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Physiology: Acid-Base Balance

Printable Flashcards — Pre-Med Biology

pH regulation, bicarbonate buffer system, respiratory and metabolic disorders, and compensation mechanisms.

130 cards — Print double-sided, flip on long edge, then cut along dashed lines.

130 cards — Printable Flashcards

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1

pH goes DOWN. Does $[H^+]$ go up or down?

2

pH goes UP. Does $[H^+]$ go up or down?

3

Acid vs base (simple): what does an acid do?

4

Acid vs base (simple): what does a base do?

5

What does 'acidic' mean in terms of H^+?

6

What does 'alkaline/basic' mean in terms of H^+?

7

Why does the body care so much about pH?

8

Blood pH is kept in a narrow range. Roughly what?

2

$[H^+]$ goes down.

1

$[H^+]$ goes up.

4

Accepts H^+ (or reduces free H^+).

3

Donates H^+ (releases hydrogen ions).

6

Less H^+ (lower hydrogen ion concentration).

5

More H^+ (higher hydrogen ion concentration).

8

About 7.35 to 7.45 (around 7.4).

7

Because enzymes and proteins only work properly in a narrow pH range.

9

Acidosis means...

10

Alkalosis means...

11

Buffers: what is a buffer in one line?

12

Buffers are made of what pair (general rule)?

13

Conjugate acid-base pair means...

14

Buffer 'logic': if you add acid (H^+), the buffer does what?

15

Buffer 'logic': if you add base (removes H^+), the buffer does what?

16

In the body, which is the MOST important blood buffer system?

10

Blood pH is too high (too basic).

9

Blood pH is too low (too acidic).

12

A weak acid and its conjugate base.

11

A system that resists big pH changes by soaking up or releasing H^+.

14

It binds some of the H^+ to reduce the pH drop.

13

Two forms of the same molecule that differ by one H^+.

16

The bicarbonate buffer system.

15

It releases some H^+ to reduce the pH rise.

17

Write the bicarbonate buffer equation (concept version).

18

In that equation, which side is the 'acid' and which side is the 'base'?

19

CO_2 is an acid in the body: true or false?

20

If CO_2 increases, what happens to blood pH (direction)?

21

If CO_2 decreases, what happens to blood pH?

22

Carbonic anhydrase: what's the idea (no detail)?

23

What makes the bicarbonate buffer system extra powerful compared to a random lab buffer?

24

High-yield: in the bicarbonate system, pH depends mainly on the ratio of...

18

H^+ is the acid. $HCO3^-$ (bicarbonate) is the base.

17

$CO2 + H2O <-> H2CO3 <-> H^+ + HCO3^-$

20

pH goes down (more acidic).

19

True (indirectly).

22

An enzyme that speeds up CO2 <-> carbonic acid conversion.

21

pH goes up (more basic).

24

Bicarbonate ($HCO3^-$) to CO2.

23

It's an open system: lungs can remove CO2, and kidneys can adjust bicarbonate.

25

Quick direction rule: more bicarbonate (HCO_3^-) tends to make blood pH...

26

Quick direction rule: less bicarbonate (HCO_3^-) tends to make blood pH...

27

Fastest pH defense in the body: buffers, lungs, or kidneys?

28

Which system controls CO2 levels the fastest?

29

Which system controls bicarbonate (HCO_3^-) long-term?

30

Time scale check: buffers vs lungs vs kidneys.

31

Lungs mainly regulate...

32

Kidneys mainly regulate...

26

Lower (more acidic).

25

Higher (more basic).

28

The lungs (ventilation).

27

Buffers (immediate).

30

Buffers: seconds. Lungs: minutes. Kidneys: hours to days.

29

The kidneys.

32

$HCO3^-$ (bicarbonate) and H^+ excretion.

31

CO2 (carbon dioxide).

33

Hyperventilation does what to CO2?

34

Hyperventilation tends to cause... acidosis or alkalosis?

35

Hypoventilation does what to CO2?

36

Hypoventilation tends to cause... acidosis or alkalosis?

37

Panic/anxiety -> fast breathing. Which acid-base pattern fits best?

38

Severe COPD / airway obstruction -> CO2 retention. Which pattern fits?

39

If a question says 'CO2 is high' and pH is low, what's the primary problem?

40

If CO2 is low and pH is high, what's the primary problem?

34

Alkalosis (respiratory alkalosis).

33

Decreases CO2 (you blow it off).

36

Acidosis (respiratory acidosis).

35

Increases CO2 (you retain it).

38

Respiratory acidosis.

37

Respiratory alkalosis.

40

Respiratory alkalosis.

39

Respiratory acidosis.

41

Kidneys fix acidosis mainly by doing what two things?

42

Kidneys fix alkalosis mainly by...

43

Urine can be acidic or basic. Why does that matter?

44

Kidney compensation is fast or slow?

45

Quick rule: respiratory disorders are about...

46

Quick rule: metabolic disorders are about...

