UDC 591.53.063+613.2.032.33+616.33-083.2-053.2
DOI: 10.56871/CmN-W.2024.25.55.004

PRACTICAL ASPECTS OF ORGANIZATION OF ENTERAL NUTRITION IN PEDIATRIC INTENSIVE CARE UNIT PATIENTS. PART 2. TEXTURAL CHANGES AND FEATURES OF CARE DURING ENTERAL FEEDING

© Ivan A. Lisitsa, Anna N. Zavyalova, Yurii S. Alexandrovich, Valeria P. Novikova, Oleg V. Lisovskii, Maksim V. Gavshchuk, Alexandra A. Bassanets, Milena N. Yakovleva, Maria A. Koleboshina, Alexey V. Meshkov, Milad M. Al-Hares

Saint Petersburg State Pediatric Medical University. 2 Lithuania, Saint Petersburg 194100 Russian Federation

Contact information:
Ivan A. Lisitsa — Assistant of the Department of General Medical Practice. E-mail: ivan_lisitsa@mail.ru
ORCID: https://orcid.org/0000-0003-3501-9660 SPIN: 4937-7071

For citation: Lisitsa IA, Zavyalova AN, Alexandrovich YuS, Novikova VP, Lisovskii OV, Gavshchuk MV, Bassanets AA, Yakovleva MN, Koleboshina MA, Meshkov AV, Al-Hares MM. Practical aspects of organization of enteral nutrition in pediatric intensive care unit patients. Part 2. Textural changes and features of care during enteral feeding. Children's Medicine of the North-West. 2024;12(4):58–72. DOI: https://doi.org/10.56871/CmN-W.2024.25.55.004

Received: 30.09.2024 **Revised: 19.11.2024** **Accepted: 16.12.2024**

ABSTRACT. Implementation of artificial nutrition in children hospitalized in intensive care unit (ICU) is an important task of the concept of multisystem organization of medical care. For enteral nutrition, taking into account contraindications or impossibility of independent feeding, food texture modifications are used. In case of swallowing disorders for various reasons, special devices — feeding tubes — are used to deliver the nutrient mixture. Implementation of care measures for feeding tubes and stomas allow to increase their service life while reducing the risk of various complications.

KEYWORDS: *textural changes of food, probe care, gastrostomy care, nutritional support, enteral nutrition in children*

ПРАКТИЧЕСКИЕ АСПЕКТЫ ОРГАНИЗАЦИИ ЭНТЕРАЛЬНОГО ПИТАНИЯ ПАЦИЕНТОВ ПЕДИАТРИЧЕСКИХ ОРИТ. ЧАСТЬ 2. ТЕКСТУРНЫЕ ИЗМЕНЕНИЯ И ОСОБЕННОСТИ УХОДА ПРИ ПРОВЕДЕНИИ ЭНТЕРАЛЬНОГО ПИТАНИЯ

© Иван Александрович Лисица, Анна Никитична Завьялова, Юрий Станиславович Александрович, Валерия Павловна Новикова, Олег Валентинович Лисовский, Максим Владимирович Гавщук, Александра Александровна Бассанец, Милена Николаевна Яковлева, Мария Александровна Колебошина, Алексей Владимирович Мешков, Милад Мтанусович Аль-Харес

Санкт-Петербургский государственный педиатрический медицинский университет. 194100, г. Санкт-Петербург, ул. Литовская, д. 2

Контактная информация:
Иван Александрович Лисица — ассистент кафедры общей медицинской практики. E-mail: ivan_lisitsa@mail.ru
ORCID: https://orcid.org/0000-0003-3501-9660 SPIN: 4937-7071

Для цитирования: Лисица И.А., Завьялова А.Н., Александрович Ю.С., Новикова В.П., Лисовский О.В., Гавщук М.В., Бассанец А.А., Яковлева М.Н., Колебошина М.А., Мешков А.В., Аль-Харес М.М. Практические аспекты организации энтерального питания пациентов педиатрических ОРИТ. Часть 2. Текстурные изменения и особенности ухода при проведении энтерального питания. Children's Medicine of the North-West. 2024. Т. 12. № 4. С. 58–72. DOI: https://doi.org/10.56871/CmN-W.2024.25.55.004

Поступила: 30.09.2024 **Одобрена: 19.11.2024** **Принята к печати: 16.12.2024**

РЕЗЮМЕ. Проведение искусственного питания у детей, госпитализированных в отделение реанимации и интенсивной терапии (ОРИТ), является важной задачей концепции мультисистемной организации оказания медицинской помощи. Для энтерального питания, учитывая противопоказания или невозможность самостоятельного питания, применяются изменения текстуры пищи. При нарушениях глотания по различным причинам для доставки питательной смеси используются специальные устройства — питательные трубки. Осуществление мероприятий ухода за питательными зондами и стомами позволяет увеличить срок их эксплуатации при снижении риска различных осложнений.

КЛЮЧЕВЫЕ СЛОВА: *текстурные изменения пищи, уход за зондом, уход за гастростомой, нутритивная поддержка, энтеральное питание у детей*

INTRODUCTION

When administering enteral nutrition to patients with swallowing disorders, which include those hospitalized in intensive care units (ICU), it becomes necessary to change the texture of the nutritional formula [1–4]. The concept of "texture" takes into account the rheological and structural properties of food products, as well as the type of heat treatment. Largely determined by consistency, food texture is a broader concept determined by the patient using mechanical, tactile, visual and auditory receptors and allows one to characterize hardness, elasticity, stickiness, friability, viscosity and fluidity for liquids. Determining the consistency of food that a child can consume without the risk of aspiration is an important resource for early rehabilitation of ICU patients. The use of standardized scales, including the Functional oral intake scale (FOIS), allows to determine the necessary nutritional support strategy from the first day of hospitalization [5]. In children hospitalized in ICU, various technical devices are used to provide enteral nutrition in case of swallowing disorders or contraindications to independent feeding [6]. Most often, tubes (stomach or intestinal) are used, much less often nutritional stomas are used. General and special care measures for them allow for successful nutritional support, prevent the development of complications both in the early and late periods.

AIM

To demonstrate modern recommendations for the care of seriously ill children during artificial feeding.

FEATURES OF FOOD TEXTURE DURING ENTERAL NUTRITION

When prescribing enteral nutrition, it is important to choose right consistency of the formula while respecting its energy value. Liquid formulas are more convenient when administered through various tubes, while thick mixtures or mixtures thickened with special additives (locust bean gum, potato starch) can cause tube obstruction. If the patient is able to eat independently, depending on the functional status (2–7 levels on the Functional Oral Nutrition Scale — FOIS), it is necessary to individually select the consistency of food. In addition, the correct texture of the food bolus allows in some cases to prevent the development of aspiration in children with dysphagia of various origins, including that developed in the structure of the syndrome of consequences of intensive care [3, 7, 8]. Known differences in the processes of swallowing liquid and solid food allow choosing a specific food consistency for a specific patient [9–14]. To determine the texture of food, it is necessary to use developed tools that allow individualization of the prescription of nutritional support [9, 15–20]. One of the most convenient of these is the classification of modified food and liquid consistencies used in patients with dysphagia, proposed in 2017 (The International Dysphagia Diet Standardisation Initiative—IDDSI) (Fig. 1) [10, 20]. The use of the FOIS scale and the IDDSI system is becoming especially important in children hospitalized not only in ICU, but also when transferred to specialized departments, including in connection with the increase in the share of parental participation in the implementation of care measures.

According to the IDDSI classification, solid or semi-solid food that can be used in children with a formed act of chewing and swallowing corresponds to levels 5–7. As the levels decrease, the texture of the food becomes more pureed (6→3), and the liquid becomes less viscous (4→0), which is indicated by food manufacturers with color marking [12]. In addition, a syringe test is used to determine the 0–3 level of liquid, a spoon tilt test is used to determine the viscosity and stickiness of food at level 4, and a fork pressure test is used to assess food products at levels 4–7 (Table 1) [21]. The possibility of using the IDDSI system in assessing the nutrition of young children, including determining the degree of thickening of the formula, has been proven [22, 23].

