

Understanding Acid-Base Data

Acid-Base Analysis

Imbalances in patient acid-base status will disrupt normal metabolic processes and can lead to organ system failure. Severe derangements can ultimately lead to irreparable damage and loss of the patient.

Acid-base balance is a critical parameter and the body has many mechanisms to maintain the blood pH within a narrow range (7.35–7.45). Outside this acceptable pH range, proteins denature, enzymes cannot function, and patient death may occur if treatment is not instituted.

Knowledge of acid-base status is useful for generating a differential diagnosis, choosing appropriate therapies, monitoring patient response to treatment and better defining patient prognosis.

Sample Handling

To ensure accurate results, proper sample handling is required. A fresh unanticoagulated whole blood or properly heparinized whole blood sample should be collected and analyzed immediately. Any delay can lead to changes in pH, PCO_2 and HCO_3 . The Element POC™ Analyzer has the ability to provide immediate and accurate results. For metabolic derangements, a venous blood sample is adequate. If respiratory function is being assessed, an arterial sample will be required to evaluate PO_2 and PCO_2 . For more information about obtaining an arterial sample, refer to the Element POC™ Technical Brief entitled, “Arterial Blood Gas Sampling” (Order# 247005-003 0913).

Interpretation of pH, PCO_2 and HCO_3 (acid-base)

Step 1: Evaluate the pH

Determine if the pH is below (acidemia) or above (alkalemia) the normal range for the species being tested.

Step 2: Evaluate the HCO_3

Determine if the HCO_3 is below (acidosis) or above (alkalosis) the normal range for the species being tested.

Step 3: Evaluate the PCO_2

Determine if the PCO_2 is below (alkalosis) or above (acidosis) the normal range for the species and sample being tested (venous vs. arterial).

Step 4: Evaluate the interaction of pH, HCO_3 and PCO_2

The value/parameter that gives the same indication as the pH reveals the primary disturbance. Normal canine values for pH (7.35–7.45), HCO_3 (20–24), PCO_2 (34–40) are used for the following examples:

1. pH: 7.21 (low), HCO_3 : 20 (normal), PCO_2 : 50 (high). Interpreted as primary respiratory acidosis without compensation.
2. pH: 7.51 (high), HCO_3 : 30 (high), PCO_2 : 48 (high). Interpreted as primary metabolic alkalosis with respiratory compensation.

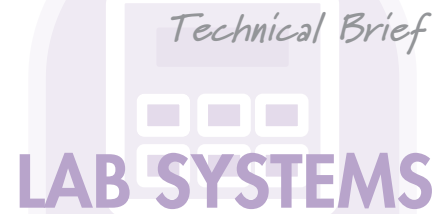
Metabolic and Respiratory Interaction Scenarios

Metabolic Condition	pH	HCO_3	PCO_2
Metabolic acidosis	↓	↓	N
Metabolic acidosis – some compensation	↓	↓	↓
Metabolic alkalosis	↑	↑	N
Metabolic alkalosis – some compensation	↑	↑	↑
Respiratory Condition	pH	HCO_3	PCO_2

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Respiratory acidosis	↓	N	↑
Respiratory acidosis – some compensation	↓	↑	↑
Respiratory alkalosis	↑	N	↓
Respiratory alkalosis – some compensation	↑	↓	↓

Common Causes for Acid-Base Disturbances

Metabolic Acidosis	Respiratory Acidosis
<ul style="list-style-type: none"> • Renal failure • Ketoacidosis • Lactic acidosis • Ethylene glycol toxicity • Obstructive uropathy • Hypoadrenocorticism (Addison’s disease) • Diarrhea, vomiting 	<ul style="list-style-type: none"> • Pulmonary edema • Thoracic trauma • Bronchial obstruction • CNS trauma or disorders • Pneumothorax • Pleural effusion • Pneumonia
Metabolic Alkalosis	Respiratory Alkalosis
<ul style="list-style-type: none"> • Prolonged vomiting • Gastric outflow obstruction • Excessive diuretic therapy • Exogenous HCO₃⁻ • Excessive cortisol and mineralocorticoid • Hyperadrenocorticism (Cushing’s syndrome) 	<ul style="list-style-type: none"> • Excessive positive pressure ventilation • Anxiety, excitement, pain • CNS trauma • Severe anemia • Congestive heart failure • Hypotension

Anion Gap, K⁺ (AGapK)

Anion gap is a calculated parameter defined as the difference between normally measured cations and normally measured anions: **Anion Gap, K = (Na⁺ + K⁺) – (HCO₃⁻ + Cl⁻)**

Abnormalities in AGapK may be helpful in determining the cause of metabolic acidosis. An increased AGapK indicates acidosis typically caused by an increase in unmeasured anions such as ketoacids, sulfates, salicylate, lactate, and ethylene glycol metabolites. Decreases in anion gap are seldom clinically significant.

Base Excess (BE)*

Base excess is a calculated parameter from blood gas analysis: **BE = (HCO₃⁻ – 24.8) + 16.2 (pH – 7.4)**

BE can be used for base deficit correction calculations in fluid therapy, and in conjunction with HCO₃⁻, can be used to assess the metabolic component of acid-base balance in patients with mixed responses. BE above the reference range indicates metabolic alkalosis and BE below the reference range indicates metabolic acidosis.

*For background information refer to M.A. Thrall, Veterinary Hematology and Clinical Chemistry (Baltimore: Lippincott, Williams & Wilkins, 349, 2004).

For questions or further assistance, please call
Heska’s Technical Support Services at **1-800-GO HESKA, option 3.**

