

Original Article

Early enteral nutrition for upper digestive tract malformation in neonates

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Background: Early enteral nutrition (EEN) is better than total parenteral nutrition (TPN) for many reasons. Our aim was to determine the safety and feasibility of EEN using a jejunum feeding tube in the duodenum or jejunum for congenital obstruction in neonates post-operatively. **Methods:** This was a retrospective review of 120 patients who had duodenal and jejunal congenital obstructions in our hospital. The patients were categorized into two groups (EEN group [n=70 patients] and control group [n=50 patients]). Differences in operative time, post-operative time to tolerate oral feeding (40 mL/3 h), post-operative hospital stay, and complications, such as catheter obstruction, diarrhea, and nutrition index, were reviewed. **Results:** The operative time and time to first defecation post-operatively was not significantly different between the two groups. The time to tolerate oral feeding (40 mL/3 h) and the hospital length of stay post-operatively for the EEN group were significantly shorter than the control group. Total protein, pre-albumin, and retinol binding protein were significantly higher in the EEN group than the control group 14 days post-operatively. The incidence of cholestasis and obstruction in the EEN group was significantly lower than the control group, and the incidence of diarrhea was lower than the control group, but not significantly lower. **Conclusion:** EEN using a jejunal feeding tube in an upper digestive tract malformation in newborns post-operatively is safe, easy, and has fewer complications.

Key Words: jejunum nutrition tube, enteral nutrition, duodenum or jejunum congenital obstruction, neonate

INTRODUCTION

Duodenal or jejunal congenital obstruction is a common intestinal malformation in newborns, and includes duodenal atresia, a simple duodenal diaphragm, duodenal stenosis, and complete discontinuity. Small intestinal atresias are classified as type I, II, IIIa, IIIb, and IV. If a duodenal or jejunal congenital obstruction is diagnosed, urgent surgical treatment is required.¹ Duodenal or jejunal surgical procedures are always performed in malnourished neonates. These patients need adequate nutritional support, but very often they may face nutritional problems.^{2,3}

To protect the anastomotic site from the stress of oral fluids and diet, and to restore intestinal motility to a normal state, a long period of starvation after gastrointestinal surgery involving intestinal resection and anastomosis is recommended.⁴ However, if patients need a longer fasting period for parenteral nutrition, they are more likely to require longer hospitalization and additional costs.⁵

Compared with total parenteral nutrition (TPN), enteral nutrition (EN) is considered to be more suitable for patients, is less expensive, requires shorter hospital stays, maintains gut structure and function, and has fewer septic complications.⁶⁻⁹

EN aims to maintain adequate nutritional status and promote peristalsis of the intestine in the distal anastomosis, and reduce complications that result from lack of nutrition or parenteral alimentation. Jejunal feeding tube placement is one of the methods used in EN. Our aim was to determine if early EN (EEN) using a jejunal feeding

tube is safe, feasible, and well-tolerated in neonates with duodenal and jejunal congenital obstruction.

MATERIAL AND METHODS

Subjects

This was a retrospective review of 120 patients with duodenal or jejunal congenital obstruction in the Department of Pediatric Surgery at Nanjing Children's Hospital affiliated with Nanjing Medical University between 1 January 2010 and 30 April 2014. The study was approved by the Ethics Committee of Nanjing Children's Hospital affiliated with Nanjing Medical University. All the guardians of subjects consented to this study.

The patients were categorized into two groups (EEN group [n=70 patients; 46 boys and 24 girls 1-5 days of age; median age=2.9 days], including annular pancreas [n=41], duodenal atresia [n=8], jejunal atresia [n=18], and jejunal duplication [n=3] and control group [n=50 patients; 34 males and 16 females 1-6 days of age; median age= days], including annular pancreas [n=6], duodenal

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atresia [n=8], and jejunal atresia [n=16]). An annular pancreas is a pancreas that surrounds the narrowed segment of the duodenum.

