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POSSIBILITY OF ENTERAL TUBE FEEDING IN SEVERE SURGICAL PATHOLOGY

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ВОЗМОЖНОСТЬ ПРИМЕНЕНИЯ ЭНТЕРАЛЬНОГО ЗОНДОВОГО ПИТАНИЯ ПРИ ТЯЖЕЛОЙ ХИРУРГИЧЕСКОЙ ПАТОЛОГИИ

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Objective. To study the possibility of using new GASTROAXILIUM mixtures in complex therapy of patients with severe surgical abdominal pathology.
Materials and methods. The study of characteristics of the developed mixtures was carried out by standard and non-standard methods in an accredited laboratory. Clinical studies were conducted in accordance with the Procedure for conducting studies of the effectiveness of specialized dietary therapeutic and dietary preventive food products. Statistical processing was carried out using analysis of variance.
Results. GASTROAXILIUM, specialized food product for tube feeding developed by the specialists of the Research and Production Center for Healthy Nutrition Technologies of Saratov State Medical University named after V.I. Razumovsky, differs from foreign ones in its technological solutions. In the main group a statistically significant reduction in the duration of postoperative intestinal paresis was noted, both in planned and emergency surgeries**,** in contrast to the comparison group.
Conclusions. We consider that the results of the use of daily nutritional complex of oligomeric dry mixtures for enteral nutrition GASTROAXILIUM are in agreement with the literature data, they will successfully complement the scientific data on the necessity for nutritional support and will play an important role in improving the quality of treatment of patients with severe postoperative abdominal pathologies.
Keywords. Possibilities of enteral tube feeding, enteral nutrition mixtures, effectiveness of nutritional support, surgical patient, severe surgical pathology.

Цель. Исследование возможности применения новых смесей GASTROAXILIUM в комплексной терапии пациентов с абдоминальной патологией.
Материал и методы. Исследование характеристик разработанных смесей проводили стандартными и нестандартными методами в аккредитованной лаборатории, клинические исследования – в соответствии с «Порядком проведения исследований эффективности специализированной диетической лечебной и диетической профилактической пищевой продукции». Статистическая обработка проводилась с применением дисперсионного анализа.
Результаты. Разработанный специалистами Научно-производственного центра технологий здорового питания Саратовского ГМУ им. В.И. Разумовского специализированный пищевой продукт для зондового питания GASTROAXILIUM имеет отличные от зарубежных технологические решения. В основной группе, в отличие от группы сравнения, отмечено статистически значимое сокращение срока послеоперационного пареза кишечника как при плановых, так и при экстренных операциях.
Выводы. Считаем, что результаты применения суточного нутриционного комплекса олигомерных сухих смесей энтерального питания GASTROAXILIUM у пациентов с хирургическими патологиями находятся в согласии с литературными данными, успешно дополняют научные данные о необходимости нутриционной поддержки и будут играть важную роль в повышении качества лечения тяжелой абдоминальной патологии.
Ключевые слова. Энтеральное зондовое питание, смеси для энтерального питания, эффективность нутриционной поддержки, хирургический пациент, тяжелая хирургическая патология.

INTRODUCTION

In modern conditions of development of surgery, anesthesiology and resuscitation, the question of choosing a method for correcting metabolic disorders in surgery remains open. Initial nutritional disorders in patients who have undergone traumatic surgical interventions inevitably lead to significant metabolic and functional changes already in the perioperative period with the formation of hypermetabolism-hypercatabolism syndrome, characterized by changes in the energy consumption system, protein breakdown, activation of lipid peroxidation, excessive accumulation of free fatty acids, and decreased glucose tolerance. An important role in solving this issue is given to perioperative nutritional support [1–3].

During both major traumatic and minimally invasive surgeries, patients are exposed to surgical stress [4]. Surgical stress is the main cause of perioperative dysfunction of various organs and systems. Surgical stress is a major cause of perioperative dysfunction of various organs and systems.

A number of publications indicate that, depending on the type of pathology, protein-energy deficiency develops in 20–50 % of surgical patients directly in the hospital in the early postoperative period [5]. A relationship has been reliably established between the severity of protein-energy malnutrition and the frequency of adverse outcomes in critically ill patients undergoing surgery [6].

