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The Effects of Early Enteral Nutrition Products on the Healing of Colo-Colonic Anastomosis

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A – research concept and design; **B** – collection and/or assembly of data; **C** – data analysis and interpretation; **D** – writing the article; **E** – critical revision of the article; **F** – final approval of article; **G** – other

Abstract

Objectives. Complications after colorectal surgery have not been reduced in recent years. Anastomotic leakage is responsible for nearly all morbidity in colonic surgery and for about one third of the mortality.
Material and Methods. For the study, 34 albino Wistar rats (about 155–190 g in weight) were divided into four experimental groups. Each of the rats underwent an abdominal incision and resection of the colon 4 cm distal to the cecum to form a colo-colonic anastomosis. In the post-operative period, the first group (n = 8) were fed with standard rat food and water, the second group (n = 9) with dextrose + Ringer solution, the third group (n = 9) with Biosorb® (Nutricia, Zoetermeer, The Netherlands), and the fourth group (n = 8) with Impact® (Novartis Nutrition, USA).
Results. The blow-out pressure of the anastomoses was significantly different in the group fed 5% dextrose + + Ringer solution group than in the Biosorb® and Impact® groups.
Conclusions. None of the various nutrients investigated in the present study were significantly superior to standard foods in terms of the blow-out pressures. On the other hand, immunonutrients were more beneficial effects than other nutrients in terms of the healing of colonic anastomoses and post-operative weight loss (**Adv Clin Exp Med 2015, 24, 3, 463–467**).

Key words: anastomosis, nutrition, healing.

Despite technological and surgical improvements, the complications of colorectal surgery have not been reduced. Anastomotic leakage is responsible for nearly all of the morbidity in colonic surgery and about one-third of the mortality [1].

Age, comorbidities, surgical techniques, radiotherapy, medications, pre-operative blood transfusions, the duration of the surgery and the nutritional status of the patient all play a crucial role in the healing of anastomoses [2, 3]. Enteral nutrition is superior than parenteral nutrition in the healing of anastomoses [4]. Also, early enteral nutrition decreases post-operative complications in gastrointestinal surgery [5, 6].

In this study, the effects of various enteral nutrition products on the healing of colonic anastomoses in rats were observed.

Material and Methods

For the study, 34 albino Wistar rats weighing about 155–190 g were divided into 4 experimental groups and isolated in metabolic cages 1 week before the surgery. They starved for 12 h before surgery. All the surgical interventions were performed in sterile rooms and under thiopental anesthesia. The abdominal skin shaved and sterilized with povidone/iodine solution. A 4-cm midline

abdominal incision was made and the colon was resected 4 cm distal of the cecum; 6/0 propylene sutures were used for the colo-colonic anastomosis. Five mL of saline solution were injected into the abdomen to avoid dehydration, and finally the midline incision was sutured with 3/0 silk sutures.

In the post-operative period, first group (n = 8) was fed with standard rat food and water; the second group (n = 9) was fed with 5% dextrose + Ringer solution (Dx + RL); the third group (n = 9) with Biosorb (Nutricia, Zoetermeer, The Netherlands); and the 4 group (n = 8) with Impact (Novartis Nutrition, USA). The solutions had 40 kcal of energy per L. The groups were fed equally in terms of energy.

The *in vivo* blow-out pressure measurements were performed on the 7th post-operative day. A colonic area 2 cm proximal to the anastomosis was transected. About 3 cm of the distal segment of the anastomosis was clamped, and after cleaning the feces from the area, the anastomotic segment was linked to an infusion pump by a catheter. While saline solution was injected at a rate of 2 mL/min, the pressure was measured with a pressure transducer located in the anastomotic segment. A sudden drop in the pressure was accepted as the blow-out pressure, and was expressed as mm Hg.

The daily urinary and stool output and the weight of the rats were recorded. The blow-out pressures of the rats were compared. Variables homogenously distributed within study groups were expressed as mean ± standard deviation. The data were analyzed using SPSS 11.0 software for Windows (SPSS Inc., Chicago, IL, USA). The confidence interval was set at 95% and a p value lower than 0.05 was considered statistically significant. The differences among the groups were evaluated with ANOVA and Levene's tests. Parameters with significant differences were evaluated with *post-hoc* Tukey and Dunnett tests.