The texture of normal food prepared using mechanical gentleness methods corresponds to level 7. Moreover, it may include a "double consistency" that simultaneously contains solid and liquid parts. It is prescribed to patients who can bite, chew for a long time, necessary to create a homogeneous food bolus, without experiencing pain and fatigue, and hold the food bolus in the oral cavity until swallowing. The assessment test can be performed with either a spoon or a fork. When

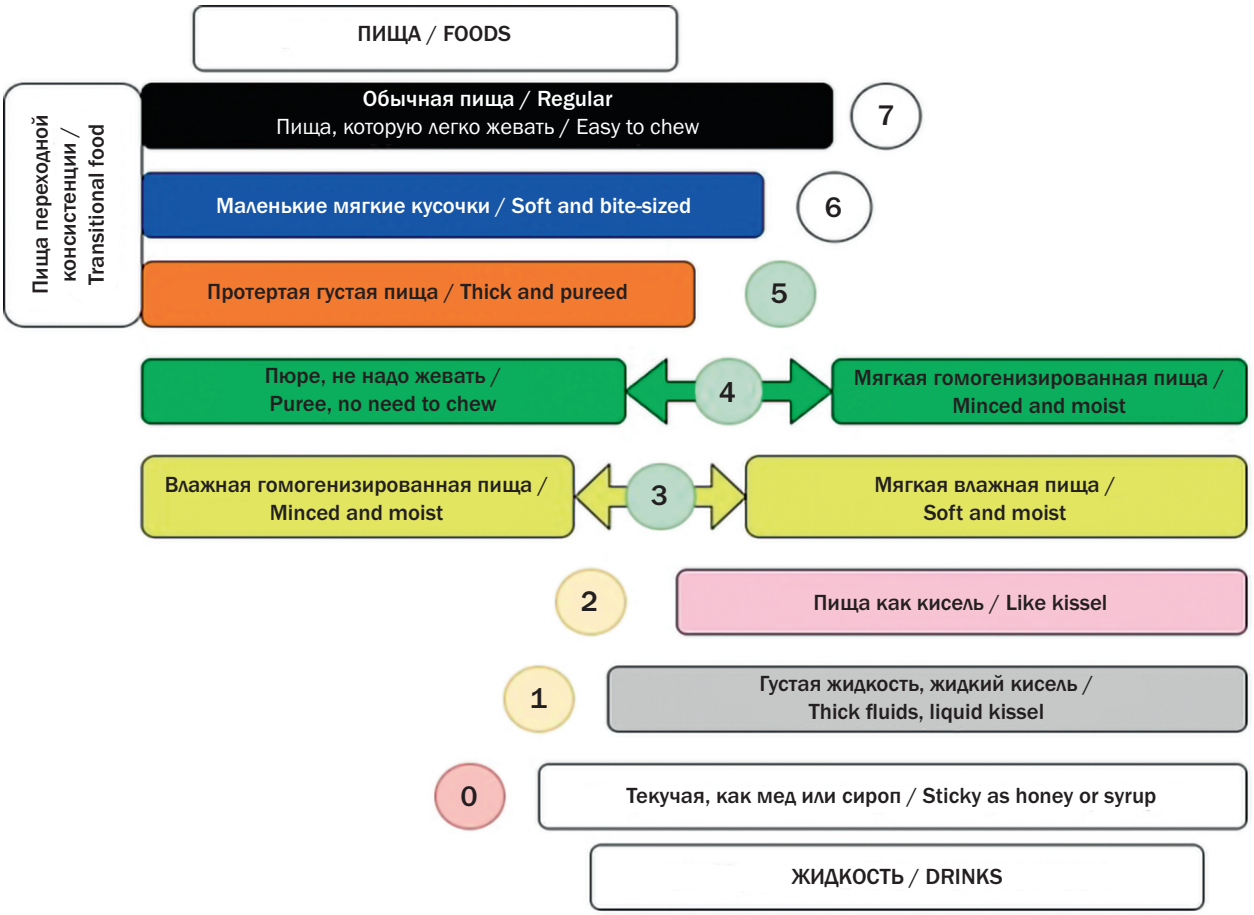
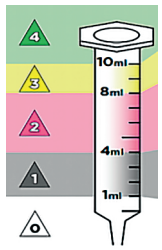
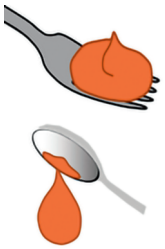
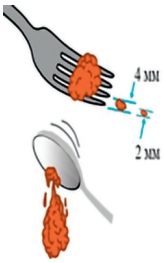
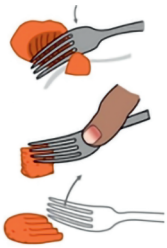


Fig. 1. Classification of modified food and liquid consistencies

Рис. 1. Классификация модифицированных консистенций пищи и жидкостей

Table 1. Levels of food and liquid consistencies [10]

Таблица 1. Классификация консистенции пищи и жидкостей [10]

Уровень / Level	0	1	2	3	4	5	6	7
Тест / Test								

performing the pressure test, a finger is pressed on a fork or spoon under a pressure of 17 kPa, which corresponds to the pressure of the tongue on food bolus during swallowing [10, 24, 25]. This is achieved by pressing the fork with a force that causes the nail plate to turn pale. Pieces of food smaller or larger than 8 mm for children under 5 years of age or 15 mm for children over 5 years of age and adults are used for the analysis [26]. After pressing, the food sample should lose its original shape without returning to its original shape after the end of the test.

Foods with a texture resembling soft pieces are classified as IDDSI level 6. These foods do not require biting, but chewing is required before swallowing.

Food samples may be crushed with a fork, spoon or chopsticks, with complete loss of the original texture. Chopped food corresponding to IDDSI level 5 is prescribed to patients who have the ability to chew minimally and swallow effectively. In this case, the chopping depends on age: for children under 5 years old, the length should not exceed 8 mm, and the width 2 mm, for children over 5 years old and adults, the length should not exceed 15 mm, the width 4 mm. In this case, the food lumps are easily separated from each other with the tongue. When pressing the fork with a finger with a force less than 17 kPa, the food lumps are easily separated and do not join together at the end of the test. The sample collected from the plate with a fork remains on it in the form of a slide, but can penetrate slightly through the teeth. When placing the sample on a spoon, the preservation of the structure of the food lumps is noted. When the spoon is tilted, the food easily "slides" down in a single lump. Puree foods or highly thickened liquids are IDDSI level 4. Such foods are eaten with a spoon or fork, but should not be drunk from a cup or with a straw. The food lump has a uniform, non-sticky consistency without lumps and does not require chewing. Under the influence of gravity (tilt of the spoon), it slowly flows down as a single lump, but does not pour, and when dropped, it retains its shape on the plate. A sample collected from the plate with a fork remains on it in the form of a slide, but a small amount may leak between the tines. When stored for a long time, the food does not separate into liquid and solid phases.

Liquid food is food with a consistency of 1–3 levels according to IDDSI. The evaluation uses a 10 ml syringe test into which the test sample is poured into the cylinder. In this case, the length of the syringe barrel at the 10 ml mark should be 61.5 mm. The amount remaining 10 seconds after opening the tip is estimated. If the remainder is 8 ml, level 3 according to IDDSI is set, 4–8 ml — level 2, 1–4 ml — level 1. Liquid remaining in a volume of less than 1 ml corresponds to the viscosity of water.

Liquid puréed food is IDDSI level 3. It can be drunk from a cup, but is difficult to drink through a 6.9 mm straw. The food does not hold its shape, and flows through the tines of a fork. Considering the consistency, the food does not require chewing and can be swallowed without first forming a bolus. Weakly thickened liquids, which are classified as level 2, can be drunk. Food does not hold its shape, flows quickly from a spoon, but more slowly than liquid of normal consistency. Requires little effort when drinking through a standard straw (diameter 5.3 mm). This consistency can be used in children with decreased muscle tone of the tongue. Level 1 is a slightly thickened liquid that passes freely through a standard tube, nipple on a bottle/cup. The consistency of the food resembles an industrially prepared formula for baby food of the "anti-reflux" type. It is used with a slight weakening of the swallowing reflex. Water, expressed breast milk, standard milk formula and liquids of similar consistency are classified as level 0 IDDSI. The liquid flows at the speed of water. You can drink from any cup and through straws of any diameter.