One of the main criteria of the modern concept of the "Enhanced Recovery After Surgery" (ERAS) is the assessment of the patient's nutritional status and the provision of nutritional support throughout the entire perioperative period. The ESPEN Nutritional Risk Scale (NRS) is used as a screening tool for malnutrition [7]. Complex and traumatic operations place special demands on perioperative patient care. The outcomes of highly traumatic surgeries depend on many factors, which are reflected in the concept of early recovery after surgery (ERAS) (Enhanced Recovery After Surgery) [8] and include a number of factors, including: preoperative preparation of the patient, anesthesia, pre- and postoperative nutritional support [9]. The outcomes of highly traumatic surgeries depend on many factors, which are reflected in the concept of early recovery after surgery (ERAS) (Enhanced Recovery After Surgery) [8] and include a number of factors, including: preoperative preparation of the patient, anesthesia, pre- and postoperative nutritional support [9].

In order for the time required to restore the body's homeostasis after surgical injury and for wound healing to be optimal, the body must receive a sufficient amount of energy and nutrients [10]. However, the body's own energy and plastic resources may be insufficient due to the traumatic nature of the surgical intervention or a pre-existing protein-energy deficiency.

Saratov State Medical University named after V.I. Razumovsky has its own developments of enteral mixtures based on domestic raw materials, unique in technology, different from Western production, without the use of separate (isolated) components, more physiological and economically feasible. Technologies of oligomeric enteral mixtures

for nutritional support of patients with abdominal pathology have been developed.

In connection with the above, the aim of the study is to analyze the possibility of using new GASTROAXILIUM mixtures in the complex therapy of patients hospitalized with abdominal pathology who are on tube feeding.

MATERIALS AND METHODS

During the conduct of this study, interstructural interaction was carried out within the Federal State Budgetary Educational Institution of Higher Education Saratov State Medical University named after V.I. Razumovsky of the Ministry of Health of the Russian Federation between the Department of Faculty Surgery and Oncology, which conducted clinical studies, and the Scientific and Production Center for Healthy Nutrition Technologies (SPC HNT) – the developer and manufacturer of GASTROAXILIUM mixtures in accordance with the unique technology.

The study of the characteristics (content of proteins, fats, carbohydrates) of the daily nutritional complex of oligomeric dry enteral nutrition mixtures GASTROAXILIUM was carried out by generally accepted methods in the accredited Testing Laboratory of Food Products and Food Raw Materials of the ETI (branch) of the Saratov State Technical University named after Yu.A. Gagarin. Osmolality was determined on a cryoscopic osmometer model 3250, Osmol (made in the USA), acidity – on a portable pH meter (made in China) based on the laboratories of the Saratov State Medical University named after V.I. Razumovsky.

Clinical studies of the effectiveness of enteral nutrition GASTROAUXILIUM were conducted in accordance with the "Procedure for conducting studies of the effectiveness of specialized dietary therapeutic and dietary preventive food products" developed by the Federal Research Center for Nutrition, Biotechnology and Food Safety (methodological guidelines, Ministry of Health, Moscow, 2016).

The study was approved by the decision of the local ethics committee of the Federal State Budgetary Educational Institution of Higher Education Saratov State Medical University named after V.I. Razumovsky (recommendations of the ethics committee of the Federal State Budgetary Educational Institution of Higher Education Saratov State Medical University named after V.I. Razumovsky of the Ministry of Health of the Russian Federation dated 06.07.2023 (protocol version 1.0) with an amendment to the new name of enteral nutrition mixtures GASTROAXILIUM dated 28.06.2024 (protocol version 2.0)).

The study included 80 patients hospitalized with severe surgical or oncological pathology who were on tube feeding. The patients were randomly divided into two groups: the main group of 46 people (matched by age and gender, receiving a specialized product for tube feeding GASTROAXILIUM, developed by the Scientific and Practical Center of TZP) and a comparison group of 34 people (matched by age and gender and receiving a standard (available at the clinic) product for tube feeding (similar to the product in group 1) with a standard con-

tent of essential substances based on the total daily intake of 30–35 kcal / kg / day and 1.2–1.5 g of protein / kg of body weight / day according to recommendations for nutritional support of patients).

