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Efficacy of Nasogastric and Nasojejunal Enteral Feeding in the Early Phase of Acute Pancreatitis

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Эффективность назогастрального и назоеюнального энтерального питания в раннюю фазу острого пакреатита

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Summary

Enteral nutrition in the early phase of predicted severe acute pancreatitis can be administered via a nasogastric or nasojejunal tube. Finding the most effective method in terms of daily balance, the volume of feeding and residual gastric volume in the early period of moderate and severe acute pancreatitis is a current challenge.

The aim of the study was to estimate the efficacy of nasogastric and nasojejunal early enteral feeding during the early phase of predicted severe acute pancreatitis.

Material and methods. The study was prospective, single-center, and randomized. The data were collected from November 2012 to October 2018. The study included 64 ICU patients in the early period of acute pancreatitis exhibiting predictors of severity. During randomization, the patients were assigned to either nasogastric (group 1) or nasojejunal (group 2) feeding for the next four days. The volume of enteral feeding on Day 1 was 250 ml/day, and on each successive day it was increased by 250 ml/day. During group allocation, the disease severity and the way of nutrient administration were taken into account. Daily balance was calculated using the difference between enterally administered and residual gastric volume. Statistical analysis was performed using SPSS v.23 software package. The null hypothesis was rejected at $P<0.05$.

Results. The volume of enteral nutrition administered over 4 days did not differ between the study groups. Patients with severe acute pancreatitis had significantly better nutrient absorption over 4 days when the postpyloric route was used (1.63±0.98 l/d) vs the nasogastric one (0.55±0.29 l/d) ($P=0.001$). In moderate pancreatitis, the enteral nutrition absorption over 4 days did not differ ($P=0.107$) between the groups with nasogastric (2.06±0.87 l/day) and nasojejunal (2.6±0.45 l/day) feeding.

Conclusion. Nasojejunal route is the preferred way to start enteral feeding in patients with severe acute pancreatitis. In moderate acute pancreatitis, feeding can be initiated via the gastric route and only in case of intolerance it should be switched to the nasojejunal one.

Keywords: acute pancreatitis; nasogastric feeding; nasojejunal feeding; nutrition; residual gastric volume

Conflict of interest. The authors declare no conflict of interest.

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Introduction

Acute pancreatitis (AP) can be associated with abnormal motility, secretion, digestion, and intestinal barrier function, which are grouped under the term «acute gut injury». These changes can cause feeding intolerance (FI) syndrome, when adequate enteral nutrition is impossible due to some clinical reason (vomiting, high gastric residual volume (GRV), diarrhea, gastrointestinal bleeding, entero-

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cutaneous fistula, etc.) [1]. Currently, there is no single, clearly formulated set of signs and symptoms, as well as quantitative characteristics that can confirm the diagnosis of FI and its severity. Administration of enteral nutrition (EN) in severe acute pancreatitis (SAP) associates with a significant reduction in mortality [2, 3]. Enteral feeding can be delivered via nasogastric (NG) or nasoejunal (NJ) tube. Several small prospective randomized studies have shown that NG feeding is not inferior to the NJ one in terms of infectious complications, changes in inflammatory marker levels, and frequency of analgesic use [4, 5]. To date, there is no convincing evidence on the superiority, disadvantages, or equivalence of nasogastric or nasojunal enteral tube feeding regimens in SAP [6], so both routes are acceptable. After the initiation of enteral feeding, the issue of gradual increase of its volume to achieve the target volumes becomes relevant. The main goal is a proper increase in EN volume, rather than strict adherence to the protocol with an inappropriate increase in volumē with no regard to its tolerability. In modern clinical practice, the GRV measurement remains the easiest and most accessible way to assess the feasibility of enteral feeding, despite the fact that this test is not considered mandatory for making a decision to start or stop enteral feeding, especially if the residual volume is less than 500 ml [7]. Most studies on early enteral feeding in AP were done before a new type of AP, moderately severe acute pancreatitis (MSAP), was recognized in 2012 [8]. The lack of information on the absorption of early enteral nutrition in patients with predicted severe acute pancreatitis, depending on the type of disease and routes of nutrient delivery with a gradual «as-per-protocol» increase of nutrition volumes, makes our study relevant.

