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The Early Growth of Small Premature Infants fed their own Mothers' Milk

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Summary

Dawodu AH, Osibanjo O and Damole IO. The Early Growth of Small Premature Infants fed their own Mothers' Milk. *Nigerian Journal of Paediatrics* **1985; 12:105.** A group of 7 appropriate–for–gestational age (AGA) infants, with birthweights of 1500g or less, was fed their own mothers' milk, while a control group of 7 AGA infants matched for birthweight and gestation with the subjects, was fed a modified infant formula (*Nan-Nestles*). The rate of weight gain, growth in length and head circumference were monitored until each infant reached a weight of 1800g. When compared with infants fed artificial formula, the infants fed their own mothers' milk took shorter time to regain birthweight and had higher rate of weight gain ($p < 0.05$). The rate of increase in length and head circumference were appropriate and similar in both groups. The study suggests that the preterm mothers' milk produces better weight gain than the modified cow's milk formula when fed to very low birthweight infants.

Introduction

THE optimal nutritional management of preterm infants is not yet established. While the nutritional and immunological benefits of breast milk are well accepted, previous studies have indicated that both mature breast milk and the commonly recommended humanized artificial milk with nutrients similar in composition to mature breast milk, do not meet the optimal nutritional needs of small preterm infants.[1-2] Recent reports[3-5] however, show that in contrast to the milk of mothers of mature babies, the milk of mothers of preterm infants contains nutrients which are closer to the nutritional requirements of preterm infants and may therefore, be more appropriate for feeding such infants. Despite this important biochemical observation, studies on the extrauterine growth of preterm infants fed on milk produced by their own mothers or pooled milk from mothers of other preterm infants, are scanty.[6-7] This study was therefore, undertaken to assess the postnatal growth of preterm very low birthweight (VLBW) infants fed their own mothers' milk.

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Materials and Methods

The study population consisted of healthy preterm appropriate-for-gestational age (AGA) infants who were admitted to the Special-Care-Baby unit of the University College Hospital, Ibadan, between February 1982 and March 1984. They all weighed 1500g or less at birth, but were well enough to tolerate complete oral feeding by 48–72 hours of age. Infants who later became ill enough to necessitate stoppage of oral feeding were excluded from the study. A locally derived intrauterine growth standard was used to assess the intrauterine growth of each infant.[8] The infants studied consisted of two groups. The study group (Group I) were consecutive infants whose mothers produced enough breast milk to feed them. A control group (Group II) consisted of infants who had to be fed on artificial formula because their mothers were not available to provide expressed breast milk (EBM) for them. These infants were chosen to match the first group with respect to birthweight and gestation.

Nursing care and feeding management

Each infant was admitted into a conventional incubator and nursed in a thermoneutral environment by using the appropriate incubator air temperature and humidity of 60–80%. The infant was nursed in the incubator until a weight of about 1.6kg was achieved when he or she was transferred to a cot.

Feeding was started 4–6 hours after birth by oro-gastric tube at 2–3 hourly intervals, depending on the maturity of the infant. The feed was supplemented if necessary, with intravenous fluid containing 5–10% glucose and 2mEq/kg/day of sodium in order to give a total fluid of 60-80 ml/kg/day during the first 48 hours. The infants were on complete oral feeding by 48 hours of age and the milk was increased gradually as tolerated, to a maximum of 200 ml/kg/day. Bottle feeding was commenced as soon as the infants showed evidence of good coordination of sucking and swallowing. Mother's milk for the group I infants was expressed manually in hospital and occasionally at home, 4–5 times a day. The volume was measured and the milk kept in a refrigerator. Milk expressed during the feeding time was measured and given fresh to the infant, while EBM which had been refrigerated was warmed before use. Each mother's 24-hour total milk expression was recorded and any milk not used within 24 hours was discarded. Aliquot samples were obtained from the 9.00 a.m expression during the second week of lactation and stored at –20°C for chemical analysis using standard analytical methods[9]: protein concentration by Kjeldhal method x 6.38, fat concentration by Roese-Cottlieb method, lactose by Lane and Eynon's method and total mineral by dry ashing at 500°C. The average caloric concentration was calculated as the sum of the measured concentrations (expressed in gm/100ml) of protein x 5.65, fat x 9.25 and lactose x 3.95.

Group II infants were fed *Nan* (*Nestle's*) which was one of the humanized artificial formulas available in the unit. The feed was prepared according to the manufacturer's instruction which gave a caloric density of 66 kcal per 100 ml.

Further management and assessment

A clinical evaluation of each infant was made daily. The weight, crown-heel length (CH) and occipito-frontal circumference (OFC) of each infant at birth, were measured and recorded. Weights were measured three times a week and the CH and OFC measurements were carried out weekly. Weighing scale accurate to the nearest 10g (*Avery Nig Ltd*), length measurement board and non-stretch tapes were used for the anthropometric measurements. The serum protein levels and haematocrits were checked weekly. Serum electrolytes and bilirubin levels were estimated when necessary and the appropriate management was instituted as indicated.

