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Nutritional support for patients in general surgery

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The modern stage of development of surgery, especially minimal invasive technologies, has significantly changed the surgeons' thoughts about the perioperative period. Until the end of the twentieth century, pre- and postoperative fasting was the most important requirement in planned surgery. It was believed that it could help to avoid complications both during surgery and in the early postoperative period. H. Kehlet in his fundamental work outlined the factors that allowed to accelerate the patient's recovery after surgery, namely: the absence of preoperative fasting.

Objective — to evaluate the effectiveness of nutritional support for surgical patients within ERAS (Enhanced Recovery After Surgery) and ESPEN (European Society for Clinical Nutrition and Metabolism) protocols.

Materials and methods. This research included both traditional laparoscopic cholecystectomy (177 cases) and single-port transumbilical cholecystectomy (8); among laparoscopic bariatric interventions, the major part was represented by classical Roux-Y gastric shunting (28), as well as sleeve gastrectomy (5) and mini-gastric shunting (4); among 123 different laparoscopic hernioplasties, in 64 cases transabdominal preperitoneal (TAPP) was performed for bubonocele, intraperitoneal onlay mesh (IPOM) for postoperative ventral and umbilical hernias (59), laparoscopic crurography and fundoplication with and without alloplasty (33). For each type of surgery two groups we identified: control and experimental. Both groups were followed by ERAS protocols in addition to nutritional support. With the prior consent of patients before surgery: the experimental group received full perioperative nutritional support according to our local protocols using protein-enriched sip feeding formula Nutridrink Protein, the control group followed the traditional scheme of fasting during 12 hours before surgery and received regular drinking water instead of protein mixtures at the first postoperative day.

Results. We found statistically significant difference between control and experimental groups in assessing of two important parameters as hunger and weakness. The hunger after laparoscopic cholecystectomy was 1.5 times ($p < 0.001$), after laparoscopic hernia repair — 1.7 times ($p < 0.001$), after laparoscopic crurography and fundoplication — 1.26 times ($p < 0.001$), after laparoscopic bariatric intervention — 1.43 times, and after laparoscopic colon intervention — 1.9 times lower in the experimental group. The weakness after laparoscopic cholecystectomy was 1.8 times ($p < 0.001$), after laparoscopic hernia repair — 1.31 times ($p < 0.001$), after laparoscopic crurography and fundoplication — 1.68 times ($p < 0.001$), after laparoscopic bariatric intervention — 1.67 times ($p < 0.001$), and after laparoscopic colon intervention — 1.38 times ($p = 0.006$) stronger in the control group.

Conclusions. Traditional long-term preoperative fasting is inappropriate. Combined with other ERAS postulates, perioperative nutritional support for surgical patients has a great chance of success. In our research, early restoration of oral nutrition significantly decreases hunger and general weakness in the early postoperative period, which allows the patient quickly return to full life.

Keywords
enhanced recovery after surgery, nutritional support.

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The modern stage of surgery development, especially minimal invasive technologies, has significantly changed the surgeons' thoughts about the perioperative period. Until the end of the twentieth century, pre- and postoperative fasting was the most important requirement in planned surgery. It was believed that fasting could help to avoid complications both during surgery and in the early postoperative period. Fasting before surgery was the main guarantee to prevent regurgitation of gastric contents to the respiratory tract [1]. Regarding complete fasting in the first days after surgery, there was a general opinion about the prevention of nausea and vomiting, decrease the load on the anastomoses' stitches of the gastrointestinal tract (GIT).

At the end of the twentieth century, research began to appear on the impact of surgical treatment on the postoperative period. H. Kehlet from Denmark is the first person who conducted a fundamental study of the effects of surgical stress on the body recovery and identified ways to significantly reduce the symptoms of surgical stress. In this fundamental work he outlined the following factors that enhanced the patient's recovery after surgery: no preoperative fasting, antibiotic prophylaxis with a daily dose up to 30 minutes before the surgery, use of regional anesthesia, minimal invasive surgery, local infiltration anesthesia before surgery, intraoperative normothermia, administration of glucocorticoids, minimal drainage use, urethral catheters and nasogastric tubes, early (first hours after surgery) postoperative activation of the patient, early oral nutrition, thromboprophylaxis, effective pain control, medical prevention of nausea/vomiting (using antiemetics), use of NSAIDs to reduce the symptoms of inflammatory reaction [2]. He defined these postulates as Fast track surgery [3]. Later, in 2001, the ERAS organization (Enhanced Recovery After Surgery) was founded according to postulates of H. Kehlet and nowadays it unites scientists and practitioners whose goal is to process the evidence bases and develop recommendations (protocols) based on them for implementation in surgical clinics [4].

