A comparison of the effectiveness of the early enteral and natural nutrition after pancreatoduodenectomy

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Key words: pancreatoduodenal resection; postoperative enteral nutrition; postoperative complications.

Summary. The role of postoperative supplementary enteral nutrition after gastrointestinal surgery is controversial. Therefore, a randomized clinical trial with attempts to address the question of plenitude of routine application of postoperative enteral feeding on rate of postoperative complications following pancreatoduodenectomy was performed.

Sixty patients undergoing pancreatoduodenectomy were blindly randomized into two groups: 30 patients in the first group received early enteral nutrition (EEN), while 30 patients in the second group were given early natural nutrition (ENN). The complications were evaluated according to definition criteria. All complications were further subdivided into infectious and noninfectious complications.

Our data showed that patients in EEN group gained a larger amount of energy in kcal a day during the first five days after surgery in comparison to ENN group. There was a higher rate of postoperative complications in ENN group (53.3% vs 23.3%, P=0.03). This difference occurred mainly due to the higher incidence of infectious complications in ENN group (46.7% vs 16.7%, P=0.025). There were six cases of bacteriemia in this group of patients, while only one case was observed in EEN group (6 (20.0%) vs 1 (3.3%), P=0.1). The overall risk for the development of any type of infectious complication was 1.5 times higher in ENN group.

In conclusion, this study suggests that supplementary postoperative enteral nutrition helps to decrease the rate of infectious complications in patients undergoing pancreatoduodenectomy, especially in those with a plasma albumin level of less than 34.5 g/L and/or ASA class III or higher, since natural nutrition is insufficient in this case.

Introduction

A period of starvation (“nil by mouth”) is common practice after gastrointestinal surgery, during which an intestinal anastomosis is formed. The rationale of “nil by mouth” is to prevent postoperative nausea and vomiting and to protect the anastomosis, allowing it time to heal before being stressed by food. It is, however, unclear whether deferral of enteral feeding is beneficial. Contrary to widespread opinion, evidence from clinical studies and animal experiments suggests that initiating feeding early is advantageous (1).

Although current reports show that early oral feeding after gastrectomy is safe, with no evidence of increased morbidity, and early postoperative oral feeding is also highly effective in reducing hospital stay (2), however gastroparesis is a frequent postoperative event following pancreatoduodenal resection (PDR) and this often necessitates prolonged gastric decompression and nutritional support (3).

The role of postoperative supplementary enteral nutrition after gastrointestinal surgery is controversial. Several trials have implicated a lower incidence of septic complications and faster wound healing upon early enteral feeding, other trials have shown opposite results (4). A recent study reports that in patients undergoing a Whipple resection, enteral nutrition is associated with a higher frequency of delayed gastric emptying (DGE) with no advantages regarding other postoperative complications and should therefore be restricted to specific indications (5).

Therefore, we performed a randomized clinical trial comparing two early nutrition methods with attempts to address the question of plenitude of early oral feeding versus influence of the routine application of postoperative enteral feeding on patients’ nutrition status and rate of postoperative complications following PDR.

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Patients and methods

The prospective randomized single-center study was performed. All patients undergoing classical Whipple procedure or pylorus preserving PDR for neoplasms of periampullary region and chronic pancreatitis were eligible. The following patients were excluded from study: 1) patients with earlier performed gastric resections and bilidigestive anastomosis (in these patients PDR is performed using different technique, using a smaller number of anastomosis); 2) patients with metastatic tumors of the pancreas; 3) patients in whom PDR was performed due to abdominal trauma (this group comprises patients with severe abdominal injuries, shock, and urgent surgery); 4) patients with preoperative enteral nutrition due to severe cachexia (no possibility to randomize further these patients postoperatively).

Patients who have not received the early enteral nutrition (EEN) for the planned minimal period postoperatively (due to loss of enteral feeding tube during the first 5 postoperative days or intolerance of enteral feeding) were eliminated from further study. The definition of enteral feeding intolerance in our study included heavy diarrhea (>6 times per day), when a patient receives the optimal dosage of antidiarrhea medications, nausea, vomiting, bowel distension, and other symptoms associated with enteral feeding that cause a significant discomfort to the patient and lead to the discontinuation of enteral nutrition. The patients that have deceased due to various complications during the first 10 days postoperatively were also excluded from further study because according to our study protocol certain parameters should be monitored up to 10 days postoperatively.