Results

All rats in all 4 groups survived without complications until the 7th post-operative day. In the measurements of anastomotic blow-out pressure, all the blow-outs occurred in the anastomotic region. The results of the study are summarized in Table 1. Anastomotic blow-out pressure was significantly different in the 5% Dx + RL group (Group 2) than in the Biosorb group (Group 3) and the Impact group (Group 4); for Group 2 vs. Group 3 p = 0.005; for Group 2 vs. 4 p < 0. 0001 (Fig. 1). There was also a significant difference between the groups in terms of weight loss (Fig. 2).

Table 1. Blow-out pressure and weight loss of the rats

Group	Blow-out pressure (mm Hg)	SD	Weight loss (gr)	SD
1. Standard food	160.00	11.24	6.43	2.15
2. % 5 Dxt + RL	142.86	17.16	14.57	7.70
3. Biosorb	169.89	18.08	4.89	4.11
4. Impact	180.00	5.77	3.43	1.13
p	0.005 (between groups 2 and 3) < 0.001 (between groups 2 and 4)		< 0.001	

Discussion

Colonic surgery is one of the main areas for general surgeons. Anastomotic leakage is common after colonic operations because of the bacterial overload of colonic flora [7, 8]. The leakage rate in colonic surgery ranges from 4.5% to 50% [9–12]. Anastomotic leakage may cause peritonitis or intra-abdominal abscesses. They may increase morbidity, mortality and the duration of hospitalization [13].

Collagen in the submucosal layer of the colonic wall is the main factor determining the mechanical strength of the colon. Therefore, blow-out pressure and breaking force are measured to determine the mechanical strength of the colon. Blow-out pressure reflects the mechanical strength more accurately, and is therefore more frequently used. In this study, the blow-out pressure was measured to determine the strength of anastomoses.

There are several factors that may affect the healing of a colonic anastomosis. In addition to standard healing factors, the age of the patient, anemia, radiotherapy, medications, pre-operative blood transfusion, the duration of the surgery and the nutritional status of the patient all play a crucial role in the healing of an anastomosis [8, 14, 15]. For a good anastomosis, the intestinal segments should be healthy and well vascularized; the anastomotic segments should not be tense; and the material used for suturing should not allow liquid to pass through. Anastomotic leakage in colonic surgery is associated with the mechanical status of the intestine, fecal contamination and sepsis [16]. Complications such as intra-abdominal abscesses and pneumonia are more frequent in patients fed with total parenteral nutrition (TPN) compared to patients who receive enteral nutrition. These complications are more common in patients in intensive care units and in patients with serious traumas

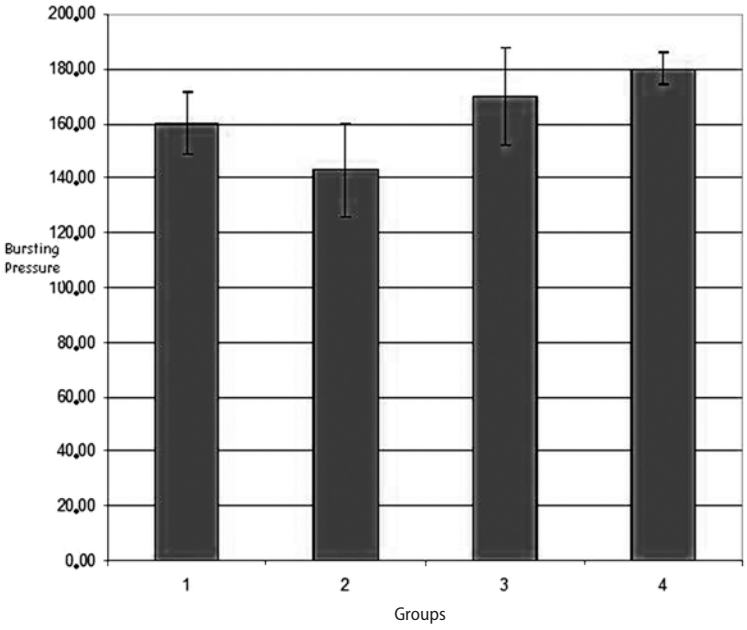

Fig. 1. Blowout pressure of the study groups (ANOVA p = 0.0000, *post hoc* Tukey p = 0.0050)

