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ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Effect of early introduction of minimal enteral feeding on growth and rate of achieving optimal nutritive intake in very low birth weight preterm infants

Vesna Marinković[1], Niveska Božinović-Prekajski[1], Milica Ranković-Janevski[1], Zorica Jelić[1], Vesna Hajdarpašić[1], Nedeljko Radlović[2,3,4]

[1]Institute for Neonatology, Belgrade, Serbia;
[2]University Children's Hospital, Belgrade, Serbia;
[3]University of Belgrade, School of Medicine, Belgrade, Serbia;
[4]Academy of Medical Sciences of the Serbian Medical Society, Belgrade, Serbia

SUMMARY

Introduction/Objective Minimal enteral nutrition (MEN) has an important stimulative effect on morphological and functional development of gastrointestinal system in preterm infants.
The aim of this study was to assess effects of early introduced MEN on rate of achieving optimal enteral nutritive intake and on body weight, body length, and head circumference gain in very low birth weight (VLBW) premature infants.

Methods This prospective study included 45 VLBW newborns (1,010–1,450; 1,350 ± 305 g), in 30 newborns MEN was introduced within three days after birth, and in 15 newborns enteral intake was introduced after five days due to hemodynamic and metabolic instability. Assessment of effect of early MEN introduction on the rate of achieving optimal nutritive intake and gain in basic anthropometric parameters was based on comparison with a group of subjects who had a delayed MEN introduction.

Results Subjects in which MEN was introduced early on had better weight gain ($p < 0.05$), reached birth weight sooner ($p < 0.05$), and achieved optimal enteral intake much sooner ($p < 0.05$), compared to subjects with delayed MEN introduction. The difference in body length gain and head circumference gain was not significant.

Conclusion Early introduction of MEN has a significant positive effect on rate of body weight gain and on earlier achievement of optimal enteral intake in VLBW preterm infants.

Keywords: very low body weight infants; early minimal enteral nutrition; optimal nutritive intake

INTRODUCTION

With perinatal care improvements in the last few decades, incidence of neonatal morbidity and mortality has been significantly decreased. Very important role goes to adequate nutrition of these very vulnerable children, and its positive effects reflect not only on survival rate and optimal growth and development, but on adulthood as well [1].

The development of gastrointestinal system starts early in the intrauterine period and continues postnatally. Although highly immature, morphologically and functionally, gastrointestinal system partially meets, initially very poorly, basic nutritive needs of premature infant. In a very complex process of progressive postnatal functional maturation of the gastrointestinal system, early introduction of enteral feeding has a key role as a physiological stimulus [1, 2].

During the 1980s, new tendencies arose advocating early initiation of enteral nutrition, which led to the abandonment of long-standing practice of delayed enteral feeding of premature infants in intensive care units [1, 2]. Minimal enteral nutrition (MEN) implies early intake of primarily mother's milk in small amounts (up to 25 mL/kg/day) in premature infants [2]. This kind of nutrition doesn't primarily provide optimal nutritive balance in premature infants. Its basic role is contained in trophic influence on the immature gastrointestinal system, i.e. on the development of process of food digestion and absorption, coordination of motility, gastrointestinal hormone activity, and on preservation of intestinal barrier integrity. In that manner better feeding tolerance is achieved, as well as faster postnatal growth and development, lower incidence of sepsis and necrotizing enterocolitis, and shorter hospitalization [2]. Nowadays, this way of nutrition is generally accepted in most neonatal intensive care units as an integral part of treatment of premature infants [3].

The effects of early introduction of MEN are assessed in regard to body weight (BW), body length, head circumference, and rate of achievement of optimal nutritive intake in very low birthweight premature infants.