The choice of the optimal food texture is especially important in patients with swallowing disorders of various genesis. Depending on the severity of dysphagia, the preservation of independent swallowing, when deciding on maintaining oral nutrition, it is necessary to determine the type of food consistency that will lead to the lowest risk of aspiration and food retention in the laryngeal valleculae and pyriform sinuses. In all children before the introduction of complementary foods and in patients with severe dysphagia during artificial enteral feeding, it is necessary to use food texture levels 0–1 according to IDDSI. Thickening to levels 1–2 is possible in children with mild dysphagia with concomitant GERD when prescribing antireflux mixtures. Food texture levels 3–5 are allowed for children without swallowing disorders or conditions that prevent independent feeding, up to 1 year after the introduction of complementary foods, as well as for children with mild dysphagia. Consistency corresponding to food texture level 6 is prescribed to healthy children and children with mild dysphagia, mainly not associated with chewing disorders. Food level 7 is not prescribed for patients with dysphagia.

To support independent swallowing in a child requiring treatment in ICU, it is necessary to use various devices, in particular, special dishes and cutlery. The use of such products allows for increased swallowing safety. Examples of adapted dishes are modified nipples, cut-out cups, weighted spoons, angled spoons, sectio-

nal plates, and non-tipping bowls. Some studies show the benefits of carbonation of beverages in reducing the frequency and severity of aspiration in neurogenic dysphagia in children [27], who are often hospitalized in ICU due to nervous anorexia and developed water-electrolyte disorders.

Saliva, which is involved in the formation of a food bolus on the surface of the tongue before swallowing, is of great importance in maintaining independent nutrition. It has been proven that the rate of saliva production increases with the presence of food in the mouth and during chewing [28], while a decrease in saliva secretion (xerostomia) leads to a deterioration in the condition of the oral mucosa and a decrease in the quality of life of patients, including those hospitalized in ICU [29].

CONTROL OF RESIDUAL VOLUME OF THE STOMACH

The concept of gastric residual volume (GRV) monitoring before feeding is based on the prevention of nausea, vomiting, and aspiration in patients with gastroparesis, which is a common symptom in critically ill children [30, 31]. Studies have noted an increased risk of these complications when GRV reaches 5 ml/kg 3–4 hours after the last meal during continuous feeding or before each bolus feeding [31]. Currently, several studies have been conducted, which have provided conflicting data on the value of this method [30, 32, 33]. Z. Wang et al. (2019) did not reveal an increase in the incidence of aspiration, ventilator-associated pneumonia, or the development of feeding intolerance in the absence of gastric residual volume monitoring [34].

Obtaining results depends on a number of factors, including the size of the syringe, the pressure used for aspiration, the viscosity of the aspirated fluid, the material and size of the gastric tube, and the location of the distal end of the tube [35, 36]. The use of small syringes results in the creation of less negative pressure, which leads to distortion of the results. The walls of silicone tubes are compressed during active aspiration, which also leads to false negative results in determining GRV [31]. At the same time, the positive aspects of aspiration include the ability to control the nature of the contents (blood, bile, gastric or intestinal discharge), which allows for timely diagnosis of the development of complications [31].

Further studies are needed to determine the role of ultrasound in assessing GRV in pediatric ICU patients as a bedside diagnostic tool [37].

CARE OF NUTRITION TUBES

The list of possible special care measures for feeding tubes is huge and includes all stages, from insertion of the tube to its removal. The manipulations should ensure not only the physical well-being of the patient, but also the psychological one. Lack of control over the implementation of care measures for tubes can lead to the development of various complications (Table 2). When directly feeding the child, certain requirements must be observed. Taking into account the constant opening of the esophageal sphincters, to prevent passive aspiration after the introduction of a nutritional mixture during bolus feeding, it is necessary to leave the child, in the absence of contraindications, in a semi-sitting position for 30–40 min. The development of emetic syndrome should be diagnosed in a timely manner with temporary cessation of the introduction of the formula, prescription of antiemetic drugs. In case of relapses of nausea and vomiting, the rate or volume of the introduced nutritional mixture is reduced. Considering the frequent placement of the distal section of the tube in the postpyloric region, after taking food and medications, the tube should be rinsed with water to prevent obstruction of the lumen, and if there are difficulties with the introduction of formula, the tube should be rinsed with water, and if ineffective, with a carbonated drink or an aqueous solution of pancreatin [6, 38]. If it is impossible to restore the tube's patency, it should be removed and replaced with a new one. With prolonged use of nasogastric tubes (more than 1–3 weeks), it is recommended to change the nasal passages to prevent trophic disorders.

Great attention must be paid to fixing the tube to prevent its displacement, completely cleaning the syringe during repeated use, and also to control the rate of administration of the mixture, since these aspects are most often not performed during feeding [39].

Table 2. Complications of gastric tube placement

Таблица 2. Осложнения постановки желудочного зонда

Частые осложнения / Frequent complications	**Редкие осложнения / Rare complications**
Интубация трахеи, аспирационная пневмония [40, 41] / Tracheal intubation, aspiration pneumonia	Перфорация пищевода [42] или желудка [43] / Perforation of the esophagus or stomach
Гастроэзофагеальный рефлюкс при постонно открытом нижнем пищеводном сфинктере / Gastroesophageal reflux in postonally open lower esophageal sphincter	Гидропневмоторакс [44] и гидропневмоперитонеум [45] / Hydropneumothorax and hydropneumoperitoneum
Транспилорическая транслокация с развитием демпинг-синдрома / Transesophageal translocation with development of dumping syndrome	Стеноз пищевода / Esophageal stenosis
Перекручивание, завязывание узла / Torsion, knotting	Перфорация решетчатого лабиринта / Perforation of the lattice labyrinth
Носовые кровотечения при постановке / Nasal bleeding during probe placement	Постановка в головной или спинной мозг при переломе основания черепа / Placement in the brain or spinal cord during skull base fracture
Отек слизистой оболочки носоглотки / Edema of nasopharyngeal mucosa	Эзофагит / Esophagitis
Риносинуситы / Rhinosinusitis	Пролежни / Bedsores
Отиты при длительном нахождении зонда / Otitis media with prolonged probe placement	Кариес, орофарингеальный кандидоз / Caries, oropharyngeal candidiasis

ORGANIZATION OF NUTRITION THROUGH NUTRITIONAL STOMATS

Gastrostomy tubes are installed in children hospitalized in ICU for a long time. Although not a physiological route for delivering nutrients, nutritional support through nutritional stomas allows for the satisfaction of patients' energy needs [46]. When organizing care measures, it is necessary to remember the possibility of developing early and late complications. In the presence of a gastrostomy, all complications can be divided by the time of occurrence (Table 3) [47–51].

In order to prevent infectious complications, it is necessary to change dressings daily [53]. In case of defective care and failure to observe asepsis when working with a postoperative wound, infectious complications arise: abscess, cellulitis, necrotizing fasciitis. The most common sources are bacterial (*Staphylococcus aureus, Pseudomonas, Escherichia coli, Enterobacter cloacae, Streptococcus, Lactobacillus and Bacteroides*) or fungal (*Candida* spp.) flora. Healthcare-associated infections are of particular importance. To prevent them, it is necessary to carry out daily dressings of the stoma area with fixation of aseptic dressings with a Y-shaped incision until the wound is completely healed. If hyperemia, pain, exudate appear, a bacteriological study of the wound discharge is carried out, systemic antimicrobial and antifungal therapy is prescribed. In the absence of positive dynamics against the background of conservative therapy, and the detection of fasciitis, surgical intervention is indicated.

