Arterial Blood Gas Interpretation

1) Determine primary disorder…
2) Acidosis or alkalosis (pH)?
3) Metabolic (HCO_3) or respiratory ($PaCO_2$)?
4) Calculate the "expected response"
5) Determine secondary disorder

Normals: pH 7.35-7.45 $PaCO_2$ 35-45 PaO_2 80-100 HCO_3 22-26
Base Excess -2+2
(For calculations assume "baseline" $PaCO_2$ 40 and HCO_3 24)

Metabolic Acidosis ↓pH ↓HCO_3 (↓$PaCO_2$)

- Expected Response: $PaCO_2 = HCO_3 (1.5) + 8 \pm 2$
  (Example: pH 7.30 $PaCO_2$ 32 PaO_2 80 HCO_3 16)

Metabolic Alkalosis ↑pH ↑HCO_3 (↑$PaCO_2$)

- Expected Response: $PaCO_2 \approx HCO_3(0.7) + 20$
  (Example: pH 7.48 $PaCO_2$ 46 PaO_2 80 HCO_3 34)

Respiratory Acidosis ↓pH ↑$PaCO_2$ (↑HCO_3)

- Expected Response: Acute: ↑HCO_3 1 ⇒ ↑$PaCO_2$ 10
  (Example: pH 7.24 $PaCO_2$ 60 PaO_2 80 HCO_3 26)

- Expected Response: Chronic: ↑HCO_3 3.5 ⇒↑$PaCO_2$ 10
  (Example: pH 7.32 $PaCO_2$ 60 PaO_2 80 HCO_3 31)

Respiratory Alkalosis ↑pH ↓$PaCO_2$ (↓HCO_3)

- Expected Response: Acute: ↓HCO_3 2 ⇒ ↓$PaCO_2$ 10
  (Example: pH 7.48 $PaCO_2$ 30 PaO_2 80 HCO_3 22)

- Expected Response: Chronic: ↓HCO_3 5 ⇒ ↓$PaCO_2$ 10
  (Example: pH 7.43 $PaCO_2$ 30 PaO_2 80 HCO_3 19)

ABG's…

Base Excess (BE) helps determine the degree of metabolic abnormalities.

Negative BE suggests a metabolic acidosis
Positive BE suggests a metabolic alkalosis

Causes of Hypoxemia

Low FiO_2
Hypoventilation
V/Q Mismatch
Diffusion Abnormality
Shunt Physiology

Alveolar Air Equation: $PAO_2 = FiO_2 (760 – 47) – PaCO_2/R$
(Shortcut: $PAO_2 = FiO_2 (700) – PaCO_2$)

A-a Gradient: $PAO_2 – PaO_2$ (normal ≈ 10 – 15)

P/F ratio = PaO_2/FiO_2

References

Narins RG, Emmett M: Simple and mixed acid-base disorders: A practical approach. *Medicine* 1980;59:161-187

Morganroth ML: Six steps to acid-base analysis: Clinical applications. *J Crit Illness* 1990:5(5):460-469

Schlichtig R, Grogono AW, SeveringhausJW: Current Status of Acid-Base Quantitation in Physiology and Medicine: *Anesthesiology Clinics of North America*1998:16(1):211-233

Examples

#1
pH 7.18
$PaCO_2$ 22
PaO_2 90
HCO_3 10
BE -12
Room air

#2
pH 7.30
$PaCO_2$ 25
PaO_2 90
HCO_3 16
BE -8
Room air

#3
pH 7.50
$PaCO_2$ 30
PaO_2 90
HCO_3 22
BE -2
Room air

#4
pH 7.50
$PaCO_2$ 30
PaO_2 90
HCO_3 22
BE -2
FiO2 80%

#5
pH 7.15
$PaCO_2$ 70
PaO_2 90
HCO_3 27
BE 2
Room air

#6
pH 7.30
$PaCO_2$ 60
PaO_2 80
HCO_3 31
BE 6
Room air

#7
pH 7.25
$PaCO_2$ 80
PaO_2 80
HCO_3 33
BE 6
Room air