Differences in operative time, post-operative time to tolerate oral feeding (40 mL/3 h [physiologic need]), post-operative hospital stay, and complications, such as catheter obstruction and diarrhea, were reviewed.

Jejunal feeding tube placement during surgery **Catheter group**

The jejunal feeding tube was a silicone catheter, 150 cm in length and 2 mm in diameter (6 Fr). When anastomotic suture surgery was completed, the EN catheter was inserted through one side of the nose, through the pylorus and anastomosis, and placed in the jejunum under direct vision assistance. The tip of the feeding tube was placed advanced approximately 15 cm into the anastomosis (Figure 1).

EEN was initiated 48-72 h post-operatively. A micro-pump was used for continuous infusion EN. Nutrients were derived from 5% dextrose with a gradual transition to a low osmolality extensively hydrolyzed formula (Pep-ti-Junior Nutricia, The Netherlands). Oral feeding was started after of EN and when no biliary drainage existed in the nasogastric aspirate tube. Then, the feeding quantity was gradually increased to complete oral nutritional feeding. Inadequate calorie intake was supplemented by parenteral nutrition. In the control group, oral feeding was started when no biliary drainage existed in the nasogastric aspirate tube, then the quantity of feeding was gradually increased to complete oral nutritional feeding.

Statistical methods

Statistical analysis was carried out using SPSS software (version 14.0; SPSS, Inc, Chicago, IL, USA). A Pearson chi-square test was used to compare the complications in the two groups. The operative time, the length of hospital stay post-operatively, the time to tolerate oral feeding (40 mL / 3 h), the time to first defecation post-operatively, and the hospital length of stay post-operatively are expressed as the mean±SD. Parameters were analyzed by

Student's t-test. For the above parameters, a $p < 0.05$ was considered statistically significant.

RESULTS

Operative time

The operative time of the EEN and control groups was 113.3±13.6 and 107.5±15.7 minutes, respectively; there was no statistically significant difference between the two groups (Figure 2A).

Time to first defecation post-operatively

The time to first defecation post-operatively in the EEN and control groups was 46.1±5.6 h and 48.4±4.3 h, respectively; there was no statistically significant difference between the two groups (Figure 2B).

Time to tolerated oral feeding

The time to tolerated oral feeding (40 mL/3 h) in the EEN and control groups was 15.2±2.3 and 19.1±3.3 days, respectively; the time to tolerated oral feeding in the EEN group was significantly shorter than the control group (Figure 2C).

Length of hospital stay post-operatively

The length of hospital stay post-operatively in the EEN and control group was 17.1±3.1 days and 23.4±3.2 days, respectively; the hospital length of stay post-operatively in the EEN group was significantly shorter than the control group (Figure 2D).

Nutrition indices

The levels of total protein, prealbumin, and retinol binding protein were not significantly different between the two groups pre-operatively, but were significantly higher in the EEN group than the control group 14 days post-operatively (Figure 3A-C).

Complications

No patients died and no patients suffered from intestinal perforation, intestinal volvulus, tube plugging, or other complications in the EEN group; however, cholestasis

