1

Oxygen Monitoring Devices

RSPT 1410

2

Oxygen Monitoring Devices

- Types of Devices
- Techniques
- Problems

3

Oxygen Monitoring

- Evaluate patient's status
  - Assess the effect of oxygen therapy
    - O2 saturation
    - PaO2
    - FiO2 requirement
  - Determine if changes in patient's therapy is indicated

4

Types of Devices

- Oxygen analyzers
- PCO2 measuring system
- PO2 measuring system
- Transcutaneous electrodes
- Pulse oximeter

5

Oxygen Analyzers

- Used for measuring the oxygen concentration of inspired gases
- 3 types
  - Paramagnetic
  - Electrical
  - Electrochemical
    - Galvanic
    - Polarographic

6

Oxygen Analyzers

- Paramagnetic
  - Included for historical purposes
  - Developed in 1946 by Pauling

7

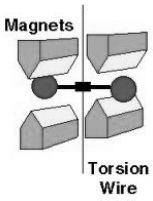
Oxygen Analyzers

- Paramagnetic
  - Uses Pauling Principle or the Principle of Paramagnetism to measure oxygen concentration
  - Oxygen is a paramagnetic gas
  - If a magnetic field is present, O2 will be attracted to it and its molecules will align themselves with the north-south magnetic flux lines
  - Other gases are _____ by the magnetic field

8

Oxygen Analyzers

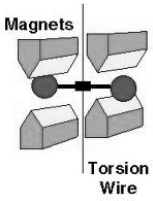
- The paramagnetic oxygen sensor consists of a cylinder-shaped container inside of which is a small glass dumbbell.
- The dumbbell is filled with an inert gas such as nitrogen and suspended on a taut platinum wire within a non-uniform magnetic field.
- The dumbbell is designed to move freely as it is suspended from the wire.



9

Oxygen Analyzers

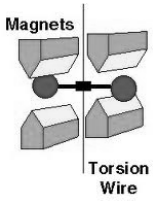
- When a sample gas containing oxygen is sent through the sensor, the oxygen molecules are attracted to the stronger of the two magnetic fields. This causes a displacement of the dumbbell which results in the dumbbell _____.
- The degree of rotation is dependant upon the partial pressure of oxygen and is converted to O2%



10

Oxygen Analyzers

- Beckman D-2 analyzer



11

Oxygen Analyzers

- Paramagnetic
  - Disadvantages
    - Cannot be used to measure _____ gas
    - Sample must be _____
    - It is very delicate
    - Affected by changes in _____

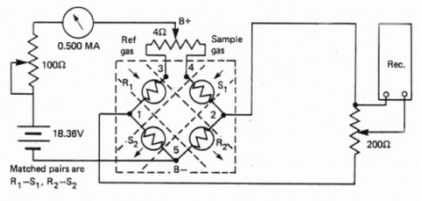
12

Oxygen Analyzers

- Electrical
  - Operate on the principle of thermal conductivity and use an electronic device called a "_____"
  - 2 parallel wires receive an electrical current from a battery
    - 1 of the wires is the reference wire exposed to room air
    - The other wire is in the gas sample chamber and exposed to the gas being measured

13

Oxygen Analyzers



14

Oxygen Analyzers

- Electrical
  - In the sample chamber – if the O2 concentration is higher than room air → the wire cools → its _____ decreases
  - The change in resistance is detected → converted to O2%

15

Oxygen Analyzers

- Electrical
  - Advantages
    - Unaffected by changes in ambient _____
  - Disadvantages
    - Can only measure static gases
    - Produces _____ – can't be used in the presence of anesthetic gases

16

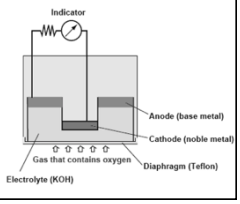
Oxygen Analyzers

- Electrochemical
  - Rely on an oxygen-mediated chemical reaction to produce a flow of current (electrons)
  - 2 types
    - Galvanic
    - Polarographic
-

17

Oxygen Analyzers

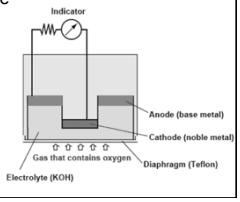
- Electrochemical – Galvanic
  - A gold electrode & a lead electrode are immersed in a potassium hydroxide bath
  - The gas sample is separated from the KOH bath by a semipermeable membrane made of Teflon