The aim of the study was to evaluate the efficacy of nasogastric and nasojejunal early enteral feeding in the early severe predicted phase of acute pancreatitis.

Material and Methods

We performed a randomized single-center study in the intensive care unit (ICU) of the «Neftyanik» medical unit in Tyumen during the period from November 2012 to October 2018. The inclusion criteria were diagnosed acute pancreatitis and at least one predictor of severe course. The exclusion criteria were age more than 80 years and terminal chronic diseases. The diagnosis of acute pancreatitis was made according to typical manifestations, confirmed by laboratory and instrumental tests [8]. C-reactive protein (CRP) > 150 mg/l, Acute Physiology And Chronic Health Evaluation (APACHE) II score >8, and Sepsis-related Organ Failure (SOFA) score >2 were considered predictors associated with severe acute pancreatitis [9]. The patient assignment to 2 groups was done using the randomization envelope method. The first group consisted of 33 patients who received early (first 12–24 h after admission) EN via the nasogastric tube. The second group included 31 patients with early EN solely via a nasogastric tube placed endoscopically. Table 1 shows that the groups are comparable in terms of age, severity of multiple organ dysfunction (MOD), plasma CRP concentration on day 1 and 48 h after admission.

Subsequently, the type of the disease according to the classification adopted in 2012 was documented [8]. In the study groups, patients with SPAP were assigned the «S» letter, and those with MSAP — with the «M» letter (Table 1). Pairwise comparison of the study groups was performed.

The standard isocaloric formula enriched with dietary fiber (BBraun Nutricomp Standard Fiber, country of origin Germany) was used for enteral feeding. The duration of study was four days. In the second group the nasojejunal route was supplemented with the nasogastric one. The nutrition formula was administered into the tube as a continuous drip. Gastric decompression was performed

Table 1. Clinical and laboratory parameters of patients in the early period of predicted severe acute pancreatitis.

Parameter	Values in groups								
	1, *n*=33	**2, *n*=31**	**S, *n*=31**	**M, *n*=33**	**S1, *n*=16**	**M1, *n*=17**	**S2, *n*=15**	**M2, *n*=16**	***P***
Sex, male/female	20/13	19/12	21/10	18/15	11/5	9/8	10/5	9/7	—
Age, years	43±11	46(34;58)	41(35;57)	42±12	42±13	42±10	47±13	45±15	0.667
Shapiro–Wilk's test	0.86	0.04	0.032	0.062	0.094	0.264	0.122	0.132	—
APACHE-II, points	5.1±2.8	6(4;10)	7.3±4.0	4(2;5)	6.5±2.9	3.6±2.1	5.5±4.9	5.4±3.6	0.002
Shapiro–Wilk's test	0.169	0.027	0.301	0.001	0.239	0.333	0.575	0.11	—
SOFA, points	2(1;2)	2(1;3)	2(1;3)	2(1;2)	2(1;2)	2(1;2)	3(1;4)	1(1;2)	0.369
Shapiro–Wilk's test	0.02	0.01	0.001	0.001	0.007	0.013	0.007	0.002	—
CRP24, mg/l	80.1±58.5	89.7±57.8	87.6±51.8	78(23;136)	72.8±54.8	85.6±64.7	101.2±47.8	77.2±67.6	0.934
Shapiro–Wilk's test	0.057	0.173	0.334	0.015	0.225	0.171	0.144	0.055	—
CRP48, mg/l	183 (146; 203)	181 (155; 203)	181 (160; 200)	181 (141; 203)	182.4±50.2	195 (130; 207)	175 (155; 203)	181 (152; 189)	1.0
Shapiro–Wilk's test	0.001	0.003	0.011	0.001	0.434	0.002	0.043	0.033	—

Note. For tables. 1–4, 1 — group 1, nasogastric tube feeding; 2 — group 2, nasojejunal tube feeding; S/M — number of patients with severe/moderately severe acute pancreatitis. Subscripts represent group numbers. APACHE — Acute Physiology And Chronic Health Evaluation; SOFA — Sepsis-related Organ Failure; CRP — C-reactive protein. CRP24 — CRP level 24 hours after admission, CRP48 — CRP level 48 hours after admission. *P*-values were derived from Kraskel–Wallis test.

every 6 hours in nasogastric feeding. In the second group, gastric decompression was continuous. The initial rate of feeding was 15 ml/h, and then every subsequent day it was increased by 15 ml/h. The required volume of enteral nutrition for the first day was 250 ml/day, and every subsequent day it was increased by 250 ml/day depending on tolerance. If nausea, vomiting, increased pain or nasogastric tube discharge >500 ml/hour appeared, the rate was reduced by half, and if the above symptoms persisted, the feeding was discontinued. Later, after symptoms of food intolerance subsided, the rate was gradually increased to the previous values. The daily volume of enteral nutrition and GRV were used to calculate the balance of absorbed nutrition.

