Capnography: DDx

Anesthetic Pearls: Anesthetic Implications and Management of Capnograph Changes

Since the first infra-red CO_2 measuring and recording apparatus was introduced in 1943 by Luft, capnography has evolved into an essential component of standard anesthesia monitoring equipment. One of the primary goals of anesthesiologists is to prevent hypoxia, and capnography helps to identify situations that can lead to hypoxia. Moreover, it also helps in the swift differential diagnosis of hypoxia before it can lead to irreversible brain damage.

The **capnogram** is a direct monitor of the inhaled and exhaled concentration or partial pressure of CO_2 ($EtCO_2$), and an indirect monitor of the CO_2 partial pressure in the arterial blood ($PaCO_2$). In healthy individuals, the difference between arterial blood and expired gas CO_2 partial pressures is very small (almost zero in children). The usual gradient between $PaCO_2$ and $EtCO_2$ is < 5 mmHg in healthy adults. In the presence of most forms of lung disease (COPD, chronic bronchitic, asthma) and some forms of congenital heart disease (cyanotic lesions) the difference between arterial blood and expired gas increases and can exceed 10 mmHg. Dead space ventilation dilutes expired CO_2 causing $EtCO_2$ to be less than $PaCO_2$.

Increased $EtCO_2$	**Decreased $EtCO_2$**
1. **Rebreathing** (CO_2 absorber)	1. **Pulmonary Embolism** (air, thrombus, amniotic, particulate)
2. Hypoventilation	2. Hyperventilation
3. Increased CO_2 production (**MH**, increased temp, bicarb, shivering)	3. **Decreased C.O.** (cardiac / non-cardiac
	4. Disconnection / leak (increased EtN_2)

"**Side-stream sampling**" removes 50-150 ml/min of gas via a sampling tube from near the ETT. The $EtC0_2$ (and other gases) are measured by infra-red absorption or mass spectrometry and then presented in graphical form on the anesthesia monitor (graphical amount vs. time, peak absolute amount, etc).

Capnography Tracing Basics:

1. Baseline CO_2 (increase associated with rebreathing)
2. Exhalation
3. Flat or slight upslope (distal alveoli emptying)
4. Inspiration

Capnography Patterns:

A. Normal
B. Rebreathing (non functioning expiratory valve, used up CO_2 absorber)
C. Muscle relaxant wearing off, diaphragmatic movement, or "curare notch"
D. Cardiac oscillations
E. Obstruction or sample contamination (neonatal / pediatric $EtCO_2$)
F. COPD or Bronchospasm – V/Q mismatch resulting in differential emptying of areas of lung and upsloping CO_2 curve