CAPNOGRAPHY

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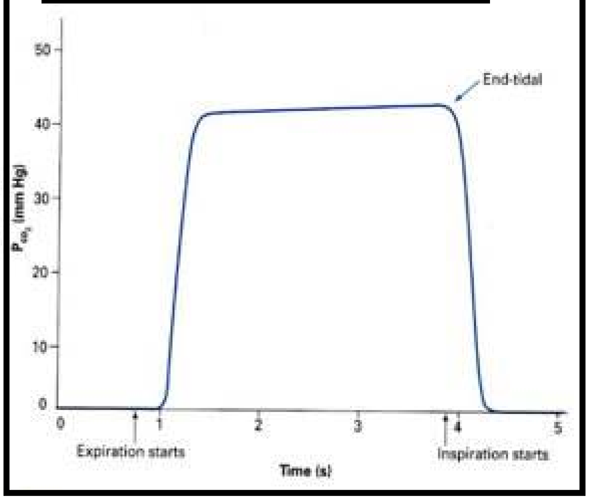
An end-tidal CO_2 monitor measures the amount of carbon dioxide emitted in the expired respiratory gases from an intubated patient's airway, and is usually positioned at the junction of the endotracheal tube to the anesthetic circuit. A bit slow to come into its own in veterinary medicine, its use has been recognized as a standard of care in human anesthesia for a couple of decades. This is because ET CO_2 monitors provide a reliable and *early* alert for some of the more common, life-threatening anesthesia incidents, such as accidental esophageal intubation, hypoventilation, apnea, circulatory failure, circuit disconnection, kinked tracheal tubes, etc. One study (Can Anaesth Soc. J 1986;33:315-20) looked at 331 anesthetic procedures. Thirty-five adverse intraoperative events were diagnosed by end-tidal CO_2 monitoring; 20 were potentially life-threatening problems, yet only two of these events were detected clinically. The conclusion was that capnography provides an early warning of potentially catastrophic anesthetic mishaps. I suggest veterinarians should also seriously consider the use of end-tidal CO_2 monitors in our anesthetized veterinary patients as an effective way to help prevent catastrophic anesthetic problems.

ET CO_2 monitors can read out simple numbers representing the gas pressure of CO_2, or they may show a graph, representing the change in CO_2 concentration over time (capnogram). A capnogram for a healthy normally ventilated patient looks like ***Image A*** below.

Image A (www.breathingwell.org)



CO_2, a product of cellular metabolism, is carried to the lungs by the venous circulation, and from the end-alveolar capillary, diffuses into the alveolar air. As one moves proximally in the respiratory tract, the concentration of CO_2 decreases to zero, and there is no exchange of O_2 or CO_2 (respiratory deadspace). On expiration, a CO_2 sensor at the mouth will initially detect no CO_2, and then rapidly rising levels of CO_2 as alveolar air is expelled. When expiration ends and inhalation starts, the concentration of the air at mouth level drops dramatically. The changes in CO_2 concentration in the respiratory cycle in a healthy individual are represented by the capnogram shown above. Deviations from this normal graph shape should be investigated.

For example, accidental esophageal intubation will look like a flat line. Other anesthetic problems such as expired soda-lime, hypoventilation, apnea, inspiratory or expiratory valve dysfunction will demonstrate predictable capnograph patterns.

Capnographs also prove to be useful in resuscitation efforts. In circulatory arrest, no CO_2 is produced by the tissue. As circulation resumes, CO_2 will be generated and will be transported to the lungs. The capnograph becomes a useful indicator of effectiveness of resuscitative efforts. It also can be used as a guide for ventilation, as a common resuscitative error is overzealous patient ventilation. Hypocarbia causes marked decrease in coronary perfusion pressure, with devastating consequences for successful resuscitation.

An excellent, free resource for learning more about capnography can be found on the internet, at www.capnography.com. This is a human-oriented website published by an anesthesiologist, but the information is equally applicable to our veterinary patients.

Feel free to contact me regarding this or any other questions pertaining to critical care.

- Dawn Crandell

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