FEATURES OF METABOLISM IN CHILDREN

Academic discipline «Pediatric Propedeutics»
Self-study guide for the 3rd year
English medium students

ОСОБЛИВОСТІ ОБМІНУ РЕЧОВИН У ДІТЕЙ
З дісципліни «Пропедевтика педіатрії»
Методичні вказівки
do самостійної роботи студентів 3-го курсу
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Затверджено
Вченою радою ХНМУ
Протокол №  від

Харків
ХНМУ
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Number of class periods: independent work – 4

Contents

The metabolism is one of the essential signs of life. The term “Metabolism” means the ability of an organism to accept, to digest, and to assimilate nourishment.

Metabolic processes include assimilation process (digestion of substances which are admitted from the environment), synthesis process (building of composite chemical compound from more simple elements for creation of live matter) and dissimilation process (disintegration of substances forming alive organism).

Processes of synthesis of organic compounds (energy expending processes) are called anabolic processes (anabolism, constructive metabolism), processes of disintegration (energy forming processes) are called katabolic processes (catabolism, destructive metabolism). Life is possible if the constant tie between processes of disintegration and synthesis are present, due to this fact development and regeneration is possible.

Children have the predominance of anabolic processes at katabolic processes during all periods of childhood, degree of prevalence is parallel to growth intensively.

Specific goals:

- to explain the peculiarities of energy, protein, carbohydrate, lipid, water, mineral and acid-base metabolism in children.
- to carry out a clinical examination in children with metabolic disorders.
- to recognize these clinical symptoms of metabolism disorders and to identify major syndromes.
- to interpret the results of laboratory and instrumental methods of investigation.

To know:

- Features of protein metabolism and semeiology of its disorders in children.
- Features of carbohydrate metabolism and its semeiology disorders in children.
- Features of lipid metabolism and semeiology of its disorders in children.
- Age characteristics of water and mineral metabolism and acid-base balance of the body in children. Violation of water and mineral metabolism and clinical manifestations.

Be able to:
- to collect anamnesis of a patient with diseases of the metabolism disorder.
- to conduct an objective examination of the child with metabolic diseases.
- to interpret the results of investigation.

**Basic knowledge, practices and skills necessary for the topic (interdisciplinary integration).**

<table>
<thead>
<tr>
<th>Names of previous branches of learning</th>
<th>Acquired skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. General physiology.</td>
<td>Knowledge of characteristics of organs and body systems functioning.</td>
</tr>
<tr>
<td>3. Introduction to psychology.</td>
<td>Analysis of patient’s emotions, interpersonal relationships, children’s behavior.</td>
</tr>
</tbody>
</table>

**Control questions to the lesson:**

1. Tell about the energetic metabolism in children, the peculiarities of neuroendocrine regulation of metabolic processes in children, overview of diseases of metabolism.
   2. Tell about the peculiarities of the protein metabolism, semeiotics of its disorder in children.
   3. Tell about the peculiarities of the carbohydrate metabolism, semeiotics of its disorder in children.
   4. Tell about the peculiarities of the lipid metabolism, semeiotics of its disorder in children.
   5. Tell about the peculiarities of the water-electrolyte and acid-base metabolism, semeiotics of their disorders in children.

**Tests for self-control:**
1. A 4-month–old boy admitted to a hospital with complaints of vomiting, often watery stool. The boy is sick during 3 days. At admission general condition is severe. Loose of weight is 12%. Results of biochemical investigation of blood: hematocrite 63%, protein 65g/l.
The prior diagnosis is:
  a) Gastroenteritis, hypotrophy
  b) Gastroenteritis, dehydration syndrome
  c) Gastroenteritis, polycytinemia
  d) Galactozemia
  e) Hypotrophy, hypoproteinemia.

2. A 7-year-old girl admitted to a hospital with complaints of thirst, vomiting, abdominal pain, restless. At admission the general condition is very severe. The girl is unconscious. Loss of weight is 8 kg. The skin is pail. Decrease of turgor and elasticity is marked. The glucose of the blood is 12 mmol/l, the glucose of urine is 2%. Acetone ++++

   The prior diagnosis is:
    a) acute gastritis, hyperglycemia
    b) acute gastroenteritis, hyperglycemia
    c) diabetus mellitus, hypoglycemic coma
    d) gastritis, syndrome of acetic vomiting
    e) myocarditis, hyperglycemia

3. A 14-year-old boy is sick with diabetus mellitus during 3 years. After injection of 15 units of insulin the child did not take any food. At 10 min the child stats to be very pale, convulsions are noticed. At moment admission to the hospital the child was unconscious, paleness of skin, decrease muscle tone, convulsions are marked. Glucose of the blood is 1,2 mmol/l.