The gastrostomy tube affects the change in the microbiome of the stomach and the entire digestive tract [54, 55]. A decrease in the α-diversity of microorganisms (a decrease in the Shannon index), a reduction in Firmicutes-type bacteria and an increase in *Bacteroides* have been shown. At the same time, a decrease in the *Firmicutes / Bacteroides* index is associated with an increase in the duration of hospitalization in ICU and the likelihood of an unfavorable outcome [55, 56].

After complete healing of the wound, it is necessary to change the position of the gastrostomy tube by 180–360°, and also move it up and down (deep) by approximately 1–2 cm to prevent the growth of granulation [38]. To prevent obstruction of the lumen of

Table 3. Postoperative complications after gastrostomy

Таблица 3. Послеоперационные осложнения после гастростомии

Ранние осложнения (менее 72–96 часов) / Early complications (less than 72–96 hours)	**Поздние осложнения (более 72–96 часов) / Late complications (more than 72–96 hours)**	**Отсроченные осложнения (более 1 месяца) / Delayed complications (more than 1 month)**	**Вне зависимости от времени / Regardless of time**
Абсцесс или целлюлит брюшной стенки / Abdominal wall abscess or cellulitis		Постпилорическая миграция / Postpyloric migration	Засорение трубки / Tube blockage
Чреспеченочное размещение / Transhepatic placement	Пневмоперитонеум / Pneumoperitoneum	Грануляции / Granulations	Внутрибрюшинное истечение желудочного содержимого / Intraperitoneal effusion of gastric contents
Кровотечение из желудочных артерий / Bleeding from gastric arteries	Расхождение краев ран, эвентрация / Wound margin separation, euteration	Демпинг-синдромом / Dumping syndrome	Перистомальная инфекция / Peristomal infection
Гемоперитонеум / Hemoperitoneum	Контактный дерматит / Contact dermatitis	Бампер-синдром [52] / Bumper syndrome	Аспирационная пневмония / Aspiration pneumonia
Постнаркозные осложнения / Post anesthesia complications			Перфорация желудка / Gastric perforation
			Незапланированное удаление трубки / Unplanned tube removal

the tube, it is necessary to correlate the diameter with formula's consistency (according to IDDSI no more than 0–3).

When there is excessive compression of tissue between the external and internal fixation devices of the gastrostomy tube, bumper syndrome occurs, characterized by ischemia, necrosis and infection of soft tissues [52]. In this case, the bumper can be at any distance between the gastric mucosa and the skin, which can lead to gastric perforation, peritonitis, and subcutaneous fat infections. A characteristic triad of symptoms is described: the inability to administer the mixture, obstruction of the tube, and leakage of gastric contents into the stoma area. To prevent this syndrome, it is necessary to ensure the correct positioning of the external cushion between the skin and the external fixator, which should be at least 10 mm. A positive effect is provided by weekly changes in the tube position by 180–360° after unfastening the external fixing plate (after the wound has healed). When bumper syndrome develops, surgical intervention with reinstallation of the tube is indicated.

If the gastrostomy is not sufficiently fixed to the skin, as well as if there is active gastrointestinal peristalsis, the intragastric balloon may be dislocated beyond the pyloric sphincter. Against this background, nausea, vomiting (especially during feeding), and hypoglycemia often develop. In severe cases, dumping syndrome develops. To prevent complications, it is necessary to apply a mark on the outer part of the gastrostomy tube as a reference point and, if necessary, tighten the tube. In case of frequent relapses, the issue of installing a low-profile gastrostomy should be considered.

Excessive traction of the gastrostomy tube or trauma leads to the growth of granulation tissue, which may cause a loose fit of the pressure plate with leakage of gastric contents or dislocation of the tube. In addition, the appearance of granulation leads to difficulty in implementing care measures with subsequent development of infectious complications.

Frequent movements of a gastrostomy tube, proliferation of granulation tissue, decreased motility of the gastrointestinal tract, severe coughing leading to

increased intra-abdominal pressure, and cracks in the tube itself lead to leakage of acidic gastric contents from the stoma. This not only increases the diameter of the stoma, but also damages the skin with the development of contact dermatitis. To prevent excessive mobility of the tube, it is recommended to attach it to the skin of the anterior abdominal wall, and not to clothing. Avoid pulling or bending the tube too tightly. Check the balloon for water at least once a week to ensure it is filled to the volume recommended by the doctor. If there are no contraindications, medications that reduce stomach acidity are prescribed. In case of problems with intestinal peristalsis, gastrostasis, pharmacological correction is also carried out. In case of development of contact dermatitis, it is necessary to use protective cream, petroleum jelly or zinc paste. In some cases, it is recommended to remove the gastrostomy tube for a short period to stimulate narrowing of the lumen. To prevent stenosis of the gastrostomy, tubes of a smaller diameter are inserted into the lumen or, if absent, a Foley catheter with subsequent inflation of the balloon.

Thickening of the formula, deposition of lumps or medications can lead to narrowing of the lumen and obstruction of the gastrostomy tube. In this case, it is technically impossible to introduce the nutritional mixture or medications. To prevent complications, it is necessary to flush the gastrostomy tube with warm water before and after the introduction of nutritional formula and medications. For children receiving continuous enteral feeding, the tube should be flushed every 4–6 hours. To prevent drug deposits due to incomplete dissolution of solid forms, solution analogues are used whenever possible. The blocked tubes are immediately washed with carbonated water using a syringe, then the contents are aspirated with a syringe, pancreatic enzymes may be used. The absence of a positive effect from the conservative therapy determines the indications for surgical intervention with reimplantation of the gastrostomy.

The algorithm for care of the postoperative wound and gastrostomy in children (adapted from Wiernicka A. et al., 2016) [57] is as follows.

Day 1:

- First dressing change in the morning after gastrostomy placement.
- Inspect the wound to determine early complications (bleeding, erythema, discharge, induration, allergic skin reaction, etc.).
- Insert the tube 1–3 cm (depending on the child's age) ventrally and gently pull it back until the internal fixation flange resists.
- Place a Y-shaped aseptic dressing under the tube.
- The external fixation plate is secured with free movement of at least 5 mm.

Days 2–7

- Change dressings daily, inspecting the wound to detect complications.
- Finish dressings by fixing aseptic dressings.
- Attach the outer part of the gastrostomy tube to the child's skin (not to clothing) to prevent accidental removal during clothing changes.

7–14 days

Dressings can be changed once every 2–3 days depending on contamination.

Regularly inspect the wound to detect late, delayed complications.

Patients' hygiene (washing with soap and water or taking a shower) is performed after the initial healing of the postoperative wound [58].

ORAL CARE

In cases of swallowing disorder, especially in intubated patients on mechanical ventilation, bacterial colonization is observed in the oropharynx. Risk factors include the use of certain medications, lack of oral food or liquid intake, and dry mouth [59].

Mechanical cleaning of teeth is carried out mainly with a toothbrush. In conscious patients, accessible to productive contact, electric toothbrushes can be used to increase the effectiveness of cleaning. In any case, brushing teeth should be aimed at areas where plaque and food debris accumulate (around the gums and fissures on the chewing surfaces of the teeth). Brushing teeth should be done carefully, using a toothbrush with a small head and soft bristles, which helps avoid accidental injury to the gums, at least 2 times a day, and after each meal, for at least 1–2 minutes. It is necessary to clean all surfaces of the teeth and, if possible, soft tissues. To clean the interdental space, it is necessary to use dental floss, as well as special solutions for rinsing (if the swallowing re-

flex is preserved). If there is no possibility for mechanical cleaning of the oral cavity with a toothbrush, it is necessary to use gauze swabs moistened with a solution of an aqueous antiseptic, for example, chlorhexidine. To remove food debris, you can use rinsing with subsequent or simultaneous aspiration with an electric suction device.