For inclusion in the study, patients were selected according to the inclusion criteria, with their consent to participate with a signed "Informed voluntary consent to participate in a clinical study", who were indicated for surgical treatment for the main disease. It should also be noted that patients without concomitant diseases were selected. The identification number was assigned according to the patient's medical history number (Tables 1 and 2).

Table 1

Underlying disease and degree of nutritional status impairment (main group)

ID	Prior Disease	General Health Status	Violation of Nutritional Status
3467	Gastric cancer	Moderate	Moderate
3643	Gastric cancer	Moderate	Moderate
3801	Gastric cancer	Moderate	Moderate
3759	Acute adhesive intestinal obstruction	Moderate	Mild
3965	Acute adhesive intestinal obstruction	Moderate	Moderate
4029	Strangulated inguinal hernia	Moderate	Moderate
4206	Acute cholecystitis, peritonitis	Bad	Moderate
4369	Incarcerated femoral hernia	Moderate	Mild
4257	Gastric cancer	Moderate	Moderate
4318	Gastric cancer	Moderate	Moderate
4522	Acute adhesive intestinal obstruction	Moderate	Mild
4375	Duodenal ulcer complicated by bleeding	Moderate	Mild
4535	Perforated duodenal ulcer	Moderate	Mild
4629	Duodenal ulcer complicated by bleeding	Moderate	Mild
4775	Acute adhesive intestinal obstruction	Moderate	Moderate
4688	Biliary fistula	Moderate	Mild
4450	Gastric cancer	Moderate	Mild
4397	UC, intestinal bleeding	Moderate	Mild
4912	Penetrating stab wound to the abdomen	Moderate	Negative
4879	Acute adhesive intestinal obstruction	Moderate	Mild
4885	Dumping syndrome, anastomosis	Relatively satisfactory	Mild
4919	Acute appendicitis. Peritonitis	Moderate	Moderate
5136	Duodenal ulcer complicated by bleeding	Moderate	Moderate
5148	Chest and abdominal wounds. Bowel injury. Peritonitis	Moderate	Mild
4785	Acute pancreatitis. Pancreatic necrosis	Moderate	Moderate
4955	Chronic pancreatitis. Pancreatic cyst.	Moderate	Mild
5347	Pancreatic cancer. Jaundice	Moderate	Moderate
5268	Metastasis of ovarian cancer to the small intestine. Acute intestinal obstruction	Moderate	Severe

End of Table 1

ID	Prior Disease	General Condition Status	Violation of Nutritional Status
5592	Duodenal ulcer complicated by bleeding	Moderate	Moderate
5501	Duodenal ulcer complicated by bleeding	Moderate	Mild
5847	Pancreatic cancer. Jaundice	Moderate	Moderate
5833	Duodenal ulcer. Gastric stenosis. Adhesions	Moderate	Mild
5839	Duodenal ulcer complicated by bleeding	Moderate	Moderate
6126	Cancer of the cecum. Carcinomatosis	Moderate	Severe
5724	Stomach ulcer	Moderate	Moderate
5616	Duodenal ulcer complicated by bleeding	Moderate	Severe
5947	Perforation of the sigmoid with a fishbone	Moderate	Mild
6228	Sigmoid cancer. Acute intestinal obstruction.	Moderate	Moderate
6235	Pancreatic cancer. Jaundice	Moderate	Moderate
6574	Gastric ulcer complicated by bleeding	Moderate	Moderate
5042	Ischemic heart disease. Acute cerebrovascular accident. Gastric ulcer. Gastrointestinal tract disease.	Тяжелое	Moderate
6348	Acute adhesive intestinal obstruction	Moderate	Moderate
6489	Gallstone disease. Pancreatic cyst. Jaundice.	Moderate	Moderate
6387	Gastric cancer T2N0M0	Moderate	Moderate
6413	Gastric cancer T2N0M0	Moderate	Moderate
6745	Gastric cancer T4N3M1, stenosis.	Severe	Severe

Table 2

Primary disease and degree of nutritional status impairment (comparison groups)

