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A STUDY ON EFFECTS OF EARLY ENTERAL NUTRITION AFTER GASTROINTESTINAL SURGERY IN CRITICALLY ILL CHILDREN

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ABSTRACT:

Background: Young children are at a developmental stage, and any change in their body growth, development and nutritional status during this period has a direct impact on the prognosis of a specific disease. Children with congenital digestive system abnormalities make up the majority of pediatric patients undergoing abdominal surgery. Following surgery, their nutritional health is frequently affected because of things like stress reactions and surgical damage. As a result, appropriate dietary support is now a necessary intervention.

Methods: A total of 80 children with gastrointestinal (GI) disorders who underwent surgical treatment at our facility between January 2020 and December 2021 were included in this study. They were randomly assigned to either the control group or the early enteral nutrition group based on their admission order. The control group did not receive early enteral nutrition (EEN), whereas the early enteral nutrition (EEN) group was provided with early enteral nutrition (EEN) through a percutaneous endoscopic jejunostomy (PEJ) tube and postoperative jejunostomy tube. We compared the recovery of GI function, alterations in biochemical markers within 7 days after surgery, postoperative nutritional status, and complications between the two groups.

Results: Post-surgery, both the time until patients could eat solid food and the time until the first flatus or defecation were significantly reduced in the early enteral nutrition (EEN) group compared to the control group (all $P<0.05$). Seven days after surgery, serum albumin (ALB), potassium, and serum calcium levels were notably greater in the early enteral nutrition (EEN) group than in the control group (all $P<0.05$). In the early enteral nutrition (EEN) group, the average duration of enteral nutrition (EN) support was 7.4 ± 2.5 days, with jejunostomy feeding lasting an average of 44.5 ± 4.8 days. Throughout the jejunostomy feeding phase, 11 newborns showed an average daily weight increase of 17.9 ± 3.1 g.

Conclusions: Adequate early enteral nutrition following gastrointestinal surgery can enhance survival rates, speed up the recovery of gastrointestinal function, and boost the nutritional status in pediatric patients. This approach can also be implemented in clinical practice.

KEYWORDS:

Early enteral nutrition (EEN), Gastrointestinal surgery, Percutaneous endoscopic jejunostomy, digestive system, Postoperative complications, Recovery of gastrointestinal function, Nutritional status.

INTRODUCTION:

Children, in particular those undergoing major gastrointestinal surgery, are particularly vulnerable to the adverse effects of prolonged fasting because of their rapid growth and increased metabolic needs. EEN has been shown in both adult studies to provide important physiological benefits, including maintaining intestinal mucosal integrity, stimulating intestinal motility and hormone secretion, improving wound healing at sites of anastomosis, and modulating inflammatory and immune responses.

Research indicates that providing nutritional support after surgery may lead to fewer complications and improved clinical outcomes for various surgical procedures. In particular, initiating enteral nutrition (EN) within the first 24 hours after major intestinal surgery is advantageous, as it can lower the incidence of infectious complications, bacterial translocation, aspiration, and the severity of multiple organ dysfunction syndromes, and is even linked to a decrease in postoperative mortality rates following gastrointestinal (GI) surgeries. Furthermore, EN is considered to be safer and more cost-effective than parenteral nutrition (PN).

The potential advantages of early enteral nutrition (EEN) also arise from the reduction of oxidative stress following surgery. As a result, healthcare providers have shown increased interest in initiating feeding for patients as soon as feasible. Nonetheless, many practitioners delay feeding until the first week due to concerns about potential risks, particularly hemodynamic instability, which has been regarded as either a relative or absolute contraindication for EEN. An early initiation of oral nutrition correlates with enhanced splanchnic blood flow. Thus, it is crucial that enteral nutrition is implemented considering the hemodynamic state without a rise in overall cardiac output, a phenomenon referred to as “steal.” In patients experiencing unstable hemodynamic conditions, enteral nutrition has been associated with gut ischemia, as demonstrated by a study involving rats with mesenteric artery occlusion. Enteral nutrition (EN) support was previously deemed impractical for infants and children post-gastrointestinal (GI) surgery. Nevertheless, recent research on GI function has demonstrated that enteral nutrition (EN) is a cost-effective and physiologically viable option that can enhance GI development following surgery, with minimal complications. After upper GI surgery, patients typically have an anastomosis, and both intra-operative anastomotic drainage and enteral nutrition (EN) support the implementation of early enteral nutrition (EEN) in these patients. In our ongoing study, we examined the effectiveness of early enteral nutrition (EEN) in facilitating the recovery of GI function and enhancing nutritional status in children after GI surgery.

Methods:

Clinical data:

A total of 80 children diagnosed with gastrointestinal diseases and receiving surgical treatment at our center between January 2020 and December 2021 participated in this study. They were randomly assigned to either the control group or the EEN group based on their order of admission, with each group comprising 40 patients.

