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A review on interpretation of blood gas analysis in canines

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Abstract
Blood gas analysers are becoming more common in veterinary practice. Analysis of blood gas in canines provides valuable information about cardio pulmonary and acid base status of a critically ill patient. It helps to diagnose various disease conditions and to select a precise and appropriate treatment protocol easily in emergency medicine and critical care management.

Keywords: Blood gas, canines, emergency medicine, oxygenation, acid-base status

1. Introduction
Metabolic derangements and respiratory distress are commonly presented problems in emergency medicine. Blood gas analysers are one of the most efficient diagnostic methods used in emergency and critical care management of dogs presented with respiratory and metabolic diseases. It is the best method to understand the acid base status of an animal. It properly determines the dissolved gaseous level and pH of the blood. Analysis does not require any specialised equipment and can be handled easily.

2. Collection and handling of samples
Arterial or venous blood can be used for blood gas analysis. It is essential that blood gas samples should be properly collected and handled. Arterial samples are usually collected from dorsal pedal artery and sublingual artery, whereas venous blood from jugular, saphenous or cephalic vein. Samples should be capped off to prevent exposure to air and immediately analysed, otherwise it may alter the results. Arterial samples are used to assess oxygenation and ventilation status of the patient whereas venous blood gases can provide information regarding acid base status and ventilation [1].

3. Parameters and their interpretations
Major parameters directly measured through blood gas analysers are pH, partial pressure of oxygen (PO_2) and partial pressure of carbon dioxide (PCO_2). Other parameters include sodium, potassium, calcium, glucose and lactate. These measured values are then used to derive the percentage of haemoglobin saturated with oxygen (SO_2), bicarbonate concentration (HCO_3^-), total Carbon dioxide concentration (TCO_2) and base excess of the extra cellular fluid (BEecf). From these values, anion gap and acid base balance of the blood is calculated using specific formulas.

3.1 pH determination
Blood pH is determined by the ratio between the metabolic (HCO_3^-) and the respiratory component (PCO_2) of the acid base balance. It represents the overall balance of all the acid and base processes in the body. Normal pH of canine blood is 7.36 to 7.44 [2]. Acidemia develops when the blood pH goes below 7.35 and alkalemia when the pH goes beyond 7.45 [3].

3.2 Evaluation of PCO_2
It is the respiratory component providing information of ventilation or the respiratory component of the acid base balance. The normal level is 35 to 45 mm Hg. Hypo ventilation occurs by increase in PCO_2 as CO2 retained in the blood and this leads to respiratory acidosis. Respiratory acidosis is caused by ventilator failure in which normal amounts of CO2 produced by tissue metabolism cannot be properly excreted. Hyperventilation is characterized by decrease in PCO_2 which leads to respiratory alkalosis.

3.3 Evaluation of metabolic component

The metabolic contribution to the acid base balance is assessed with the bicarbonate concentration and base excess of the extra cellular fluid. Reference range for HCO_3^- in dogs is 19 to 23 mEq/L [4]. Values less than this range indicates metabolic acidosis whereas greater values indicate metabolic alkalosis. The BEecf takes into account all of the body's buffer system to predict the quantity of acid or alkali required to return the extra cellular fluid compartment to neutrality while the paCO2 is held constant at 40 mm Hg [5]. It is the representative of all the acid base disturbances in a patient. Normal value of BEecf is 0 +/- 4 mEq /L [6]. Lower values indicate metabolic acidosis whereas higher values indicate metabolic alkalosis.

3.4 Anion Gap Estimation

Anion gap can be estimated by subtracting the level of major anions from the major cations $[(Na^+ + K^+) – (HCO_3^- - Cl^-)]$. This helps to determine the electrolyte disturbances of the body.

3.5 Evaluation of lactate concentration

Lactic acid level demonstrates the perfusion rate and is a good indicator of anaerobic metabolism taking place in the critically ill animal. Normal lactate level is less than 2.6 mmol/L in dogs [7].

3.6 Evaluation of oxygenation

Reduction of oxygen in the arterial blood is determined by measuring PO_2 values. Normal PO_2 is 90 to 100 mm Hg. Hypoxemia develops when the value goes below 80 mm Hg [8].

4. Conclusion

Analysis of blood gases help to assess three vital physiological processes in critically ill dogs; acid base status, ventilation and oxygenation. The most common acid base disturbance encountered in dogs is metabolic acidosis, which is represented by a lower pH, a negative BEecf or lower HCO_3^- concentration along with a decrease in the PCO_2. The blood gas analysis helps to diagnose underlying disease processes much earlier and guide to provide immediate therapeutic interventions.

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