Blood pH Clues

Trace a pH change to the lungs or a metabolic cause.

HS-AP10-4 "Differentiate between metabolic and respiratory acidosis and alkalosis."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the two sentences that explain how a rise or fall in CO_2 changes pH. Circle the two sentences that explain how a drop or rise in bicarbonate changes pH, then write R beside each underlined sentence and M beside each circled sentence.

Finding the Source of a pH Shift

1. Inside a hospital lab, a blood sample can help reveal why a patient's blood pH has shifted. Normal arterial blood pH is about 7.35 to 7.45. A pH below this range signals acidosis, and a pH above it signals alkalosis. Those labels describe the direction of change, not its cause. To identify the cause, compare two measurements: carbon dioxide, written CO_2, and bicarbonate, written HCO_3^-. Carbon dioxide is linked to acid in blood, while bicarbonate helps buffer that acid. A disturbance that starts with CO_2 is respiratory. One that starts with bicarbonate is metabolic.

2. The lungs control how much CO_2 leaves the body. If breathing removes too little CO_2, blood CO_2 rises and pH falls. That pattern points to respiratory acidosis. If breathing removes CO_2 too quickly, blood CO_2 falls and pH rises. That pattern points to respiratory alkalosis. For example, someone breathing rapidly at high altitude may initially blow off extra CO_2. Look for the changing CO_2 as the primary clue, rather than relying on a symptom alone. Later, the kidneys may adjust bicarbonate to partly offset the shift. That adjustment does not change where the disturbance began.

3. Metabolic disturbances begin with a change in bicarbonate or another nonrespiratory source of acid or base. When bicarbonate drops, pH usually drops: metabolic acidosis. When bicarbonate rises, pH usually rises: metabolic alkalosis. The digestive system can shift this balance because stomach fluid is acidic, while fluid from farther along the intestine contains bicarbonate. Kidneys also regulate bicarbonate and remove acid from the body. A later change in breathing can partly correct a metabolic shift, just as a later kidney response can partly correct a respiratory shift. These responses are called compensation. They do not change the name of the original disorder.

2 ANSWER WITH EVIDENCE

Use the passage

1. A ventilator moves air through a patient's lungs too quickly. The patient's CO_2 falls and pH rises. Which disorder is this, and why?

2. During a severe asthma attack, a patient cannot exhale enough CO_2. The patient's CO_2 rises and pH falls. Which disorder is this, and why?

3. A patient takes too much of a bicarbonate-containing medicine. Blood bicarbonate and pH both rise. Which disorder is this, and why?

4. A patient's kidneys fail to remove enough acid. A blood test shows low bicarbonate and low pH. Which disorder is this, and why?

3 YOUR TURN

Your own words

Invent two brief patient situations, one respiratory and one metabolic, with opposite pH directions. For each, name the disorder and explain which primary change in CO_2 or bicarbonate makes pH move that way.

Blood pH Clues

PART 1 · READ AND MARK

Underline the two sentences that explain how a rise or fall in CO_2 changes pH. Circle the two sentences that explain how a drop or rise in bicarbonate changes pH, then write R beside each underlined sentence and M beside each circled sentence. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A ventilator moves air through a patient's lungs too quickly. The patient's CO_2 falls and pH rises. Which disorder is this, and why?	**Respiratory alkalosis. Excess CO_2 removal is the primary change, and lower CO_2 raises pH.**
2	During a severe asthma attack, a patient cannot exhale enough CO_2. The patient's CO_2 rises and pH falls. Which disorder is this, and why?	**Respiratory acidosis. Retained CO_2 is the primary change, and higher CO_2 lowers pH.**
3	A patient takes too much of a bicarbonate-containing medicine. Blood bicarbonate and pH both rise. Which disorder is this, and why?	**Metabolic alkalosis. The primary change is higher bicarbonate, which raises pH.**
4	A patient's kidneys fail to remove enough acid. A blood test shows low bicarbonate and low pH. Which disorder is this, and why?	**Metabolic acidosis. The nonrespiratory acid buildup is accompanied by low bicarbonate and low pH.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

After a head injury, a patient breathes shallowly, so CO_2 rises and pH falls. This is respiratory acidosis because retained CO_2 is the primary change. Another patient loses stomach acid through prolonged stomach drainage, and blood bicarbonate and pH rise. This is metabolic alkalosis because the primary disturbance is nonrespiratory, not a change in CO_2 removal.

Accept correctly named disorders when the stated primary change and pH direction agree. A compensating change does not change the classification of the original disturbance.