The OMFS Survival Guide

Session 10: Blood Gases for Dentists

Aims & Objectives

- To understand the basic physiology of acid- base balance in relation to interpreting blood gases
- To understand the indications for an arterial blood gas vs a venous blood gas
- To understand the differences between respiratory and metabolic causes of acid- base disturbances
- To understand the basic interpretation of a blood gas
- To understand some common causes of disturbances to acid- base balance

Indications for an Arterial Blood Gas (ABG) and Venous (VBG)

- The main difference between an arterial blood gas and a venous blood gas is that the ABG has an accurate O_2 and CO_2
- Therefore, the main indication for an ABG over a VBG is in a patient with reducing O_2 saturations or is struggling to breathe. A VBG is for any other unwell patient where breathing and saturations are normal, e.g. abdominal pain, chest pain etc
- The remainder of the parameters on a VBG such as pH, bicarbonate, haemoglobin, lactate, and electrolytes won't be any different to what you see on an ABG

How do you take an ABG?

- Palpate the radial pulse, as close to the wrist as possible
- Disinfect the area
- Using an ABG syringe, go in at 45 degrees to the skin over where you felt the pulsation, should feel some give as you go through the artery wall
- The syringe will fill up automatically
- Discard the needle and push the plunger up so all air is removed from the top of the syringe and there is blood only
- Watch a few first and try to do one supervised
- Video on procedure here: https://geekymedics.com/arterial-blood-gas-sampling/

Acid- Base Balance

- There are two main mechanisms the body uses to keep the pH of your blood within range- the respiratory and metabolic (renal) components

Respiratory Component

- When you breathe in, carbon dioxide dissociates into carbonic acid in the blood- which lowers the pH. It's also excreted by cells as a waste product which adds to this. Therefore, any condition where you are unable to efficiently breathe out the CO_2 (e.g. asthma exacerbation, COPD) may cause you to harbour more CO_2 and become acidotic.
- In contrast, breathing out very quickly (with no obstruction) will cause you to lose more CO_2 which raises the pH of the blood (alkalosis)
- **This respiratory mechanism can develop within minutes as the chemoreceptors detect this quickly and adjust your breathing rate accordingly**

Metabolic Component

- The kidneys produce and resorb bicarbonate which is a buffer for acids
- If there is an acidosis of the blood (e.g. in COPD pt retaining CO_2) the kidneys will produce more bicarb which gets used to buffer that acid and bring the blood pH back to normal. Or in some renal disease the kidneys are not able to produce bicarbonate which then causes acidosis (e.g. acute tubular necrosis)
- If the kidneys are producing excess bicarbonate, or you also have a reduction of CO_2 in the blood (e.g. from hyperventilation) you will have a metabolic alkalosis as the excess bicarbonate pushes the pH up
- **The metabolic mechanism takes at least 48 hours to develop, and therefore will not compensate for a respiratory problem quickly**

Respiratory & Metabolic Compensation

- The lungs and kidneys will use the above mechanisms to compensate for an issue
- E.g. If a patient chronically retains CO_2 and the blood becomes acidic, the kidneys will secrete bicarbonate to buffer that acid and bring the pH back within normal range
- If you develop a metabolic acidosis from diabetic ketoacidosis, your breathing rate will increase to try and get rid of more CO_2 to try and reduce the acidity
- Hence, you may look at a blood gas and the pH may be normal but with abnormal CO_2 and bicarbonate due to one compensating for the other.

ABG Interpretation

- As the CO_2 rises, the pH falls (due to more carbonic acid)
- As the CO_2 falls, the pH rises (due to less carbonic acid)
- As the bicarbonate rises, the pH rises (more bicarb makes more alkaline)

- As the bicarbonate falls (either due to not being made or used up to buffer carbonic acid), the pH falls (less bicarbonate means more acidity)

The above pattern can be remembered by the mnemonic ROME:

Respiratory
Opposite
Metabolic
Equal

I.e. if your pH imbalance is respiratory, the CO_2 moves in the opposite way to the pH, but if it's primarily metabolic, the bicarbonate moves in the same direction as the pH.

Type 1 Respiratory Failure

- Hypoxia alone due to impaired gas exchange
- On the ABG you will see a low O_2 but either a normal or low CO_2

Type 2 Respiratory Failure

- Hypoxia with hypercapnia, this is due to the alveoli being unable to expel the excess CO_2 e.g. in obstructive lung diseases like asthma and COPD
- The ABG will show acidosis, low O_2 with a raised CO_2

Common Causes of Respiratory Acidosis

- COPD, asthma, pulmonary oedema, Covid pneumonitis, pneumonia

Common Causes of Respiratory Alkalosis

- Hyperventilation (panic attack), Pulmonary Embolus, head injury

Common Causes of Metabolic Acidosis

- Sepsis, diabetic ketoacidosis, toxicity from drugs

Common Causes of Metabolic Alkalosis

- Vomiting, diuretics

Further reading:

Geeky Medics ABG Interpretation:
https://geekymedics.com/abg-interpretation/

Mind the Bleep ABG Interpretation:
https://www.mindthebleep.com/abg-interpretation/