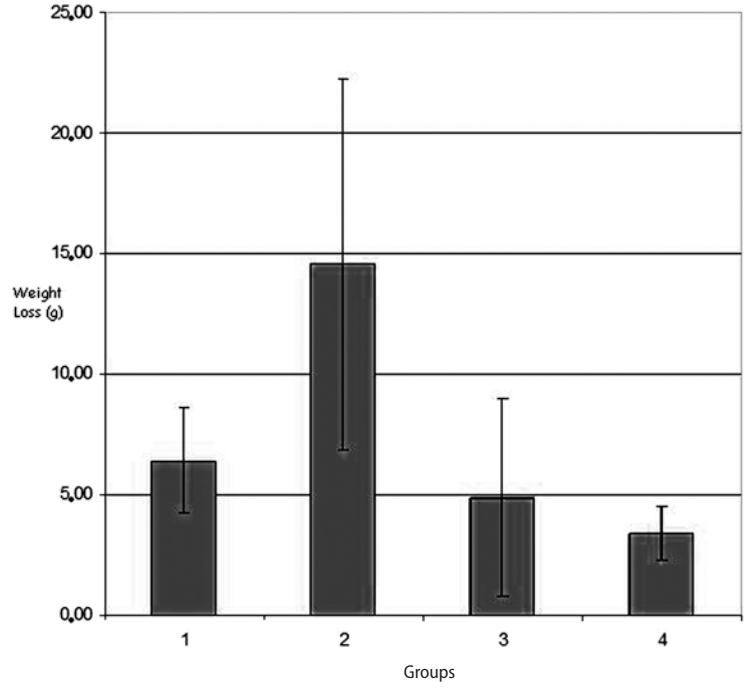

Fig. 2. Weight loss in the study groups

[17–19]. T and/or B lymphocytes in the intestinal mucosa are reduced in patients receiving TPN [20], and intestinal and respiratory IgA levels decrease [21]. Nutrition is a well-known influence on the healing of colonic anostomosis [3, 22]. Good nutrition must include adequate intake of energy, nitrogen, vitamins and trace elements [18, 23, 24]. The most appropriate route for this purpose is enteral nutrition. Enteral nutrition hinders mucosal damage in the intestinal mucosa, allows continuous mucosal IgA production, inhibits bacterial overload and translocation, and reduces the duration of hospitalization and post-operative complications [21]. Several studies have shown that enteral nutrition is superior to parenteral nutrition in the healing of anastomoses [25–27]. The current study showed that mortality and anastomotic leakage rates were higher in rats that were not fed with early enteral nutrition. Late enteral nutrition causes a lack of basic nutrients that are essential for anastomotic healing.

In addition to the beneficial effects of enteral nutrition, the ingredients of the nutrients may have beneficial effects too. There are many studies investigating nutrients that include glutamine, arginine, probiotic bacteria and fatty acids. In the present study one group of rats was fed with Impact. Impact is rich in glutamine, which is essential for

the metabolic needs of enterocytes. It also contains arginine and omega 3 fatty acids. Biosorb is a standard nutrient and has no advantages or disadvantages as compared to standard foods. Sax et al. asserted that nutrient status meliorates and bacterial translocation is reduced when 25% of the total caloric intake is received by the enteral route [28]. The authors concluded that enteral nutrition should be established in patients with anastomoses. In our study, Impact was found to be superior to the other nutrients in terms of weight loss, but there was no difference among the nutrients in terms of anastomotic healing.

Nutrients are essential for biological processes and growth. Surgeons usually do not use enteral nutrition for patients with anastomoses to avoid leakage. Therefore, a lack of substrate causes complications. The authors found that complications were more common in rats that were not fed with early enteral nutrients, and concluded that anastomotic subjects should receive early enteral nutrition. The Group 2 animals, treated with only dextrose and electrolytes, suffered from more weight loss and their blow-out pressure was lower. The ingredients of early enteral nutrients should be modified for more beneficial effects after colonic anastomosis.

In conclusion, none of the various nutrients investigated in the present study were significantly superior to standard foods in terms of the blow-out pressures. On the other hand, immunonutrients have more beneficial effects on the healing of colonic anastomosis and post-operative weight loss compared to other nutrients.

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