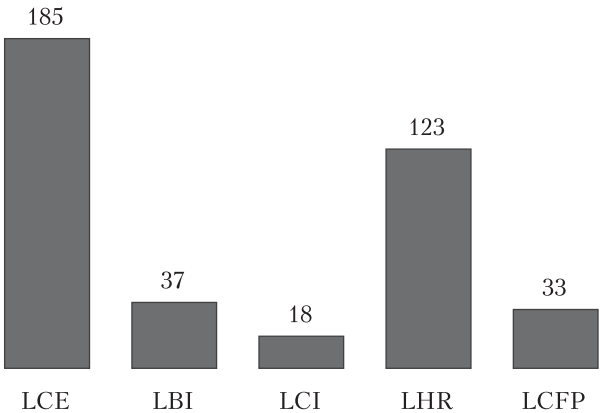
Why the perioperative nutritional support for surgical patients is so important component of ERAS? Surgery, as any intervention, causes SIRS (Systemic Inflammatory Response Syndrome), which accelerates the catabolism of glycogen, protein and fat. Free fatty acids and aminoacids enter the circulation to do protective and reparative functions instead of their main one — plastic (building) function [5]. The longer the catabolic phase lasts after surgery, the longer is the patient's recovery. Nutritional status is a risk factor for the development of postoperative complications. ESPEN (European Society for Clinical Nutrition and Metabolism) considers the main requirements of the perioperative period: integration of nutrition in the treatment of the patient at all stages; prevention of prolonged fasting state; continuation of oral nutrition as soon as possible after surgery; beginning of nutritional support before the onset of signs of nutritional deficiency; metabolic control (e.g. blood glucose control); reduction of factors that increase stress-related catabolism and reduce gastrointestinal function; minimization of time of action of paralytic medicines after artificial ventilation of lungs in the postoperative period; early mobilization to activate protein synthesis and restore muscle function [6].

Objective — to evaluate the effectiveness of nutritional support for surgical patients according to ERAS and ESPEN protocols

Materials and methods

We have performed 363 surgery operations according to ERAS protocols (Fig. 1) during period from September 2019 to December 2021.

This research included both traditional laparoscopic cholecystectomy (LCE) (177 cases) and single-port transumbilical cholecystectomy (8); among laparoscopic bariatric interventions (LBI), the major part was represented by classical Roux-Y gastric shunting (28), as well as sleeve gastrectomy (5) and mini-gastric shunting (4); among 123 different laparoscopic hernioplasties, in 64 cases transabdominal preperitoneal (TAPP) was performed for bubonocele, intraperitoneal onlay mesh (IPOM) for postoperative ventral and umbilical hernias (59), laparoscopic crurography and fundoplication (LCFP) with and without alloplasty (33). For each



LCE — laparoscopic cholecystectomy; LBI — laparoscopic bariatric intervention; LCI — laparoscopic colon intervention; LHR — laparoscopic hernia repair; LCFP — laparoscopic crurography and fundoplication

Figure 1. **Differentiation of surgery interventions according to ERAS protocols**

type of surgery two groups we identified: control and experimental. Both groups were followed by ERAS protocols in addition to nutritional support. With the prior consent of patients before surgery: the experimental group received full perioperative nutritional support according to our local protocols, the control group followed the traditional scheme of fasting during 12 hours before surgery and received water instead of protein mixtures at the first postoperative day.