To reduce the risk of dental caries, mechanical cleaning with a toothbrush should be supplemented with methods of remineralization of the tooth structure. Methods of maintaining hydration of the oral mucosa, diet modification, and the use of special pastes enriched with fluoride are used. The inclusion of fluorides in the crystalline structure of tooth enamel reduces the pH at which it dissolves.

CONCLUSION

Organization of nutritional support in patients hospitalized in ICU is a complex process that requires an individual approach to the choice of food consistency, feeding method, and care of feeding tubes during artificial nutrition. Optimization of food texture in patients with dysphagia and changes in feeding methods helps to prevent complications, while routine measurement of residual gastric volume during nutritional support does not reduce the incidence of aspiration and manifestations of emetic syndrome.

ADDITIONAL INFORMATION

Author contribution. Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

Competing interests. The authors declare that they have no competing interests.

Funding source. This study was not supported by any external sources of funding. The work was carried out as part of the research work (number of state registration of NIOKTR AAAA-A18-118113090077-0 dated 11/30/18) «Screening of the nutritional status in children with somatic, surgical and neurological pathology, the possibility of correction».

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования. Работа выполнена в рамках НИР (номер госучета НИОКТР AAAA-A18-118113090077-0 от 30.11.18) «Скрининг нутритивного статуса у детей с соматической, хирургической и неврологической патологией, возможности коррекции».

REFERENCES

1. Zavyalova A.N., Novikova V.P., Orel V.I. i dr. Organization of the stomy patient nutrition. Choice of food substrate. Pediatr. 2023;14(2):93–104. DOI: 10.17816/PED14293-104. EDN: FRTBWO. (In Russian).
2. da Silva P.S.L., Reis M.E., Fonseca T.S.M. et al. Postextubation dysphagia in critically ill children: A prospective cohort study. Pediatr Pulmonol. 2023;58(1):315–324. DOI: 10.1002/ppul.26202.
3. Lisitsa I.A., Aleksandrovich Yu.S., Zavyalova A.N. i dr. Dysphagia in pediatric intensive care unit patients (review). Vestnik anesteziologii i reanimatologii. 2023;20(6):97–105. DOI: 10.24884/2078-5658-2022-20-6-97-105. (In Russian).
4. Silva F.M., Bermudes A.C., Maneschy I.R. et al. Impact of early enteral nutrition therapy on morbimortality reduction in a pediatric intensive care unit: a systematic review. Rev Assoc Med Bras. 2013;59(6):563–570. DOI: 10.1016/j.ramb.2013.06.013.
5. Yi Y.G., Shin H.I. Psychometrics of the Functional Oral Intake Scale for Children With Dysphagia. J Pediatr Gastroenterol Nutr. 2020;71(5):686–691. DOI: 10.1097/MPG.0000000000002861.
6. Lisovskii O.V., Gostimskii A.V., Lisitsa I.A. i dr. Organization of therapeutic nutrition in a medical organization.

Uchebnoe nagljadnoe posobie dlja studentov. Saint Petersburg; 2022. EDN: RYHOTG. (In Russian).
7. Matsuo K., Fujishima I. Textural Changes by Mastication and Proper Food Texture for Patients with Oropharyngeal Dysphagia. Nutrients. 2020;12(6):1613. DOI: 10.3390/nu12061613.
8. Cichero J.A.Y. Evaluating chewing function: Expanding the dysphagia field using food oral processing and the IDDSI framework. J Texture Stud. 2020;51(1):56–66. DOI: 10.1111/jtxs.12462.
9. Cichero J.A., Steele C., Duivestein J. et al. The Need for International Terminology and Definitions for Texture-Modified Foods and Thickened Liquids Used in Dysphagia Management: Foundations of a Global Initiative. Curr Phys Med Rehabil Rep. 2013;1(4):280–291. DOI: 10.1007/s40141-013-0024-z.
10. Cichero J.A., Lam P., Steele C.M. et al. Development of International Terminology and Definitions for Texture-Modified Foods and Thickened Fluids Used in Dysphagia Management: The IDDSI Framework. Dysphagia. 2017;32(2):293–314. DOI: 10.1007/s00455-016-9758-y.
11. Wang I.C. International Classification Systems for Texture-Modified Foods. Hu Li Za Zhi. 2020;67(4):24–32. Chinese. DOI: 10.6224/JN.202008_67(4).04.
12. Sella-Weiss O. What could go wrong? Non-standardized versus standardized food texture classification. Int J Lang Commun Disord. 2022;57(6):1244–1254. DOI: 10.1111/1460-6984.12749.
13. Mishellany A., Woda A., Labas R. et al. The challenge of mastication: preparing a bolus suitable for deglutition. Dysphagia. 2006;21(2):87–94. DOI: 10.1007/s00455-006-9014-y.
14. Merino G., Marín-Arroyo M.R., Beriain M.J. et al. Dishes Adapted to Dysphagia: Sensory Characteristics and Their Relationship to Hedonic Acceptance. Foods. 2021;10(2):480. DOI: 10.3390/foods10020480.
15. Gisel E.G. Effect of food texture on the development of chewing of children between six months and two years of age. Dev Med Child Neurol. 1991;33(1):69–79. DOI: 10.1111/j.1469-8749.1991.tb14786.x.
16. Volkert V.M., Peterson K.M., Zeleny J.R. et al. A clinical protocol to increase chewing and assess mastication in children with feeding disorders. Behav Modif. 2014;38(5):705–729. DOI: 10.1177/0145445514536575.
17. Le Révérend B.J., Edelson L.R., Loret C. Anatomical, functional, physiological and behavioural aspects of the development of mastication in early childhood. Br J Nutr. 2014;111(3):403–414. DOI: 10.1017/S0007114513002699.
18. Simione M., Loret C., Le Révérend B. et al. Differing structural properties of foods affect the development of mandibular control and muscle coordination in infants and young children. Physiol Behav. 2018;186:62–72. DOI: 10.1016/j.physbeh.2018.01.009.
19. Nip I.S.B., Wilson E.M., Kearney L. Spatial Characteristics of Jaw Movements During Chewing in Children with Cerebral Palsy: A Pilot Study. Dysphagia. 2018;33(1):33–40. DOI: 10.1007/s00455-017-9830-2.
20. Zavyalova A.N., Novikova V.P., Gavshchyuk M.V. i dr. Dysphagia: diagnosis, modern methods of diet therapy. Voprosy detskoy diyetologii. 2022;20(6):51–62. DOI: 10.20953/1727-5784-2022-6-51-62. (In Russian).
21. Sungsinchai S., Niamnuy C., Wattanapan P. Texture Modification Technologies and Their Opportunities for the Production of Dysphagia Foods: A Review. Compr Rev Food Sci Food Saf. 2019;18(6):1898–1912. DOI: 10.1111/1541-4337.12495.
22. Marshall J., Buttsworth J., Grandt H.D.S. et al. Testing and Development of Slightly Thick Infant Formula Recipes for Dysphagia Management: An Australian Perspective. Dysphagia. 2023;38(4):1254–1263. DOI: 10.1007/s00455-022-10550-1.
23. Brooks L., Liao J., Ford J. et al. Thickened Liquids Using Pureed Foods for Children with Dysphagia: IDDSI and Rheology Measurements. Dysphagia. 2022;37(3):578–590. DOI: 10.1007/s00455-021-10308-1.
24. Fei T., Polacco R.C., Hori S.E. et al. Age-related differences in tongue-palate pressures for strength and swallowing tasks. Dysphagia. 2013;28(4):575–581. DOI: 10.1007/s00455-013-9469-6.
25. Youmans S.R., Stierwalt J.A. Measures of tongue function related to normal swallowing. Dysphagia. 2006;21(2):102–111. DOI: 10.1007/s00455-006-9013-z.
26. Berzlanovich A.M., Muhm M., Sim E. et al. Foreign body asphyxiation — an autopsy study. Am J Med. 1999;107:351–355.
27. Lundine J.P., Bates D.G., Yin H. Analysis of carbonated thin liquids in pediatric neurogenic dysphagia. Pediatr Radiol. 2015;45(9):1323–32. DOI: 10.1007/s00247-015-3314-z.
28. Engelen L., van den Keybus P.A., de Wijk R.A. et al. The effect of saliva composition on texture perception of semi-solids. Arch Oral Biol. 2007;52(6):518–525. DOI: 10.1016/j.archoralbio.2006.11.007.
29. Venkatasalu M.R., Murang Z.R., Ramasamy D.T.R. et al. Oral health problems among palliative and terminally ill patients: an integrated systematic review. BMC Oral Health. 2020;20(1):79. DOI: 10.1186/s12903-020-01075-w.
30. Martinez E.E., Pereira L.M., Gura K. et al. Gastric Emptying in Critically Ill Children. JPEN J Parenter Enteral Nutr. 2017;41(7):1100–1109. DOI: 10.1177/0148607116686330.
31. Tume L.N., Arch B., Woolfall K. et al. Gastric Residual Volume Measurement in U.K. PICUs: A Survey of Prac-