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Correspondence to:
Vesna MARINKOVIĆ
Institute for Neonatology
50 Kralja Milutina St.,
11000 Belgrade
Serbia
vesnam55@ptt.rs

METHODS

This prospective study included 45 very low birth weight (VLBW) premature infants hospitalized at the Institute for Neonatology, Belgrade, Serbia, since June 2012 until September 2013. The subjects were divided into two groups according to the time of MEN introduction: group A, n = 30, in which after establishing hemodynamic stability, normal blood pressure, blood pH above 7.3 and FiO_2 under 40%, MEN was introduced within three days after birth; and group B, n = 15, in which MEN was introduced 5–10 days (average 6.07) after birth due to hemodynamic and metabolic instability and/or meteorism ($t = 0.02$, $p < 0.05$). Basic characteristics of both groups of subjects are presented in Table 1. Distribution of subjects according to sex was identical between groups. Group A had 14 male subjects (46.7%) and 16 female subjects (53.3%), and group B had seven male (46.7%) and eight (53.3%) female subjects.

The basic way of meeting nutritive needs in both group of subjects during the first days of life was via parenteral nutrition, while enteral feeding via nasogastric tube was introduced according to the above mentioned criteria. Enteral nutrition in all newborns was started with human milk, be it donor milk or mother's milk. Daily intake volume in the first five days was 25 mL/kg/day, and was increased gradually according to feeding tolerance. When enteral volume intake of 80 mL/kg/day was achieved, fortified human milk was introduced (FM 85 Nestlè, Vevey, Switzerland) in a dose of 5 g / 100 mL, and/or specialized milk formula for premature infants (Mil PRE, Impamil d.o.o., Belgrade, Serbia).

The following parameters were followed in all subjects: daily gain in body weight, day of achieving birth weight, weekly increase in body length and head circumference, and day of achieving optimal enteral intake.

All data obtained during research was analyzed with SPSS 10.0 for Windows software package. Both parametric and non-parametric statistical tests were used to analyze the data. Comparison of the two groups was done using Student's t-test and Mann–Whitney U-test, depending on the data homogeneity. Comparison of data between more than two groups was done with Kruskal–Wallis test. Statistical significance was set at $p < 0.05$.

RESULTS

Subjects with early introduced MEN (group A) compared to subjects with delayed introduction of MEN (group B) had a significantly better body weight gain (10.88 ± 3.25 g vs. 7.73 ± 1.85 g daily; $t = 0.017$, $p < 0.05$), and achieved birth weight sooner (16.38 ± 3.36 days vs. 21 ± 7.16 days; $t = 0.017$, $p < 0.05$) (Figure 1). Also, group A subjects achieved optimal enteral intake significantly sooner compared to group B (25.7 ± 7.2 days vs. 28.33 ± 7.35 days; $t = 0.021$, $p < 0.05$) (Figure 2).

The difference in weekly gain in body length during the observed period between subjects in group A (0.45–0.58; 0.51 ± 0.35 cm) and group B (0.45–0.53; 0.49 ± 0.33 cm) was not significant ($t = 0.025$, $p > 0.05$).

The difference in weekly head circumference gain between group A (0.46–0.67; 0.49 ± 0.21 cm) and group B (0.44–0.53; 0.5 ± 0.21 cm) during the observed period was also not significant ($t = 0.022$, $p > 0.05$).

DISCUSSION

Because of its stimulating effect on morphological and functional development of the gastrointestinal system,

Table 1. Basic characteristics of subjects at birth (n = 45)

Characteristics	Group A (n = 30)		Group B (n = 15)	
	Range	($\bar{x}$ ± SD)	Range	($\bar{x}$ ± SD)
Birth weight (g)	1,000–1,500	1,274.0 ± 144.6	1,000–1,500	1,250 ± 152.2
Gestational age (weeks)	26–32.5	29.5 ± 1.6	27–31.5	29.0 ± 1.2
Apgar score 1′	1–8	4.9 ± 1.9	2–8	5.53 ± 1.9
Apgar score 5′	2–8	5.9 ± 1.5	4–8	6.33 ± 1.5

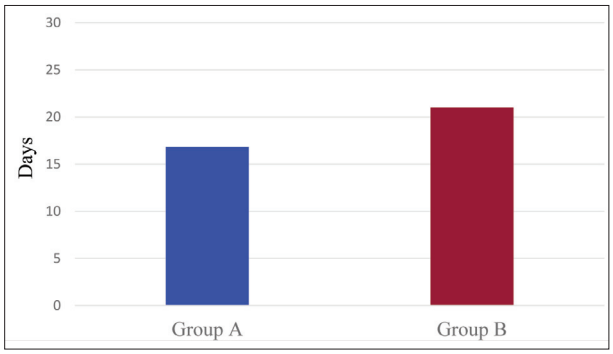

Figure 1. Achievement of birth weight (day)