The experimental group of LCE consists of 101 patients: 88 women (87.13 %), 13 men (12.87 %), the control group consists of 84 patients: 73 women (86.9 %), 11 men (13.1 %). The average age in the experimental group was 48.6 ± 11.5 years; in the control group it was 47.6 ± 10.98 years. Group structure for LBI represented 18 patients for control group: 16 women (88.9 %), 2 men (11.1 %), average age was 43.2 ± 7.7 years; 19 patients for experimental group: 16 women (84.21 %), 3 men (15.8 %), average age was 41.3 ± 8.4 years. The control group for laparoscopic colon intervention (LCI) consists of 9 patients: 4 women (44.44 %), 5 men (55.56 %), the average age was 62.4 ± 8.9 years; the experimental group consists of 9 patients: 5 (55.56 %) women, 4 (44.44 %) men, the average age was 63.4 ± 8.5 years. Laparoscopic hernia repair (LHR) groups were formed by control group of 59 patients: 34 women (57.62 %), 25 men (42.38 %); average age was 44.1 ± 8.7 years; experimental group with 64 patients: 38 women (59.37 %), 26 men (40.63 %), the average age was 41.7 ± 8.3 years. After LCFP control group consisted of 16 patients: 9 women (56.25 %), 7 men (43.75 %), average age was 44.6 ± 7.8 years; experimental group consisted of 17 patients: 10 women (58.82 %), 7 men (41.18 %), average age was 45.6 ± 6.9 years.

According to our local protocols based on ERAS recommendations, the time of fasting is minimal. No later than 2 hours before surgery (general anesthesia) patients consumed 200 ml of warm boiled water with 5 g of glucose or sweet black tea of the same volume. In the absence of stomach pathology, there is no threat of regurgitation, because in 2 hours this fluid completely eliminates from the stomach. Carbohydrate intake increases the anabolic effect in the early postoperative period: decrease of postoperative nitrogen and protein loss, and maintenance of postoperative body weight and muscle function, decrease the risk of insulin resistance in the early postoperative period, which is actually a protective response to fasting. In addition, decrease of the thirst and hunger feelings reduces the feeling of surgery fear, which affects the strength of the body's stress response to intervention [7—10].

We have already had experience of using special adapted mixtures to restore early oral nutrition since 2011 [11]. We outlined the main requirements for postoperative nutrition as low dosage, adequate amounts of calories, easy using by patient, absorption in the proximal gastrointestinal tract, dietary fiber-free and glucose-free content. Nutridrink Protein special food product completely met these requirements on the Ukrainian market:

Balanced composition:

- High protein content in a low volume: 18 g per 125 ml.
- High energy content: 306 kcal per 125 ml.
- Contains vitamins and microelements (selenium, chrome etc.).
- Free of dietary fiber.
- Gluten-free product.

According to our local protocols, developed on the basis of ESPEN and ERAS recommendations, 2 hours before surgery all patients received 5 g of glucose dissolved with 200 ml of water. We adapted the diet for all patients undergone ERAS-compliant surgery according to the type of surgery. The preoperative and postoperative early nutrition regimen was provided as following: in 4 hours after extubating-administration 125 ml Nutridrink Protein (any chosen flavor) twice daily. Water consumption was limited according to patient's need. On the 2nd postoperative day, all patients received sip feeding nutrition according to the manufacturer's recommendations, 2—3 bottles per day.

The assessment was performed the day after surgery according to the criteria, that we have developed. There was ascertained the presence of nausea/vomiting, bloating, flatulence, defecation, and there was assessed the patients' feelings of hunger, thirst, general weakness, and depression on a scale from 1 to 10 (where 1 is the lowest intensity symptoms, 10 is the highest intensity).

Results and discussion

We performed surveys on the first postoperative day. Results are represented in the Table.

Nausea/vomiting and bloating in all types of surgery did not correlate with the use of early postoperative nutrition in both groups and were statistically insignificant, but during hunger assessment we found statistically significant differences: the hunger after LCE was 1.5 times ($p < 0.001$), after LHR — 1.7 times ($p < 0.001$), after LCFP — 1.26 times ($p < 0.001$), after LBI—1.43 times, and after LCI — 1.9 times lower in the experimental group (Fig. 2).

