Enteral diet in critically ill newborns: a practical protocol

Dieta enteral em recém-nascidos criticamente enfermos: um protocolo prático

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DOI: 10.5935/2238-3182.20140058

ABSTRACT

In recent years, advances in obstetric and neonatal care have significantly increased the survival of premature infants, especially those with very low weight. Several studies highlight the importance of a proper diet and its appropriate starting time for these high-risk infants. This article aimed to review the literature regarding enteral nutrition in newborns, especially premature neonates, admitted in the intensive care unit (ICU), and was based on the PubMed, Scientific Electronic Library Online (SciELO), National Library of Medicine (MedLine), and LILACS data bases; the study proposes a practical protocol of indications and administration of the enteral diet. The methodology for starting, advancing, and maintaining the enteral diet in newborns requiring intensive care is very diverse. The standardization of a protocol of enteral nutrition in intensive care unit results in improved nutrition, growth, and development, and reduced complications in premature neonates.

Key words: Premature; Newborn; Enteral Nutrition; Feeding; Protocols

RESUMO

Nos últimos anos, avanços no cuidado obstétrico e neonatal têm elevado significativamente a sobrevida dos prematuros, principalmente aqueles de muito baixo peso. Vários estudos destacam a importância da dieta adequada e do momento oportuno de seu início para esses lactentes de alto risco. Este artigo teve por objetivos revisar a literatura em relação à nutrição enteral em recém-nascidos, principalmente prematuros, admitidos em unidade de terapia intensiva (UTI), a partir das bases de dados científicas PubMed, Scientific Eletronic Library Online (SciELO), National Library Of Medicine (MedLine) e LILACS, e propor um protocolo prático de indicações e administração de dieta enteral. A metodologia de iniciar, avançar e manter dieta enteral em recém-nascidos que necessitam de cuidados intensivos é muito diversificada. A padronização de um protocolo de nutrição enteral em unidade de terapia intensiva resulta em melhoria da nutrição, crescimento e desenvolvimento e redução das complicações em recém-nascidos prematuros.

Palavras-chave: *Prematuro; Recém-Nascido; Nutrição Enteral; Alimentação; Protocolo*

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Submitted: 2013/05/28
Approved: 2014/04/12

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INTRODUCTION

Nutritional support to the critically ill newborn must be introduced as soon as possible because it provides nutritional trophic benefits, prevents mucosal atrophy, stimulates intestinal maturation, reduces incidence of necrotizing enterocolitis (NEC), and prevent prolonged parenteral nutrition (NPT).[1] However, for various rea-

sons, a significant number of newborns is maintained in exclusive NPT in the first week of life.[1]

The standardization of enteral diet helps reducing parenteral nutrition related complications, use of central catheters, infections related to or associated with the central access, and hospital stay consequently reducing costs.[2]

METHODOLOGY

A literature review was conducted on the scientific databases PubMed, Scientific Electronic Library Online (SciELO), National Library of Medicine (MedLine), and LILACS, in Portuguese and English. The descriptors "nutrition", "enteral diet", "premature", and "newborn" were used. A total of 26 articles were selected and used together with textbooks, considering the relevance and the informational value of the material, and some key articles selected from citations in other articles.

REVIEW OF THE LITERATURE

The gastrointestinal tract is anatomically well developed around 24 gestational weeks, and most of the digestive enzymes are present. Gastric acid secretion is sufficient for intra-gastric digestion, although lactase activity is relatively low and present in quantity and activities that are low enough to moderate the digestion of lactose, except in most premature newborns. The limiting factor in the success of enteral nutrition is the limited gastrointestinal motility in the premature.[3] The intestinal transit and gastric emptying are significantly slow when compared to the term newborn, and definite intestinal motility does not start until the final 32-34 weeks of gestational age.[1,4]

Although extremely low weight newborns are dependent on NPT in the first days of life, the administration of minimal enteral diet has been indicated for nutritional support for these newborns. The presence of intraluminal nutrients seems to stimulate the development of the gastrointestinal mucosa, maturation of intestinal motor activity,[4,5] and the increased secretion of hormones and regulatory peptides.[6-8] The trophic diet can be started in the early days of life if the newborn is relatively stable and presents clinical findings such as peristalsis and abdominal examination within normality but not necessarily elimination of meconium.[9]