A:B; $p < 0.05$

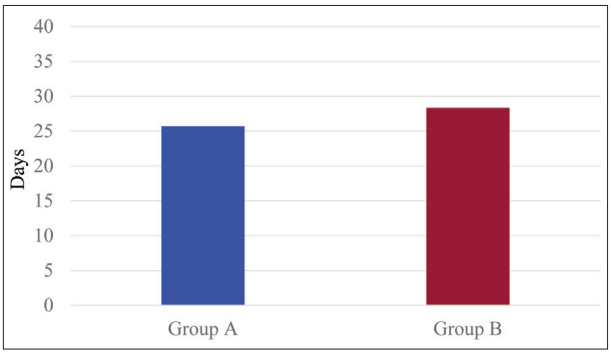

Figure 2. Achievement of optimal nutrition intake (day)

A:B; $p < 0.05$

MEN introduced during the first 24–72 hours after birth is also known in literature as „trophic feeding" [4]. Some authors consider early introduction of MEN to be within four days after birth [5].

In our subjects, MEN was introduced within the first 72 hours as advocated by most authors [4]. Amount of enteral intake was also a problem in everyday work, because it varied greatly between studies. Therefore, MEN was defined as small volume enteral intake, up to 25 mL/kg/day, or less than 20 kcal/kg/day [6]. MEN was introduced in our subjects in accordance with the aforementioned recommendation.

Precondition for the initiation of MEN is clinical state of a patient, his/her metabolic and hemodynamic stability. Precaution should be taken in case of severe perinatal asphyxia, sepsis, severe hemodynamic instability, absence of end-diastolic flow, indomethacin therapy and hemodynamically significant persistent ductus arteriosus, because of possible necrotizing enterocolitis development [7]. Before enteral feeding was introduced in our subjects, their mean arterial pressure was within reference range for body weight and gestational age, there was no meteorism, and pH value exceeded 7.3.

It is fully understood nowadays that MEN should be initiated with mother's milk, using colostrum whenever possible [3]. Otherwise, when mother's milk is not available, human donor milk from a milk bank is an optimal choice [8]. Current tendencies show the need for establishing human milk banks which should be the foundation of nutritive support of premature infants and can contribute greatly to lactation preservation [9]. It is general attitude that mother's milk, with appropriate supplementation, represents the foundation of nutrition of preterm infants. Unfortunately, in most cases, production of human milk is inadequate or lactation is not established at all, in which case nutrition with donor milk is appropriate choice [9, 10]. In all our subjects, MEN was conducted with human donor milk, in which colostrum was used in five subjects.

The duration of MEN and further increase in volume intake are also not precisely defined. There is a need for a unique protocol considering increase in volume intake which would have primarily practical role in everyday neonatologist's work [11]. In our subjects, MEN was conducted over a period of days, with a volume of up to 25 mL/kg/day. After this time, an increase in volume intake was 15–20 mL/kg/day, adjusted to individual feeding tolerance.

Measurements of body weight, body length, and head circumference represent basic anthropometric indicators of growth in the neonatal period. Skinfold thickness and subscapular test are far less significant in neonatal clinical practice, considering very small changes in neonates [12]. Proper technique of measurement and adequately trained personnel need to perform measurements in intervals prescribed by the protocol or research methodology. During this study, body weight was measured on digital scales incorporated in incubators or on classic mechanical scales (accuracy range ± 5 g). The proper way of measuring body length is by using a stadiometer, but depending on the clinical state of a patient, various forms of adapted flexible plastic-coated tape measure are used. The use of tape measure made from impregnated unstretchable cloth is the most optimal way of measuring head circumference [13].

