Capnography

- Capnography is the continuous, real time, non invasive and rapid monitoring technique to measure and display carbondioxide .
- Carbondioxide waveforms are plotted against time (Timed capnography)or expired volume (Volume capnography). Time capnography is most commonly used now.
- Equipment used to generate graph is called capnograph. The waveform is called capnogram.

Method of sampling

- Sidestream sampling
- Main stream sampling

Mainstream and sidestream ETCO2 Sensors for intubated patients

ET CO2 Cannula for non intubated patients

Capnogram

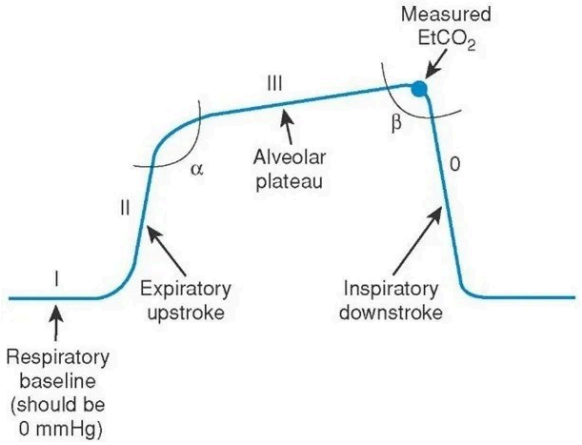
- The time capnogram has two phase 1) Inspiratory 2) Expiratory phase
- The expiratory phase is further divided into three phases (I, II, III) and an occasional phase4.

- **Phase I** does not contain any CO2.
- In **phase II**, the Pco2 rises rapidly as carbondioxide laden alveolar gas replaces zero-carbondioxide dead space gas.
- **Phase III** is the alveolar plateau that represents the evolution of carbondioxide from alveoli.

- The slope of the of the phase III represents the V/Q status of the lung.
- The angle between phase II & phase III is called **alpha angle.** Normally it is around 100 degree. This degree is increased in case of bronchoconstriction.

- Height of the alveolar plateau is related to the ratio of cardiac output to alveolar ventilation.
- For a given alveolar ventilation the height of the plateau increases or decreases with abrupt change in cardiac output.
- The angle between phase III &0 (IV) is **beta angle** . Generally it is 90 degrees.
- This angle increases in the presence of rebreathing.

- The difference between Paco2 & PETCO2 gives physiological dead space volume. The normal gradient is 5mmHg.



Indication

- It is recommended for confirmation of endotracheal intubation.

- When feasible, monitoring P_{ETCO2} during chest compression is advised. (ACLS)
    - If P_{ETCO2} < 10 mmHg during CPR, the clinician should attempt to improve the quality of compressions.
    - If P_{ETCO2} increases abruptly to a normal value of 35 -40 mmHg is considered as indicator of ROSC