Grouping of patients

Informed written consent was obtained from all patients before operation, and the study was conducted following approval by the Independent Ethical Committee at Kaunas University of Medicine (Protocol No. 68/10-22-2002). During the study period, 75 PDRs were performed. Thirteen patients did not meet the inclusion criteria. Patients who met the inclusion criteria were blindly randomized and assigned to either of two groups: patients in the first group received EEN, while patients in the second group were given early natural nutrition (ENN). The allocation of the patient to one of the groups was performed after drawing a sealed paper envelope with an appropriate card inside by the member of operating team before surgery. Sixty patients after PDR were included into our final study (30 patients in each group) as two patients (by one from each group) were excluded during the study.

Later, the homogeneity and comparability of the groups were assessed using the standard preoperative and postoperative evaluation criteria.

The same management protocol and treatment scheme were used in both study groups with differences in postoperative nutrition protocol.

Early enteral nutrition protocol

During the operation, a special enteral nutrition tube (4.0 mm in diameter, 110 cm in length, manufactured by Kangaroo, Sherwood Services AG, Ireland) was placed in the jejunum below the gastroduodenojejunal junction in all patients assigned to EEN group. EEN was initiated immediately after operation according to the standard protocol (Table 1).

Table 1. Protocol of standard early enteral nutrition after the operation

| Postoperative day | Solution   | Speed (mL/h) | Dilution | kcal/day |
|-------------------|------------|--------------|----------|----------|
| 0                 | Normal saline | 20           | –        | 0        |
| 1                 | EN solution | 40           | 1:1      | 400      |
| 2                 | EN solution | 40           | nondiluted | 800    |
| 3                 | EN solution | 60           | nondiluted | 1200   |
| 4                 | EN solution | 80           | nondiluted | 1600   |
| 5                 | EN solution | 100          | nondiluted | 2000   |
| 6                 | EEN is discontinued and replaced by normal oral feeding, if there are no clinical or radiological signs of DGE | | | |

EN – enteral nutrition; EEN – early enteral nutrition; DGE – delayed gastric emptying.
Enteral nutrition (EN) was continuously delivered day-long for no less than 20 hours per day with only minor interruptions needed to clean the feeding tube, etc. EN was continued for 5–6 days, when the radiological assessment of gastric emptying was performed, and normal oral nutrition was started. EN was discontinued only when normal gastric evacuation was present, and patients were able to drink and eat. When supplementary EN was necessary because of the postoperative complications, it was started or continued until needed in both groups of the patients. In our study, we have used two types of commercially available polymeric enteral nutrition solutions: Semper Standard and Fresubin Standard.

**Early natural nutrition protocol**

Patients in ENN group received intravenous fluids and a special diet according to our natural nutrition protocol during the first 5 postoperative days (Table 2).

The nutrition regimen was appointed by the supervising physician. Patients were fed orally (with an aid of nurses when needed) and only received the food provided by hospital; no supplementary products were allowed.

**Determination of postoperative complication rate and energetic and protein value**

The complications were evaluated according to definition criteria. All complications were further subdivided into infectious (bacteremia, intra-abdominal abscess, infected biliary and pancreatic fistula, infection of surgical wound, and pneumonia) and noninfectious complications (biliary and pancreatic fistula, dehiscence of anastomosis, delayed gastric emptying, bleeding, pulmonary embolization, thrombosis of superior mesenteric artery).

The sources of energy for the patients in EEN group were intravenous glucose, sweet beverages, and enteral nutrition. The sources of energy for the patients in ENN group were intravenous glucose, sweet beverages, and special diet. We have calculated the energetic value of allocated nutrition for each patient in kcal a day. Later it was expressed as a percentage of necessary amount of energy. We considered the necessary energetic value of postoperative nutrition to be 25 kcal per 1 kg of body weight a day. We also assumed that the necessary protein amount for the postoperative nutrition is 1g per 1 kg of body weight a day.

**Statistical analysis**

Statistical analysis was performed using SPSS 8.0 (Statistical Package for Social Sciences) for Windows (Chicago, Illinois, USA). Differences between means were evaluated using Student \( t \) test when normal distribution was confirmed by Shapiro-Wilks test. When the hypothesis of normal distribution was rejected, differences between groups were tested by nonparametric statistics using Mann-Whitney test for unpaired samples and Wilcoxon criteria for paired samples. Fisher’s exact test was used for analysis of categorical values when appropriate. Odds ratio for complications in ENN group and relative risk for the occurrence of postoperative infectious complications in ENN group was evaluated. A \( P \) value of <0.05 was considered statistically significant.