The EEN group included 23 males and 17 females aged 9 days to 9 years. There were 13 newborns, including 7 males and 6 females. The birth weight of these 40 children was 1.18 to 4.13 kg, with an average body mass of 2.51 ± 0.54 kg. Symptoms in the EEN group included short bowel syndrome (n=7), intestinal perforation (n=3), large protruding umbilicus (n=8), intestinal malrotation (n=5), jejunal atresia (n=3), esophageal atresia (n=5), gastric wall muscular layer defect (n=4), duodenal atresia (n=3), intestinal fistula (n=1), and heterotopic pancreas (n=1). The surgeries were performed 11 days to 9 years after birth.

The control group included 25 males and 15 females aged 10 days to 9 years. There were 15 newborns, including 8 males and 7 females. The birth weight of these 40 children was 1.17 to 4.03 kg, with an average body mass of 2.46 ± 0.58 kg. Symptoms in the control group included short bowel syndrome (n=7), intestinal malrotation (n=7), large protruding umbilicus (n=4), esophageal atresia (n=4), jejunal atresia (n=4), duodenal atresia (n=4), intestinal perforation (n=3), intestinal fistula (n=3), and heterotopic pancreas (n=4). The surgeries were performed 11 days to 9 years after birth.

Methodology:

In the control group, no enteral nutrition was utilized; however, the enteral nutrition group received it through a percutaneous endoscopic jejunostomy (PEJ) tube and a postoperative jejunostomy tube. A split-style PEJ tube (Flocare; CH5, with a diameter of 1.7 mm) was utilized in the enteral nutrition group. Enteral nutrition was administered in the following manner:

Jejunostomy:

After the operation had been completed and before the abdomen was closed, a trocar was used to perform the puncture. The lateral wall of the intestine was punctured at the mesentery by a depth of approximately 20 cm below the anastomosis. A jejunostomy tube was inserted through a trocar to the distal end of the colon. After withdrawal of the trocar, the puncture cannula entered the left upper abdominal wall and catheterisation was performed. The trocar was pulled out and torn, and then the silk stitches were applied to close and anchor it.

Formulation and infusion of nutrient solutions:

The newborn was breast-fed. For infants unable to receive breast milk, formula milk was used instead: PRE-LACTOGEN (Nestle) was used for premature infants and NAN (Nestle) was used for full-term infants; Peptamen Junior (Nestle) was used for infants from 1 year of age. All nutrient solutions have been prepared at the nutrition center of our hospital. Prior to infusion of the nutrient solution, a suitable volume of normal saline should be injected. The nutrient solution was administered in a range of low volume concentration (1:1 formula milk) to high volume concentration (2:1 formula milk). The initial volume was 1 to 2 ml, after which it was increased gradually. After continuous infusion for 2 to 7 days, the intestinal tract becomes tolerant to the nutrient solution; thereafter, the dose is increased each time to 2 ml. After 1 week of jejunostomy-feeding, the feeding regimen was gradually switched to a single oral dose. Any insufficient calorie intake during the jejunostomy feeding was supplemented by intravenous nutrition. The symptoms of the child should be monitored during the feeding process. If any undesirable effects, such as distension, vomiting or diarrhoea, occur, the increase in the feeding dose should be discontinued and changes in these symptoms closely monitored. Where necessary, the use of the nutrient solution was discontinued and EN was gradually reintroduced only after the symptoms had resolved. Oral feeding is usually initiated 7 to 21 days after the administration of the jejunostomy. The specific nutrition programme and the composition of the nutrient solution could be adapted in the light of the daily rounds of wards.

Main measures:

Liver function was monitored during treatment and a routine blood test was carried out. The children's body weight, blood glucose and electrolyte measurements were measured and recorded. The recovery of gastrointestinal function, changes in biochemical parameters within 7 days after surgery, post-operative nutrition status and complications were compared between the two groups.

Statistical analysis:

The statistical analysis was carried out using the SPSS 17.0 software package. Time and biochemical indicators are presented as mean ± standard deviation and inter-group differences have been compared by t-test. The count data, including the adverse events, are presented as percentages and the differences between the groups were compared by chi square test. A p value below 0.05 was considered to be statistically significant.

Postoperative recovery:

There was no significant difference between the EEN and control groups in the incidence of post-operative complications (P>0.05). After surgery, the time to eat a solid meal and the time to first urinate or defecate were significantly shorter in the EEN group compared to the control group (all P<0.05).

Table 1: Comparison of postoperative recovery between the two groups

Group	n	Adverse reactions	Time to eating solid food (h)	Time to first flatus (h)	Time to first defecation (h)
Control group	40	10	57.3 ± 3.4	54.7 ± 5.1	57.3 ± 4.8
EEN group	40	07	41.3 ± 4.1	39.9 ± 2.8	45.9 ± 2.3
x2/t	-	0.419	17.381	13.837	12.247
P	-	>0.05	<0.05	<0.05	<0.05

EEN (Early enteral nutrition)

Comparison of biochemical indicators between both groups 7 days after surgery:

Serum albumin (ALB), potassium, and serum calcium levels in the EEN group were significantly higher than those in the control group 7 days after surgery (all P<0.05). The serum sodium level showed no significant difference (P>0.05).