- Continuous capnography monitoring of a mechanically ventilated patient is suggested.
- It is reasonable to confirm the position of supraglottic airways.
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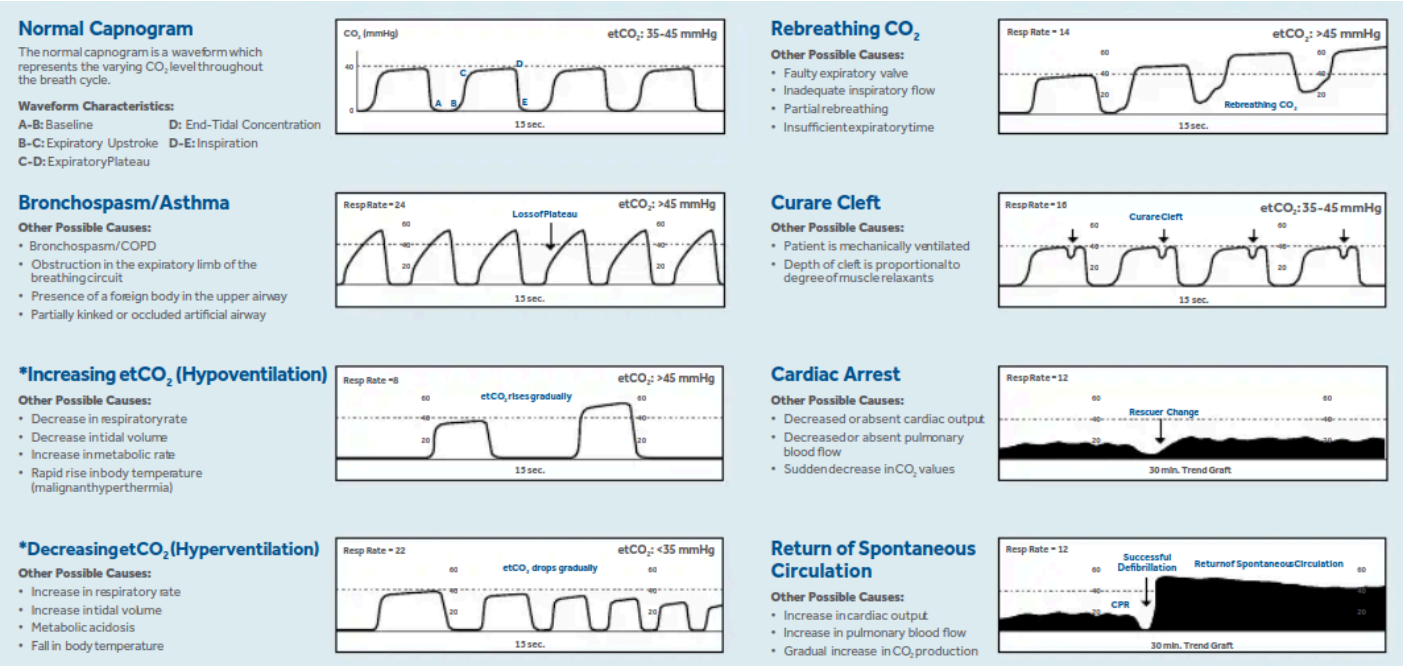
- It helps to adjust the trigger sensitivity, decrease the duration of ventilatory support.
- Monitoring of V/Q mismatch during independent lung ventilation.

- It also helps us to recognise bronchospasm, measure alveolar dead space.



False Positive

- False positive results are seen if contaminated with acidic or CO2 filled gastric content, intratracheal medication such as epinephrine, extreme humidity or presence of trichloroethylene or chloroform anesthetics.
- Detection of CO2 in expired gas after esophageal intubation as result of prior bystander mouth to mouth ventilation may result in a false positive reading.
- A transient rise of P_{ETCO2} after sodium bicarbonate administration is expected, but should not be interpreted as an improvement in quality of CPR or a sign of spontaneous circulation.

False Negative

- Low cardiac output may cause a false negative result when attempting to verify endotracheal position in the trachea.
- Pulmonary embolism
- Elimination and detection of CO2 can be dramatically reduced in patients with severe airway obstruction and pulmonary edema.

Complication

- Increases dead space; which may be minimal.
- The gas sampling rate can diminish delivered Vt in neonates ; may cause auto trigger when flow triggering of mechanical breath is used.

- **Esophageal Detector Devices**

- EDD consists of a bulb that is compressed and attached to the endotracheal tube.
- If the device is in the esophagus, the suction created by EDD will collapse the lumen of the esopahgus or pull the esophagus tissue against the tip of the tube

and bulb will not reexpand.
- If the EDD also consists of a syringe that is attached to the ET tube, the provider attempts to pull the barrel of the syringe. If the tube is in the esophagus, it will not be possible to pull the barrel with syringe.

Colorimetry Device

- Colorimetric device provides continuous, semiquantitative end tidal CO2 monitoring.
- It helps to verify ET tube placement. It can be used to monitor for max of 2hrs.
- Depending on the percentage of CO2 it causes a colour change from purple to yellow.

- Normal end tidal CO2 is more than 4% hence the device should turn yellow when ET tube is inserted in patients with intact circulation.

Colorimetric Device

Updated on 17/5/2015
Reference

- Tintinalli
- ACLS : 2010 AHA Guidelines for CPR and Emergency Cardiovascular Care.