tice. Pediatr Crit Care Med. 2019;20(8):707–713. DOI: 10.1097/PCC.0000000000001944.
32. Williams S., Bostain R., Couch N. et al. Routine versus no assessment of gastric residual volumes in preterm infants receiving enteral feeding via intermittent feeding tubes: a randomized controlled trial. J Matern Fetal Neonatal Med. 2023;36(1):2211200. DOI: 10.1080/14767058.2023.2211200.
33. Yasuda H., Kondo N., Yamamoto R. et al. Monitoring of gastric residual volume during enteral nutrition. Cochrane Database Syst Rev. 2021;9(9):CD013335. DOI: 10.1002/14651858.CD013335.pub2.
34. Wang Z., Ding W., Fang Q. et al. Effects of not monitoring gastric residual volume in intensive care patients: A meta-analysis. Int J Nurs Stud. 2019;91:86–93. DOI: 10.1016/j.ijnurstu.2018.11.005.
35. Sangers H., De Jong P.M., Mulder S.E. et al. Outcomes of gastric residuals whilst feeding preterm infants in various body positions. Journal of Neonatal Nursing, 2013;19(6):337–341.
36. Valla F.V., Cercueil E., Morice C. et al. Point-of-Care Gastric Ultrasound Confirms the Inaccuracy of Gastric Residual Volume Measurement by Aspiration in Critically Ill Children: GastriPed Study. Front Pediatr. 2022;10:903944. DOI: 10.3389/fped.2022.903944.
37. Cho A.R. Will ultrasound be able to bring back the lost glory of gastric residual volume? Acute Crit Care. 2023;38(1):142–143. DOI: 10.4266/acc.2023.00409.
38. Gavshchuk M.V., Zavyalova A.N., Gostimsky A.V. i dr. Care of patients with gastrostomy. Uchebnoe nagljadnoe posobie dlja obuchajushhihsja. Saint Petersburg; 2020. EDN: TEMOIH. (In Russian).
39. Gunes N.E.O., Cetinkaya S. Assessment the knowledge, care, and experiences of neonatal nurses about enteral nutrition. Medicine (Baltimore). 2023;102(21):e31081. DOI: 10.1097/MD.0000000000031081.
40. Elpern E.H., Killeen K., Talla E. et al. Capnometry and air insufflation for assessing initial placement of gastric tubes. Am J Crit Care. 2007;16(6):544–9.
41. Metheny N.A., Stewart B.J., McClave S.A. Relationship between feeding tube site and respiratory outcomes. J Parenter Enteral Nutr. 2011;35(3):346–55. DOI: 10.1177/0148607110377096.
42. Vidarsdottir H., Blondal S., Alfredsson H. et al. Oesophageal perforations in Iceland: a whole population study on incidence, aetiology and surgical outcome. Thorac Cardiovasc Surg. 2010;58(8):476–80. DOI: 10.1055/s-0030-1250347.
43. Ebenezer K., Bose A., Carl S. Neonatal gastric perforation following inadvertent connection of oxygen to the nasogastric feeding tube. Arch Dis Child Fetal Neonatal Ed. 2007;92(5):F407. DOI: 10.1136/adc.2006.112367.
44. Hosheh O., Mckechnie L. Rare and unexpected complication after a malpositioned nasogastric tube in a neonate. BMJ Case Rep. 2018;2018:bcr2018224976. DOI: 10.1136/bcr-2018-224976.
45. Gidda H., Mansour M., Singh I. et al. The Forgotten Complication of Nasogastric Tube Insertion: Esophageal Perforation and Associated Hydropneumothorax and Hydropneumoperitoneum. Cureus. 2023;15(5):e38699. DOI: 10.7759/cureus.38699.
46. Erpuleva Y.V., Lekmanov A.U., Gribakin S.G. i dr. Modern technologies of enteral nutrition in critically ill children. Russian Journal of Pediatric Surgery, Anesthesia and Intensive Care. 2014;4(1):80–87. DOI: 10.17816/psaic18. EDN: SFZCXL. (In Russian).
47. Di Leo G., Pascolo P., Hamadeh K. et al. Gastrostomy Placement and Management in Children: A Single-Center Experience. Nutrients. 2019;11(7):1555. DOI: 10.3390/nu11071555.
48. Rahnemai-Azar A.A., Rahnemaiazar A.A., Naghshizadian R. et al. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. World J Gastroenterol. 2014;20(24):7739–51. DOI: 10.3748/wjg.v20.i24.7739.
49. Tazi K., Kotilea K., Dassonville M. et al. Complications of Percutaneous and Surgical Gastrostomy Placements in Children: a Single-Centre Series. JPGN Rep. 2023;4(2):e316. DOI: 10.1097/PG9.0000000000000316.
50. Gestels T., Hauser B., Van de Vijver E. Complications of Gastrostomy and Gastrojejunostomy: The Prevalence in Children. Pediatr Gastroenterol Hepatol Nutr. 2023;26(3):156–164. DOI: 10.5223/pghn.2023.26.3.156.
51. Yi D.Y. Enteral Nutrition in Pediatric Patients. Pediatr Gastroenterol Hepatol Nutr. 2018;21(1):12–19. DOI: 10.5223/pghn.2018.21.1.12.
52. Cyrany J., Rejchrt S., Kopacova M. et al. Buried bumper syndrome: A complication of percutaneous endoscopic gastrostomy. World J Gastroenterol. 2016;22(2):618–27. DOI: 10.3748/wjg.v22.i2.618.
53. Ryzhov E.A., Erpulyova Yu.V., Korsunsky A.A. et al. Experience with gastrostomy for children in critical conditions. Russian Journal of Pediatric Surgery, Anesthesia and Intensive Care. 2014;4(3):21–26. DOI: 10.17816/psaic54. EDN: SWMGPV. (In Russian).
54. Markovskaya I.N., Lisitsa I.A., Kuznetsova Yu.V. et al. Dynamics of microbiome development in a child hospitalized in the intensive care unit for a long period of time. Clinical case. Children's Medicine of the North-West. 2024;12(1):123–135. DOI: 10.56871/CmN-W.2024.50.20.013. (In Russian).

55. Kuznetsova Yu.V., Zavyalova A.N., Lisovskii O.V. i dr. Features of the microbial landscape of the stomach in children, feeding through the gastrostomy or nasogastric tube. Pediatr. 2023;14(2):17–27. DOI: 10.17816/PED14217-27. EDN: JOAVNM. (In Russian).
56. Suzuki H., Joshita S., Nagaya T. et al. Relationship of early acute complications and insertion site in push method percutaneous endoscopic gastrostomy. Sci Rep. 2020;10(1):20551. DOI: 10.1038/s41598-020-77553-6.
57. Wiernicka A., Matuszczyk M., Szlagatys-Sidorkiewicz A. et al. The protocol for a randomised-controlled trial of the evaluation of the tolerance and safety of early enteral nutrition in children after percutaneous endoscopic gastrostomy placement (protocol version 09.01.2015). BMC Pediatr. 2016;16(1):163. DOI: 10.1186/s12887-016-0705-8.
58. Dunitz-Scheer M., Scheer P.J. Tube Management and Maintenance. In: Child-led Tube-management and Tube-weaning. 2022. Springer, Cham. DOI: 10.1007/978-3-031-09090-5_11.
59. Almirall J., Cabré M., Clavé P. Complications of oropharyngeal dysphagia: aspiration pneumonia. Nestle Nutr Inst Workshop Ser. 2012;72:67–76. DOI: 10.1159/000339989.
60. Mohapatra B., CCC-S.L.P., Mohan R. et al. Speech-Language Pathologists' Role in the Multi-Disciplinary Management and Rehabilitation of Patients with Covid-19. J Rehabil Med Clin Commun. 2020;3:1000037. DOI: 10.2340/20030711-1000037.