18

Oxygen Analyzers

- As O2 diffuses through the membrane into the KOH bath – it reacts with H2O & free electrons from the gold cathode to form hydroxyl ions (OH^-)
- The hydroxyl ions diffuse towards the lead anode forming lead oxide (PbO_2), H2O & free electrons
- The flow of the electrons produces electrical current in proportion to the O2 concentration that is measured & converted to O2%



19

Oxygen Analyzers

- Electrochemical – Galvanic
  - Example: Hudson Galvanic O2 Analyzer

20

Oxygen Analyzers

- Electrochemical – Polarographic
  - Also use an oxygen-mediated chemical reaction to produce electrical current but do have some differences
  - Contain a platinum cathode & a silver anode immersed in KOH bath
  - Also have a 9-V battery to polarize the silver anode → shorter response time

21

Oxygen Analyzers

- Electrochemical – Polarographic
  - Example: Teledyne

22

Oxygen Analyzers

- Electrochemical Analyzers
  - Advantages
    - _____ gas samples can be analyzed
    - Can be used with flammable gases
    - Used for intermittent or continuous monitoring

23

Oxygen Analyzers

- Electrochemical Analyzers
  - Disadvantage
    - The chemicals in the fuel cell are _____ used → the cell "goes dead" and must be replaced - to prolong the fuel cell life, it is important to keep the fuel cell capped so it is not continually exposed to room air
    - Affected by changes in ambient pressure
    - Also affected by _____

24

Oxygen Analyzers

- Must be calibrated to _____ and _____% O2
- In most cases, FiO2 is measured as close to the patient as possible
- Documented as either % or FiO2
  - Example: O2% - 40% or FiO2 - 0.40
  - Not O2% - 0.40 or FiO2 – 40%

25

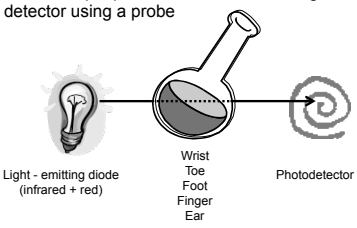
Pulse Oximeters

- Measures the % of oxygen-saturated _____ or % of oxyhemoglobin (oxyHb)
- Non-invasive
- Performed continuously or intermittently
- Utilizes technique called _____

26

Pulse Oximeters

- Spectrophotometry
  - Blood sample placed between infrared light source & a light detector using a probe



27

Pulse Oximeters

- Photodetector measures the amount of _____ light passing through the blood sample
- Desaturated Hb absorbs _____ light than saturated Hb
- Amount of light passing through is converted to a % reading, i.e the % of Hb carrying O2
- Expressed as SpO2
- Also measures _____

28

Pulse Oximeters

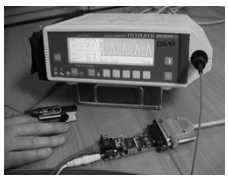
- Does not measure Hb level
- Inaccurate if: poor blood flow, dark fingernail polish, bright ambient light
- Cannot differentiate between Hb carrying O2 and _____
  - If SpO2 = 95% & COHb = 25%

    ↓

    % of Hb carrying O2 = _____%

29

Pulse Oximeters



30

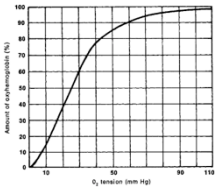
Co-Oximeters

- Table-top oximeter = _____
  - Also using spectrophotometry, measures
    - Hb
    - SaO2
    - COHb
    - MetHb
    - Other Hb's
  - Highly accurate

31

Pulse Oximeters

- Normal = ≥ _____% (sea level), ≥ _____% (Amarillo)
- Have an good idea of the patients PaO2 if we know the SO2



32

Blood Gas Analyzers

- Measure PO2, PCO2, pH, $HCO3^-$
  - Arterial blood
  - Venous blood
  - Capillary blood
  - Pleural fluid

33

Transcutaneous Monitors

- Non-invasive
- Measure PaO2 and PaCO2 _____ through the skin
- Utilizes a heated probe sealed to the _____
- Used mostly on infants

35

- Paramagnetic gas = a gas that can be changed in position from its rested state with a _____
- For example, if the gas was in a sealed glass tube → you could see it move or change in color when a magnet is close to it
- Oxygen is the most paramagnetic gas

back