During assessment of thirst only after bariatric interventions, we found a significant difference of 1.29

Table. **The questionnaire results of patients after various surgical interventions in the first postoperative day**

Index	Group	LCE	LHR	LCFP	LBI	LCI
Number of patients	Control	84	59	16	18	9
	Experimental	101	64	17	19	??
Nausea/ vomiting	Control	15 (17.86 %)	5 (8.47 %)	2 (12.5 %)	4 (22.22 %)	1 (9.0 %)
	Experimental	11 (10.9 %)	6 (9.37 %)	1 (5.88 %)	1 (5.26 %)	0
	p	0.256*	0.889*	0.953*	0.305*	1.000*
Bloating	Control	11 (13.09 %)	12 (22.22 %)	1 (6.25 %)	3 (16.67 %)	1 (9.0 %)
	Experimental	8 (7.92 %)	8 (12.5 %)	0	1 (5.26 %)	0
	p	0.364*	0.889*	0.976*	0.559*	1.000*
Hunger	Control	4.28 ± 0.90	4.75 ± 0.76	4.31 ± 1.25	3.94 ± 0.72	4.22 ± 1.39
	Experimental	2.84 ± 0.81	2.78 ± 0.63	3.41 ± 0.79	2.74 ± 0.99	2.22 ± 0.67
	p	< 0.001**	< 0.001**	< 0.001**	< 0.001**	< 0.001**
Thirst	Control	2.57 ± 0.65	2.32 ± 0.63	2.06 ± 0.57	2.72 ± 0.57	2.44 ± 0.53
	Experimental	2.4 ± 0.65	2.14 ± 0.56	1.82 ± 0.53	2.10 ± 0.57	2.00 ± 0.47
	p	0.069***	0.094***	0.221**	0.003**	0.156**
Flatulence	Control	19 (22.61 %)	19 (32.2 %)	7 (43.75 %)	5 (27.78 %)	4 (44.44 %)
	Experimental	41 (40.59 %)	38 (59.37 %)	11 (64.71 %)	11 (57.89 %)	7 (77.77 %)
	p	0.014*	0.005*	0.396*	0.135*	0.342*
Defecation	Control	12 (14.28 %)	6 (10.17 %)	6 (37.5 %)	2 (11.11 %)	2 (22.22 %)
	Experimental	26 (25.74 %)	18 (28.12 %)	9 (52.94 %)	8 (42.1 %)	6 (66.66 %)
	p	0.078*	0.020*	0.593*	0.079*	0.166*
General weakness	Control	4.61 ± 0.71	3.36 ± 0.78	3.56 ± 0.73	4.22 ± 0.73	4.00 ± 0.67
	Experimental	2.56 ± 0.64	2.55 ± 0.71	2.12 ± 0.6	2.53 ± 0.61	2.89 ± 0.60
	p	< 0.001**	< 0.001**	< 0.001**	< 0.001**	0.006**

Note. * Fisher z-transformation (according to Yates's correction).
** Wilcoxon Signed Rank Test.
*** Student's criteria.

times (p = 0.003) between the control and experimental groups. In the experimental group of patients, we observed a significant difference of 1.79 times (p = 0.014) and 1.84 times (p = 0.005) in flatulence (restoration of full intestinal motility) after LCE and LHR respectively. Defecation rate in the first postoperative day was statistically significant: in 2.76 times (p = 0.02) more often observed in patients after LHR.

After hunger assessment, where we received a statistically significant difference after all types of surgery, weakness was the next one. The weakness after LCE was 1.8 times (p < 0.001), after LHR — 1.31 times (p < 0.001), after LCFP — 1.68 times (p < 0.001), after LBI — 1.67 times (p < 0.001), and after LCI — 1.38 times (p = 0.006) stronger in the control group (Fig. 3).

Thus, we admit statistically significant difference between control and experimental groups in assessing of two important parameters: hunger and weakness. These two subjective parameters are included in the list of factors formulated by H. Kehlet [2], which do not allow fast recovery of patients' life quality after surgery and affect the prolongation of hospital stay. In the experimental groups after LCE and LHR, we associate fast recovery of intestinal motility with the absence of mechanical or saline bowel cleansing in patients in the preoperative period of these types of surgery, as it was after LBI and LCI. Although, we don't perform the bowel cleansing after LCFP. This may be due to the involvement of the esophagus and stomach during surgery, and to some extent provokes prolonged gastrointestinal paresis.

