SIMPLY… Arterial Blood Gases Interpretation

Week 4

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Plan

- Structure for interpretation
  - 5-step approach
  - Works for majority of cases
- Case scenarios
- Some common concerns
  - A-a gradient
  - BE
  - Anion Gap

SIMPLY FINALS

5 step approach

1. HOW IS THE PATIENT?
2. Assess Oxygenation
3. pH- acidosis vs alkalosis
4. Respiratory component
5. Metabolic component

5 step approach

1. **HOW IS THE PATIENT?**

Treat the patient and not the numbers…

2. Assess Oxygenation
3. osis
4. nt
5. t

SIMPLY FINALS

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5 step approach

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Assess Oxygenation

PaO_2 should be >10 kPa (75mmHg) ON AIR

OR

<10kPa less than the % inspired concentration

e.g. 15 L/min delivers approx. 50-60% O_2 so should have PaO2 of ~40

RESPIRATORY FAILURE

- **Type 1** – ONE Problem - PaO_2 <8kPa
- **Type 2** – TWO Problems - PaO_2 <8kPa
  AND - $PaCO_2$ >6.0kPa

5 step approach

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5 step approach

1. HOW IS THE PATIENT?
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3. **pH- acidosis vs alkalosis**
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pH

Normal = 7.35-7.45

?Acidaemic pH<7.35

?Alkalaemic pH>7.45

$$pH \propto \frac{HCO3}{CO2}$$

SIMPLY FINALS

5 step approach

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5 step approach

1. HOW IS THE PATIENT?
2. Assess Oxygenation
3. pH- acidosis vs alkalosis
4. **Respiratory component**
5. **Metabolic component**

Respiratory vs Metabolic Component

- Take your time
- Analyse the pCO_2 and HCO_3 separately and compare with the pH

$$pH \propto \frac{carb}{pCO_2}$$

  - pCO_2 opposite way as pH *(high CO2 = Acidosis)*
  - HCO_3 same way as pH *(high HCO3 = Alkalosis)*

SIMPLY FINALS

Respiratory vs Metabolic Component

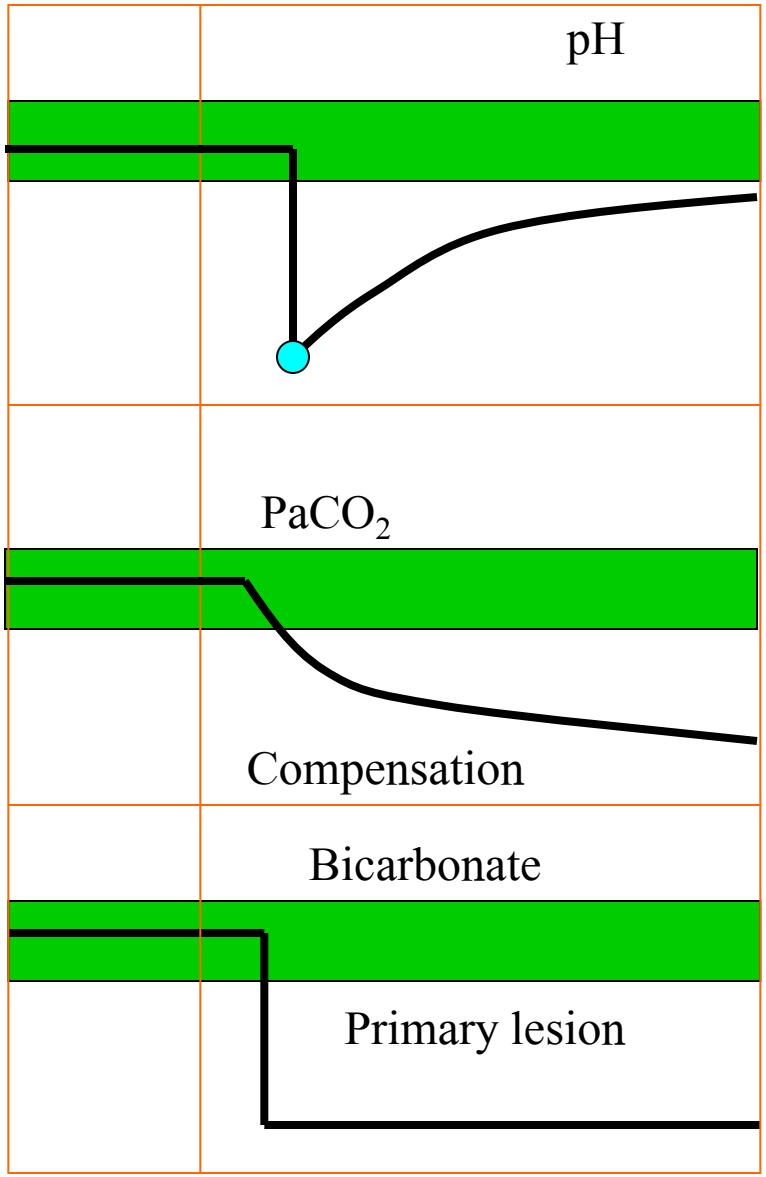
?Primary change vs. Mixed picture

$$pH \propto \frac{carb}{pCO_2}$$

Compensation

- Response to correct initial problem
- *Will not "over" compensate*
- *Resp = quick / Met = slow*

SIMPLY FINALS



HYPER VENTILATION

METABOLIC ACIDOSIS

SIMPLY FINALS

Base Excess

- Alternative to HCO3- but **SAME** information
  - ***Changes in acute setting***

