Blood-Gas Analysis

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Analysis of arterial or venous blood gas can rapidly provide information about the sick, anesthetized or critical patient. There are frequently several questions on boards that will involve blood gas interpretation. Establishing a methodical way of reading and interpreting blood gases will allow you to approach these questions with a plan. This PowerPage presents the approximate normal range across mammalian species for blood gas values as well as an approach to blood-gas questions.

Normal Blood-Gas Values

Value	Normal arterial value (normal venous value if different)
pH	7.35-7.45
pCO_2 (mmHg)	34-40 (38-45)
pO_2 (mmHg)	80-120 (~45-65)
HCO_3	18-24
Base excess	-6 to +1

Interpreting Blood-Gas Results

- One of the most important steps is to assess the acid/base status of the patient
  - Is the pH acidotic, alkalotic, or normal?
  - Is PCO2 high, low, or normal
  - Is HCO3 high, low, or normal
  - This information (assuming it is not all normal) allows you to determine the primary problem
    - If pH is low, the primary problem can only be a metabolic acidosis (low HCO3) or a respiratory acidosis (high pCO2)
      - Rarely, you can have both a metabolic acidosis and respiratory acidosis
    - If pH is high, the primary problem can only be a metabolic alkalosis (high HCO3) or a respiratory alkalosis (low pCO2)
      - Rarely, you can have both a metabolic alkalosis and respiratory alkalosis

- Once you determine the primary problem, you can then determine whether compensation is occurring
  - If the primary problem is respiratory acidosis (high pCO_2), a metabolic alkalosis (high HCO_3) indicates compensation
  - If the primary problem is respiratory alkalosis (low pCO_2), a metabolic acidosis (low HCO_3) indicates compensation
  - If the primary problem is a metabolic acidosis (low HCO_3), a respiratory alkalosis (low pCO_2) indicates compensation
  - If the primary problem is a metabolic alkalosis (high HCO_3), a respiratory acidosis (high pCO_2) indicates compensation

- It is fairly straightforward to assess the ventilatory status of the patient
  - Is the patient hyperventilating (low pCO_2)
  - Is the patient hypoventilating (high pCO_2)
  - Is the patient ventilating normally (normal pCO_2)
- Assess whether the patient is oxygenating well (this can only be assessed from an arterial sample)
  - Is the PO_2 normal
    - Keep in mind the inspired oxygen concentration
  - Calculating the alveolar-arterial gradient is probably beyond the scope of a board exam but for completeness is discussed here
    - Alveolar oxygen= [Inspired oxygen concentration (usually 0.21)] (Barometric pressure – 47) – pCO_2(0.8)
    - Arterial oxygen pressure is just the pO_2
    - The A-a gradient is the difference between alveolar and arterial oxygen
      - = 0.21(Barometric pressure – 47) – pCO_2(0.8) - pO_2
    - A normal A-a gradient is >200. If it is lower, oxygenation is impaired