Guidelines ESPEN, based on an analysis of scientific research on perioperative nutrition of patients in general surgery and oncology, gives 27 recommendations, including preoperative use of liquid

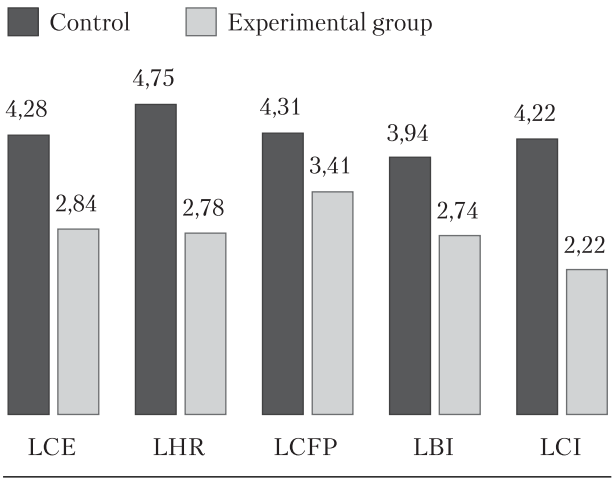


Figure 2. **Hunger in the first postoperative day**

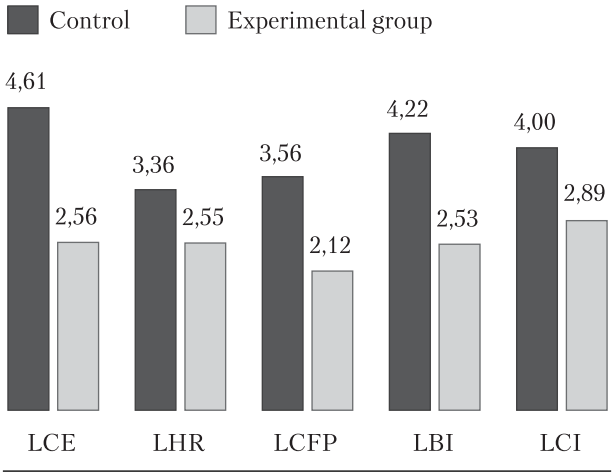


Figure 3. **Weakness in the first postoperative day**

carbohydrates, continuation of oral nutrition in the form of liquid mixtures in the first hours after surgery [6]. The daily requirement for energy is 25—30 kcal/kg, and for protein — 1.5 g/kg [12]. In our work, we follow all these recommendations for perioperative nutrition. Lobo et all. in 2009, based on MRI data of volunteers, proved that small amounts of liquid leave the healthy stomach in 60—90 minutes, so there is no need for long-term preoperative fasting [13]. Early continuation of oral nutrition is one of the main principles of ERAS and, in addition to decrease the level of postoperative complications, allows to speed up the recovery of patients and reduce the length of stay of patients in the hospital [14]. Early continuation of oral nutrition with special protein mixtures is also recommended after bariatric interventions. The level of protein requirement in obese patients in the postoperative period should be 60 g/day [6]. The only requirement for postoperative mixtures for bariatric patients is the absence of glucose as most of these patients have impaired glucose tolerance or type 2 diabetes. Therefore, we chose adapted glucose-free Nutridrink Protein (Nutricia) for the mentioned population of patients.

Conclusions

There is no need in traditional durable preoperative fasting. Since the implementation of carbohydrate preoperative load into ERAS protocols there were no cases of regurgitation and asphyxia during tracheal intubation [6].

Early continuation (first hours after extubating) of oral nutrition does not affect the rate of digestive anastomoses complications [15, 16], does not cause discomfort to the patient, and decreases the risk of postoperative wound infection, decrease recovery time and therefore allows decrease the number of patients in the hospital.

In our research, early continuation of oral nutrition with protein-enriched sip feeding formula Nutridrink Protein significantly decreases hunger and general weakness in the early postoperative period, which allows quickly recovering patient to full life.

