Monitoring Parameters – Part 6

Capnometry

Angel Rivera, CVT, VTS(ECC)

Capnometry is a noninvasive mode of monitoring partial pressure of end-tidal CO2. It is defined as the measurement and numeric display of End-tidal CO2 (ETCO2). Capnography is the measurement and graphic display of expired carbon dioxide PCO2 versus time. Exhaled CO2 is a reflection of CO2 production (metabolism), transport (blood and circulation) and elimination (ventilation).

Though a variety of techniques can be used to measure CO2 (colorimetric, mass spectrometry, Raman analysis), the majority of capnographs rely on infrared absorption. Use of this technique can reliably and quantitatively provide vital information regarding the respiratory status of operative and critically ill patients.

Infrared absorption:

Most clinically used capnographs use infrared spectography to monitor expired CO2. Since the amount of light absorbed is proportional to the concentration of the absorbing molecules, the concentration of CO2 can be determined by comparing absorbance with that of a known standard.

According to sampling techniques, infrared CO2 monitors can be separated into two main categories: side stream monitors (bedside monitors) and mainstream monitors (anesthetic/ventilator equipment). Side stream monitors draw a continuous sample of gas from the circuit into the measuring cell. Mainstream monitors directly straddle the airway with a reading cell placed at the attachment between the respiratory circuit and the endotracheal tube.

The normal capnogram consist of four phases:

1. Phase I: represents the beginning of exhalation, during which PCO2 remains almost zero while gas from the anatomic dead space leaves the upper airway.

2. Phase II: depicts the waveform rising sharply as exiting alveolar gas mixes with dead-space gas.

3. Phase III: the capnogram reaches a plateau representing gas from the alveolar space

    a. The terminal and highest portion of plateau represents PetCO2.
    b. The slope of phase III is determined by ventilation/perfusion (V/Q) status of lungs.
    c. Patients that have increased dead space have a steeper phase III and may not reach a plateau.

4. Phase IV: the waveform sharply declines as inspiration begins.

Normally, $ETCO_2$ is 2 – 5 mmHg lower than $PaCO_2$. Increase levels may be due to increased production, depression of respiratory center, or hypoventilation. Abnormally low levels of $ETCO_2$ most often are associated with hyperventilation or due to increased dead space. A sudden or abrupt decrease in $ETCO_2$ can be due to ventilator disconnection, leakage in circuit, an obstructed ET, acute hypotension, hyperventilation or massive pulmonary embolism. Accidental placement of ET into the esophagus or ET dislodgement will result in total absence of waveform.

Elevation of baseline or phase I is indicative of CO_2 rebreathing and suggests that either the absorbance of the CO_2 is exhausted or malfunctioning valves. Prolongation or slanting of phase II occurs with obstruction of expiratory gas flow (kinked ET) or leak in breathing system. Increases in the slope of phase III can be due to events that impede or obstruct expiration.