Statistical analysis was performed using the SPSS-23 software package. After checking for distribution normality using the Shapiro–Wilk's test, the results were presented as means with standard deviation $M \pm \sigma$ or medians with quartiles *Me*, (Q25; Q75). Parametric and nonparametric criteria were used for group comparison. The null hypothesis was rejected at $P<0.05$.

Results

The results obtained during 4 days of treatment in ICU are shown in Tables 2–4: Table 2 describes the daily volume of enteral feeding, Table 3 presents the daily GRV, and Table 4 displays the balance between the enteral nutrition administered and the GRV.

Discussion

The volume of delivered nutrition did not differ significantly between patients fed via nasogastric (group 1) or nasojejunal (group 2) tubes (Table 2). Nasogastric tube spillage was significantly greater in the NG group than in NJ (Table 3). This was reflected in the 4-day absorbed nutrition balance, which was significantly greater in the group with the postpyloric nutrient delivery (Table 4).

Thus, due to lower GRV, the volume of absorbed nutrition was greater with postpyloric feeding than with the NG route. Based on the results presented in Table 4, starting from day 3 and altogether over the entire follow-up period, patients with MSAP absorbed significantly more nutrition than those with SAP. The volume of nasogastric nutrition did not differ between the SAP and MSAP groups (Table 2), but in the MSAP group, starting from day 3 and over the whole follow-up period, the daily GRV was significantly lower (Table 3) resulting in a higher volume of nutrition absorbed by the MSAP patients (Table 4). Thus, with nasogastric feeding, patients with MSAP, starting from day 3, absorbed more nutrition (Table 4) than patients with SAP due to lower

Table 2. The volume of enteral feeding in patients with predicted severe acute pancreatitis.

Parameter	Values in groups											
	1, *n*=33	**2, *n*=31**	***P***	**S, *n*=31**	**M, *n*=33**	***P***	**S1, *n*=16**	**M2, *n*=17**	***P***	**S2, *n*=15**	**M2, *n*=16**	***P***
Day 1	0.25 (0.25; 0.30)	0.25 (0.25; 0.27)	0.775	0.25 (0.25; 0.30)	0.25 (0.25; 0.25)	0.656	0.25 (0.25; 0.30)	0.25 (0.25; 0.25)	0.557*	0.25 (0.25; 0.25)	0.25 (0.25; 0.30)	0.984
Shapiro–Wilk's test	0.001	0.001	—	0.001	0.001	—	0.005	0.001	—	0.001	0.001	—
Day 2	0.5 (0.5; 0.5)	0.5 (0.5; 0.5)	0.260	0.5 (0.5; 0.5)	0.5 (0.5; 0.6)	0.691	0.5 (0.5; 0.5)	0.5 (0.5; 0.5)	0.986	0.5 (0.5; 0.5)	0.5 (0.5; 0.6)	0.599
Shapiro–Wilk's test	0.001	0.001	—	0.001	0.001	—	0.001	0.004	—	0.001	0.018	—
Day 3	1.0(0.8; 1.0)	1.0 (0.8; 1.0)	0.811*	0.8 (0.5; 1.0)	1.0 (1.0; 1.0)	0.002*	0.8 (0.6; 1.0)	1.0 (0.8; 1.0)	0.309	0.8 (0.5; 1.0)	1.0 (1.0; 1.0)	0.004
Shapiro–Wilk's test	0.001	0.001	—	0.001	0.001	—	0.002	0.003	—	0.028	0.001	—
Day 4	1.0 (1.0; 1.0)	1.0 (1.0; 1.3)	0.376*	1.0 (0.95; 1.3)	1.3 (1.0; 1.5)	0.019*	1.0 (1.0; 1.5)	1.3 (1.0; 1.5)	0.444*	1.0±0.3	1.2 (0.1; 1.5)	0.037*
Shapiro–Wilk's test	0.001	0.012	—	0.017	0.001	—	0.023	0.002	—	0.552	0.001	—
Total	2.8±0.6	2.8±0.5	0.766#	2.6±0.5	3.0±0.5	0.014**	2.7±0.6	2.9±0.6	0.399**	2.5±0.5	2.9±0.6	0.002**
Shapiro–Wilk's test	0.284	0.281	—	0.236	0.262	—	0.76	0.646	0.001	0.487	0.577	—

