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Early postoperative gastric enteral nutrition improve gastric emptying after cardiac surgery

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Abstract: Postoperative intragastric enteral feeding in cardiac surgery patients is frequently complicated by delayed gastric emptying. The aim of the study was to evaluate how early postoperative gastric enteral nutrition affects the gastric emptying in coronary artery by-pass graft (CABG) surgery patients.

In the prospective, randomized study 40 patients treated at intensive care unit after CABG surgery were studied. Patients were divided in two groups: enteral feeding group E (20 patients: age 59±8 yr.; male 70%) and control group C (20 patients: age 58±10 yr.; male 80%), respectively. Paracetamol absorption test was used to evaluate gastric emptying. In the group E postoperative gastric supply of enteral formula begun 18 hours after surgery and after 6 hours the supply was stopped and paracetamol solution was administrated by nasogastric tube. The patients in group C for first 24 hours received only crystalloid solutions intravenously and paracetamol solution by nasogastric tube. Blood samples were obtained at 0 (t_0), 15 (t_{+15}), 30 (t_{+30}), 60 (t_{+60}) and 120 (t_{+120}) min after administration of paracetamol.

The values of plasma paracetamol concentration (PPC) at 15 and 120 min were significantly higher in group E *vs.* group C: (t_{+15}) 3.3±2.5 *vs.* 1.7±1.9 and (t_{+120}) 5.2±2.8 *vs.* 3.3±1.6 ($p < 0.05$). The PPC values at 30 and 60 min were higher, but not significantly, in group E *vs.* group C: (t_{+30}) 3.7±2.0 *vs.* 2.9±2.7 and (t_{+60}) 5.1±3.2 *vs.* 3.9±3.5 (p = NS). The area under the PPC curve was 429 ± 309 in the E group *vs.* 293 ± 204 in the group C ($p < 0.05$).

In conclusion an early postoperative gastric administration of nutritients after CABG surgery stimulates the gastric emptying.

Keywords: Early postoperative enteral nutrition, gastric emptying

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1 Introduction

Over the past few years it have been clearly recognized that early enteral feeding has certain crucial advantages over delayed enteral feeding and also over conventional total parenteral nutrition: it preserves the integrity of gut mucosa, reduces bacterial translocation, stimulates the host‘s defense mechanisms, and improves the outcome [1–3].

Recently, it has been demonstrated that early enteral feeding after multiple injury diminishes gastric intolerance towards food and promotes earlier establishment of motility in the gastroduodenal segment of digestive tract [4]. Nevertheless, we could not find any data in relevant literature about the impact of early postoperative enteral feeding upon the gastric motility in patients after cardiac surgery. The aim of the study was to establish how early postoperative gastric enteral nutrition affects the gastric emptying in patients after coronary artery by-pass graft (CABG) surgery.

2 Material and methods

The investigation was designed as prospective, randomized clinical study. All patients were preoperatively informed about the study protocol and they accepted to participate. The protocol was approved by Investigational University Board.

Forty patients treated at cardiac surgery ICU, after CABG surgery, were included in the study. Exclusion criteria for the study were: anamnestic data about diseases of gastroduodenal part of digestive tract or endoscopic findings confirming gastric or duodenal ulcer in the last five years, loss of weight over 10% in the last three months or extreme obesity (BMI $>$ 35), diabetes mellitus, preoperative elevated biochemical parameters of hepatic (ASAT, ALAP, gammaGT and bilirubin) or renal function (urea, creatinine), preoperative intake of drugs which could influence gastric motility (cisapride, methoclopramide, erythromycin, dopamine in doses $>$ 2 μg/kg/min) or paracetamol absorption test (e.g. NSAID). The patients with serious concomitant valvular disease, recent infarct ($<$ 3 weeks), preoperative ejection fraction $<$ 35% and intraoperative use of intra-aortic balloon pump due to the possible influence of hemodynamic instability on the gastric motility were also excluded [5]. Software generated random numbers assigned the patients who entered the study to the early postoperative gastric enteral nutrition (E) group (20 patients) and control (C) group (20 patients). All forty patients underwent the same preoperative procedure: intestinal enema day before operation, overnight fasting and night premedication with diazepam. Surgery started in all patients after 8 hours of fasting. Anesthesia with etomidate as induction agent was maintained with midazolam and fentanyl, using rocuronium for relaxation. Cephalosporin 3^{rd} generation (ceftriaxone or cefotaxime) was used as intraoperative antimicrobic prophylaxis. All patients received a two-lumen nasogastric tube; the exact gastric position was verified by x-ray immediately after entering ICU. All patients were monitored hemodynamically with PA catheter (as a part of protocol guided peri-operative care in our institution) and operated with technique of intermittent ischemia (occlusion). Postoperative mechanical ventilation lasted at least

six hours postoperatively with continuous sedation with propofol. The infusion of propofol was terminated after 6 hours and the patients were taken off mechanical ventilation and extubated by decision of senior anesthesiologist. All patients included in the study were extubated inside twelve hours from the end of surgery and all were normothermic on the beginning of the study. Postoperative analgesia, when required, was maintained with morphine sulphate (during the study maximum one "bolus" of 0.01 mg/kg i.v.). The age, gender, number of coronary grafts, EuroSCORE, severity of illness (SAPS II), body mass index (BMI), overall quantity of used fentanyl, duration of cardiopulmonal by-pass and surgical procedure of patients from both groups are presented on table 1.