**Results**

Sixty patients were enrolled in this study. They were subdivided into two groups based on the type of nutrition they have received after surgery: Group 1 – patients that were administered EEN; Group 2 – patients that were given ENN. There were 30 patients in each study group. Based on the data presented in Table 3, we could assume that both groups were homogeneous and showed no significant disparity.

**Comparison of postoperative nutrition value in prospective study groups**

There was no difference in the nutrition of patients in both groups on the day of surgery, since all patients

| Postoperative day | Diet            | kcal/day | Protein, g/day |
|-------------------|-----------------|----------|----------------|
| 0 (operation)     | Starvation      |          |                |
| 1                 | Liquid diet     | 400      | 0              |
| 2                 | Liquid diet     | 600      | 0              |
| 3                 | Semiliquid diet | 900      | 52             |
| 4                 | Solid diet      | 2100     | 112            |
| 5                 | Solid diet      | 2500     | 115            |

*Table 2. Protocol of standard early natural nutrition after the operation*
were given only intravenous glucose solution. Nevertheless, patients in EEN group were given a constantly increasing quantity of enteral nutrition solution starting from the first postoperative day. Meanwhile, the patients in ENN group obtained the necessary energy only from glucose administered intravenously and a limited amount of sweet beverages that they could drink. Our data show that patients in EEN group gained a statistically significantly larger amount of energy in kcal a day during the first five days after surgery in comparison to ENN group (Fig. 1).

Very similar situation appeared to be with the daily supply of proteins. Patients in EEN group were given a constantly increasing quantity of proteins via enteral nutrition solution starting from the first postoperative day. Patients in ENN group yielded proteins only when they started eating solid diet. None of the patients in either group gained proteins on the day of surgery, since parenteral nutrition was not administered, and patients were given only intravenous crystalline solutions. On the other hand, majority of patients in ENN group started eating normal diverse food with rather

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**Table 3. Comparison of patients’ data between groups**

| Characteristic                        | EEN (n=30) | ENN (n=30) | P value |
|---------------------------------------|------------|------------|---------|
| Sex (male/female)                     | 12/18      | 15/15      | 0.3*    |
| Age in years (median/quartile)        | 58 (47–69) | 62.5 (57–75) | 0.07*** |
| Consecutiveness of surgery (I/II)     | 19/11      | 19/11      | 1.0*    |
| Type of lesion (benign/cancer)        | 9/21       | 8/22       | 1.0*    |
| Bilirubin in μmol/L (median/quartile) | 22.3 (8.5–99) | 31.5 (10.3–156.7) | 0.43*** |
| BMI in kg/m² (median/quartile)        | 24.6 (21.6–28.4) | 24.5 (22.2–28.1) | 0.66**  |
| Total protein in g/L (median/quartile)| 68.1 (64.5–73.6) | 69.7 (64.1–75.4) | 0.46**  |
| Albumin in g/L (median/quartile)      | 38 (35–41.7) | 37 (33.7–41.3) | 0.83**  |
| Body weight in kg (median/quartile)   | 74 (68–79) | 71.5 (62–81) | 0.61**  |
| ASA class (II/III)                    | 24/6       | 20/10      | 0.38*   |
| Type of surgery (PPPDR/PDR)           | 27/3       | 25/5       | 0.7*    |
| Duration in minutes (median/quartile) | 327 (310–390) | 345 (310–400) | 0.77*** |
| Blood loss in mL (median/quartile)    | 500 (400–500) | 500 (400–800) | 0.54*** |
| Bile culture (bacterial growth/sterile)| 14/16    | 18/12      | 0.44*   |

BMI – body mass index; PDR – pancreatoduodenal resection; ENN – early natural nutrition; EEN – early enteral nutrition.

*Fisher’s exact test. **Student t test. ***Mann-Whitney test.
high protein content (112–115 g a day) on the fifth postoperative day. Therefore, a statistically significant difference in the daily protein yield was observed only in the period of 1st–4th postoperative day, assuming that the necessary protein amount in the postoperative nutrition is 1 g per 1 kg of body weight a day (Fig. 2).

**Analysis of postoperative complications**

Detailed characteristics of postoperative complications and mortality are shown in Table 4 and Table 5. It is quite obvious that there was a higher rate of postoperative complications in ENN group (53.3% vs 23.3%, \( P = 0.03 \)), with an odds ratio of 3.8. This difference occurred mainly due to the higher incidence of infectious complications (ICs) in ENN group (46.7% vs 16.7%, \( P = 0.025 \)), with an odds ratio 4.4 (Table 4).

