing through two chambers. One acts as a reference whereas the other one is the sampling chamber.



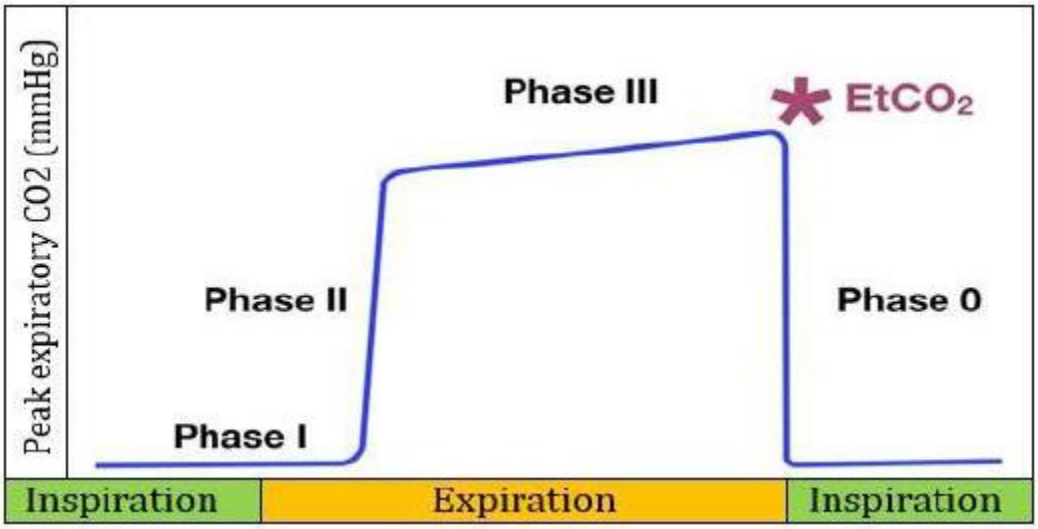
Normal program:

The program consists of two segments:

- ✓ An inspiratory segment.
- ✓ An expiratory segment.

The expiratory segment consists of phase I, II, III:

- ✓ Phase I: represents the initial stage of expiration where there is no rise in CO2 due to clearing dead space.
- ✓ Phase II: which is characterized by a rapid rise in CO2 concentration as air reaches the upper airway.
- ✓ Phase III: is the alveolar plateau phase representing CO2 evolution from the alveoli.
- ✓ The maximum concentration at the end of the alveolar plateau (phase III) is referred to as end-tidal CO2 (EtCO2).



Advantages of capnography

1. Noninvasive monitoring of expiratory CO2
2. Rapid and Physically small
3. Provide continuous measurement
4. Confirmation of ETT.

5. Provides an estimate of cardiac output and organ perfusion during cardiac arrest and can therefore be used to monitor the quality of CPR and predict return of spontaneous circulation.

Factors that increase and decrease end-tidal CO2:

Increased end-tidal CO2	Decreased end-tidal CO2
Hypoventilation	Hyperventilation
Rebreathing	Pulmonary embolism
Sepsis	Hypo perfusion
Malignant hyperpyrexia	Hypotension
Hyperthermia	Hypothermia
Skeletal muscle activity	Hypovolemia
Hyper metabolism	Hypo metabolism