The normal base excess is +/- 2 mmol/l

- Base excess < -2 = metabolic acidosis
- Base excess >+2 = metabolic alkalosis

5 step approach

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A-a Gradient

- Measure of difference between **A**lveolar oxygenation and **a**rterial oxygenation
- Evaluates the SOURCE of **hypoxaemia**

- Normal Aa = extrapulmonary problem
- Raised Aa = intrapulmonary problem

- *A-a gradient = PaO2 – FiO2 x (760-47) – (PaCO2/0.8)*
- ***Normal = 5-10***

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Anion Gap

- ONLY DO IN METABOLIC ACIDOSIS
- Calculates level of unmeasured anions

Anion Gap = *MEASURED* Positive ions – *MEASURED* Negative ions
= Na^+ - (Cl^- + $HCO3^-$)

Normal = 6-12

High anion gap
- Lactic / Keto- / Urate- acidosis

Normal anion gap
- Diarrhoea, Renal tubal acidosis

SIMPLY FINALS

Example 1

An 18-year-old insulin dependent diabetic is admitted to the emergency department. He has been vomiting for 48h and because he was unable to eat, he has taken no insulin.

Breathing spontaneously RR 35 /min, oxygen 4 l/min via Hudson mask, SpO2 98% P 130 /min, BP 90/65 mmHg, GCS 12 (E3, M5, V4)

ABGs on 15l/min are:

- pH 7.01 ↓
- PaC02 2.9KPa ↓
- Pa02 36.6KPa ↔
- HC03 7mmol/l ↓
- BE -21.9mmol/l ↓
- Sats 100%

METABOLIC ACIDOSIS WITH PARTIAL RESPIRATORY COMPENSATION

NORMAL VALUES

pH	*7.35 – 7.45*
paO2	*>10 kPa on air*
PaCo2	*4.7-6.0 kPa*
Bicarb	*22 – 26 mmol/l*
BE	*+/- 2 mmol/l*

BM 30 mmol/l Urine ketones +++ in the urine

DDx / Ix / Mx

SIMPLY FINALS

Example 1 (cont.)

Biochemistry on admission:

Na^+ 136 K^+ 4.8 Cl^- 101 urea 8.1

Reminder of the ABG:

pH 7.01 pCO2 2.9 pO2 36.6 HCO3 7 BE -21.9

What's the anion gap?

Does it fit with our diagnosis?

AG = Na – (Cl + HCO3)

= 136 – (101 + 7)

= 28

Example 2

A 64yo lifelong smoker is seen in outpatients clinic with a 2 year history of worsening cough and exertional dyspnoea. Walks into clinic room

ABGs on room air show:

- pH 7.37
- PaC02 6.9KPa
- Pa02 7.1KPa
- HCO3 33mmol/l
- Base excess + 8.9mmol/l
- Sats 89%

DDx / Ix / Mx

TYPE 2 RF RESPIRATORY ACIDOSIS WITH METABOLIC COMPENSATION (CHRONIC)

NORMAL VALUES

pH	*7.35 – 7.45*
paO2	*>10 kPa on air*
PaCo2	*4.7-6.0 kPa*
Bicarb	*22 – 26 mmol/l*
BE	*+/- 2 mmol/l*

Example 3

A 78yo man attends A&E with a 3 month history of weight loss and a sensation of 'early fullness' on eating. This is now associated with a four day history of worsening 'projectile' vomiting.

His ABGs on room air

- ↑ pH 7.62
- ↔ PaC02 4.8KPa
- ↔ Pa02 12.6KPa
- ↑ HC03 54.8mmol/l
- ↑ Base excess + 20.9mmol/l

Sats 96%

DDx / Ix / Mx

NORMAL VALUES

pH	*7.35 – 7.45*
paO2	*>10 kPa on air*
PaCo2	*4.7-6.0 kPa*
Bicarb	*22 – 26 mmol/l*
BE	*+/- 2 mmol/l*

METABOLIC ALKALOSIS WITH NO RESPIRATORY COMPENSATION

SIMPLY FINALS

Example 4

pH	7.21
pCO2	7.3
pO2	5.9
HCO3	14.6
BE	-7.9
Sats	76%

NORMAL VALUES

pH	*7.35 – 7.45*
paO2	*>10 kPa on air*
PaCo2	*4.7-6.0 kPa*
Bicarb	*22 – 26 mmol/l*
BE	*+/- 2 mmol/l*

Type 2 Respiratory Failure
MIXED ACIDOSIS
Both Resp and Met component

SIMPLY FINALS

Respiratory

Acidosis (PaCO2>6.0kPa)

Hypoventilation

T2 RF-Impaired gas exchange

- COPD
- Heroin OD
- Chest wall defect
- Resp. muscle weakness
  e.g. G.Barre

Hyperventilation due to

- Anxiety
- Hypoxemia
- Metabolic acidosis
- Neurologic Lesions
- Trauma
- Infection

Alka $\propto \frac{HCO_3^-}{pCO_2}$ (PaCO2<4.7kPa)

SIMPLY FINALS

Metabolic

Acidosis (HCO3 <22mmoll/l)

- DM Ketoacidosis
- Urate acidosis (Renal failure)
- Lactic Acidosis
  - Decreased perfusion
  - Severe hypoxemia/sepsis
- Drugs (e.g. Salicylates)

Anion gap

Alkalosis (HCO3 >26mmoll/l)

- XS loss (e.g. Vomiting)
- Ingestion of alkali

$$pH \propto \frac{BICARB}{pCO_2}$$

SIMPLY FINALS

Summary

- Make sure you look at the clinical scenario
- Be systematic and always use the 5 step approach
- Look out for compensation and mixed pictures

SIMPLY FINALS