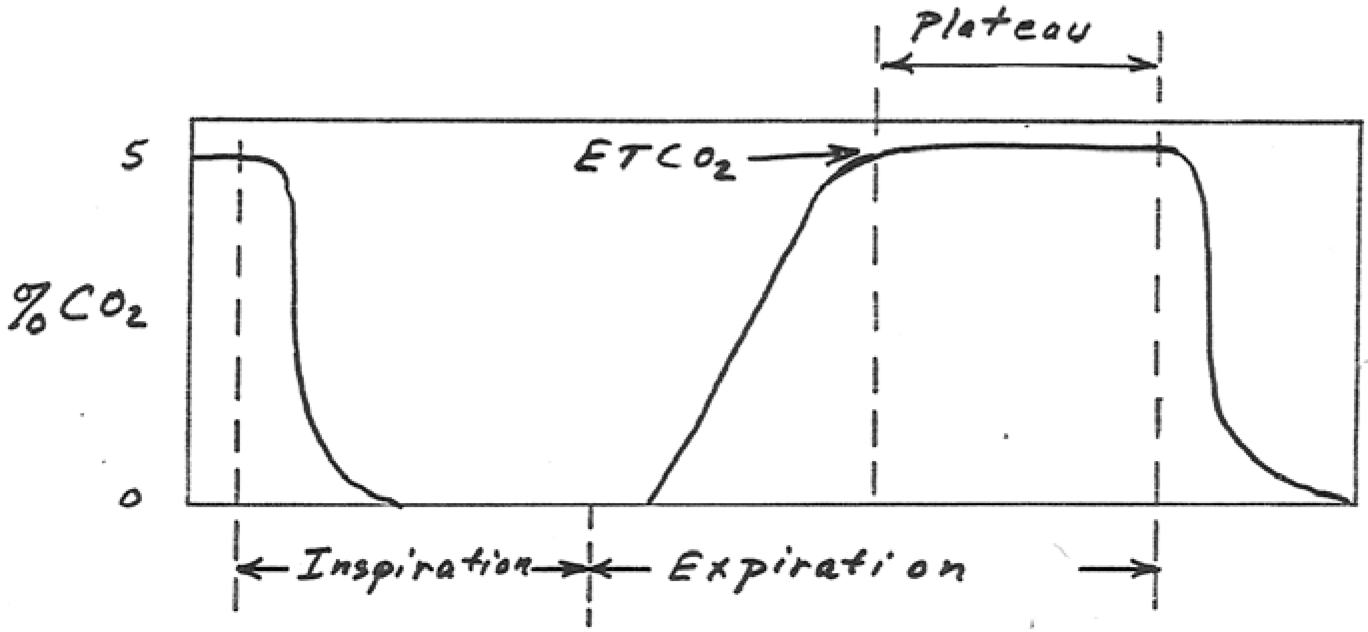
EE 4BD4 Lecture 27

Carbon Dioxide Monitoring

CO_2 Concentration During Breathing
(Capnogram)



Capnometry

- Capnometer measures CO_2 concentration but outputs only a single value ($ETCO_2$)
- Capnograph measures CO_2 during breathing cycle and displays capnogram

Capnogram


mmHg
ETCO2
38
INS
2
AwRR
14
SpO2(%)
PR(BPM)
99
60
DRE - Call: 1.800.462.8195 - Visit: www.dremed.com

