A Quick Reference on Respiratory Acidosis

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KEYWORDS

• Alveolar hypoventilation • Arterial blood gas • Hypercapnia
• Metabolic compensation • Respiratory acidosis

KEY POINTS

- Respiratory acidosis, or primary hypercapnia, occurs when carbon dioxide production exceeds elimination via the lung and is mainly owing to alveolar hypoventilation.
- Concurrent increases in $Paco_2$, decreases in pH and compensatory increases in blood HCO_3^- concentration are associated with respiratory acidosis.
- Respiratory acidosis can be acute or chronic, with initial metabolic compensation to increase HCO_3^- concentrations by intracellular buffering.
- Chronic respiratory acidosis results in longer lasting increases in renal reabsorption of HCO_3^-.
- Alveolar hypoventilation and resulting respiratory acidosis may also be associated with hypoxemia, especially evident when patients are inspiring room air (20.9% O_2).

Pco_2: RESPIRATORY ACIDOSIS – QUICK REFERENCE

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The author has nothing to disclose.
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Vet Clin Small Anim 47 (2017) 185–189
http://dx.doi.org/10.1016/j.cvsm.2016.10.012 **vetsmall.theclinics.com**

Analysis

Typical reference range

Normal arterial blood gas values for dogs and cats inspiring room air are presented in Table 1.

Diagnosis

$Paco_2$ should be evaluated in patients suspected of having respiratory failure or increased carbon dioxide production with concurrent alveolar hypoventilation ($Paco_2$ values >45 mm Hg).[1]

Danger values

- Moderately increased $Paco_2$ (60–70 mm Hg) causes sympathetic activation, decreases in myocardial contractility and systemic vascular resistance, increases in cardiac output, and potential tachyarrhythmias.[2–4]
- Extremely high levels of $Paco_2$ (>95 mm Hg) produce disorientation, narcosis, and coma.[5]
- Cerebral blood flow and intracranial pressure increase linearly with increases in $Paco_2$.[6]
- In acute respiratory acidosis, pH can decrease to less than 7.2.
- Extremely acute hypoventilation (eg, cardiopulmonary arrest, airway obstruction) may result in life-threatening hypoxemia within 4 minutes, whereas hypercapnia would not develop for 10 to 15 minutes.[7]

Artifacts

Correct sample handling is imperative to reduce falsely elevated $Paco_2$ readings.

- Pco_2 increases and pH decreases as the sample waits before analysis (20–30 minutes); the rate of increase is quicker at 25°C than at 4°C.[8]
- Failure to obtain an arterial sample is common owing to the close proximity of the arteries and veins, making it easy to obtain a venous sample accidentally; a known paired venous sample should be obtained for comparison if there are questionable results.[9]

Drug effects

Many drugs produce respiratory acidosis by means of respiratory center depression (eg, opioids, barbiturates, inhalant anesthetics) or neuromuscular dysfunction (eg, organophosphates, aminoglycosides used in conjunction with anesthetics).

Table 1
Typical reference ranges for normal arterial blood gas values for dogs and cats inspiring room air

	Dog	Cat
pH	7.407 (7.351–7.463)	7.386 (7.310–7.462)
$Paco_2$ (mm Hg)	36.8 (30.8–42.8)	31.0 (25.2–36.8)
$[HCO_3^-]$ (mEq/L)	22.2 (18.8–25.6)	18.0 (14.4–21.6)
Po_2 (mm Hg)	92.1 (80.9–103.3)	106.8 (95.4–118.2)

Data from Haskins SC. Blood gases and acid-base balance: clinical interpretation and therapeutic implications. In: Kirk RW, editor. Current veterinary therapy VIII. Philadelphia: WB Saunders; 1983. p. 201.