

# **Physiological, anatomical features of the digestive system in children**

## **Semiotics of digestive disorders and main diseases**

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### **Digestive system**

- **The digestive tract**
  - a long muscular tube with many sections and areas
  - begins with the mouth and ends with the anus
- **Accessory parts**
  - organs that are not in the digestive tract but helps in the digestion

### **Peculiarities of oral cavity in infant**

- It is relatively small
- Maxillar alveolar apophysis are short and immature
- Soft palate is located horizontally, and hard palate is broad and flat
- Mucosa is fine, dry and well vascularised
- The sucking fat in the cheeks fill the mouth and help to maintain negative pressure
- The tongue is relatively thick and large
- Teeth are absent

### **The salivary glands**

- The salivary glands are formed at birth, but are not functional (secretion of saliva is low).
- Insufficient saliva in the first months of life is explained by incomplete development of the CNS and by reduced size of the salivary glands.
- Salivation begins to increase with teething because excitation of the trigeminal nerve (the fifth pair) or by excitation of pain receptors.
- Parotid gland is missing at birth but develops intensively from the age of 3-4 months

### **Peculiarities of pharynx in infants**

- Pharynx in the newborn is larger and located lower than in adults, the oral part is on the same level as oral cavity
- Has a length of 40 mm which is 1/3 of the adult size.
- The lymphoid tissue of Waldeyer's ring is located at the gateway of adult pharynx. In children this ring is missing (is missing the most important component of the ring – palatine tonsils).
- Eustachian tube (communicate with the middle ear) is situated in a horizontal position, is shorter and the lumen is wider.
- The baby can breath and swallow the food at once

### **Peculiarities of the esophagus in infants**

- Is well developed, has the shape of two funnels enlarged upper and lower, which facilitates leaking milk
- Average length of the esophagus in newborn is 10-16 cm
- It is relatively narrow
- The entrance into the esophagus is:
  - in newborn – between the III-IV cervical vertebra
  - 2 years of live – IV-V cervical vertebra
  - 12 years of live – VI-VII cervical vertebra
- The localization of lower esophagus sphincter is the same in children of different age groups (X-XI thoracic vertebra)

Ratio between the length of the esophagus and the length of the body is the same in children of different age groups (1:5)

### **Peculiarities of the stomach in infants**

- The stomach lying horizontally, is cylindrical until approximately 2 year of age
- In horizontally lying of baby the gastric fundus is lower as the antral part of the stomach – gastroesophageal reflux is frequent
- Cardial sphincter has a poor development of mucous membrane and muscular lining.

- The cardia is fixed on the left to the Th<sub>x</sub> vertebra.
- Pyloric part is developed well, is on the median line at the level of the Th<sub>xii</sub> vertebra
- The fundus of stomach is under the left dome of diaphragm
- The weight of the stomach in newborn is 6-7 g, in 1 year – 18-21 g

#### **Peculiarities of the small intestine in infants**

- The small intestine is a specialized tubular structure with the stomach proximally and the colon distally
- The small bowel increases 20 times in length with aging, from 200 cm in the newborn to almost 6 m in the adult
- Small intestine has three segments:
  - Duodenum – upper part, connected to the stomach
    - » is located at the I lumbar vertebra, at the age of 12 years is found in the III and IV lumbar vertebrae
    - » where the digestive juices from the pancreas and the liver combine with chyme making it thin and watery
    - » at the age of 7 years begins to develop adipose tissue that fix duodenum
  - Jejunum – occupies the left upper portion of the abdomen
  - Ileum – is positioned in the right abdomen and upper part of the pelvis
- The length of small intestine mesentery is relatively longer

#### **Small Intestine**

- Digested nutrients are absorbed through intestinal walls
- Chemical digestion must be completed in the small intestine through enzymatic activity
- Intestinal mucosa secretes several enzymes that acts on the food, but very few
- Absorbed materials cross the mucosa into the blood then other parts of the body for storage or further chemical change

#### **Peculiarities of the large intestine in infants**

- The large intestine is not completely developed
- Intestine length is approximately equal to body length (in any age)
- The mucosa is smooth, does not contain villi, but contains glands Lieber (larger than in adults)
- Lymph follicles are more numerous, but they do not form Peyer's patches. These patches appear at 2-3 years, so local protection is weak
- Haustrumes appear after 6 month of life
- Muscle tissue is poorly developed so the propulsion capacity is insufficient, this is the major cause of constipation and common inflammation in the intestine

#### **Peculiarities of the liver in infants**

- Before the birth the liver is the largest organ of the body, occupying ½ of the whole abdomen
- It is in the upper quadrant of the abdomen and one part of the left and epigastrium
- The left lobes before the birth up to 1 year of life is very massive
  - may be below the costal margin of 2-4 cm
  - can be palpated below the right costal margin until the age of 7 years
- Large size of the liver is explained by the importance of liver function – hematopoietic organ
- Hematopoietic function in the newborn is imperfect so there is a volume compensation from the liver
- Liver capsule is very thin
- In the capsule and parenchyma are present elastic and collagen fibers

#### **Peculiarities of the gallbladder in infants**

- Gallbladder has a cylindrical shape in newborns, is smaller in relation to the liver and is fully protected by it
- The gallbladders bottom is covered with peritoneum
- Duct length is greater (5-18 mm) in comparison with adults

#### **Peculiarities of the pancreas in infants**

- Pancreas contains exocrine (97%) and endocrine (3%) cells
- **Exocrine function** – the secretion of enzymes
  - proteolytic (trypsin kimotrypsin, elastase)