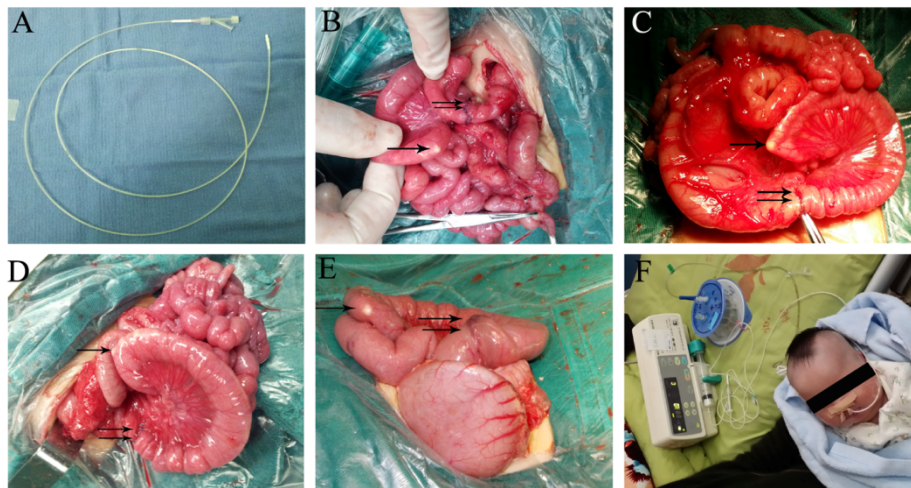


Figure 1. Jejunal feeding tube placement. A, The leading subtype of enteral nutrition silicone catheter (length, 150 cm; diameter, 2 mm). B,C,D,E, The end of the catheter (arrow), intestinal atresia anastomotic position (double arrow). F, Nutrition tube is directly connected to the nipple of the injector to pump milk.

occurred in one patient, aspiration pneumonia occurred in two patients, obstruction occurred in one patient, and diarrhea occurred in three patients in the EEN group. No patients died in the control group; however, cholestasis occurred in six patients, obstruction occurred in six patients, and diarrhea occurred in three patients in the control group. The incidence of cholestasis and obstruction in the EEN group was significantly lower than the control

group, and the incidence of diarrhea was lower than the control group, but the differences were not significant (Figure 3D).

DISCUSSION

In this paper, we have reviewed our experience with a 6 Fr jejunal feeding tube in a neonatal population. No patients died and no patients suffered from intestinal perforation.

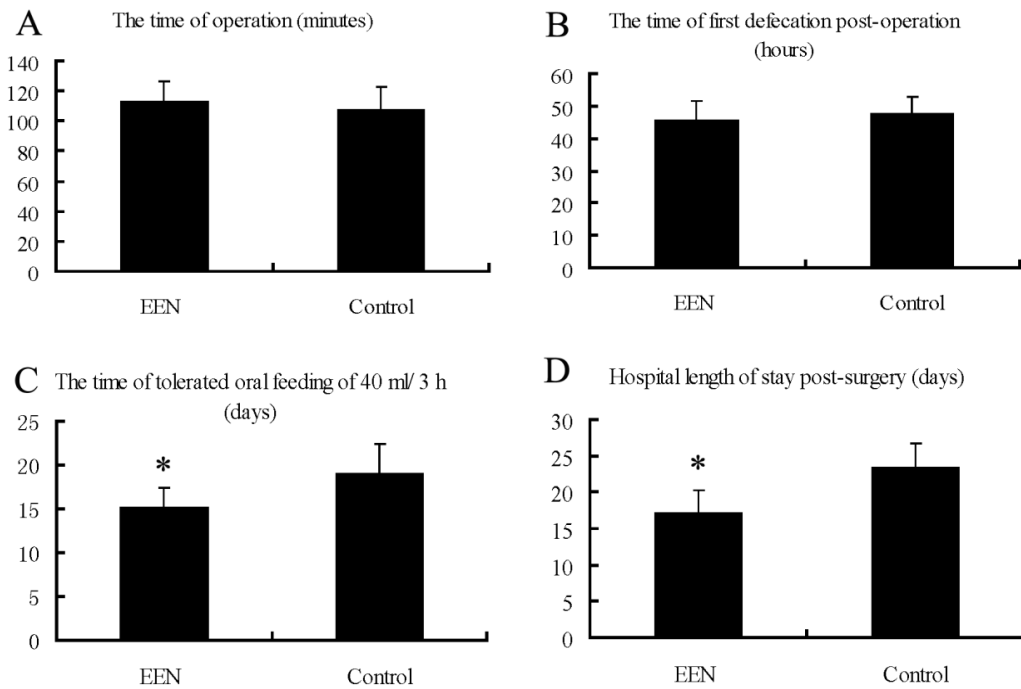


Figure 2. A. The operative time was not significantly different between the two groups. B. The time to first defecation post-operatively was not significantly different between the two groups. C. The time to tolerated oral feeding (40 ml/3 h) of the EEN group was significantly shorter than the control group. D. The length of hospital stay post-operatively of the EEN group was significantly shorter than the control group. $*p < 0.05$