47

Metabolic acidosis: what's the main chemistry idea?

48

Metabolic alkalosis: what's the main idea?

42

Excreting more bicarbonate (and conserving H^+).

41

Excreting more H^+ and conserving/making more bicarbonate.

44

Slow.

43

Because kidneys adjust urine acidity to control blood pH.

46

Bicarbonate ($HCO3^-$) or other acids/bases in the blood.

45

CO2.

48

Too much bicarbonate or too little acid -> pH rises.

47

Too much acid or too little bicarbonate -> pH drops.

49

If pH is low and bicarbonate is low, primary problem is...

50

If pH is high and bicarbonate is high, primary problem is...

51

Mnemonic check (not cringe, just useful): ROME stands for...

52

Using ROME: if CO_2 goes up, pH goes...

53

Using ROME: if HCO_3^- goes up, pH goes...

54

Compensation means...

55

If the problem is metabolic acidosis, the fastest compensation comes from...

56

Metabolic acidosis compensation: breathing rate tends to...

50

Metabolic alkalosis.

49

Metabolic acidosis.

52

Down.

51

Respiratory Opposite, Metabolic Equal.

54

The body tries to push pH back toward normal (it doesn't fix the cause).

53

Up.

56

Increase (hyperventilate).

55

The lungs (hyperventilation to drop CO2).

57

Metabolic alkalosis compensation: breathing rate tends to...

58

If the problem is respiratory acidosis (CO_2 high), the compensation comes mainly from...

59

If the problem is respiratory alkalosis (CO_2 low), kidneys compensate by...

60

Compensation direction trick: if pH is low, does the body try to make it higher or lower?

61

Compensation direction trick: if pH is high, does the body try to make it higher or lower?

62

If someone is acidotic (pH low), which direction should CO_2 move during lung compensation?

63

If someone is alkalotic (pH high), which direction should CO_2 move during lung compensation?

64

Vomiting tends to cause metabolic acidosis or alkalosis?

58

The kidneys (retain/generate bicarbonate).

57

Decrease (hypoventilate) to retain CO_2.

60

Higher (toward normal).

59

Excreting bicarbonate (lowering HCO_3^-).

62

Down (blow off CO_2).

61

Lower (toward normal).

64

Metabolic alkalosis.

63

Up (retain CO_2).

65

Diarrhea tends to cause metabolic acidosis or alkalosis?

66

Diabetic ketoacidosis (DKA) is mainly...

67

Intense anaerobic exercise can cause... (acid-base)

68

High altitude initially tends to cause respiratory acidosis or alkalosis?

69

Opioid overdose (slow breathing) tends to cause...

70

Holding your breath for a while pushes you toward...

71

Besides bicarbonate, name one other buffer in blood.

72

Hemoglobin helps buffer blood by...

66

Metabolic acidosis.

65

Metabolic acidosis.

68

Respiratory alkalosis.

67

Metabolic acidosis (lactic acid).

70

Respiratory acidosis.

69

Respiratory acidosis.

72

Binding H^+ (especially when deoxygenated).

71

Hemoglobin/proteins (and phosphate plays a role too).

73

Phosphate buffer is more important in...

74

Why are proteins good buffers?

75

If pH is low, which word matches: acidemia or alkalemia?

76

If pH is high, which word matches: acidemia or alkalemia?

77

Acidosis vs acidemia: are they identical words?

78

Compensation can happen without fully fixing pH: true or false?

79

If both CO_2 and HCO_3^- are abnormal, how do you tell what's primary?

80

pH low + CO_2 high =

74

They have groups that can accept or donate H^+ (amino acids).

73

Cells and urine (not the main blood buffer).

76

Alkalemia.

75

Acidemia.

78

True.

77

No. Acidosis is the process; acidemia is the result (low blood pH).

80

Respiratory acidosis.

79

Look at the pH direction and ask which variable explains it.

81

pH high + CO_2 low =

82

pH low + HCO_3^- low =

83

pH high + HCO_3^- high =

84

Metabolic acidosis compensation should make CO_2 go...

85

Metabolic alkalosis compensation should make CO_2 go...

86

Respiratory acidosis compensation should make HCO_3^- go...

87

Respiratory alkalosis compensation should make HCO_3^- go...

88

Trap check: 'Hyperventilation makes you more acidic.' True or false?

82

Metabolic acidosis.

81

Respiratory alkalosis.

84

Down.

83

Metabolic alkalosis.

86

Up.

85

Up.

88

False.

87

Down.

89

Trap check: 'CO2 is basically a base in blood.' True or false?

90

Trap check: 'If pH is low, the body should hold onto CO2.' True or false?

91

Trap check: 'Kidneys fix pH instantly.' True or false?

92

Trap check: compensation can make pH overshoot and become the opposite problem. Usually true or false?

93

If you see the word 'respiratory' in a stem, what variable should you immediately check?