The time of birth weight achievement is also an indirect indicator of nutritive support, and it is three weeks in VLBW preterm infants, but according to clinical condition it can be even longer [14]. Our subjects in whom MEN was introduced early on reach birth weight on day 17, which is significantly shorter compared to day 21 in group with delayed enteral nutrition ($p < 0.05$).

Body weight gain during intrauterine growth is about 15–20 g/kg/day, while postnatal growth of 10–20 g/kg/day is considered to be appropriate [15]. Average body weight gain in the group with early introduced MEN was 10.88 g/kg/day, which is significantly more compared to 7.73 g/kg/day in the group with delayed enteral intake ($p < 0.05$).

Increase in body length and occipitofrontal head circumference of 0.9 cm per week is ideal, and represents a goal of adequate nutritive support, although this value is far lower and harder to reach in clinical practice. Monitoring of early postnatal growth through series of body length measurements in preterm infants shows a value of 0.5–0.9 cm per week, and occipitofrontal head circumference of 0.5–1.1 cm per week [16, 17, 18]. Average weekly gain in body length in our subjects was 0.45–0.58 cm, and in head circumference 0.46–0.67 cm. The conducted study wasn't coherent considering the question of effect of minimal enteral nutrition on short-term growth, while analysis of long-term growth and its developmental effects was not analyzed [19]. There is a need for new randomised studies that will include extremely low birth weight infants in this research, as well as infants with intrauterine growth restriction [20, 21].

CONCLUSION

Minimal enteral nutrition with human milk as an addition to parenteral nutrition represent a very important practical approach in treatment of VLBW premature infants, naturally stimulating the development of gastrointestinal functions. Minimal enteral nutrition introduction within 72 hours compared to five or more days after birth significantly contributes to the rate of body weight gain and to earlier achievement of optimal nutritive intake, so it should be practiced whenever possible.

NOTE

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REFERENCES

1. Hans DM, Pylipow M, Long JD, Thureen PJ, Georgieff MK. Nutritional practices in the neonatal intensive care unit: analysis of a 2006 neonatal nutrition survey. Pediatrics. 2009; 123(1):51–7.
2. Embelton ND. When should enteral feeds be started in preterm infants? Pediatr Child Health. 2008; 18:200–1.
3. Klingenberg C, Embleton ND, Jacobs SE, O'Connell LAF, Kuschel CA. Enteral feeding practices in very preterm infants: an international survey. Arch Dis Child Fetal Neonatal Ed. 2012; 97(1):F56–61.
4. Ziegler EE. Meeting the nutritional needs of low birth weight infant. Ann Nutr Metab. 2011; 58(Suppl 1):8–18.
5. De Nisi G. Enteral feeding: how, when, how much? Minerva Pediatr. 2010; 62 (3 Suppl 1):207–10.
6. Tyson JE, Kennedy KA. Trophic feedings for parenterally fed infants. Cochrane Database Syst Rev. 2005; 3:CD000504.
7. Chauhan M, Henderson G, McGuire W. Enteral feeding for very low birth weight infants: reducing the risk of necrotising enterocolitis. Arch Dis Child Fetal Neonatal Ed. 2008; 93:F162–6.
8. Heiman H, Schanler RJ. Benefits of maternal and donor human milk for premature infants. Early Hum Dev. 2006; 82(12):781–7.
9. Wagner J, Hanson C, Berry AA. Donor human milk for premature infants: a review of current evidence. ICAN: Infant Child Adolesc Nutr. 2013; 5:71–7.
10. Boyd CA, Quigley MA, Brocklehurst P. Donor breast milk versus infant formula for preterm infants: systematic review and meta-analysis. Arch Dis Child Fetal Neonatal Ed. 2007; 92:F169–75.
11. Krishnamurthy S, Gupta P, Debnath S, Gomber S. Slow versus rapid enteral feeding advancement in preterm newborn infants 1000-1499 g: a randomized controlled trial. Acta Pediatr. 2010; 99(1):42–6.
12. Moyer-Mileur Lj. Antropometric and laboratory assessment of very low birth weight infants:the most helpful measurements and why. Semin Perinatol. 2007; 31(2):96–103.
13. Greer FR. Post-discharge nutrition: what does the evidence support? Semin Perinatol. 2007; 31(2):89–95.
14. Leaf A, Dorling J, Kempley S, McCormick K, Mannix P, Linsell L, et al. Early or delayed enteral feeding for preterm growth-restricted infants: a randomized trial. Pediatrics. 2012; 129(5):1260–8.
15. Gregory KE, Connolly TC. Enteral feeding practices in the NICU: results from a 2009 Neonatal Enteral Feeding Survey. Adv Neonatal Care. 2012; 12(1):46–55.
16. Ehrenkranz RA, Younes N, Lemons JA, Fanaroff AA, Donovan EF, Wright LL, et al. Longitudinal growth of hospitalized very low birth weight infants. Pediatrics. 1999; 104(2 Pt 1):280–9.
17. Olsen IE, Groveman SA, Lawson ML, Clark RH, Zemel BS. New intrauterine growth curves based on United States data. Pediatrics. 2010; 125(2):e214–24.
18. Fenton TR. A new growth chart for preterm babies: Babson and Benda's chart updated with recent data and a new format. BMC Pediatr. 2003; 3:13.
19. Morgan J, Bombell S, McGuire W. Early trophic feeding versus enteral fasting for very preterm or very low birth weight infants. Cochrane Database Syst Rev. 2012; (4):CD000504.
20. Agostoni C, Buonocore G, Carnielli VP, De Curtis M, Darmaun D, Decsi T, et al. ESPGHAN Committee on Nutrition. Enteral nutrient supply for preterm infants: commentary from the European Society of Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. J Pediatr Gastroenterol Nutr. 2010; 50(1):85–91.
21. Hay WW, Thureen P. Protein for preterms infants: how much is enough? How much is too much? Pediatr Neonatol. 2010; 51(4):198–207.

