What is Capnography & End Tidal CO2 Measurement?

Capnography is the clinical monitoring of the concentration or partial pressure of carbon dioxide (CO2) in the respiratory gases.

Some have described it as the vital sign of respiration.

It may be presented as a graph (or capnogram) of expiratory CO2 plotted against time, or, less commonly, expired volume. Some devices show only a numerical figure which is of considerably less use diagnostically.

The capnogram is a direct monitor of the exhaled concentration or partial pressure of CO2, and an indirect monitor of the CO2 partial pressure in the arterial blood. In healthy individuals, the difference between arterial blood and expired gas CO2 partial pressures is very small, and is probably zero in children. However in the presence of most forms of lung disease, and some forms of congenital heart disease (the cyanotic lesions) the difference between arterial blood and expired gas increases and can exceed 1 kPa.

During anaesthesia, there is interplay between two components: the patient and the anaesthesia administration device (which is usually a breathing circuit and a ventilator or respirator). The critical connection between the two components is either an endotracheal tube or a mask, and CO2 is typically monitored at this junction. Capnography directly reflects the elimination of CO2 by the lungs to the anaesthesia device. Indirectly, it reflects the production of CO2 by tissues and the circulatory transport of CO2 to the lungs.

Capnographs usually work on the principle that CO2 absorbs infra-red radiation. A beam of infra-red light is passed across the gas sample to fall on to a sensor. The presence of CO2 in the gas leads to a reduction in the amount of light falling on the sensor, which changes the voltage in a circuit. The analysis is rapid and accurate, and is far faster in its reaction than pulse oximetry. The presence of Carbon Monoxide in the patient is a recognised contraindication for use and will adversely affect the reading.

Capnography is increasingly being used by paramedics to aid in their assessment and treatment of patients in the pre-hospital environment. These uses include verifying and monitoring the position of an endotracheal tube. A properly positioned tube in the trachea guards the patient's airway and enables the paramedic to breathe for the patient. A misplaced tube in the oesophagus can lead to death through insufficient ventilation.

The American Heart Association (AHA) confirmed the importance of using capnography to verify tube placement in their 2005 CPR and ECG Guidelines. The AHA also notes in their new guidelines that capnography, which indirectly measures cardiac output, can also be used to monitor the effectiveness of CPR and as an early indication of return of spontaneous circulation (ROSC). Studies have shown that when a person doing CPR tires, the patient's end-tidal CO2 (ETCO2, the level of carbon dioxide released at the end of expiration) falls, and then rises when a fresh rescuer takes over. Other studies have shown when a patient experiences ROSC the first indication is often a sudden rise in the ETCO2 as the rush of circulation washes untransported CO2 from the tissues. Likewise, a sudden drop in ETCO2 may indicate the patient has lost pulses and CPR may need to be initiated.

Capnography, because it provides a breath by breath measurement of a patient's ventilation, can quickly reveal a worsening trend in a patient's condition providing paramedics with an early warning system into a patient's respiratory status. As more clinical studies are conducted into the uses of capnography in asthma, congestive heart failure, diabetes, circulatory shock, pulmonary embolus, acidosis, and other conditions, the pre-hospital use of capnography will greatly expand.

The term Capnography comes from the Greek work KAPNOS, and means smoke.