Human milk has a protective effect on the development of necrotizing enterocolitis (NEC).[3, 10,11] The potentially protective mediators present in breast milk are anti-infective agents such as lysozyme, immunoglobulins, complements, macrophages, lymphocytes, and lactoferrins.[12] Excessive volume feeding or accelerated feeding are associated with increased frequency of NEC[13]; some studies have shown that the standardization of limited volumes at 20 mL/kg/day carries out protection against NEC. Infants with NEC have the high likelihood of being fed early with complete formulas, volumes, and more increments. In addition, stress and respiratory problems may make patients more vulnerable to NEC. Studies have provided subsidies for standardized nutrition in newborns of low birth weight (500 to 2500 g) in which all used the maximum volume of 20 mL/kg/day beginning at 24 to 72 hours after birth, depending on weight and gestational age.[14,15] In infants of very low birth weight, the administration of trophic diet exerts[16,17] protection and does not raise the risk of NEC.[5] When breast milk is not available, specific formulas for term newborns and premature neonates are indicated.[18]

There are several clinical conditions in premature neonates that require modifications in nutritional strategies. Such conditions include hypoxic-ischemic encephalopathy, administration of drugs that affect tolerance or metabolism (for example indomethacin, dexamethasone, and dopamine) and states of catabolism such as sepsis. There are few prospective studies in humans that discuss different strategies for these conditions. Premature research shows that patent ductus arteriosus (PDA) reduces the flow in the descending aorta, superior mesenteric artery, and celiac arteries. This intestinal hypoperfusion has been implicated as the etiology in increased incidence of NEC.[19] Indomethacin, non-surgical therapy of symptomatic PDA, is associated with the reduction of gastrointestinal blood flow evaluated by ultrasound Doppler and its administration has been linked to NEC.[20]

The time when the enteral diet must be suspended in asphyxiated newborns is not well established. The time of three to five days is commonly used with the aim of reducing the risk of NEC. This is based on experimental data demonstrating that ischemia and hypoxia may result in intestinal congestion and vascular bleeding that can be aggravated with the administration of enteral diet.[21] This period of three to five days coincides with the time required for regeneration of the intestinal mucosa after injury. There are few studies that define specific clinical situations that counter indicate mini-

mal enteral diet; however, clinical and physiological conditions of unknown transition associated with intestinal development indicate several situations in which the diet can be stopped or at least not advanced.

Some conditions that reduce the intestinal blood flow may be counter-indications for enteral diet. Hypotension and asphyxiation may predispose to intestinal injury when enteral diet is offered.[22] Enteral nutrition studies have not been conducted in premature neonates in those circumstances, however, it is prudent to believe that in some newborns these conditions compromise the integrity and functioning of their gastrointestinal tract. Because, often, there is no diagnostic criteria to identify these newborns, diets are frequently interrupted for several days in ill or very premature newborns.

The standardization of the enteral diet helps reducing parenteral nutritional related complications, use of central catheters, infections that are related or associated with central access, and hospital stay[2] consequently reducing costs.[2,23]

PRACTICAL PROTOCOL

Dietary administration forms

Orogastric probe should be placed and if this is not possible, nasogastric probe.

The transpyloric probe should be restricted to cases of serious gastroesophageal reflux disease (GERD).

The schemes are defined according to birth weight (Table 1).

Indications for minimal enteral diet

- newborn ≤ 32 weeks of gestational age at birth;
- perinatal hypoxia (APGAR at 5th min ≤ 7);
- restricted intrauterine growth;
- small for gestational age.

Counter-indications for enteral diet

- hemodynamic instability: hypotension, need of amines, metabolic acidosis with increased anion-gap;
- functional septic ileum;
- suspected or confirmed necrotizing enterocolitis;
- post-operative abdominal surgery;
- clinical signs of intestinal disease;
- use of indomethacin;
- intestinal bleeding;
- intestinal obstruction;
- high-debt enterocutaneous fistula .[18, 24,25]

Table 1 - Schemes of enteral diet for each weight range

Scheme/ Weight at birth (grams)	Diet start (hours of life)	Days of diet	Volume (mL/kg/day)	Interval between diets (hours)	Infusion time (minutes)	NPT	Maximum volume ≥ 11th day of life (mL/kg/day)
A ≤ 1.000	24	1° – 2° 3° – 7° ≥ 8°	10 20 increase 20 daily	2	60 (when reaching Yes* 10 mL/diet)	Yes*	160
B >1.000-1.500	24	1° 2° – 5° ≥ 6°	10 20 increase 20 daily	2	60 (when reaching 10 mL/diet)	Yes*	160
C >1.500-2.000	24	1°-3° ≥4°	20 increase 20 daily	3	30	Yes*	160
D >2.000-2.500	at birth	1° ≥ 2°	20 increase 20 daily	3	20	No	160
E >2.500	at birth	1° ≥ 2°	30 increase 30 daily	3	20	No	160

Observations: * Start at this time if there is no counter-indication.
When the NB reaches 1,500 g, change the diet interval to 3/3 hours. Suspend parenteral nutrition when reaching 100 kcal/kg/day of enteral diet.