94

If you see the word 'metabolic' in a stem, what variable should you immediately check?

95

Main buffer system in blood:

96

Breathing faster decreases which variable?

90

False.

89

False.

92

Usually false.

91

False.

94

$HCO3^-$ (bicarbonate) / fixed acids.

93

CO2.

96

CO2

95

Bicarbonate buffer system

97

Kidneys mainly adjust which base in blood?

98

pH low = (acidemia or alkalemia?)

99

pH high = (acidemia or alkalemia?)

100

pH down + CO_2 up =

101

pH down + HCO_3^- down =

102

pH up + CO_2 down =

103

pH up + HCO_3^- up =

104

Lower pH means {{c1::higher}} $[H^+]$.

98

Acidemia

97

Bicarbonate ($HCO3^-$)

100

Respiratory acidosis

99

Alkalemia

102

Respiratory alkalosis

101

Metabolic acidosis

104

Lower pH means higher $[H^+]$.

103

Metabolic alkalosis

105

$CO_2 + H_2O$ <-> {{c1::H_2CO_3}} <-> H^+ + {{c2::HCO_3^-}}.

106

CO_2 up -> pH {{c1::down}} (more acidic).

107

Hyperventilation -> CO_2 {{c1::down}} -> pH {{c2::up}}.

108

Hypoventilation -> CO_2 {{c1::up}} -> pH {{c2::down}}.

109

Respiratory disorders: pH and CO_2 move in {{c1::opposite}} directions (ROME).

110

Metabolic disorders: pH and HCO_3^- move in the {{c1::same}} direction (ROME).

111

Buffers act in {{c1::seconds}}, lungs in {{c2::minutes}}, kidneys in {{c3::hours-days}}.

112

Mini boss: patient is acidotic. What should their breathing do if the lungs are compensating?

106

CO_2 up -> pH down (more acidic).

105

$CO_2 + H_2O <-> H_2CO_3 <-> H^+ + HCO_3^-$.

108

Hypoventilation -> CO_2 up -> pH down.

107

Hyperventilation -> CO_2 down -> pH up.

110

Metabolic disorders: pH and HCO_3^- move in the same direction (ROME).

109

Respiratory disorders: pH and CO_2 move in opposite directions (ROME).

112

Speed up (hyperventilate).

111

Buffers act in seconds, lungs in minutes, kidneys in hours-days.

113

Mini boss: patient is alkalotic. What should breathing do if the lungs compensate?

114

Mini boss: CO_2 is high because breathing is poor. What should kidneys do over time?

115

Mini boss: CO_2 is low because of hyperventilation. What should kidneys do over time?

116

Mini boss: diarrhea causes loss of bicarbonate. What compensation is quickest?

117

Mini boss: vomiting causes loss of acid. What compensation is quickest?

118

If you answered 'pH down means H^+ down', what did you mess up?

119

If you answered 'CO_2 up makes blood more basic', what did you mess up?

120

If you answered 'kidneys change CO_2', what did you mess up?

114

Increase bicarbonate (retain/make $HCO3^-$) and excrete more H^+.

113

Slow down (hypoventilate).

116

Hyperventilation (lower CO2).

115

Excrete bicarbonate.

118

You flipped the pH scale. Lower pH = higher H^+.

117

Hypoventilation (retain CO2).

120

Job roles. Lungs change CO2. Kidneys change bicarbonate/H^+.

119

You forgot CO2 makes carbonic acid -> H^+. CO2 up makes blood more acidic.

121

If you answered 'respiratory acidosis means bicarbonate is the main problem', what did you mix up?

122

If you answered 'compensation fixes the cause', what's the correction?

123

Why is CO_2 linked to acid-base balance at all?

124

In tissues (high CO_2), hemoglobin tends to pick up H^+. Why is that helpful?

125

If the body produces CO_2 constantly, why doesn't pH constantly drop?

126

What happens to blood pH if ventilation matches CO_2 production?

127

Why does the body choose bicarbonate as the main blood buffer?

128

If you remove CO_2, the bicarbonate equation shifts which way?

122

Compensation only helps pH. It doesn't remove the underlying problem.

121

Respiratory problems are CO_2 problems. Metabolic problems are HCO_3^- problems.

124

It buffers the acid load while CO_2 is transported to the lungs.

123

Because CO_2 + water forms carbonic acid, which can release H^+.

126

pH stays stable (steady state).

125

Because we ventilate CO_2 out and buffer systems handle temporary changes.

128

Toward CO_2 production (pulls H^+ into carbonic acid and reduces acidity).

127

Because it's adjustable by BOTH lungs (CO_2) and kidneys (HCO_3^-).

129

If you add CO_2 (hypoventilation), the bicarbonate equation shifts which way?

130

Final sanity check: pH low, CO_2 high, HCO_3^- high. What's going on?

130

Primary respiratory acidosis with kidney compensation (bicarbonate up).

129

Toward $H^+ + HCO3^-$ (more acid).