- glycolytic ( $\alpha$ -amylase,  $\beta$ -lactase, maltase)
  - lipolytic (lipase, phospholipase A and B)
- **Endocrine function** is expressed through the secretion of hormones (insulin, glucagon, somatostatin, lipocain)

#### Phases in control of gastric function

- Cephalic Phase
- Gastric Phase
- Intestinal Phase

#### The most common complaints of digestive disorders

- Dispeptic disturbances
- Appetite (poor, excessive, moderate)
- Heartburn (gastro-esophageal reflux)
- Nausea and Vomiting
- Abdominal pain
- Diarrhea and Constipation
- Bloating, Hiccups and Excessive gas
- Ingesting a nonfood item or poison
- Anal Fissures, odd color or blood in stools

#### Gastro-esophageal reflux

- The term **gastro-esophageal reflux** (GER) implies a functional or physiologic process in a healthy infant with no underlying systemic abnormalities
- GER is a common condition involving regurgitation, or “spitting up” which is the passive return of gastric contents retrograde into the esophagus
- The prevalence of GER peaks between 1-4 months of age, and usually resolves by 6 to 12 months of age
- Regurgitation has been reported in 40-65% of healthy infants, but decreases to 1% by one year of age.

#### Nausea

**Nausea** is the unpleasant feeling of repulsion towards certain foods, accompanied by imminent desire to vomit

#### Causes:

- *Digestive:* appendicitis, biliary, intestinal obstruction, pancreatitis, peptic ulcer disease, pyloric stenosis
- *Neurological:* brain tumors, meningitis
- *Metabolic and endocrine:* diabetes, Addison's disease
- Renal: chronic renal failure
- Other: febrile illness, pregnancy, seasickness, drugs

#### Vomiting

- **Vomiting** is a reflex act which represents the evacuation of the stomach contents (food or fluid) through the mouth, following the simultaneous contraction of the stomach, diaphragm, abdominal muscles, contraction of the pylorus and opening of the cardia
- The act of vomiting takes place in three successive stages
  - nausea and autonomic phenomena associated with it
  - muscle contractions (effort vomiting)
  - expulsion of gastrointestinal content (vomiting itself)
- Types of vomiting
  - acute vomiting
  - chronic vomiting

#### Acute diarrhea in children

- Acute diarrhea is defined as the abrupt onset of 3 or more unusually loose stools in a 24 hour period and lasts no longer than 14 days; persistent diarrhea is defined as an episode that lasts longer than 14 days.
- However, it is the consistency of the stools rather than the number that is most important

- frequent passing of formed stools is not diarrhea.
- babies fed only breast-milk often pass loose, "pasty" stools; this also is not diarrhea.

#### Clinical types of diarrheal diseases

- **acute watery diarrhea** (including cholera), which lasts several hours or days: the main danger is dehydration; weight loss also occurs if feeding is not continued;
- **acute bloody diarrhea**, which is also called dysentery: the main dangers are damage of the intestinal mucosa, sepsis and malnutrition; other complications, including dehydration, may also occur;
- **persistent diarrhea**, which lasts 14 days or longer: the main danger is malnutrition and serious non-intestinal infection; dehydration may also occur;
- **diarrhea with severe malnutrition** (marasmus or kwashiorkor): the main dangers are severe systemic infection, dehydration, heart failure and vitamin and mineral deficiency.

#### Constipation

- For practical clinical purposes, **constipation** is generally defined as infrequent defecation, painful defecation, or both. In most cases, parents are worried that their child's stools are too large, too hard, not frequent enough, and/or painful to pass.
- The North American Society of Gastroenterology, Hepatology, and Nutrition (NASPGHAN) defines **constipation** as *"a delay or difficulty in defecation, present for 2 weeks or more, and sufficient to cause significant distress to the patient."*
- The Paris Consensus on Childhood Constipation Terminology (PACCT) defines **constipation** as *"a period of 8 weeks with at least 2 of the following symptoms: defecation frequency less than 3 times per week, fecal incontinence frequency greater than once per week, passage of large stools that clog the toilet, palpable abdominal or rectal fecal mass, stool withholding behavior, or painful defecation."*

#### Health History Assessment

- **Appetite:** Assess any changes in appetite, food intolerances, and the presence of nausea and/or vomiting.
- **Pain:** include specific questions about when the pain occurs – before meals, after meals, in the middle of the night, and any food associations. Specifically ask about heartburn and problems with a sore mouth, tongue, or throat.
- **Teeth/Gums:** Ask about problems with bleeding gums, dental caries
- **Throat:** Ask about any hoarseness or voice changes that might indicate the presence of a tumor, any difficulty swallowing, and the presence or absence of tonsils.
- **Lower GI:** Assess for problems with eructation, flatulence, the color, frequency, and amount of stools.
- Assess previous GI disease history such as cholecystitis, inflammatory bowel disease

#### Examination of abdomen

- Inspection:
  - Shape.
  - Visible swellings, hernias.
  - Umbilicus, veins.
  - Visible peristalsis.
- Percussion:
  - Fluid wave, shifting dullness.
  - Liver, spleen.
- Palpation:
  - Masses.
  - Areas of tenderness, rebound, guarding.
  - Liver, spleen: <3 years may palpate up to 2 cm below costal margin.
  - Kidneys, bladder.
- Auscultation:
  - Bowel sounds.

**Special methods of investigation**

- Laboratory tests
- Gastroscopy
- Duodenal intubation
- Esophageal intubation
- Colonoscopy
- Scanning of the liver
- Laparoscopy
- Esophagoscopy