   The prior diagnosis is:
    a) Diabetes mellitus, hyperglycemic coma
    b) Diabetes mellitus, hypoglycemic coma
    c) Epilepsy, hyperglycemia
    d) Vegetative dysfunction, hyperglycemia
    e) Meningoencephalitis, hypoglycemia

4. A 3-month infant has the natural feeding. The child can not keep up the head, does not smile. Periodical convulsions has appeared 2 weeks ago. At admission the child to the hospital high level of phenylalanine was found in the blood of the child.

   The prior diagnosis is:
    a) Meningitis, hyperphenylalaninemia
    b) Meningitis, hypophenylalaninemia
    c) Phenylketonuria
    d) Retardation of psychomotor development, hypophenylalaninemia
    e) Epilepsy, hypophenylalaninemia

5. A 7-day-old newborn has vomiting, distention of the abdomen, watery stool 12 times a day after taking breast milk. At admission to the hospital jaundice, enlargement of liver are founded (border of liver palpated on 5 cm below arcus of
ribs). It is known from anamnesis that the farther of the infant does not use milk due to disfunction of stool after taking milk.

   The prior diagnose is:
   a) Gastroenteritis, conjugation jaundice
   b) Gastroenteritis, dehydratation syndrome
   c) Galactosemia
   d) Hepatitis
   e) Hypotrophia, dehydratation syndrome

6. A 4-month-old infant has artificial feeding, uses diluted cow’s milk in proportion 1:1. Deficit of the body mass is 25%. At admission to the hospital the protein of the blood is 48 g/l.

   The prior diagnose is:
   a) Hypotrophy II degree, hyperproteinemia
   b) Hypotrophy II degree, hypoproteinemia
   c) Hypotrophy I degree, hyperproteinemia
   d) Hypotrophy III degree, hypoproteinemia
   e) Hypotrophy III degree, hyperproteinemia

7. A 7-month-old infant starts to have the dysfunction of the intestines, distention of the abdomen, watery stool after introduction of the semolina and bread. The infant lost 800 g of weight. At admission to the hospital the infant was examined, HT was 62%, protein – 42 g/l.

   The prior diagnose is:
   a) Hypotrophy II degree, gastroeneritis
   b) Hypotrophy II degree, dehydratation syndrome
   c) Celiac disease
   d) Gastroeneritis, hypovolemia
   e) Hypotrophy II degree, hypoproteinemia

Answers: 1 – B, 2-C, 3-B, 4-C, 5-C, 6-B, 7-C.

The list of study materials:

Main:

Additional:

Graflogic structre for topic “Features of metabolism in children”

The scheme of digestion and absorption of protein

<table>
<thead>
<tr>
<th>Organ</th>
<th>Albuminous substratum</th>
<th>Enzymes</th>
<th>Operation of the enzyme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>Native protein</td>
<td>Pepsin, gastrin</td>
<td>Lysing of peptides links</td>
</tr>
<tr>
<td>In small bowel under the operation of enzymes of pancreas</td>
<td>Poly peptides</td>
<td>Trypsin, chomotepysin, carbopeptidase, elastase</td>
<td>Lysing of internal peptides links</td>
</tr>
<tr>
<td>Mucosa of small bowels</td>
<td>Amino acids</td>
<td>Oligosacharidase, disacharidase, aminopeptidase and others (more than 20), and also enzymes of digestive glands</td>
<td>The completion of hydrolysis and the absorption into blood and lymphatic systems</td>
</tr>
<tr>
<td>Liver</td>
<td>Amino acids</td>
<td>Decarboxilase, eransaminase</td>
<td>Utilization, splitting, distribution all over the organism</td>
</tr>
</tbody>
</table>

The differential diagnosis of hyperglycemia and hypoglycemia

<table>
<thead>
<tr>
<th>Clinical signs</th>
<th>Hyperglycemia</th>
<th>Hypoglycemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin and mucous membranes</td>
<td>Dry</td>
<td>Skin is moist, profuse sweating The turgidity is maintained</td>
</tr>
<tr>
<td>Tone of muscles</td>
<td>Decreased</td>
<td>Increased, often trembling, seizures</td>
</tr>
</tbody>
</table>
### The features of an amount of water in an organism

<table>
<thead>
<tr>
<th>Age</th>
<th>Common water</th>
<th>Extracellular fluid</th>
<th>Entracellular fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonatal period:</td>
<td>75-80</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>6 months</td>
<td>70</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>1 year</td>
<td>65</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>5 years</td>
<td>65</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>The adult man</td>
<td>60-65</td>
<td>22</td>
<td>40</td>
</tr>
</tbody>
</table>