ID	Prior Disease	General Condition Status	Violation of Nutritional Status
3472	Acute pancreatitis. Peritonitis.	Severe	Severe
3711	Gallstone disease. Acute pancreatitis. Peritonitis.	Moderate	Mild
4033	Appendicular abscess. Peritonitis.	Moderate	Moderate
4042	Diverticulitis of the sigmoid colon. Peritonitis.	Moderate	Moderate
4375	Acute pancreatitis. Peritonitis. Abdominal phlegmon.	Severe	Moderate
4412	Acute appendicitis. Peritonitis	Moderate	Mild
4189	Thrombosis of mesenteric vessels.	Severe	Moderate
4203	Acute adhesive intestinal obstruction	Moderate	Moderate
4817	Acute intestinal obstruction.	Moderate	Mild
4214	Stomach cancer	Moderate	Moderate
4826	Liver cirrhosis. AO. Primary peritonitis.	Moderate	Moderate
4925	Gallstone disease. Acute cholecystitis.	Moderate	Mild
4822	Cancer of the cecum T3N0M0. Peritonitis.	Moderate	Moderate

End of Table 2

ID	Prior Disease	General Condition Status	Violation of Nutritional Status
5167	Gastric ulcer. Completed gastrointestinal tract infection. Phytobezoar.	Moderate	Moderate
5394	Rectal cancer T4NxM1 mts in liver. Acute intestinal obstruction.	Severe	Severe
5430	Gastric cancer T4N3M1, carcinomatosis. Acute intestinal obstruction.	Severe	Moderate
5412	Adhesive intestinal obstruction	Moderate	Moderate
5436	Transverse colon cancer T3N0M0. Acute intestinal obstruction.	Moderate	Mild
5414	Gastric ulcer complicated by bleeding.	Moderate	Moderate
5516	Perforated duodenal ulcer. Peritonitis.	Moderate	Moderate
5732	Sigmoid cancer T3N0M0. Peritonitis.	Moderate	Moderate
5625	Pancreatic cancer T3N0M0. Jaundice. Diabetes mellitus.	Severe	Mild
5862	Sigmoid colon cancer. Acute intestinal obstruction.	Moderate	Moderate
5798	Pancreatic cancer T4N2M0. Jaundice.	Moderate	Mild
6134	Sigmoid cancer T3N0M0. Acute intestinal obstruction.	Moderate	Moderate
5842	Acute adhesive intestinal obstruction	Moderate	Moderate
6315	Perforated duodenal ulcer. Peritonitis.	Moderate	Moderate
6324	Cancer of the sigmoid colon. T3N0M0. Acute intestinal obstruction.	Moderate	Moderate
6350	Small bowel lymphoma	Moderate	Mild
6361	Gastric ulcer. Stenosis.	Moderate	Moderate
6392	Perforated ulcer of the duodenum. Peritonitis. AO.	Moderate	Mild
6404	Retroperitoneal sarcoma.	Moderate	Moderate
6618	Pancreatic tumor. Jaundice	Moderate	Mild
6623	Retroperitoneal sarcoma.	Moderate	Mild

The daily nutritional complex of oligomeric dry enteral nutrition mixtures GASTROAUXILIUM was introduced into the duodenum or the initial sections of the small intestine using a nasogastrointestinal tube installed intraoperatively. For the main group of patients, a manual method of active portioned (bolus) administration of the nutritional mixture was used. It is administered in portions using a Janet syringe. In this case, a single volume for the stomach and small intestine should not exceed 200 ml after 3–4 hours, administered slowly over 5–10 minutes. The nutritional mixture "Fresubin" (FresiniusKabi) was administered using a dropper at a rate of 5–10 ml/min through the perfusion channel of the probe.

The daily nutritional complex of oligomeric dry enteral nutrition mixtures

GASTROAXILIUM has been developed based on the principle of physiological perception of nutrition by the human body with adequate distribution of the caloric content of the daily diet by feeding, which allows for labile control of metabolic stress.

The technology of the nutritional complex of oligomeric dry enteral nutrition mixtures GASTROAXILIUM is based on the use of natural dietary hypoallergenic domestic raw materials, combined in accordance with the rules of food combinatorics and technology of preparing dishes for dietary therapeutic nutrition, converted into a semi-elemental state using enzyme technologies with subsequent dehydration. The characteristics of the daily nutritional complex of oligomeric dry enteral nutrition mixtures GASTROAXILIUM, developed by the Scientific and Production Center of TZP, are presented in Table 3.