Note. For Tables 2–4: * — Mann–Whitney test; ** — Student's *t*-test; # — given that the Levene's test for the equality of variances is less than 0.05, Mann–Whitney test is used.

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Table 3. Daily residual gastric volume in early enteral feeding in patients with predicted severe acute pancreatitis.

Parameter	Values in groups										
	1, *n*=33	2, *n*=31	*P*	S, *n*=31	M, *n*=33	*P*	S1, *n*=16	M2, *n*=17	*P*	S2, *n*=15	M2, *n*=16	*P*
Day 1	0.1 (0.1; 0.4)	0.1 (0.0; 0.2)	0.035*	0.2 (0.1; 0.4)	0.0 (0.0; 0.1)	0.001*	0.4 (0.8; 0.5)	0.1 (0.0; 0.2)	0.014*	0.1 (0.1; 0.2)	0 (0.0; 0.0)	0.019*
Shapiro–Wilk's test	0.001	0.001	—	0.001	0.001	—	0.001	0.001	—	0.035	0.001	—
Day 2	0.3 (0.2; 0.5)	0.2 (0.0; 0.3)	0.034*	0.3 (0.2; 0.5)	0.2 (0.1; 0.5)	0.234*	0.3 (0.2; 0.5)	0.2 (0.1; 0.5)	0.168*	0.3 (0.0; 0.4)	0.2 (0.1 (0.3)	0.711*
Shapiro–Wilk's test	0.001	0.001	—	0.039	0.001	—	0.007	0.001	—	0.04	0.008	—
Day 3	0.5 (0.15; 0.8)	0.1 (0; 0.5)	0.004*	0.5 (0.2; 0.8)	0.1 (0; 0.4)	0.001*	0.8 (0.5; 1.0)	0.2 (0.05; 0.5)	0.001*	0.2 (0.1; 0.6)	0.0 (0.0; 0.2)	0.049*
Shapiro–Wilk's test	0.001	0.001	—	0.001	0.001	—	0.001	0.001	—	0.008	0.001	—
Day 4	0.1 (0.0; 0.3)	0.0 (0.0; 0.1)	0.062*	0.2 (0.0; 0.3)	0.0 (0.0; 0.0)	0.001*	0.4±0.4	0.0 (0.0; 0.1)	0.001*	0.1 (0.0; 0.2)	0.0 (0.0; 0.0)	0.119*
Shapiro–Wilk's test	0.001	0.001	—	0.002	0.001	—	0.073	0.001	—	0.004	0.001	—
Total	1.3 (0.7; 1.9)	0.6 (0.25; 1.1)	0.001*	1.4 (0.8; 2.0)	0.6 (0.3; 1.1)	0.001*	2.2±1.3	0.8±0.6	0.001**	0.9±0.2	0.3 (0.1; 0.7)	0.119*
Shapiro–Wilk's test	0.003	0.001	—	0.01	0.005	—	0.169	0.263	—	0.435	0.01	—

Table 4. Daily balance between enterally administered nutrition and residual gastric volume in patients with predicted severe acute pancreatitis.

