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Lecture 1 • Mark Klimek • 92:21

Acid/Base Balance (Start times: 30:00)

In order to solve acid-base disorders, it is important to know the normal values for pH, CO₂ and HCO₃ (bicarbonate), which are shown below

- pH 7.35 to 7.45
- CO₂ 35 to 45
- HCO₃ 22 to 26

The first value to look at in an acid-base disorder is the pH

- If pH is <7.35, the acid-base imbalance is **acidotic**
- If pH is >7.45, the acid-base imbalance is **alkalotic**

Acid Base Disorders

Disorder	pH	[H ⁺]	Primary disturbance	Secondary response
Metabolic acidosis	↓	↑	↓ [HCO ₃ ⁻]	↓ pCO ₂
Metabolic alkalosis	↑	↓	↑ [HCO ₃ ⁻]	↑ pCO ₂
Respiratory acidosis	↓	↑	↑ pCO ₂	↑ [HCO ₃ ⁻]
Respiratory alkalosis	↑	↓	↓ pCO ₂	↓ [HCO ₃ ⁻]

Now, to determine if the imbalance is **metabolic** or **respiratory**, determine whether HCO₃ goes in the same or opposite direction with pH

- Rule of the Bs: If **pH** and **Bicarb** move **both** in the same direction, then the acid-base imbalance is **metabolic** ... Otherwise, it is **respiratory**

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Example #1

- pH 7.3 Acidotic
- HCO₃ 20 Metabolic
- This is an example of metabolic acidosis

Example #2

- pH 7.58 Alkalotic
- HCO₃ 32 Metabolic
- This is an example of metabolic alkalosis

Example #3

- pH 7.22 Acidosis
- HCO₃ 35 Respiratory
- This is an example of respiratory acidosis

As the pH goes, so goes my patient, except for Potassium ... That means

- If pH is low, everything is low, except potassium
- If pH is high, everything is high, except potassium

If pH goes over 7.45, this is alkalosis

- Therefore everything is up: tachycardia, tachypnea, HTN, seizures, irritability, spastic, diarrhea, borborygmi (increase bowel sounds), hyperreflexia (3+, 4+)
- However, potassium is opposite. Therefore, hypokalemia
- What is the nursing intervention?
 - Pt need suctioning because of seizures

If pH goes below 7.35, this is acidosis

- Therefore, everything is down: bradycardia, constipation, absent bowel sounds, flaccid, obtunded, lethargy, coma hyporeflexia (0, 1+), bradypnea, low BP
- However, potassium is high (hyperkalemia)
- What is the nursing intervention?
 - Pt needs to be ventilated with an Ambu bag—respiratory arrest

So, remember that “**MAC Kussmaul**” is the only acid-base imbalance to cause **Metabolic ACidosis** with **Kussmaul** respirations

Causes of Acid/Base imbalance

First ask yourself, “Is it LUNG?” ... If yes, then it is **respiratory**

- Then ask yourself, “Are they **overventilating** or **underventilating**?”
 - If **UNDER**ventilating, then pick acidosis—pH is under 7.35
 - If **OVER**ventilating, then it is alkalosis, pH is over 7.45

What type of acid-base derangement is present in the following condition?

- In labor?
 - Respiratory alkalosis ... **Overventilating**—pH increases ... Alkalosis
- Drowning?
 - Respiratory acidosis ... **Underventilating**—pH decreases ... Acidosis
- Pt is on PCA (patient-controlled anesthesia) pump?
 - Ventilation is down ... **Respiratory acidosis**

If it is not LUNG, then it is **metabolic**. If the patient has **prolonged gastric** vomiting or suction (sucking out acid), pick **alkalosis**

- For everything else that isn't lung, pick **metabolic acidosis**
- So, **when you don't know what to pick, pick metabolic acidosis**

Tip

- Set your default setting to Metabolic Acidosis
- Always pay attention to modifying phrase rather than original noun



Figure 1. Patient-controlled anesthesia (PCA) pump.