COMPULSORY CARE IN ALL WEIGHT RANGES

Before commencing enteral diet, critically ill newborns should be assessed for signs that define indication for enteral diet. Abdominal distention and absence of peristalsis are criteria to delay the start of the diet.

Start three days after hemodynamic stability

Hemodynamic stability

- not receiving adrenaline or dopamine.
- may be in use of dobutamine on a maximum dose of 5 mcg/kg/min and not requiring more expansions with crystalloids and normotensive.
- absence of abdominal distension.
- absence of metabolic acidosis with increased anion-gap (≥ 15 mEq/L).
- from the moment on which the stability, the count begins to a total of three days.

Diet intolerance, presence of gastric residue

Dairy

If the residue is above 20% of the administered volume: return and redeem the total volume being offered.

Bilious

Suspend the diet during which the residue occurred, in any volume.

If there are more than two bilious residue in the same day: suspend the day diet. If the diet is suspended for more than 24 hours, NPT should be initiated.

Septic ileum or necrotizing enterocolitis

Studies have shown that the start of diet four days after the beginning of NEC has reduced the length of stay in the intensive care unit, use of catheters and NPT, and incidence of infections.[2] Use B-type scheme (Table 1) for increments, considering four days of suspended diet, regardless of birth weight and always associate NPT.

Elimination of meconium

In newborns, the elimination of meconium is not required to start the diet.

When the diet is suspended on grounds that counter-indicate enteral diet

Restart with 50% of the volume already previously administered on the last day, except for indomethacin, which follows the scheme of item 10.

Restart after three days from the beginning of hemodynamic stability.

Follow the established scheme for each weight range.

Perinatal Hypoxia (APGAR in the 5th Min ≤ 7)

Start after three days of fasting and follow the scheme for weight greater than 1500 g for increments.

Restricted intrauterine growth

Start after 48 hours of fasting by following the scheme of 2,000 g in weight in relation to increases.

Small newborn for gestational age (SGA)

Start after 48 hours of fasting and follow increments according to birth weight range.

Newborns ≤ 32 weeks of gestational age at birth

Start the diet following the schemes according to weight.

Use of indomethacin or ibuprofen

Use the scheme according to weight range. Suspend diet while using indomethacin or ibuprofen and restart 24 hours after the last dose, in the same volume previously used, if there was no hemodynamic instability.

Post-operative period of abdominal surgery

The start of enteral diet in infants undergoing abdominal surgery should remain suspended until the paralytic ileus is resolved. The absence of bilious and gastric residues and reduction of gastric secretion indicate gastrointestinal motility recovery and possibility of introduction of enteral nutrition.[2,3] Criteria for hemodynamic stability and surgical indications of suspended diet must be observed.

SPECIAL SITUATIONS

Criteria for oral diet

Newborns weighing more than 1,500 g without respiratory involvement or illness that prevents suction. If the oral diet is possible, use amounts according to age (Table 2):

Table 2 - Diet volume according to age

Day of life	Diet volume mL/kg/day
1°	70
2°	80
3°	90
4°	100
5°	110
6°	120
7°	130
8°	140
9°	150
10°	160
≥11°	170

In the case of bronchopulmonary dysplasia and congenital heart disease[16-24]

maximum water volume 120 mL/kg/day;
desired caloric intake: 140-160 Kcal/kg/day.

Mechanical ventilation

Enteral nutrition is offered through a nasogastric probe. There is an important debate if the newborn with respiratory failure should receive intermittent or continuous diet.

However, the intermittent form is more physiological[3].

Gastroesophageal reflux (GERD)

In the case of newborns with GERD, the diet can be used in small volumes and shorter intervals, using the left lateral decubitus position and head elevation of 30° after diets.

DISCUSSION

There is a great discussion around the use of minimal enteral diet in newborns, especially in premature newborns and those with very low weight. There is no evidence that rapid progression increases the risk of necrotizing enterocolitis and other complications. The slow increase in diet volume cannot be related to a reduced risk of complications either. However, it is known that the minimum early enteral diet in extremely low weight newborns does not improve diet tolerance.[26] Randomized and controlled studies are needed to determine the influence of daily speed of volume increments in the diet on the occurrence of infections, nutritional recovery, and restriction of nutrients.

CONCLUSION

The standardization in the administration of enteral diet to newborns, especially premature infants in the neonatal intensive care unit, reduces risk factors for neonatal infection, which significantly impacts healthcare quality because it is the most potent trophic stimulation of growth in the gastrointestinal tract. There are few studies that define specific clinical situations that counter-indicate the minimal enteral diet. Enteral nutrition maintains water intake, glycemic homeostasis, normalization of mineral and electrolyte concentrations, and reduces risk factors for necrotizing enterocolitis.

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