Comparative characteristics of the daily nutritional complex of oligomeric dry enteral nutrition mixtures GASTROAXILIUM, developed by the Scientific and Production Center of TZP, and the mixture "Fresubin" are presented in Table 4.

Table 3

Characteristics of daily nutritional complex of oligomeric dry enteral nutrition mixtures GASTROAXILIUM

Daily Nutritional Complex of Oligomeric Dry Enteral Nutrition Mixtures GASTROAXILIUM					Osmolality, mOsm/kg H2O	pH
Nutrition Frequency	Nutritional and Energy Value GASTROAXILIUM					
	Proteins, g	Fats, g	Hydrocarbons, r	Energie, kcal		
Morning feeding (breakfast)	7.3	3.7	25.8	165.5	494	4
Lunch feeding (dinner)	23.7	2.9	10.3	161.5	438	4
Afternoon feeding (afternoon snack)	7.1	7.5	26.2	164.9	362	3.8
Evening feeding (dinner)	19.8	2.64	14.3	160.3	432	4
Total	57.9	16.7	76.6	652.2	Average 431.5	4

Note: each portion of the feeding mixture is diluted with 150 ml of water at 40–42 °C, 4-time feeding provides 1 ml/1.1 kcal (9.7 g protein/ 108.7 kcal / 100 ml). Depending on the patient's condition, weight and if 4-time use of the PI is insufficient to replenish the nutritional needs, the patient will receive an additional feeding.

Table 4

Comparative characteristics of daily nutritional complex of oligomeric dry enteral nutrition mixtures GASTROAXILIUM, developed by scientific and production center of tzp, and mixture “Fresubin” (FresiniusKabi)

Mixture Name	Nutritional and Energy Value				Osmolality, mOsm/kg H2O	pH
	Proteins, g	Fats, g	Hydrocarbons, r	Energie, kcal		
GASTROAXILIUM	57.9	16.7	76.6	652.2	431.5	4
“Fresubin”	50	16	64.5	610	740	6.7

The nutritional complex of oligomeric dry enteral nutrition mixtures GASTRO-AXILIUM has a microbiome-forming effect due to its high antioxidant activity, anti-inflammatory and anti-cancer effects due to the presence of natural polyphenols, anthocyanins, ascorbic acid, and vitamins of group P. The food raw materials used in the production of enteral nutrition are hypoallergenic, dietary, have a low glycemic index, and are gluten-free. To collect data and implement communications during the study, a patient observation scheme was used, including: screening conducted on the day of the patient's hospitalization, namely: identification of the degree of malnutrition Nutritional Risk Screening 2002 (NRS 2002) [9], assessment of the general condition of the patient, laboratory monitoring (complete blood count, BH blood test), collection of complaints and anamnesis, and objective examination.

All actions with the research base were recorded on paper and electronic media. Primary and secondary analysis are presented by descriptive statistics. All continuous variables were summarized using the following parameters: *n* (sample range of available patients), mean, standard deviation, median, 25th and 75th percentiles, or maximum and minimum. Critical *p*-values and confidence intervals were calculated as two-sided. The study adopted a statistical significance level of 0.05. Continuous variables were described using mean, standard deviation, 95 % confidence intervals, median, upper and lower quartiles. Primary and secondary endpoint analyses were performed on the full data set.

RESULTS AND THEIR INTERPRETATION

All patients had nutritional status disorders to varying degrees (Table 5).

Table 5

Degree of nutritional status impairment in groups in comparison

Degree of Nutritional Status Impairment	Group	
	Basic	Comparison
Negative	1	–
Mild	16	10
Middle	25	22
Severe	4	2

The data in Table 5 show that the degree of nutritional status impairment in patients in all groups is identical. In the main group, there are more patients with mild and severe nutritional status impairment, in contrast to the comparison group, where there are more patients with moderate impairment. Nevertheless, the highest percentage of patients is with moderate impairment of nutritional status.

