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**

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 **M**etabolic **AC**idosis 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 UNDERventilating, then pick acidosis—pH is under 7.35
  - If OVERventilating, 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**

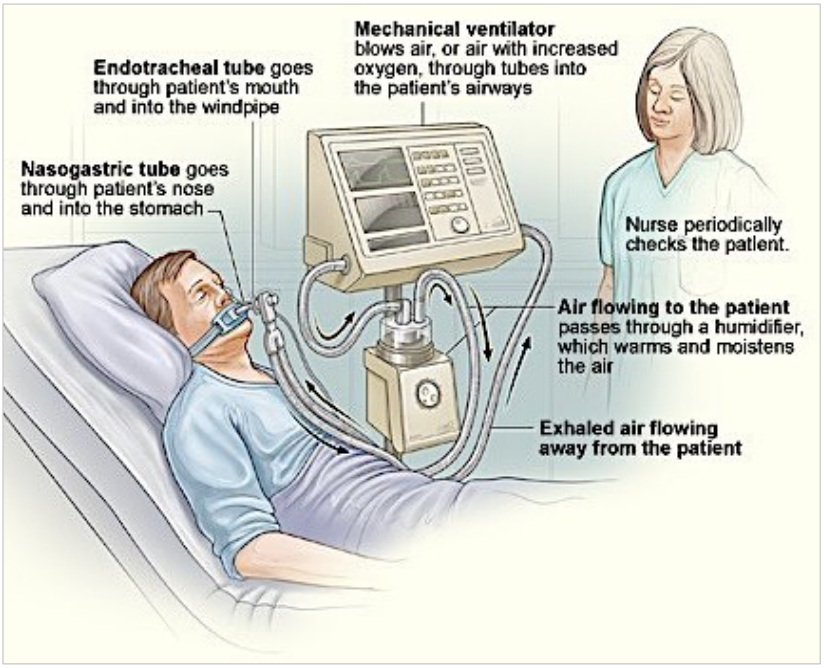
Tip

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

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

Ventilator

A ventilator is a machine designed to move breathable air into and out of the lungs, aids patients who are physically unable to breathe, or breathing insufficiently to breathe … A ventilators is equipped with a **high** and a **low-pressure** alarm



High pressures alarms are always triggered by **increased** resistance to air flow. **Look for obstructions,** i.e.,

- Kinks in tubing … Solution: unkink the tube
- Condensed water in the dependent tube … Solution: empty it
- Mucus plugs … Solution: Ask pt to turn, cough, deep breathe; or suction the tubing PRN

What is the appropriate order to address high pressure alarm in a mechanical ventilator?

- (1) Unkink. (2) Empty water out of tubing. (3) turn pt, ask pt to cough or deeply breathe, and (4) suction

Low pressures alarms are always triggered by **decrease** in resistance. This can be caused by

- Main tubing disconnection
- O2 sensor tube disconnection
- In both cases, reconnect the disconnected tubing unless tube is on floor … Bag pt and call Respiratory Therapist

The ventilator may be set too high or too low

- Setting is too high … Pt is overventilated
  - Respiratory Alkalosis … Panting
- Setting is too low … Pt is underventilated

- Respiratory Acidosis … Pt is retaining CO2

Question

The physician wants to wean pt off vent in the morning. At 6 am, the ABGs say respiratory acidosis. What would you do next?

- Notify the physician that the pt is not ready to be weaned off the respirator
  - Pt is is respiratory acidosis, which means that he is underventilated … Therefore not ready to be weaned off the ventilator
  - If pt were in respiratory alkalosis (overventilated), he should be ready to be weaned off