### Age metrics of fluid maintenance (10 ml/kg of body weight)

<table>
<thead>
<tr>
<th>Age</th>
<th>Fluid maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 days</td>
<td>80-100</td>
</tr>
<tr>
<td>6 months</td>
<td>130-150</td>
</tr>
<tr>
<td>1 year</td>
<td>120-140</td>
</tr>
<tr>
<td>2 years</td>
<td>115-125</td>
</tr>
<tr>
<td>5 years</td>
<td>90-100</td>
</tr>
<tr>
<td>10 years</td>
<td>70-85</td>
</tr>
<tr>
<td>15 years</td>
<td>50-60</td>
</tr>
<tr>
<td>18 years</td>
<td>40-50</td>
</tr>
</tbody>
</table>

A state of aqueous exchange judge on the value **hematocrit**, calculated on such formula:

\[ \text{Ht} = \frac{\text{Volume of red blood cells}}{\text{Blood plasma}} / \text{Blood plasma} \]

### Normative age metrics of hematocrit

<table>
<thead>
<tr>
<th>Age</th>
<th>Unit of measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early neonatal</td>
<td>52-54</td>
</tr>
<tr>
<td>2 months</td>
<td>42</td>
</tr>
<tr>
<td>3-5 months</td>
<td>36</td>
</tr>
<tr>
<td>1 year</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>3-5 years</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>36-37</td>
</tr>
<tr>
<td></td>
<td>0,36-0,37</td>
</tr>
</tbody>
</table>

**Degrees of exsicosis, clinical manifestations**

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Degree of exsiccosis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I (mild)</td>
<td>II (moderate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III (severe)</td>
</tr>
<tr>
<td>The losses of fluid (% of body weight) for the patients of 1-3 years</td>
<td>4-5%</td>
<td>6-9%</td>
</tr>
<tr>
<td>Deficit of fluid (mL/kg of body weight)</td>
<td>40-50</td>
<td>60-90</td>
</tr>
<tr>
<td>The thirst</td>
<td>Is sharply expressed</td>
<td>Is sharply expressed</td>
</tr>
<tr>
<td>The fontanel (of patients of breast feeding age)</td>
<td>Is not changed</td>
<td>Little bit sunk down</td>
</tr>
<tr>
<td>The elasticity of skin</td>
<td>Normal</td>
<td>Decreases</td>
</tr>
<tr>
<td>The eye balls</td>
<td>Are not changed</td>
<td>'Soft'</td>
</tr>
<tr>
<td>Pulse</td>
<td>Normal</td>
<td>Tachycardia, weak pulse</td>
</tr>
<tr>
<td>The heart sounds</td>
<td>Are amplified</td>
<td>Moderately weakened</td>
</tr>
<tr>
<td>BP</td>
<td>Normal</td>
<td>Is reduced</td>
</tr>
<tr>
<td>Urine color</td>
<td>Normal</td>
<td>Yellowish</td>
</tr>
<tr>
<td>Diuresis</td>
<td>Normal</td>
<td>Less than norm</td>
</tr>
<tr>
<td>Common state</td>
<td>Anxiety</td>
<td>Anxiety or sleepiness, hyperesthesia</td>
</tr>
</tbody>
</table>

**Groups of vitamins**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Physical and chemical qualities</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin Group</td>
<td>Properties</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| C (Ascorbic acid) B₁  
(Thiamin) B₂  
(Riboflavin) B₃  
(Nicotinic acid, PP) B₄  
(Choline) B₅  
(Pantothenic acid) B₆  
(Pyridoxine) B₇ (H, bioozes) B₈  
(Folic acid) B₉  
(Cyanocobalamin) B₉  
(Orotic acid) B₉  
(Pangamic acid) P  
(Rutinum) | Are dissolved in water  
• Thermolabile  
• Capable to be destroyed in the main environment  
• Steady in acid environment  
• Not cumulated in an organism |
| A (Retino) t>2 3  
(Ergocalciferol and cholecalciferol) K,j 2  
(Antihemorrhagic) E (b-Tocopherol) Q  
(Ubiquinone) F  
(Polyunsaturated fat acids) U  
(Methylmethioninsulfonni chloride) _N (Lipoic acid)-------- | Fat-soluble vitamin’s  
• Thermostabile  
• Steady in the main and acid environments  
• Can accumulate in an organism |
Навчальне видання

Особливості обміну речовин у дітей

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Ум. друк. арк.____. Тираж____ прим. Зам. №____.