From the data in Table 6 it is evident that in 46 patients receiving the GASTROAUXILIUM complex of oligomeric dry enteral nutrition mixtures as nutritional support. The average duration of paresis was 3.4 days, while in 34 patients receiving Fresubin as nutritional support, the average duration of paresis was 4.5 days. At the end of the observations, a comparison was made of the mean values (median and quartiles) of the duration of intestinal paresis resolution by the number of days in the main group and in the comparison group (Table 7): in the comparison group, the duration of paresis

Table 6

Summary data on effectiveness of paresis resolution in groups

Pathology	PI Support		Support with Fresubin Drug	
	Number of Observations, abs.	Paresis Resolution Period, Days.	Number of Observations, abs.	Paresis Resolution Period, Days.
Diseases of Stomach (Tumor, Perforation-damage to the Wall)				
Gastrectomy	4	3.2	1	4
Gastric Resection	14	3.2	3	4
Gastroenteroanastomosis	1	3		
Suturing of the stomach wall and duodenum	3	3	3	4
Acute Surgical Pathology				
Peritonitis	7	3.5	9	6.1
Acute intestinal obstruction	9	3.8	10	4.7
Pancreatic tumor	3	3.6	3	4.3
Strangulated hernia	2	3		
Other diseases of the gastrointestinal tract	3	4.3	5	4.5
TOTAL	46	3.4	34	4.5

Table 7

Duration of intestinal paresis resolution in groups

Group	Number of Patients	Duration of Intestinal Paresis
Basic	46	3 [3; 4]*
Comparison	34	5 [4; 5]

Note: * – differences with the comparison group are significant at $p < 0.05$.

resolution was, on average, 2 days longer than in the study group.

The significance of differences between groups in the duration of paresis resolution was confirmed using the nonparametric Kolmogorov – Smirnov test ($Z = 2.21$; $p < 0.001$). Moreover, regardless of the type of disease, the duration of paresis resolution (Figure) was shorter in the main group. In patients with peritonitis, duodenal ulcer and gastric cancer, resolution of paresis occurred on the 3rd day, only in patients with acute intestinal obstruction the duration of resolution of paresis in the study group was one day longer.

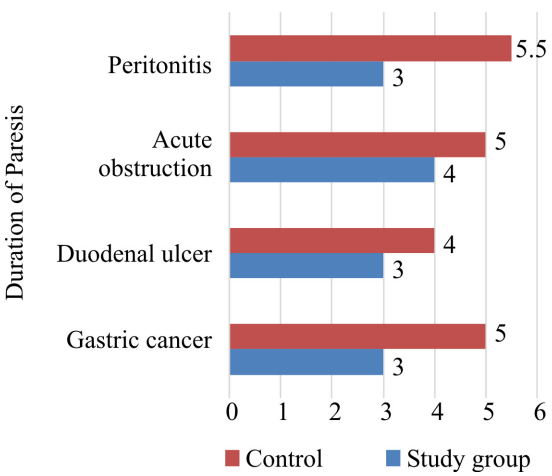

Fig. Duration of paresis resolution depending on disease

Table 8

Results of study of local complications

Group	Number of Patients	Feces Features	
		Soft decorated	Liquid
Basic	46	43	3
Comparison	34	6	28

Table 9

Results of study of common complications

Group	Number of Patients	General Complication	
		Diarrhea	Pain in Stomach
Basic	46	–	6
Group	34	18	7

The duration of paresis resolution in the comparison group was longer in all cases, and the longest in patients with peritonitis.

It should be noted that peritonitis developed as a postoperative complication in the main group in 3 cases out of 46 (6.5 %), and in the comparison group – in 7 cases out of 34 (20.6 %). Thus, the proportion of postoperative complications in the comparison group was 14.1 % higher than in the main group. When comparing the two groups by the peritonitis criterion using the chi-square test, there were no significant differences between the groups at $p < 0.05$ (the χ^2 value = 3.537).

As a local complication (Table 8), liquid stool was observed in 3 out of 46 patients (6.5 %) in the study group and in 28 out of 34 patients in the comparison group (82.4 %).

Comparison of two groups according to the "stool type" criterion using the chi-square test allowed us to identify reliable differences between the groups at $p < 0.001$ (χ^2 value = 47.366).

