A Quick Reference on Metabolic Alkalosis

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KEYWORDS

• Bicarbonate • Hypochloremia • Base deficit • Alkalosis • Hypoalbuminemia

KEY POINTS

- Metabolic alkaloses are characterized by an increase in bicarbonate concentration, base excess, and pH, and a compensatory increase in carbon dioxide pressure.
- Normal bicarbonate concentration is approximately 19 to 23 mEq/L in dogs and 17 to 21 mEq/L in cats, whereas normal base excess is approximately 0 to −5 in dogs and cats.
- Hypochloremic alkalosis is the most common cause of metabolic alkalosis and is most commonly secondary to vomiting of stomach contents or diuretic administration.

BICARBONATE AND BASE EXCESS: METABOLIC ALKALOSIS—QUICK REFERENCE

- Metabolic alkaloses are characterized by an increase in HCO_3^- concentration and base excess, increase in pH, and a compensatory increase in P_{CO_2} (Fig. 1).
  - Metabolic alkalosis is identified by an increase in HCO_3^- concentration or base excess.
  - Base excess is the amount of acid needed to return blood pH to normal. A positive base excess is associated with metabolic alkalosis.
  - There is a compensatory hypoventilation that increases P_{CO_2} and minimizes the change in pH:
    - In dogs, for each 1 mEq/L increase in HCO_3^-, P_{CO_2} increases by ~0.7 mm Hg.
    - Respiratory compensation for metabolic alkalosis is similar in cats.
- Metabolic alkalosis can result from increase in the strong ion difference (SID; the difference between all strong cations and strong anions in blood; simplified SID = $[Na^+] + [K^+] - [Cl^-]$) or decrease in nonvolatile weak acids.

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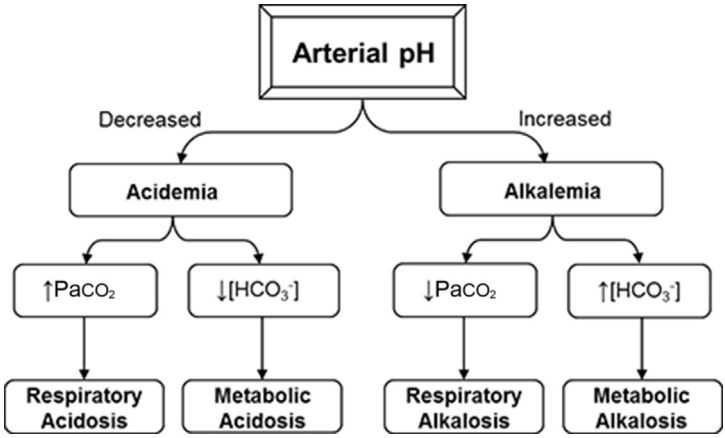

Fig. 1. Algorithm for evaluation of patients with acid-base disorders.

ANALYSIS

- Indications: Measurement of base excess and HCO_3^- concentration is useful in severely ill pets at risk of developing alkalosis (eg, vomiting) or in animals that have a condition known to be associated with metabolic alkalosis or an increase in total carbon dioxide (total CO_2) concentration.
  - A blood gas analysis is necessary to determine if the high total CO_2 is caused by a metabolic alkalosis or a compensation for respiratory acidosis.

Box 1
Principal causes of metabolic alkalosis

SID alkalosis

Concentration alkalosis (recognized by ⇑ $[Na^+]$)
- Pure water loss
  - Water deprivation
- Hypotonic fluid loss
  - Vomiting
  - Diarrhea

Hypochloremic alkalosis
- Vomiting of stomach content[a]
- Diuretic administration (loop diuretics and thiazides)[a]
- $NaHCO_3$ administration

Chloride-resistant hypochloremic alkalosis
- Hyperadrenocorticism
- Hyperaldosteronism

Miscellaneous
- Marked potassium deficiency

Nonvolatile ion buffer alkalosis

Hypoalbuminemic alkalosis
- Liver failure
- Protein-losing nephropathy
- Protein-losing enteropathy

[a] Most important causes in small animal practice.