All above mentioned measures reduce the hospital system burden and saves money of health care facilities. It should be noted that only in combination with other postulates of the ERAS program perioperative nutritional support of surgical patients has a great chance of success.

Declaration of interests

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Author contributions

Work concept and design, final approval of the article: O. Y. Ioffe; data collection and analysis: O. P. Stetsenko, M. S. Kryvopustov, T. V. Tarasiuk; responsibility for statistical analysis: M. S. Kryvopustov; writing the article: O. P. Stetsenko; critical review: Y. P. Tsiura, T. V. Tarasiuk

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Нутритивна підтримка пацієнтів у загальній хірургії

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Сучасний етап розвитку хірургії, а саме малоінвазивних технологій, суттєво змінив уявлення хірургів про періопераційний період. До кінця XX ст. доопераційне та післяопераційне голодування було чи не найголовнішою умовою в плановій хірургії. Вважалося, що це дає змогу уникнути ускладнень як під час операції, так і в ранній післяопераційний період. H. Kehlet у своїй фундаментальній праці визначив чинник, що дає змогу пришвидшити відновлення пацієнта після хірургічної операції — відсутність доопераційного голодування.

Мета — оцінити ефективність нутритивної підтримки хірургічних пацієнтів у межах протоколів ERAS (Enhanced Recovery After Surgery) та ESPEN (European Society for Clinical Nutrition and Metabolism).

Матеріали та методи. Проаналізовано дані пацієнтів як після традиційної лапароскопічної холецистектомії (177 випадків), так і після однопортової трансумбілікальної холецистектомії (8). Серед лапароскопічних баріатричних втручань переважало класичне Roux-Y-шлункове шунтування (28). У 5 випадках проведено слів-резекцію шлунка, у 4 — міні-шлункове шунтування. Із 123 пацієнтів виконано лапароскопічні герніопластики: у 64 — TAPP при пахових грижах, у 59 — IPOM при післяопераційних вентральних та пупкових грижах, у 33 — лапароскопічна крурорафія та фундоплікація як з алопластикою, так і без неї. Для кожного виду оперативних втручань виділено дві групи — контрольну та дослідну. Обидві групи вели за протоколами ERAS, окрім нутритивної підтримки. За згодою пацієнтів до операції дослідна група отримувала повну періопераційну нутритивну підтримку згідно з локальними протоколами, контрольну групу вели за традиційною схемою — голодування 12 г до операції, замість протеїнових сумішей — питна столова вода в першу післяопераційну добу.

Результати. Виявлено статистично значущу різницю між контрольними та дослідними групами при оцінці двох важливих параметрів — відчуття голоду і відчуття слабкості. Після лапароскопічної холецистектомії відчуття голоду було в 1,5 разу нижче у дослідній групі ($p < 0,001$), після лапароскопічної герніопластики — у 1,7 разу ($p < 0,001$), після лапароскопічної крурорафії та фундоплікації — в 1,26 разу ($p < 0,001$), після лапароскопічного баріатричного втручання — в 1,43 разу, після лапароскопічних втручань на товстій кишці — в 1,9 разів. Після лапароскопічної холецистектомії сильнішим у 1,8 разу ($p < 0,001$) відчуття слабкості було у контрольній групі, після ЛГП — у 1,31 разу ($p < 0,001$), після лапароскопічної крурорафії та фундоплікації — в 1,68 разу ($p < 0,001$), після лапароскопічного баріатричного втручання — у 1,67 разу ($p < 0,001$), після ЛВТК — у 1,38 разу ($p = 0,006$).

Висновки. Традиційне тривале доопераційне голодування є недоцільним. У комплексі з іншими постулатами програми ERAS періопераційна нутритивна підтримка хірургічних пацієнтів має великий шанс на успіх. У нашій роботі раннє відновлення орального харчування значно зменшувало відчуття голоду та відчуття загальної слабкості в ранній післяопераційний період, що давало змогу швидше повернути пацієнта до повноцінного життя.

Ключові слова: прискорене відновлення після операції, періопераційний догляд нутритивна підтримка.

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