It is worth noting that severe IC, i.e. bacteremia, was more frequent in ENN group. There were six cases of bacteremia in this group of patients, while only one case was observed in EEN group (6 (20.0%) vs 1 (3.3%), \( P = 0.1 \)). The estimated frequency of other ICs in both groups was roughly equal (Table 5). There were also patients in whom several ICs have occurred; therefore, 18 ICs have been registered in 14 patients of ENN group. In most cases, these were closely related complications, i.e. abscess and bacteremia, sepsis and pneumonia, intra-abdominal and wound infection. According to our findings, the risk for the occurrences of single distinct postoperative complications was similar in both study groups. But the relative risk for the development of any type of infectious complication in ENN group was 1.5 (Table 5).

**Characteristics of patients with and without infectious complications and assessment of nutrition**

There were ICs present in both study groups of patients. Distribution of ICs in the ENN group was equal, as there were 14 patients with and 16 patients without ICs. Therefore, we decided to compare the

**Table 4. Odds ratio for postoperative complications and mortality in ENN group**

| Number of patients                              | EEN (n=30) | ENN (n=30) | \( P^* \) | Odds ratio (95% CI) |
|------------------------------------------------|------------|------------|-----------|---------------------|
| Complications, n (%)                            | 7 (23.3)   | 16 (53.3)  | 0.03      | 3.8 (1.2–11.4)      |
| Total infectious complications, n (%)           | 5 (16.7)   | 14 (46.7)  | 0.025     | 4.4 (1.3–14.5)      |
| Total noninfectious complications, n (%)        | 3 (10.0)   | 3 (10.0)   | 1.0       | 1.0 (0.2–5.4)       |
| Deaths, n (%)                                   | 0 (0)      | 2 (6.7)    | 0.49      | –                   |

ENN – early natural nutrition; EEN – early enteral nutrition.

\*Fisher’s exact test.
characteristics of these two subgroups within ENN group and investigate if the nutrition was uniform in these two subpopulations of patients. According to our data, there was no statistically significant difference in nutrition (energetic value and total protein content per day) of patients with and without ICs in ENN group (data not shown).

We have compared the preoperative characteristics of patients with ICs (IC+, n=14) and without ICs (IC–, n=16) in ENN group. The statistical analysis revealed following statistically significant differences between the subgroups: there were more patients with ASA class III and low plasma albumin level (median, 34.5 g/L) in subgroup IC+ (Table 6).

Number of patients with clinical or radiological manifestation of DGE varied between the study groups, but statistically significant difference was not established between the groups. DGE clinically manifested in three patients in EEN group and was recorded only in one patient in ENN group. All patients were administered supplementary enteral nutrition until the time point when natural nutrition was reestablished. The radiological manifestation of DGE was registered in 10 cases, but 7 patients in this group had no clinical signs of DGE (nausea, dependence upon nasogastric decompression, inability to drink). When only mild radiological manifestation of DGE was present, in majority of cases patients could drink and eat according to our protocol without any further limitations. There was no statistically significant

**Table 5. Comparison of infectious postoperative complications between EEN and ENN groups and estimation of relative risk for the development of complications in ENN group**

| Characteristics of patients | EEN (n=30) | ENN (n=30) | P* value | Odds ratio (95% CI) |
|-----------------------------|------------|------------|----------|--------------------|
| Intra-abdominal infection    | 1          | 4          | 0.35     | 1.11 (0.96–1.3)    |
| Skin and surgical wound infection | 0          | 3          | 0.24     | 1.1 (0.98–1.25)    |
| Pneumonia                   | 3          | 5          | 0.7      | 1.1 (0.88–1.3)     |
| Bacteriemia                 | 1          | 6          | 0.1      | 1.2 (0.99–1.46)    |
| Any type of infectious complication | 5          | 14         | **0.02** | **1.56 (1.08–2.26)** |

ENN – early natural nutrition; EEN – early enteral nutrition.
*Fisher’s exact test.

