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Original Article

Application of prolonging small feeding volumes early in life to prevent of necrotizing enterocolitis in very low birth weight preterm infants

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ABSTRACT

Objective: To study the effects of prolonging small feeding volumes early in life on the incidence of necrotizing enterocolitis (NEC) in very low birth weight (VLBW) preterm infants.

Methods: A total of 128 VLBW infants who could not be breastfed were assigned into the experimental group (63 cases) and the control group (65 cases) using a random number table. The experiment group was fed 12 mL/(kg·d) on day 1 which was increased to 24 mL/(kg·d) for the first 10 study days. The control group was fed 12 mL/(kg·d) for the first 14–48 hours. Then, the feeding volume increased by 24–36 mL/(kg·d) up to 140–160 mL/(kg·d) and maintained until the 10th day after birth. The incidence of feeding intolerance and NEC, duration of hospitalization, time to full enteral feedings, incidence of intrahepatic cholestasis, and the levels of gastrin and motilin in serum were assessed.

Results: The incidence of feeding intolerance was significantly lower in the experimental group compared with the control group (15.87% *vs.* 33.84%). There was a significant reduction in the incidence of NEC between the experimental and control groups (7.9% *vs.* 16% in the control group).

Conclusion: A protocol that prolongs small feeding volumes early in life can reduce the incidence and severity of NEC, but still warrants further study.

1. Introduction

Neonatal necrotizing enterocolitis (NEC), discovered in very low birth weight (VLBW) infants, is a common gastrointestinal emergency during the neonatal period. NEC occurs 5%–15% of infants with a death rate of 22%, which increases to 50% in infants whose birth weight are lower than 1000 g. Twenty to 40% of NEC cases require surgery for intestinal necrosis and perforation [1]. NEC has a variety of pathogenic factors, mostly discovered in enteral feeding preterm infant [2]. A clinical study of the incidence of NEC in preterm infants with formula

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feeding, mixed feeding, and simple breast feeding were 7.2%, 2.5%, and 1.2%, respectively [3]. While hospitalized, VLBW infants may be fed formula if there are problems with breast milk supply or breast milk safety [4]. Because of high permeability and large volume feeding of milk in some infants, intestinal mucosal can easily be damaged. It was controversial between small volume and routine feeding in early preterm infants [2,5–6]. Berseth [7] had a control study on early small volume feeding and early rapid feeding, but did not explain the type of milk he used. Since there are various uncertain factors in VLBW early feeding, we explored a protocol for prolonging small feeding volumes early in life to observe the biological characteristics of VLBW infant feeding. In addition we determined the clinical effect of preventing NEC by promoting the development of gastrointestinal function while not increasing the burden on the intestinal gastrointestinal tract.

2. Subjects and methods

2.1. Subjects

We assessed 128 cases of VLBW infants (67 male cases and 61 female cases) born from July 2012 to July 2013 at our hospital. This study was approved by the Hospital Ethics Committee, and consent was provided by the family of the VLBW infants in the study. Inclusion criteria: Birth weight was less than 1500 g, gestational age was less than 32 weeks, formula feeding for preterm infant, started enteral feeding at 12–48 h after birth, no obvious abnormal appearance and chromosome abnormality; Exclusion criteria: Severe asphyxia (Apgar score less than 3 points, umbilical cord blood (pH < 7.15 or residual alkali (BE) <−15 mmol/L), full breast feeding or partial breast feeding. VLBW infants (n = 63; 33 males and 30 females) who could not be breastfed were assigned to the experimental group using a random number table. Infant characteristics included: Gestational age (29.7 ± 1.1), weight (1187 ± 238) g, maternal age (30.1 ± 2.1), 50 pregnancy complications, 47 prenatal hormone applications, 39 caesarean sections, 18 premature rupture of membranes, 5 placental strippings, 1 minute Apgar score (6.8 ± 2.1), cord blood pH value (7.19 ± 0.07), and cord blood EB value (−8.2 ± 2.7. While 65 infants (34 male and 31 female) were assigned to the control group, Control group infant characteristics included: gestational age (29.9 ± 1.3) weeks, weight (1201 ± 245) g, maternal age (30.3 ± 2), 50 cases of pregnancy complications, 51 cases of hormone apply 17 cases of cesarean sections, 5 cases of premature rupture of membranes, 1 minute Apgar score (0.10 ± 2.3), and cord blood BE (−8.4 ± 3). There was no statistically significant difference between two groups ($P > 0.05$).

2.2. Methods

2.2.1. Feeding methods

VLBW infants who could not be breastfed were kept warm with far infrared rays and received intravenous fluid infusion and parenteral nutrition. The infants respiratory was unobstructed and blood glucose levels were maintained.

2.2.1.1. *Experimental group*. Used formula with an energy density of 338,700 J/100 mL; sealed within the validity period in our hospital was marked with the opening date and time, stored at 0–4 °C, and discarded after 4 hr later. VLBW infants with no enteral feeding contradiction were fed 12 mL/(kg·d) every 2 hr. Gastric tube was properly indwelled according to pediatric nursing practice and was fixed with cross method. The formula was poured into a sterile milk cup, and incubate at 37 °C for 20 min. The milk vehicle was pushed near the infant's bed and the formula and feeding frequency were confirmed, as done for gastric tube placement. A 10 ml sterile syringe without the core bar and needle was used, the syringe and gastric tube are connected and in a suspension type. The warm formula milk was poured into the syringe according to the prescribed dose, with dairy liquid level 20 cm higher than infant's mouth plane, liquid formula milk was slowly dispensed by gravity (at least 10 min) [8,9]. To prevent milk from hanging on the wall, small amounts of air were injected. [10]. Using aseptic techniques, covered the mouth with a sterile bag tube. The feeding volume was increased to 24 mL/(kg·d) and maintained for the first 10 days after birth. On the 11^{th} day after birth, the volume would be increased to 15–20 mL/(kg·d) until the feeding volume reached 1400–160 ml/(kg·d) when their nutrients are fully supplied by the gastrointestinal tract.

2.2.1.2. *Control group*. The formula was the same as the experimental group. There were no enteral feeding contraindication in control VLBW infants. Infants were fed 12 mL/(kg·d) on day 1 12–48 h after birth every 2h. Feeding method was the same as the experiment group, If infants were tolerated, feeding volume would be increased to 24–36 mL/(kg·d) and up to 140–160 mL/(kg·d). If not, feeding volume restore to 1 day before till the symptoms disappear. Feeding volume would not be increased once infants reached total gastrointestinal nutrition.

2.2.2. Observation index

2.2.2.1. The incidence and severity of NEC VLBW for the two groups (NEC staging and the NEC ratio of surgical intervention) was assessed, the NEC diagnostic criteria referred to Bell staging of the Management Of The Very Low Birth Weight Infants [11] was used.

2.2.2.2. *Feeding tolerance of VLBW infants*. Although the retention volume (2–3 ml) reached 50%–100% of the feeding volume, it was noted as feeding tolerance if mild abdominal distension and retention was observed [11]. The retention volume was noted as feeding intolerance if there were abdominal distension and fluid retention when the feeding volume was 20–75 ml/(kg d) and more than 50% of the first feeding volume was retained. If the gastric retention was bloody, bilious, or had abdominal distention (abdominal circumference growth >1.5 cm/d), feedings were stopped and an NEC examination was done, if deemed necessary.

2.2.2.3. Days of infants reach total gastrointestinal nutrition in two groups [150 ml/(kg·d)], hospitalization time and the