ЛИТЕРАТУРА

1. Завьялова А.Н., Новикова В.П., Орел В.И. и др. Организация питания стомированного пациента. Выбор пищевого субстрата. Педиатр. 2023;14(2):93–104. DOI: 10.17816/PED14293-104. EDN: FRTBWO.
2. da Silva P.S.L., Reis M.E., Fonseca T.S.M. et al. Postextubation dysphagia in critically ill children: A prospective cohort study. Pediatr Pulmonol. 2023;58(1):315–324. DOI: 10.1002/ppul.26202.
3. Лисица И.А., Александрович Ю.С., Завьялова А.Н. и др. Дисфагия у пациентов педиатрических отделений реанимации и интенсивной терапии (обзор литературы). Вестник анестезиологии и реаниматологии. 2023;20(6):97–105. DOI: 10.24884/2078-5658-2022-20-6-97-105.
4. Silva F.M., Bermudes A.C., Maneschy I.R. et al. Impact of early enteral nutrition therapy on morbimortality reduction in a pediatric intensive care unit: a systematic review. Rev Assoc Med Bras. 2013;59(6):563–570. DOI: 10.1016/j.ramb.2013.06.013.
5. Yi Y.G., Shin H.I. Psychometrics of the Functional Oral Intake Scale for Children With Dysphagia. J Pediatr Gastroenterol Nutr. 2020;71(5):686–691. DOI: 10.1097/MPG.0000000000002861.
6. Лисовский О.В., Гостимский А.В., Лисица И.А. и др. Организация лечебного питания в медицинской организации. Учебное наглядное пособие для студентов. СПб.; 2022. EDN: RYHOTG.
7. Matsuo K., Fujishima I. Textural Changes by Mastication and Proper Food Texture for Patients with Oropharyngeal Dysphagia. Nutrients. 2020;12(6):1613. DOI: 10.3390/nu12061613.
8. Cichero J.A.Y. Evaluating chewing function: Expanding the dysphagia field using food oral processing and the IDDSI framework. J Texture Stud. 2020;51(1):56–66. DOI: 10.1111/jtxs.12462.
9. Cichero J.A., Steele C., Duivestein J. et al. The Need for International Terminology and Definitions for Texture-Modified Foods and Thickened Liquids Used in Dysphagia Management: Foundations of a Global Initiative. Curr Phys Med Rehabil Rep. 2013;1(4):280–291. DOI: 10.1007/s40141-013-0024-z.
10. Cichero J.A., Lam P., Steele C.M. et al. Development of International Terminology and Definitions for Texture-Modified Foods and Thickened Fluids Used in Dysphagia Management: The IDDSI Framework. Dysphagia. 2017;32(2):293–314. DOI: 10.1007/s00455-016-9758-y.
11. Wang I.C. International Classification Systems for Texture-Modified Foods. Hu Li Za Zhi. 2020;67(4):24–32. Chinese. DOI: 10.6224/JN.202008_67(4).04.
12. Sella-Weiss O. What could go wrong? Non-standardized versus standardized food texture classification. Int J Lang Commun Disord. 2022;57(6):1244–1254. DOI: 10.1111/1460-6984.12749.
13. Mishellany A., Woda A., Labas R. et al. The challenge of mastication: preparing a bolus suitable for deglutition. Dysphagia. 2006;21(2):87–94. DOI: 10.1007/s00455-006-9014-y.
14. Merino G., Marín-Arroyo M.R., Beriain M.J. et al. Dishes Adapted to Dysphagia: Sensory Characteristics and Their Relationship to Hedonic Acceptance. Foods. 2021;10(2):480. DOI: 10.3390/foods10020480.
15. Gisel E.G. Effect of food texture on the development of chewing of children between six months and two years of age. Dev Med Child Neurol. 1991;33(1):69–79. DOI: 10.1111/j.1469-8749.1991.tb14786.x.
16. Volkert V.M., Peterson K.M., Zeleny J.R. et al. A clinical protocol to increase chewing and assess mastication in children with feeding disorders. Behav Modif. 2014;38(5):705–729. DOI: 10.1177/0145445514536575.
17. Le Révérend B.J., Edelson L.R., Loret C. Anatomical, functional, physiological and behavioural aspects

of the development of mastication in early childhood. Br J Nutr. 2014;111(3):403–414. DOI: 10.1017/S0007114513002699.
18. Simione M., Loret C., Le Révérend B. et al. Differing structural properties of foods affect the development of mandibular control and muscle coordination in infants and young children. Physiol Behav. 2018;186:62–72. DOI:10.1016/j.physbeh.2018.01.009.
19. Nip I.S.B., Wilson E.M., Kearney L. Spatial Characteristics of Jaw Movements During Chewing in Children with Cerebral Palsy: A Pilot Study. Dysphagia. 2018;33(1):33–40. DOI: 10.1007/s00455-017-9830-2.
20. Завьялова А.Н., Новикова В.П., Гавщук М.В., и др. Дисфагия: диагностика, современные методы диетотерапии. Вопросы детской диетологии. 2022;20(6):51–62. DOI: 10.20953/1727-5784-2022-6-51-62.
21. Sungsinchai S., Niamnuy C., Wattanapan P. et al. Texture Modification Technologies and Their Opportunities for the Production of Dysphagia Foods: A Review. Compr Rev Food Sci Food Saf. 2019;18(6):1898–1912. DOI: 10.1111/1541-4337.12495.
22. Marshall J., Buttsworth J., Grandt H.D.S. et al. Testing and Development of Slightly Thick Infant Formula Recipes for Dysphagia Management: An Australian Perspective. Dysphagia. 2023;38(4):1254–1263. DOI: 10.1007/s00455-022-10550-1.
23. Brooks L., Liao J., Ford J. et al. Thickened Liquids Using Pureed Foods for Children with Dysphagia: IDDSI and Rheology Measurements. Dysphagia. 2022;37(3):578–590. DOI: 10.1007/s00455-021-10308-1.
24. Fei T., Polacco R.C., Hori S.E. et al. Age-related differences in tongue-palate pressures for strength and swallowing tasks. Dysphagia. 2013;28(4):575–581. DOI: 10.1007/s00455-013-9469-6.
25. Youmans S.R., Stierwalt J.A. Measures of tongue function related to normal swallowing. Dysphagia. 2006;21(2):102–111. DOI: 10.1007/s00455-006-9013-z.
26. Berzlanovich A.M., Muhm M., Sim E. et al. Foreign body asphyxiation — an autopsy study. Am J Med. 1999;107:351–355.
27. Lundine J.P., Bates D.G., Yin H. Analysis of carbonated thin liquids in pediatric neurogenic dysphagia. Pediatr Radiol. 2015;45(9):1323–32. DOI: 10.1007/s00247-015-3314-z.
28. Engelen L., van den Keybus P.A., de Wijk R.A. et al. The effect of saliva composition on texture perception of semi-solids. Arch Oral Biol. 2007;52(6):518–525. DOI: 10.1016/j.archoralbio.2006.11.007.
29. Venkatasalu M.R., Murang Z.R., Ramasamy D.T.R. et al. Oral health problems among palliative and terminally ill patients: an integrated systematic review. BMC Oral Health. 2020;20(1):79. DOI: 10.1186/s12903-020-01075-w.
30. Martinez E.E., Pereira L.M., Gura K. et al. Gastric Emptying in Critically Ill Children. JPEN J Parenter Enteral Nutr. 2017;41(7):1100–1109. DOI: 10.1177/0148607116686330.
31. Tume L.N., Arch B., Woolfall K. et al. Gastric Residual Volume Measurement in U.K. PICUs: A Survey of Practice. Pediatr Crit Care Med. 2019;20(8):707–713. DOI: 10.1097/PCC.0000000000001944.
32. Williams S., Bostain R., Couch N. et al. Routine versus no assessment of gastric residual volumes in preterm infants receiving enteral feeding via intermittent feeding tubes: a randomized controlled trial. J Matern Fetal Neonatal Med. 2023;36(1):2211200. DOI: 10.1080/14767058.2023.2211200.
33. Yasuda H., Kondo N., Yamamoto R. et al. Monitoring of gastric residual volume during enteral nutrition. Cochrane Database Syst Rev. 2021;9(9):CD013335. DOI: 10.1002/14651858.CD013335.pub2.
34. Wang Z., Ding W., Fang Q. et al. Effects of not monitoring gastric residual volume in intensive care patients: A meta-analysis. Int J Nurs Stud. 2019;91:86–93. DOI: 10.1016/j.ijnurstu.2018.11.005.
35. Sangers H., De Jong P.M., Mulder S.E. et al. Outcomes of gastric residuals whilst feeding preterm infants in various body positions. Journal of Neonatal Nursing, 2013;19(6):337–341.
36. Valla F.V., Cercueil E., Morice C. et al. Point-of-Care Gastric Ultrasound Confirms the Inaccuracy of Gastric Residual Volume Measurement by Aspiration in Critically Ill Children: GastriPed Study. Front Pediatr. 2022;10:903944. DOI: 10.3389/fped.2022.903944.
37. Cho A.R. Will ultrasound be able to bring back the lost glory of gastric residual volume? Acute Crit Care. 2023;38(1):142–143. DOI: 10.4266/acc.2023.00409.
38. Гавщук М.В., Завьялова А.Н., Гостимский А.В. и др. Уход за пациентами с гастростомой. Учебное наглядное пособие для обучающихся. СПб.; 2020. EDN: TEMOIH.
39. Gunes N.E.O., Cetinkaya S. Assessment the knowledge, care, and experiences of neonatal nurses about enteral nutrition. Medicine (Baltimore). 2023;102(21):e31081. DOI: 10.1097/MD.0000000000031081.
40. Elpern E.H., Killeen K., Talla E. et al. Capnometry and air insufflation for assessing initial placement of gastric tubes. Am J Crit Care. 2007;16(6):544–9.
41. Metheny N.A., Stewart B.J., McClave S.A. Relationship between feeding tube site and respiratory outcomes. J Parenter Enteral Nutr. 2011;35(3):346–55. DOI: 10.1177/0148607110377096.