**Table 6. Preoperative characteristics of patients with and without infectious complications in ENN group**

| Characteristics of patients | IC+ (n=14) | IC– (n=16) | P* value |
|-----------------------------|------------|------------|----------|
| Sex (male/female)           | 8/6        | 7/9        | 0.53     |
| Age in years (median/quartile) | 66 (61–75) | 59.5 (51.5–76) | 0.19     |
| Consecutiveness of surgery (I/II) | 8/6       | 11/5     | 0.59     |
| Type of lesion (benign/cancer) | 3/11       | 5/11     | 0.65     |
| Bilirubin in µmol/L (median/quartile) | 69.2 (32–201) | 22.8 (6.5–93.5) | 0.06     |
| BMI in kg/m² (median/quartile) | 26.2 (22.2–29) | 24.3 (22.4–26.4) | 0.59     |
| Body weight in kg (median/quartile) | 75.3 (64–89) | 66.5 (62–74.3) | 0.2      |
| Total protein in g/L (median/quartile) | 68.8 (66.8–74.3) | 71.2 (62.9–76.2) | 0.56     |
| Albumin in g/L (median/quartile) | 34.5 (32–37.3) | 38.75 (36.7–42.5) | 0.006    |
| ASA class (II/III)          | 5/9        | 15/1      | 0.007    |
| Type of surgery (PPPDR/PDR)  | 2/12       | 3/13      | 0.84     |
| Blood loss in mL (median/quartile) | 500 (400–800) | 500 (450–650) | 0.85     |
| Duration in minutes (median/quartile) | 342 (310–360) | 350 (320–412) | 0.36     |
| Bile culture (bacterial growth/sterile) | 9/5       | 9/7       | 0.71     |

BMI – body mass index; PDR – pancreatoduodenal resection; ENN – early natural nutrition; EEN – early enteral nutrition.
*Mann-Whitney test.

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difference in clinical (3 vs 1, $P=0.61$, Fisher exact test) or radiological (7 vs 3, $P=0.3$, Fisher exact test) manifestation of DGE between EEN and ENN groups.

Discussion

PDR and its modifications currently remain the only curative measure in the treatment of periampullary cancer (6). In addition, although this surgical procedure is associated with a rather high rate of perioperative complications, it remains the first choice treatment modality whenever feasible.

For decades, there has been an ongoing debate about the role and influence of various postoperative nutritional methods in the outcome of major abdominal surgery. There is an ample of studies published about the benefits and limitations of the total parenteral nutrition, various approaches in enteral feeding, immunity diets, and alimentary supplements.

Malnutrition has been shown to have an adverse effect on the clinical outcome of surgical patients. During the past 25 years, investigators have sought to determine whether clinical outcome can be improved by the administration of pre- or postoperative (perioperative) nutritional support (7). There is hardly any discussion about the fact that patients with poor nutrition benefit from the supplementary feeding. However, many authors suggest that complementary postoperative nutrition should not be administered routinely to patients with normal body physique.

Our study examined an important question. Of a major interest to us was the issue if early natural nutrition could substitute the early supplementary enteral nutrition, and if these two nutrition methods are comparable in the aspect of postoperative complications. Prospective randomized trial proved that the group of patients receiving EEN after PDR was statistically significantly less likely to develop postoperative ICs, while odds ratio for development of ICs in ENN group was 1.56. These results are comparable with data published by Lewis et al. in systematic review and meta-analysis of controlled trials (1). Analysis showed that EEN reduced the risk of any type of infection (relative risk 0.72, 95% confidence interval 0.54 to 0.98, $P=0.036$) and the mean length of stay in hospital (number of days was reduced by 0.84, 0.36 to 1.33, $P=0.001$). There is main discrepancy between current study and trials, analyzed in meta-analysis. We have randomized patients into groups receiving supplementary enteral nutrition and those who were given early natural (oral) nutrition, whereas randomized controlled trials compared enteral feeding started within 24 hours after surgery with “nil-by-mouth” management in elective gastrointestinal surgery.

Patients in ENN group received intravenous fluids and a special diet according to our natural nutrition protocol, i.e. liquid diet on the postoperative day 1–2 followed by gradual reintroduction of diet on the postoperative day 3–5. Nevertheless, patients in ENN group gained a significantly lesser amount of energy and protein during the first five days after surgery in comparison to EEN group. Early postoperative jejunal feeding of elemental diet supplies more nutrients (8). Immediate postoperative enteral feeding in patients undergoing intestinal resection seems to be safe, prevents an increase in gut mucosal permeability, and produces a positive nitrogen balance (9). Patients who receive the enriched solution recover both their nutritional and immunological status quicker (10, 11).

Proposition that enteral nutrition is beneficial in reducing infectious complications is supported by the evidence that changes in mucosal defense have been implicated as important factors affecting infections complications in critically ill patients (12). Enteral nutrition influences the ability of gut-associated lymphoid tissue to maintain mucosal immunity. Both route and type of nutrition influence antibacterial respiratory tract immunity (13). The integrity of both the immunologic and nonimmunologic barriers may be affected by any number of pathologic insults as well as by nutritional influences (14).