Parameter	Values in groups										
	1, *n*=33	2, *n*=31	*P*	S, *n*=31	M, *n*=33	*P*	S1, *n*=16	M2, *n*=17	*P*	S2, *n*=15	M2, *n*=16	*P*
Day 1	0.2 (–0.1; 0.3)	0.2 (0.1; 0.3)	0.13*	0.2 (–0.2; 0.3)	0.2 (0.2; 0.3)	0.012*	0.0 (–0.2; 0.3)	0.2 (0.1; 0.3)	0.074*	0.1±0.2	0.3 (0.2; 0.3)	0.232*
Shapiro–Wilk's test	0.001	0.007	—	0.001	0.001	—	0.001	0.022	—	0.267	0.04	—
Day 2	0.2 (–0.1; 0.3)	0.3±0.3	0.032*	0.2 (0.1; 0.3)	0.3 (0.1; 0.4)	0.155*	0.0±0.4	0.3 (0.0; 0.4)	0.231*	0.3±0.3	0.3±0.3	0.704**
Shapiro–Wilk's test	0.01	0.379	—	0.038	0.001	—	0.126	0.02	—	0.361	0.226	—
Day 3	0.5 (0.0; 0.7)	0.8 (0.3; 0.1)	0.023*	0.3 (–0.1; 0.5)	0.9 (0.6; 1.0)	0.001*	0.2 (–0.2; 0.4)	0.6 (0.5; 0.9)	0.001*	0.4±0.5	1.0 (0.8; 1.0)	0.004*
Shapiro–Wilk's test	0.001	0.001	—	0.001	0.001	—	0.001	0.018	—	0.544	0.001	—
Day 4	1.0±0.4	1.0±0.3	0.434**	0.8±0.4	1.2 (1.0; 1.5)	0.001*	0.7±0.4	1.2 (1.0; 1.5)	0.001*	0.9±0.3	1.1 (1.0; 1.4)	0.001*
Shapiro–Wilk's test	0.069	0.123	—	0.777	0.001	—	0.909	0.022	—	0.776	0.041	—
Total	1.3±1.3	2.1±0.9	0.007**	1.1±1.2	2.3±0.8	0.001**	0.56; 0.3	2.1±0.9	0.001**	1.63; 1.0	2.6±0.4	0.009**
Shapiro–Wilk's test	0.376	0.133	—	0.829	0.306	—	0.335	0.768	—	0.814	0.554	—

GRV (Tables 3, 4). With NJ nutrition in the group of patients with MSAP, on the contrary, starting from day 3, it was possible to deliver more nutrition (Table 2), and GRV in postpyloric feeding did not differ significantly between the groups with MSAP and SAP (Table 3).

Thus, we can say that patients with MSAP absorbed a larger volume of nutrition in postpyloric delivery due to a better tolerance of its «per-protocol» volume increase. The main function of the stomach is known to be mixing and propelling food into the small intestine at a rate optimal for nutrient absorption through increasing contact time with the mucosa. The mechanisms leading to impaired gut motility in the critical illness are complex [10]. The activity of gastric smooth muscles is regulated by internal myogenic activity, signals from parasympathetic and sympathetic enteric nervous system, and also by some hormones [11]. The main pathophysiological mechanism leading to these disorders is primary gastric motor dysfunction with impaired coordination between its proximal and distal parts [12, 13] as a result of imbalance of hormones secreted by gut, such as ghrelin [14], cholecystokinin, peptide YY [15], and motilin [16]. In critically ill patients, delayed gastric emptying increases as the severity of the disease progresses [17].

Thus, the reduced ability to absorb enteral nutrition in SAP is probably related to the severity of disease in this patient group in the first week of illness [18] due to a longer period of multiple organ failure [19]. The survival of a critically ill patient is affected by the amount of energy and protein he receives with food [20]. Therefore, it is very important to know whether a particular route of nutrient delivery will be more beneficial in a specific type of disease. In the group with SAP, the balance of absorbed nutrition with its postpyloric delivery was significantly

(*P*=0.001) three times greater than with nasogastric route. The results we obtained are consistent with the ones of earlier study proving that the more severe the condition, the more preferable is postpyloric route of feeding compared to nasogastric, due to the greater amount of digested nutrients [21]. In patients with MSAP, the balance of digested nutrition over four days did not differ significantly (*P*=0.107) between NJ (2.6±0.5 L/day) and NG (2.1±0.9 L/day) routes.

Conclusion

Enteral feeding in patients with severe acute pancreatitis should preferably be initiated via nasojejunal tube due to better absorption of nutrients compared to the nasogastric route. In moderately severe acute pancreatitis starting with the gastric route of feeding is appropriate; however, if intolerant, the nutrient delivery should be switched to the nasojejunal route.

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