Table 1 The age, gender, number of coronary grafts, EuroSCORE, severity of illness (SAPS II), body mass index (BMI), duration of cardiopulmonal by-pass and surgical procedure and overall quantity of used fentanyl during the surgical procedure (mg) in the control group C and E group (early postoperative gastric supply of nutritients).

	Control group	Group E	P value
Age (yr.)	58 ± 10	59 ± 8	NS
Gender (male; %)	14 (70%)	16 (80 %)	NS
EuroSCORE	3,8 ± 0,9	4 ± 0,7	NS
Coronary grafts	3 ± 0,7	2,9 ± 0,9	NS
SAPS II	21 ± 7	20 ± 9	NS
BMI	30.4 ± 3.5	28.8 ± 2.4	NS
Duration of cardiopulmonary by-pass (min)	95 ± 13	98 ± 18	NS
Duration of surgical procedure (min)	181 ± 34	177 ± 45	NS
Overall quantity of used fentanyl during the surgical procedure (mg)	2.5 ± 0.3	2.4 ± 0.5	NS

2.1 Enteral feeding protocol [6,7]

The patients in the E group started with isoosmolar enteral feeding (Osmolite®; Ross) through nasogastric tube 18 hours after CABG surgery according to the scheme: the first 3 hours 30 ml/h, next 3 hours 50 ml/h, i.e. after 6 hours total 240 ml. After 6 hours of feeding (i.e. 24 hours after surgery) the gastric supply was stopped and paracetamol solution (1000 mg/50 ml) was administrated by nasogastric tube. The patients in the group C for the first 24 hours received only crystalloid solutions intravenously and after 24 hours paracetamol solution (1000 mg/50 ml) was administrated, also by nasogastric tube.

2.2 Gastric motility (emptying) measurement

Paracetamol absorption model was used as an indirect measure of gastric motility and emptying [8, 9]. Venous blood samples were obtained from an indwelling peripheral can-

nula immediately before (calibration sample) and at 15 (t_{+15}), 30 (t_{+30}), 60 (t_{+60}) and 120 (t_{+120}) min after administration of paracetamol. Plasma concentration of paracetamol was determined by an immunologic method including fluorescence polarization (TDx®acetaminophen, Abbott Laboratories, North Chicago, IL, USA). Paracetamol absorption was assessed from the plasma paracetamol concentration (PPC), peak paracetamol plasma levels (C_{max}), and the area under the paracetamol concentration curve from 0 to 120 min (AUC_{120}) calculated by using the trapezoidal model.

2.3 Statistical analysis

All values are presented as mean value ± standard deviation. Statistical analysis was done with software Statistica 6.0 (StatSoft. inc., USA), using Chi-square test for compared qualitative baseline variables between groups and Mann-Whitney *U* or one-way ANOVA tests for comparisons of quantitative variables of unpaired samples.

3 Results

The patients from both groups did not differ as regards age, gender, number of coronary grafts, EuroSCORE, SAPS II, BMI, the duration of cardiopulmonal by-pass and duration of surgery (Table 1). The results are presented in tables 2 and 3. All values of PPC as well as the values of $C_{max}$and AUC_{120} obtained during this study were higher in patients from E group. Statistically significant increase in the value of AUC_{120} (Figure 1) and PPC after 15 and 120 min. ($p < 0.05$) was noticed.

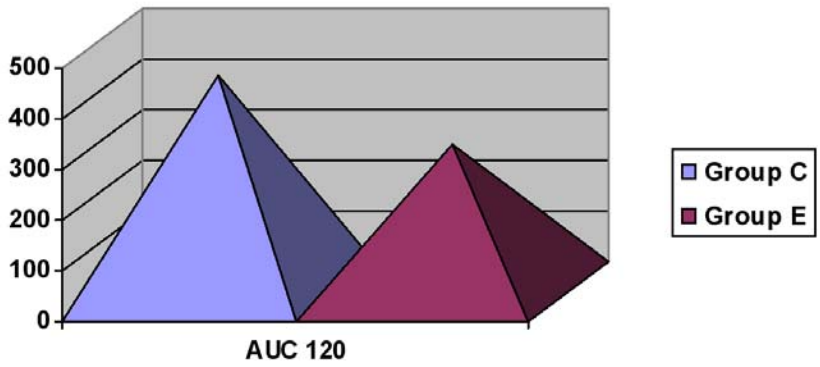

Fig. 1 The area under the paracetamol concentration curve from 0 to 120 min (AUC_{120}) in the control group C and E group (early postoperative gastric supply of nutritients) [$p = 0.026$].