Having determined that there were no differences in nutrition of patients with and without ICs, we have investigated what could be other possible disparities between these two subgroups of patients. Analysis revealed that there were more patients with ASA class III and low plasma albumin level (median, 34.5 g/L) in subgroups with ICs. Di Carlo et al. advocate that preoperative supplementary nutrition should be initiated for the patients with poor nutrition, and it should be also continued postoperatively. For the patients with an average nutrition status, early complementary postoperative nutrition is sufficient but it should be administered until patients are able to consume self-dependently at least 800 kcal per day. For the patients with normal body physique and nutrition, necessary amount of energy could be provided by intravenous administration of glucose, and enteral feeding should be reserved only for those patients who are not able to return to early normal nutrition due to postoperative complications (15). Moreover, recent data show that in patients undergoing a Whipple resection, enteral nutrition is associated with a higher frequency of DGE with no advantages regarding other postoperative complications and should therefore be restricted to

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specific indications (16). There was no evidence of increase in clinical or radiological manifestation of DGE in EEN group in our series. Although there is strong evidence that “nil by mouth” is not justified, the data are still conflicting over the role of EEN compared with the traditional methods of postoperative feeding (17). There seems to be no clear advantage to keeping patients “nil by mouth” after elective gastrointestinal resection. Early feeding may be of benefit (1). Moreover, early oral feeding after major abdominal surgery is safe, with no evidence of increased morbidity, and early postoperative oral feeding is also highly effective in reducing hospital stay (2). In our department, we encourage the patients to start early oral intake of fluids and early natural nutrition after pancreatic and gastric surgery, which, according to our experience, did not increase the manifestation of DGE.

Conclusions
This study suggests providing with supplementary postoperative enteral nutrition the patients undergoing PDR with plasma albumin level of less than 34.5 g/L and/or ASA class III or higher, since natural nutrition is insufficient in this case. For normally nourished patients, it is safe to allow early oral postoperative intake of fluids (1st–2nd postoperative day) and food (3rd–4th postoperative day) for patients after PDR.

Ankstyvosios enterinės ir natūralios mitybos po pankreatoduodeninės rezekcijos efektyvumo palyginimas

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Raktažodžiai: pankreatoduodeninė rezekcija, pooperacinė enterinė mityba, pooperacinės komplikacijos.

Santrauka. Papildomo pooperacinio maitinimo reikšmė po gastrointestinalinių operacijų vertinama priešingai. Iki šiol nėra vieingos nuomonės, ar įprasta pooperacinė enterinė mityba turi įtakos pooperaciniams komplikacijoms, kurias randasi po pankreatoduodeninės rezekcijos. Norėdami atsakyti į klausimą, ar pooperacinė enterinė mityba turi įtakos pooperacinių komplikacijų (ypač infekcinii) atsiradimui, atlikome perspektyvųjų atsitiktinių imių tyrimą.

60 pacientų, kuriems buvo atliekta pankreatoduodeninė rezekcija, suskirstyti į dvi grupes: 30 pacientų buvo skiriama ankstyvoji enterinė mityba (AEM), kitiems 30 – ankstyvasis natūralus maitinimas (ANM). Pooperacinių komplikacijos fikuotos pagal vieinings kriterijus. Visos komplikacijos buvo susikurystos į infekcinės ir neinfekcinės.

Tyrimas parodė, jog AEM grupės ligoniai pirmiasias penkias parą gaudavo daugiau kilokalorių per parą nei ANM grupės pacientai. ANM grupės ligioniams atsirado daugiau komplikacijų po operacijos (53,3 proc. ir 23,3 proc.), šis padaugėjimas yra infekciniių komplikacijų sąskaita (46,7 proc. ir 16,7 proc.) ir skirtumas yra statistiškai reikšmingas. ANM grupės šešiems ligioniams atsirado bakteriemija, AEM grupėje – tik vienam ligioniui (6 vs 1, 20,0 proc. vs 3,3 proc., p=0,1). Infekcinės komplikacijos rizika ANM grupės ligioniams yra 1,5 karto didesnė.

Tyrimas parodė, jog ligioniams, kurie priklauso III ar didesnei ASA klasei ir kurių albumino kiekis iki operacijos yra iki 34,5 g/l, rekomenduotas papildomas maitinimas po operacijos (enterinė mityba).

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