42. Vidarsdottir H., Blondal S., Alfredsson H. et al. Oesophageal perforations in Iceland: a whole population study on incidence, aetiology and surgical outcome. Thorac Cardiovasc Surg. 2010;58(8):476–80. DOI: 10.1055/s-0030-1250347.
43. Ebenezer K., Bose A., Carl S. Neonatal gastric perforation following inadvertent connection of oxygen to the nasogastric feeding tube. Arch Dis Child Fetal Neonatal Ed. 2007;92(5):F407. DOI: 10.1136/adc.2006.112367.
44. Hosheh O., Mckechnie L. Rare and unexpected complication after a malpositioned nasogastric tube in a neonate. BMJ Case Rep. 2018;2018:bcr2018224976. DOI: 10.1136/bcr-2018-224976.
45. Gidda H., Mansour M., Singh I. et al. The Forgotten Complication of Nasogastric Tube Insertion: Esophageal Perforation and Associated Hydropneumothorax and Hydropneumoperitoneum. Cureus. 2023;15(5):e38699. DOI: 10.7759/cureus.38699.
46. Ерпулева Ю.В., Лекманов А.У., Грибакин С.Г. и др. Современные технологии энтерального питания у тяжелобольных детей. Российский вестник детской хирургии, анестезиологии и реаниматологии. 2014;4(1):80–87. DOI: 10.17816/psaic18EDN SFZCXL.
47. Di Leo G., Pascolo P., Hamadeh K. et al. Gastrostomy Placement and Management in Children: A Single-Center Experience. Nutrients. 2019;11(7):1555. DOI: 10.3390/nu11071555.
48. Rahnemai-Azar A.A., Rahnemaiazar A.A., Naghshizadian R. et al. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. World J Gastroenterol. 2014;20(24):7739–51. DOI: 10.3748/wjg.v20.i24.7739.
49. Tazi K., Kotilea K., Dassonville M. et al. Complications of Percutaneous and Surgical Gastrostomy Placements in Children: a Single-Centre Series. JPGN Rep. 2023;4(2):e316. DOI: 10.1097/PG9.0000000000000316.
50. Gestels T., Hauser B., Van de Vijver E. Complications of Gastrostomy and Gastrojejunostomy: The Prevalence in Children. Pediatr Gastroenterol Hepatol Nutr. 2023;26(3):156–164. DOI: 10.5223/pghn.2023.26.3.156.
51. Yi D.Y. Enteral Nutrition in Pediatric Patients. Pediatr Gastroenterol Hepatol Nutr. 2018;21(1):12–19. DOI: 10.5223/pghn.2018.21.1.12.
52. Cyrany J., Rejchrt S., Kopacova M. et al. Buried bumper syndrome: A complication of percutaneous endoscopic gastrostomy. World J Gastroenterol. 2016;22(2):618–27. DOI: 10.3748/wjg.v22.i2.618.
53. Рыжов Е.А., Ерпулева Ю.В., Корсунский А.А. и др. Опыт гастростомии у детей в критических состояниях. Российский вестник детской хирургии, анестезиологии и реаниматологии. 2014;4(3):21–26. DOI: 10.17816/psaic54. EDN: SWMGPV.
54. Марковская И.Н., Лисица И.А., Кузнецова Ю.В. и др. Динамика развития микробиома ребенка, длительно госпитализированного в отделении интенсивной терапии. Клинический случай. Children's Medicine of the North-West. 2024;12(1):123–135. DOI: 10.56871/CmN-W.2024.50.20.013.
55. Кузнецова Ю.В., Завьялова А.Н., Лисовский О.В. и др. Особенности микробного пейзажа желудка у детей, питающихся через гастростому или назогастральный зонд. Педиатр. 2023;14(2):17–27. DOI: 10.17816/PED14217-27. EDN: JOAVNM.
56. Suzuki H., Joshita S., Nagaya T. et al. Relationship of early acute complications and insertion site in push method percutaneous endoscopic gastrostomy. Sci Rep. 2020;10(1):20551. DOI: 10.1038/s41598-020-77553-6.
57. Wiernicka A., Matuszczyk M., Szlagatys-Sidorkiewicz A. et al. The protocol for a randomised-controlled trial of the evaluation of the tolerance and safety of early enteral nutrition in children after percutaneous endoscopic gastrostomy placement. (protocol version 09.01.2015). BMC Pediatr. 2016;16(1):163. DOI: 10.1186/s12887-016-0705-8.
58. Dunitz-Scheer M., Scheer P.J. Tube Management and Maintenance. In: Child-led Tube-management and Tube-weaning. 2022. Springer, Cham. DOI: 10.1007/978-3-031-09090-5_11.
59. Almirall J., Cabré M., Clavé P. Complications of oropharyngeal dysphagia: aspiration pneumonia. Nestle Nutr Inst Workshop Ser. 2012;72:67–76. DOI: 10.1159/000339989.
60. Mohapatra B., CCC-S.L.P., Mohan R. et al. Speech-Language Pathologists' Role in the Multi-Disciplinary Management and Rehabilitation of Patients with Covid-19. J Rehabil Med Clin Commun. 2020;3:1000037. DOI: 10.2340/20030711-1000037.