Утицај ране минималне ентералне исхране на раст и брзину постизања оптималног нутритивног уноса превремено рођене деце веома мале телесне масе

Весна Маринковић[1], Нивеска Божиновић-Прекајски[1], Милица Ранковић-Јаневски[1], Зорица Јелић[1], Весна Хајдарпашић[1], Недељко Радловић[2,3,4]

[1]Институт за неонатологију, Београд, Србија;
[2]Универзитетска дечја клиника, Београд, Србија;
[3]Универзитет у Београду, Медицински факултет, Београд, Србија;
[4]Академија медицинских наука Српског лекарског друштва, Београд, Србија

Увод/Циљ Минимална ентерална исхрана (МЕИ) има битан стимулативни ефекат на морфолошки и функционални развој гастроинтестиналног система код превремено рођеног детета.

Циљ рада била је процена ефеката ране МЕИ на брзине постизања оптималног ентералног нутритивног уноса и раст телесне масе, телесне дужине и обима главе код превремено рођене деце веома мале телесне масе (ВМТМ).

Методе рада Проспективном студијом је обухваћено 45 новорођенчади ВМТМ (1.010–1.450; 1.350 ± 305 *g*), 30 код којих је МЕИ започет унутар три дана по рођењу и 15 код којих је због хемодинамске и метаболичке нестабилности ентерални унос започет након пет дана. Процена ефекта ране МЕИ на брзину постизања оптималног нутритивног уноса и раст основних антропометријских параметара анализирана је на поређењу са групом испитаника код којих је ентерални унос започет касније.

Резултати Испитаници са рано започетом МЕИ у односу на оне код којих је ентерална исхрана одложена су боље напредовали у телесној маси ($p < 0,05$), брже достизали порођајну телесну тежину ($p < 0,05$) и знатно раније успостављали оптимални ентерални унос ($p < 0,05$), док разлика у расту телесне дужине и обима главе између ове две групе испитаника није била значајна.

Закључак Рана МЕИ има знатан позитиван ефекат на брзину пораста телесне тежине и раније успостављање оптималног ентералног уноса код превремено рођене деце ВМТМ.

Кључне речи: новорођенчад веома мале телесне масе; рана минимална ентерална исхрана; оптимални нутритивни унос