Table 2: Comparison of biochemical indicators between both groups 7 days after surgery

Group	n	ALB (g/L)	Serum potassium (mmol/L)	Serum calcium (mmol/L)	Serum sodium (mmol/L)
Control group	40	34.12±0.77	3.95±0.37	1.95±0.88	141.56±12.05
EEN group	40	36.78±1.23	4.56±0.54	2.41±0.59	144.17±11.55
t	–	9.991	5.567	2.554	0.863
P	–	<0.05	<0.05	<0.05	>0.05

EEN (Early enteral nutrition), ALB (Albumin)

Postoperative EN in the EEN group:

In the first enteral nutrition (EEN) group, the initiation of enal nutrition (EN) was 1 to 60 days after surgery, with an average EN duration of 7.5±2.5 days. Jejunostomy-feeding lasted from 14 to 180 days (mean 44.98±4.3 days). Oral feeding was reintroduced 0 to 1 day after the jejunostomy (7 to 75 days after surgery) with an average time to reintroduce 10.8±2.6 days. During the course of jejunostomy feeding, body weight increased at 18.5±2.6 g per day in 14 neonates.

Postoperative complications in the EEN group:

Seven EEN children had gastrointestinal surgery complications (mild in 5 cases and severe in 2 cases). In 4 cases, the jejunal tube slipped out; as all four children could start oral administration, no second catheterization was performed. In one case, the tube was blocked 33 days after catheterization; as the patient could feed orally, the tube was removed. In the remaining 2 patient, it was found that the jejunal tube penetrates the intestinal wall and causes abdominal distension 3 days after catheterization; a second surgery was then performed and the jejunal tube replaced. The remaining 34 EEN patients were not observed to develop complications.

Discussion:

Young children are at a developmental stage, and any change in their body growth, development and nutritional status during this period has a direct impact on the prognosis of a specific disease. Children with congenital digestive system abnormalities make up the majority of pediatric patients undergoing abdominal surgery. Following surgery, their nutritional health is frequently affected because of things like stress reactions and surgical damage. As a result, appropriate dietary support is now a necessary intervention. In this prospective trial, we looked into how early enteral nutrition (EEN) affected children's nutritional status and recovery of gastrointestinal (GI) function following GI surgery.

Clinical use of total parenteral nutrition (TPN) has dramatically reduced the incidence of fatal cases and improved the nutrition status of children undergoing abdominal surgery. However, TPN is also the major cause of post-operative cholestasis, intestinal mucosal atrophy and increased intestinal permeability. In addition, TPN may increase the risk of intestinal translocation, sepsis, liver damage and other diseases. Proper EN support may effectively promote growth of intestinal mucosa, speed up the recovery of intestinal endocrine function and speed up the recovery from anastomosis. Advances in PEJ plus catheterisation technologies have made EEN remarkably feasible for children undergoing abdominal surgery.

In the current study, patients in the EEN group started receiving jejunostomy feeding 1 to 60 days after gastrointestinal surgery, and continued receiving feeding for 14 to 180 days. During the course of jejunostomy feeding, body weight increased at 18.5±2.6 g per day in 15 neonates. The feeding of patients with jejunostomy lasted for up to 6 months and no complications were observed during treatment. Seven children in the EEN group developed post-operative complications (mild in 5 cases and severe in 2 cases), which did not develop into severe complications due to intervention and prompt treatment. The remaining 34 EEN patients were not observed to develop complications. These indicate that PEJ plus catheterisation may be used in patients undergoing long-term gastrointestinal surgery and offer some nutritional support.

However, feeding through a jejunostomy as a method of EN after surgery has been associated with certain complications. Clinically, PEJ plus catheterisation may cause common gastrointestinal complications such as abdominal pain, distension, diarrhoea, dyspepsia, vomiting, and intestinal blockage. There may also be mechanical complications (e.g. pulmonary intramuscular injury and catheter obstruction), metabolic and infectious complications (e.g. bacterial colonization, bacterial invasion and fluid imbalance). In children who develop GI complications during feeding with a jejunostomy, all symptoms should be monitored closely and treated promptly. In children who develop metabolic and infectious complications, biochemical and electrolyte indicators should be monitored, as well as the care of stools and the feeding of jejunostomy tubes. During surgery and, if necessary, during or after feeding by a jejunostomy, mechanical complications should be managed in a standardized way. After each feeding session with the jejunostomy tube, the jejunostomy tube should be flushed with normal saline. In the current study, the time to eat a solid meal and the time to first urinate or defecate were significantly shorter in the EEN group compared to the control group ($P<0.05$) at 7 days post surgery, and serum levels of ALB, potassium and calcium were significantly higher in the EEN group. In summary, a correct EEN after gastrointestinal surgery may increase survival, speed recovery of gastrointestinal function and improve nutrition in paediatric patients. This intervention may be further developed in clinical practice.

Conclusion:

Current evidence strongly supports the use of early enteral feeding in paediatric patients following gastrointestinal surgery, particularly those with a functional gut. EEN is a key component of improved recovery protocols, which support recovery, reduce resource use and improve results. A proper EEN after gastrointestinal surgery may increase survival, speed recovery of gastrointestinal function and improve nutrition in paediatric patients. This intervention may be further developed in clinical practice.

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