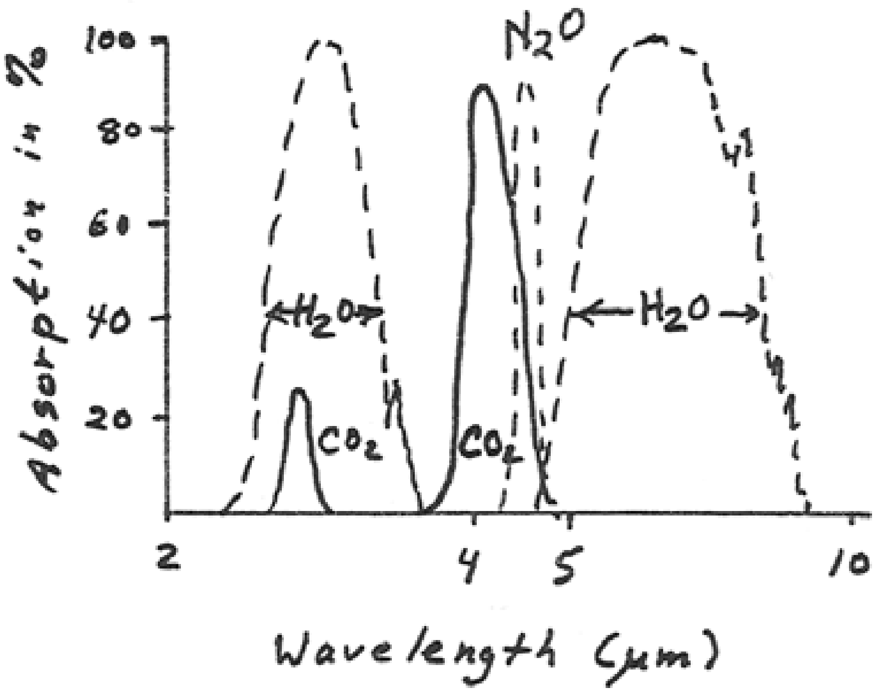
Clinical Use

- To provide evidence of the correct placement of the ET (endotracheal tube).
- To detect malignant hyperpyrexia. A massive increase in CO_2 production is caused by increased muscle metabolism. This increase occurs early before the rise in temperature. Early detection of this is one of the most important reasons for routinely monitoring $ETCO_2$, post ingestion of ecstasy.
- To detect air, fat or pulmonary emboli. A massive decrease in $ETCO_2$ occurs as a result of increased dead space.
- For routine monitoring of the adequacy of ventilation To assess the effectiveness of CPR. if no effective circulation is present CO_2 may not be present in the lungs. The capnograph is not susceptible to the mechanical artefacts associated with chest compression like the ECG monitor and chest compressions do not have to be interrupted to assess circulation

Instrumentation

- Basic mechanism is absorption of IR by CO_2
- IR spectroscopy can be used to measure concentration of any molecule that absorbs IR light
- Only CO_2 and H_2O have selective IR absorption characteristics
- Absorption of light is proportional to concentration of absorbing molecule, concentrations can be determined by comparing absorbance of gas to a known standard

