

LESSON № 12

Topic: DISORDERS OF ACID-BASE BALANCE

Aim of the lesson: to study disorders of acid-base balance, mechanisms of acidosis and alkalosis, and their complications.

QUESTIONS:

1. Mechanisms of acid-base balance maintaining. Role of buffer systems, lungs and kidney in the acid-base balance regulation.
2. Parameters of acid-base balance and their importance. Siggart-Andersen nomograms.
3. Classification of acid-base disturbances. Compensatory and decompensatory, absolute and relative, respiratory and metabolic disorders.
4. Causes and parameters of acid-base balance in:
 - a. respiratory acidosis;
 - b. metabolic acidosis;
 - c. respiratory alkalosis;
 - d. metabolic alkalosis.
5. Consequences of acid-base disturbances. Clinical manifestations of alkalosis and acidosis.

Tasks

1

The patient was on the high altitude (3000 m) about 3 days. After arterial blood gas analysis the parameters of acid-base balance were following:

pH = 7,47

pCO₂ = 33,4 mm Hg

HCO₃⁻ = 20 mM

BB = 41,4 mM

BE = 2,0 mM

Make a conclusion about the type of acid-base balance disorder and about the cause of this disturbance.

2

The patient with peptic ulcer was treated by sodium bicarbonate.

After arterial blood gas analysis the parameters of acid-base balance were following:

$$\text{pH} = 7,48$$

$$\text{pCO}_2 = 53,4 \text{ mm Hg}$$

$$\text{HCO}_3^- = 31 \text{ mM}$$

$$\text{BB} = 55 \text{ mM}$$

$$\text{BE} = 5 \text{ mM}$$

Make a conclusion about type of disorder of acid-base balance and about the cause of this disturbance.

3

The patient with diabetes mellitus presents in reanimation in coma state. Arterial blood gas analysis reveals changing in the acid-base parameters. Make a conclusion about the type of this disorder.

$$\text{pH} = 7,28$$

$$\text{pCO}_2 = 31,4 \text{ mm Hg}$$

$$\text{HCO}_3^- = 21 \text{ mM}$$

$$\text{BB} = 36,4 \text{ mM}$$

$$\text{BE} = -8,5 \text{ mM}$$

Make a conclusion about the type of acid-base disorder.

4

The patient with bronchial asthma was treated in pulmonic department of hospital. The arterial blood gas analysis revealed the following changes in the acid-base parameters:

$$\text{pH} = 7,29$$

$$\text{pCO}_2 = 51,4 \text{ mm Hg}$$

$$\text{HCO}_3^- = 31 \text{ mM}$$

$$\text{BB} = 44,4 \text{ mM}$$

$$\text{BE} = -2,5 \text{ mM}$$

Make a conclusion about the type of acid-base disorder.

5

$$\text{pH} = 7,18$$

$$\text{pCO}_2 = 75 \text{ mm Hg}$$

$$\text{SB} = 24 \text{ mM}$$

$$\text{BE} = +2,5 \text{ mM}$$

The patient is undergoing surgical operation with cardiopulmonary bypass.

Make a conclusion about the type of acid-base disorder.

6

$$\text{pH} = 7.25$$

$$\text{pCO}_2 = 52 \text{ mm Hg}$$

SB – 22 mM

BB – 45 mM

BE – +2 mM

The patient has a bronchial asthma attack. Make a conclusion about the type of acid-base disorder.

7

pH – 7.20

pCO₂ – 32 mm Hg

SB – 14 mM

BB – 29 mM

BE – -12 mM

The patient is undergoing surgical operation with cardiopulmonary bypass. Make a conclusion about the type of acid-base disorder.

8

pH – 7.36

pCO₂ – 31 mm Hg

SB – 19.5 mM

BB – 39 mM

BE – -5 mM

Ketone bodies in blood – 10 mM

Titrateable acidity in urine – 37 mmol/d (N=10-30 mmol/d)

The patient suffers from diabetes mellitus. Make a conclusion about the type of acid-base disorder.

9

pH – 7.30

pCO₂ – 32 mm Hg

SB – 18 mM

BB – 36 mM

BE – -6 mM

Lactic acid in blood – 10 mM

The patient is admitted to hospital with a preliminary diagnosis of an acute myocardial infarction. Make a conclusion about the type of acid-base disorder.