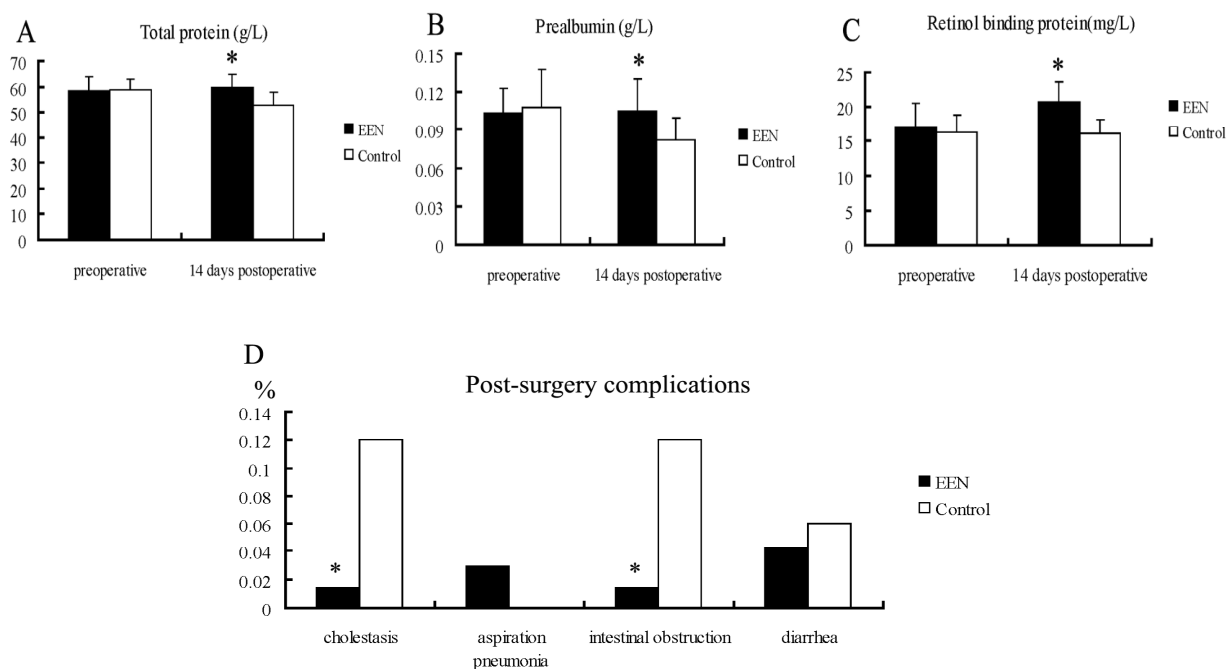


Figure 3. Levels of total protein (A), prealbumin (B), and retinol binding protein (C) were not significantly different between the two groups pre-operatively, but were significantly higher in the EEN group than the control group 14 days post-operatively. (D) showed the incidences of cholestasis and intestinal obstruction in the EEN group were significantly lower than the control group, and the incidence of diarrhea was lower than the control group, but the difference was not significant. $*p < 0.05$.

ration, intestinal volvulus, and tube plugging in the EEN group, and the incidences of cholestasis, obstruction diarrhea, in the EEN group were lower than the control group, but aspiration pneumonia occurred in two patients in the EEN group.

Pepti-Junior is a depth-hydrolyzed protein formula powder (80% short peptides + 20% amino acids) that is suitable for intestinal dysfunction in infants, especially infants with absorption dysfunction. Pepti-Junior has low osmotic pressure, and it has been suggested that at a concentration of 12.8%, the osmotic pressure is 210 mOsm/kg. Moreover, Pepti-Junior contains glutamine, which helps to restore intestinal function, so we chose Pepti-Junior as our enteral nutrition liquid.