Table 2 Relationship between plasma paracetamol concentration (PPC) in the control group C and E group (early postoperative gastric supply of nutritients).

	PPC_{15}(mg/L)	PPC_{30}(mg/L)	PPC_{60}(mg/L)	PPC_{120}(mg/L)
E group	3.26 ± 2.5	3.66 ± 2.0	5.12 ± 3.2	5.15 ± 2.8
Control group	1.68 ± 1.9	2.94 ± 2.7	3.87 ± 3.5	3.25 ± 1.6
P value	0.021	NS	NS	0.034

Table 3 Peak paracetamol plasma levels (C_{max}), and the area under the paracetamol concentration curve from 0 to 120 min (AUC_{120}) in the control group C and E group (early postoperative gastric supply of nutritients).

	C $_{max}$(mg/L)	AUC $_{120}$
E group	5.15 ± 2.8	429 ± 309
Control group	3.87 ± 3.5	293 ± 204
P value	NS	0.026

4 Discussion

This study focuses on only one question: does early postoperative gastric enteral nutrition improve gastric emptying in patients after cardiac surgery? From the presented results it is noticeable that patients who underwent early postoperative gastric enteral nutrition protocol, after 24 hours (that is 6 hours after beginning of enteral feeding), when 240 ml of enteral formula and 1000 mg of paracetamol was given, had a significantly higher concentration of paracetamol in the plasma in the next 120 min regarding the control group. As groups were reciprocally comparable, and due to the fact that E group had higher values of PPC and AUC_{120} we can conclude that early postoperative gastric nutrition stimulate gastric motility and emptying.

It has been demonstrated that early enteral feeding, after multiple injury, supports the motility of gastroduodenal segment [4]. The results of the present study show that the effect of early enteral nutrition is probably the same in patients after uncomplicated CABG surgery. Therefore, early postoperative gastric enteral nutrition might be an important factor in diminishing postoperative gastric hypomotility and gastric paresis with subsequent intolerance of enteral formula which is not rare in critically ill patients, nor in patients after cardiac surgery [5, 10]. Postoperative intolerance of enteral food in cardiac surgery patients is caused by various factors as for example the use of certain anesthetics, opiates, vasoactive drugs and postoperative mechanical ventilation. It may also be consequence of perioperative splanchnic hypoperfusion or the use of extracorporal circulation [5]. Although enteral feeding is the method of choice in nutritional treatment of surgical patients, due to postoperative intolerance of liquid enteral formula it is often not established adequately. This favors in insufficient intake of calories and greater postoperative

complications, further adding to the cost of treatment [11–13]. In order to suppress and to treat gastric hypomotility and intolerance, promotility drugs and small-bowel tube feeding were used [7, 14–16]. However, in routine clinical use, bearing in mind economic and rational approach, and also to avoid side-effects, promotility drugs are exclusively used in treating already existing gastric intolerance but not for the prevention of postoperative gastric hypomotility [14, 15]. The post-pyloric placement of feeding tube requires certain clinical experience and is technically demanding and time-consuming. With regard to the simple gastric placement, post-pyloric placement of small-bore feeding tube is more expensive and burdened with higher percent of complications and unsuccessful attempts. It should be stressed that recent meta-analysis of Marik and Zaloga did not indicate any clinical benefits of post-pyloric versus gastric tube feeding in a mixed group of critically ill patients, including medical, neurosurgical, and trauma ICU patients [16]. Thus, in every day clinical routine, nasogastric tube presents a standard approach to the gastrointestinal tract with gastric feeding as usual way of enteral nutrition. In our study we used nasogastric feeding tubes and the presented results demonstrate that early postoperative enteral feeding by gastric approach stimulate gastric motility and emptying in uncomplicated cardiosurgery patients.

However, the study has certain important limitations. Firstly, because of exclusion of all cases with perioperative circulatory failure as well as seriously ill cardiac patients i.e. those with increase risk for development of gastric paresis and gastric intolerance [5, 10]. In our opinion, before determining a definitive postoperative enteral feeding guidelines, a similar study should be done on cardiosurgical patients with significant hemodynamic instability or/and with verified (subsequent) splanchnic hypoperfusion. Secondly, due to relatively small number of patients included in the study and owing to the fact that paracetomol test is somewhat robust method for evaluating gastric emptying. In our opinion this is the main reason for such insignificant difference in the values of PPC after 30 and 60 minute, as well as in the values of C_{max}.

5 Conclusions

Summing up, in our study, we have shown that early postoperative gastric supply with liquid isoosmolar enteral formula probably improves gastric emptying after uncomplicated cardiac surgery and may present a mode to prevent postoperative gastric hypomotility with subsequent gastric intolerance.

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