10

pH – 7.30

pCO₂ – 35 mm Hg

SB – 16.5 mM

BB – 35 mM

BE – -9 mM

Titrateable acidity – 8 mmol/d

NH_4^+ – 17 mmol/d (N = 30-50 mmol/d)

The patient suffers from an acute glomerulonephritis. Make a conclusion about the type of acid-base disorder.

11

pH – 7,22

pCO₂ – 32 mm Hg

SB – 14 mM

BB – 24 mM

BE – -8 mM

The patient has intestinal fistula; he has been losing intestinal juice for a long period of time. Make a conclusion about the type of acid-base disorder.

12

pH – 7.22

pCO₂ – 27 mm Hg

SB – 18.5 mM

BB – 40.5 mM

BE – -7 mM

Lactic acid – 28 mg/dL

Titrateable acidity in urine – 8 mmol/d

NH_4^+ in urine – 15 mmol/d

The patient suffers from severe toxic injury of the liver and kidneys with oligouria. Make a conclusion about the type of acid-base disorder.

13

pH – 7.11

pCO₂ – 24 mm Hg

SB – 15.5 mM

BE – -13 mol/L

BB – 38 mM

Ketone bodies of the blood – 33 mM

Titrateable acidity urine – 70 mmol/d

The patient has hepatic coma. Make a conclusion about the type of acid-base disorder.

14

pH – 7.17

pCO₂ – 51 mm Hg

SB – 24 mM

BB – 45 mM

BE – 2,5 mM

The patient suffers from an acute left ventricular insufficiency with lungs edema. Make a conclusion about the type of acid-base disorder.

15

pH – 7.52

pCO₂ – 25 mm Hg

SB – 21 mM

BE – -2 mM

BB – - 44 mM

The patient is undergoing surgery with mechanical ventilation. Make a conclusion about the type of acid-base disorder.

16

pH – 7.51

pCO₂ – 56 mm Hg

SB – 29 mM

BB – 57 mM

BE – +5.5 mM

The patient suffers from uncontrollable vomiting. Make a conclusion about the type of acid-base disorder.

17

pH – 7.59

pCO₂ – 50 mm Hg

SB – 30 mM

BE – +5 mM

BB – 56 mM

The patient with brain contusion has cyclic vomiting. Make a conclusion about the type of acid-base disorder.

18

pH – 7.27

pCO₂ – 25 mm Hg

SB – 11 mM

BB – 27 mM

BE – -17 mM

Hematocrit – 0.36

The patient had an acute blood loss. Make a conclusion about the

type of acid-base disorder.

19

pH – 7.33
pCO₂ – 35 mm Hg
SB – 18 mM
BB – 42 mM
BE – -5.5 mM
Titratable acidity urine – 12 mM
Hematocrit – 0.3

The patient has been admitted to hospital with a diagnosis of hemolytic anemia of unclear etiology. Make a conclusion about the type of acid-base disorder.

20

pH – 7.57
pCO₂ – 28 mm Hg
SB – 24 mM
BE – +2,5 mM
BB – 48 mM
Titratable acidity of urine – 20 mmol/d

The patient has had the hysteria hyperventilation episode just before the analysis. Make a conclusion about the type of acid-base disorder.

21

pH – 7,09
pCO₂ – 51 mm Hg
SB – 15 mM
BE – -12.5 mM
BB – 38 mM
Lactic acid (blood) – 15 mM
Titratable acidity of urine – 18 mmol/d

The patient with diabetes mellitus in coma. Make a conclusion about the type of acid-base disorder.

LITERATURE:

1. General and clinical pathophysiology / ed. by A.V. Kubyshkin. – Vinnytsa: Nova Knyha Publishers. – 2011. – P. 343-348.
2. Litvitsky P.F., Pirozhkov S.V., Tezikov E.B. Pathophysiology: Concise Lectures, test, clinic-pathophysiological situations and clinic-

laboratory problems. Students manual / Moscow «Geotar-Media», 2012. – P. 56-61.

3. General and systematic pathology / ed. by J. C.E. Underwood. 2nd ed. – 1996. – P. 150-152.

PATHOLOGY OF VITAMINES METHABOLISM

Deficiency of water-soluble vitamins (B₁, B₂, B₆, B₁₂, C, PP).

Deficiency of fat-soluble vitamins (A, D, E, K).

LITERATURE:

1. Lecture material.
2. General and systematic pathology / ed. by J. C.E. Underwood. 2nd ed. – 1996. – P. 153-155.