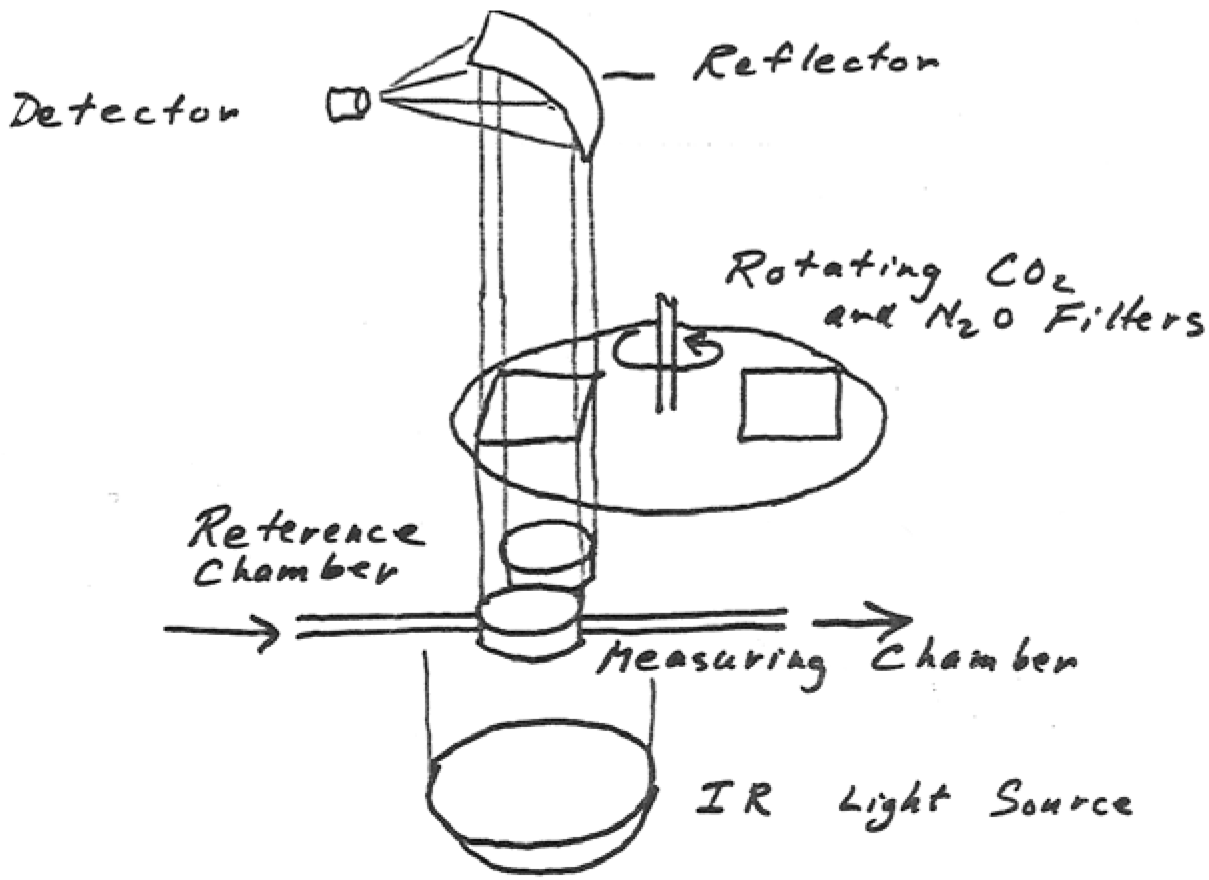
CO_2 Infrared Spectrometry



Instrumentation Components

- Infrared source
- Measuring chamber for air sample Reference chamber or filter
- Optical filter
- Detector

Instrumentation Setup



Description

- Measures N_2O and CO_2 (N_2O main anesthetic gas) in the OR
- Light beam alternately passes through sample chamber and reference chamber or filter with no CO_2 absorption
- Reference chamber allows unit to compensate for effects common to both paths, e.g. reduced light output
- Calibrated by known CO_2 concentration
- Results given as partial pressure of CO_2 in mm Hg

Side-stream and Main-Stream Sensors

- Most have side-stream where the unit withdraws gas from the patient airway by capillary tubing to the sensor located in the unit
- Tubing connected to a T piece placed on tracheal tube or anesthesia mask connector
- Main-stream sensor monitors have a special breathing circuit insert (cuvette) that allows light from attached sensor to pass through the airway

Accuracy of IR CO_2 Momitoring

- Affected by changes in atmospheric pressure or the pressure of gas in the chamber. Side-stream sensors require a reduced sensor pressure to draw the sample.
- Halogenated anesthetic vapours, N_2O, O_2 and water vapour affect CO_2 measurement (halogenated anesthetics are generally used at very low concentrations and absorb at much longer wavelengths but may be at high concentration during initial induction
- N_2O causes falsely high CO_2 measurements and must be compensated for electronically by reducing CO_2 reading by fixed amount based on a normally used N_2O concentration or reading N_2O concentration (in figure) and automatically correcting CO_2 reading

Accuracy (cont'd)

- O_2 does not absorb IR light, but if it collides with CO_2 it broadens the absorption peak causing lower CO_2 reading. Not as significant as N_2O but some units correct for O_2
- Water vapour is removed by filters or traps. Patient generated water vapour can condense on filters, absorb IR and cause high CO_2 readings. Main-stream sensors are therefore heated above body temperature. Side-stream units purge tubing with reverse flow or greatly increased flow to force condensed water to a trap