Diarrhea was the most frequent complication in the EEN group. Some authors consider diarrhea to be caused by a high osmotic enteral nutrition liquid infused directly into the jejunum.¹⁰⁻¹³ In the current study, however, the osmotic pressure had low osmolality, the incidence of diarrhea was very low in both groups, but lower in the EEN group due to prevention of bacterial translocation and gut mucosal atrophy. Aspiration pneumonia is thought to be one of the potential complications in patients receiving EN.¹⁰ In the current study, there were two patients who developed aspiration pneumonia.

Clinical evidence has demonstrated the benefits of EEN in malnourished patients. EEN is an integral part of intestinal surgery and of great importance in the management of malnourished patients. Patients with duodenal and jejunal congenital obstruction are often malnourished due to frequent vomiting at the time of initial diagnosis.¹ EEN improves malnourished status by ensuring or increasing nutrient intake in the intestine.¹⁴⁻¹⁷ Previous studies also suggest that EEN support may alter the hypermetabolic response, which begins after surgery.¹⁸ In the current study, the levels of total protein, prealbumin, and retinol binding protein were significantly higher in the EEN group than the control group; thus, EEN support can improve nutritional status.

EEN is superior to TPN for several reasons, such as fewer catheter infections, maintenance of gut integrity and motility, and shortening the period of post-operative ileus, and EEN may increase intestinal peristalsis and reduce intestinal adhesions leading to a faster recovery of bowel function, thus contributing to a shorter hospital stay.^{6-13,19} Moreover, compared with parenteral nutrition (PN), EEN prevents bacterial translocation and gut mucosal atrophy and improves nitrogen balance.^{20,21} Furthermore, EEN (<72 h post-operatively) can enhance these effects.^{5,12,19,22} Indeed, the incidences of intestinal obstruction and diarrhea in the EEN group were lower than the control group. Therefore, EEN support may be preferred.

A jejunal feeding tube was placed intra-operatively in the current study, and correct positioning of this tube was confirmed intra-operatively. Compared with EN by jejunostomy, placement of the jejunal feeding tube through natural cavities (the nose), there was no trauma, fewer infections, easy care, and easy to unplug.

The study showed that duodenal feeding tube for duodenal and jejunal congenital obstruction is safe, feasible, well-tolerated, and associated with fewer complications

and better clinical outcomes.

AUTHOR DISCLOSURES

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The authors declare no conflict of interest.

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Original Article

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早期肠内营养在新生儿上消化道梗阻中的应用

背景：已有的研究证明早期肠内营养优于完全肠外营养。我们的研究目的是探讨早期肠内营养（采用空肠营养管的方法）在新生儿十二指肠或空肠梗阻术后使用的安全性和可行性。**方法：**我们回顾性研究本院 120 例十二指肠或空肠梗阻的病人。这些病人被分为两组，早期肠内营养组（70 例），完全肠外营养组即对照组（50 例）。我们比较两组的手术时间、术后经口喂养达到 40mL/3 h 的时间、术后住院时间、并发症如导管堵塞、腹泻等及术后营养指标。**结果：**手术时间和术后首次排便时间两组间没有显著性差异。经口喂养达到 40 mL/3 h 的时间和术后住院时间肠内营养组均明显短于完全肠外营养组。术后 14 天时总蛋白、前白蛋白及视黄醇结合蛋白肠内营养组明显高于完全肠外营养组。胆汁淤积的发生率肠内营养组明显低于完全肠外营养组。腹泻发生率肠内营养组低于完全肠外营养组，但无统计学意义。**结论：**采用空肠营养管的早期肠内营养方法在新生儿上消化道梗阻术后使用是可行的，并且并发症较少。

关键词：空肠营养管、肠内营养、十二指肠或空肠先天性梗阻、新生儿