As a general complication (Table 9), diarrhea was not observed in patients of the main group, but in patients of the comparison group, diarrhea was a frequent occurrence – in 18 cases out of 34 (52.9 %). Abdominal pain was present in some cases both in the main (13 %) and in the comparison group (20.5 %).

Comparison of two groups on the criterion of diarrhea using the chi-square test allowed us to identify reliable differences between the groups at $p < 0.001$ (χ^2value = = 31.423).

The presence of diarrhea indicates poor absorption of nutrients in enteral nutrition. In the main group, diarrhea was not observed, which is a sign of good absorption of the mixture in the intestinal lumen. Diarrhea was noted in more than half of the cases in the comparison group. Diarrhea develops when unabsorbed water-soluble substances accumulate in the intestine, which attract water along the osmotic gradient. Osmotic diarrhea occurs when certain substances that cannot be absorbed through the wall of the colon remain in the intestine. These substances lead to the fact that an excess amount of water remains in the feces, causing diarrhea.

Abdominal pain was more common in the comparison group than in the main group. When comparing the groups by the criterion of "abdominal pain" using the chi-square test, there were no significant differences at $p < 0.05$ (the value of $\chi^2 = 0.277$).

Table 10

Results of study on probe removal in groups

Group	Number of Patients	Probe Removal, days
Basic	45	4 [3; 4]
Comparison	32	5 [4; 6]

When comparing the mean values (median and quartiles) of the time of tube removal (Table 10) in both groups, it was noted that the tube was removed in the main group on average one day earlier than in the comparison group.

The significance of differences between groups in probe removal time was confirmed using nonparametric Kolmogorov – Smirnov criterion ($Z = 2.204293659$; $p < 0.001$).

Further in Table 11 the indicators of general and biochemical blood analysis in patients of two groups before and after surgical treatment are presented.

In the comparison group, after surgery, there was a significant decrease in the number of leukocytes ($p < 0.05$), an increase in the level of total protein and albumin ($p1 < 0.05$ and $p2 < 0.001$, respectively), and a decrease in the level of ALT and AST ($p1 < 0.001$ and $p2 < 0.05$, respectively).

In the main group after the operation, there was a significant increase in hemoglobin ($p < 0.01$), a decrease in the number of leukocytes ($p < 0.01$), a decrease in the level of urea and creatinine ($p < 0.01$), an increase in the level of total protein and albumin ($p < 0.01$), a decrease in the level

Table 11

Results of general and biochemical blood tests in patients of main group and comparison group

Value	Comparison Group		Study Group	
	Preoperatively: *Me* [25 %; 75 %]	Postoperatively: *Me* [25 %; 75 %]	Preoperatively: *Me* [25 %; 75 %]	Postoperatively: *Me* [25 %; 75 %]
Hemoglobin	133[127.75; 137.25]	130[124.75; 135.25]	125 [104.25; 135]	131[129; 135.25]**
Erythrocyte	3.85[3.6; 4.2]	3.75[3.5; 4.2]	3.8[3.45; 4.23]	3.8[3.7; 4.2]
Leukocytes	11.4[9.98; 13.13]	7.25[6.6; 8.35]*	12.45[11; 14.6]	7.3[6.75; 7.8]**
Thrombocytes	229.5[194.5; 267.8]	202.5[196.2; 251.3]	232[199; 304.8]	227[210; 250.3]
Urea	7.15[6.38; 7.55]	7.8[6.85; 8.65]	9.45[9; 11.3]	7.1[6.38; 8]
Creatinine	107[89.75; 121.25]	99.5[88.75; 114]	126[120; 138.5]	99[87; 105]
Total protein	58[55.75; 61]	64[62; 65.25]*	54[49.75; 57]	75[69.75; 78]
Albumin	29[28; 31]	35[34; 37]*	29[26; 32]	48.5[46; 50]
ALT	50[43; 62]	43[34.75; 45]*	58.5[49; 89]	42.5[39; 44]
AST	49[42.5; 61.25]	44.5[41.25; 49]*	62 [53; 87.75]	46.5[44; 48.25]
Bilirubin	15.6[13.78; 17.83]	15.5[14.75; 16.55]	18.3[15.8; 20.28]	14.9[14.3; 15.73]
Glucose	5[4.5; 5.73]	5.1[4.6; 5.5]	5.3[4.8; 5.6]	4.9[4.4; 5.23]

Note: * – differences with the comparison group before surgery are significant at $p < 0.05$.

of ALT and AST 9 ($p < 0.01$), a decrease in the level of bilirubin and glucose ($p < 0.01$).

When comparing the biochemical blood test parameters after surgery, the main group showed a lower urea level ($p < 0.05$), a more pronounced increase in the level of total protein and albumin after the therapy ($p < 0.01$), compared with the corresponding data of the comparison group. No reliable differences were found between the patient groups for other parameters of the general and biochemical blood test after surgery.

The decrease in the urea level in the main group indicates favorable processes of deamination reactions of amino acids supplied with the patient's diet, in contrast to the comparison group, where the urea level does not decrease, but, on the contrary, increases slightly.

The increase in the amount of protein and albumin in the blood of patients in the main group indicates a significantly more successful elimination of protein-energy deficiency than in the comparison group, where an insignificant increase was statistically confirmed.

In our study, virtually all patients had some degree of nutritional status impairment. Only one patient out of 80 had no nutritional status impairment.

Early initiation of enteral nutrition is recommended [13]. The standard polysubstrate isocaloric enteral diet is the basis for initiating enteral nutrition.

Over the last three decades, our country has widely used foreign-made enteral formulas, the nutrient composition of which is known and is used depending on the state of the body. There are 17 global companies producing enteral nutrition, and it is known that modern enteral formulas are produced by mixing individual nutrients obtained on high-tech equipment, assembling, like a food designer, according to a given nutritional value. However, the raw material base and technologies used by foreign manufacturers in the manufacture of such formulas are in top-secret mode. In the conditions of uncertainty, sanctions and the current geopolitical crisis, our country is in dire need of its own enteral nutrition technologies.

The specialized food product for tube feeding GASTROAUXILIUM, developed by specialists of the Scientific and Production Center for Healthy Nutrition Technologies of the Saratov State Medical University named after V.I. Razumovsky, has technological solutions that are different from foreign ones, based not on the principles of high-tech production and the isolation of individual nutrients from the food raw material base, but on the principles of food combinatorics of natural domestic food products, enzyme technologies and IR dehydration processes. Such technological solutions are import-independent, economically feasible and physiologically justified.

Enteral food product for tube feeding GASTROAUXILIUM, intended for severe postoperative patients with abdominal pathologies, is a complete means of enteral nutrition with an innovative technological component, possessing a native microbiome-forming nutrient composition, a complete isocaloric formula. It differs from well-known enteral mixtures – food constructors of isolated nutrients – by its completely natural composition of food raw

materials with a preserved bioactive profile, combined according to the rules of dietary nutrition with minimal technological impact on the product (without ultra-processing), without the addition of food additives: stabilizers, preservatives.

The present study of the effectiveness of enteral mixtures for tube feeding GASTROAUXILIUM in comparison with the standard Fresubin was conducted during a 28-week randomized controlled trial. During the study of enteral mixtures for tube feeding GASTROAUXILIUM, we obtained convincing data on the effectiveness and safety of the studied product.

In our opinion, the most important endpoints are the following: in the main group, compared with the comparison group, the duration of paresis resolution was, on average, statistically significantly 2 days shorter.

As a local complication, diarrhea was observed in 3 patients out of 46 (6.5 %) in the main group, in 28 patients out of 34 (82.4 %) in the comparison group. As a general complication, diarrhea was not observed in patients in the main group, in patients in the comparison group, diarrhea was a frequent occurrence and was observed in 18 cases out of 34 (52.9 %).

When comparing the mean values (median and quartiles) of the time of probe removal in both groups, it was noted that the probe was removed in the main group on average one day earlier than in the comparison group. These data obtained a statistically significant result.

Changes in blood parameters (urea, total protein, albumin) were statistically significant, which proves the successful elimination of protein-energy deficiency in patients of the main group, in contrast to the comparison group.

Conclusions

We believe that the results of the study of the daily nutritional complex of oligomeric dry enteral nutrition mixtures GASTROAXILIUM are in agreement with the literature data, successfully complement the scientific data on the need for nutritional support and will play an important role in improving the quality of treatment of severe postoperative patients with abdominal pathologies.

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