The study was terminated when each infant reached a weight of 1800g which was the usual discharge weight in the unit.

Statistical comparison between the two groups was made by means of the student's t test.

Results

Nine infants met the criteria for inclusion in Group I, but two were later excluded because of inadequate milk production by their mothers.

One of the 8 infants originally selected for inclusion into Group II developed necrotising enterocolitis and was thus, excluded. Thus, a matched pair of seven preterm AGA very low birthweight infants were included in the final analysis.

Chemical analysis of the milk obtained during the second week of lactation in the preterm mother gave the following results (expressed as mean $\pm$ SD): serum protein 2.5 $\pm$ 0.3 g/100ml, fat 3.0 $\pm$ 0.2 g/100ml, lactose 5.9 $\pm$ 0.2 g/100ml and minerals 0.36 $\pm$ 0.04 g/100ml. The calculated energy was 65kcal per 100ml. Comparison of the composition of the preterm milk with mature milk and the available artificial formula is summarised in Table I. The preterm mothers' milk contained higher protein and minerals and lower amount of lactose than both mature milk and *Nan*.

TABLE I

Nutrient Composition of Preterm Milk, Mature Breast Milk and Artificial Formula

Nutrients	*Preterm Milk*†	*Mature Breast Milk**	*Nan***
Protein (g/100ml)	2.5	1.5	1.6
Fat (g/100ml)	3.0	2.6	3.4
Lactose (g/100ml)	5.9	8.3	7.2
Ash (Minerals) (g/100ml)	0.4	0.2	0.3
Energy (kcal/100ml)	65	65	66

† Data from present study
* Fomon [10]
** Data supplied by manufacturer

Table II is a summary of the comparison of nutrients taken from 200ml/kg/day of various milk types and the estimated nutritional requirement of a growing preterm infant. While all the milk met the energy needs of the preterm infant, the preterm mother's milk provided higher protein and total minerals for the growth of preterm infant than either the mature breast milk or the available cow's milk formula.

The clinical data of the two groups of infants and the results of the subsequent growth parameters are compared in Table III. There was no significant difference in the weight, gestation, OFC and CH measurements between the two groups on entering the study. By the second week of life, both groups I and II infants were on an appropriate milk intake of 188 and 194 ml/kg/day respectively. Compared with infants fed on *Nan*, the VLBW preterm infants fed their own mothers' milk had a significantly higher rate of daily weight gain ($p<0.05$) and regained birthweight earlier ($p<0.05$). Although the infants fed preterm mothers' milk had a shorter stay in hospital when compared with infants fed *Nan*, the difference was not statistically significant. The growth velocity in the OFC and CH and the results of the serum proteins were within normal limits and were similar in the two groups.

Three infants in each group, had blood transfusions for anaemia and one infant fed *Nan* developed metabolic acidosis (serum $HCO_3 < 15$mEq/L) and hyponatraemia (serum Na < 130mEq/L). None of the infants had significant neonatal jaundice requiring blood transfusion.

Discussion

Since the nutritional composition of mature breast milk[1] and the humanized artificial milk[2] do not meet the optimal requirements for adequate growth of low birthweight infants, various artificial milk preparations have been suggested to meet the special requirements of preterm infants.[11] Such artificial milks are not available in most developing countries and even when they are available for use, they cannot provide the non-nutritional benefits of breast milk. The recent reports[3-5] which showed that the preterm mothers'

TABLE II

Average Nutrient intake from various Milk Types compared with Nutritional needs for Growing Preterm Infants

	Energy kcal/kg	*Protein gm/100kcal*	*Calcium mg/100kcal*	*Sodium mg/100kcal*	*Total Ash (Minerals) mg/100kcal*
Nan†	132	2.4	75	1.6	455
Mature milk* (2nd week of lactation)	130	2.3	43	1.3	354
Preterm Milk** (2nd week of lactation)	130	3.8	NA	NA	554
Estimated requirement for growing preterm infant*	130	2.8	310	2.3	NA

† Calculated from data given by manufacturer

* Fomon[10]

** Calculated from data from present study

NA=Data not available

milk may provide appropriate nutritional requirements necessary for adequate growth of preterm LBW infants is therefore, of great interest.

The mean daily milk volume of 188ml/kg expressed by mothers of preterm infants in this study, provided enough energy for their offsprings during the second week of life. Although an aliquot from a 24-hour collection for chemical analysis gives a more representative composition of nutrients in milk,[12] this was not possible in this study, because each infant had to be fed from each day's expression. However, the nutrient content of the morning sample collected during the second week of lactation in this study agrees with results from a previous study[4] in which similar methods of collection and chemical analysis were used. The chemical analysis also showed that the milk of mothers of preterm infants supply VLBW preterm infants with more protein and mineral than the cow's milk based formula used in our unit.

Although the numbers were small, the extrauterine growth pattern exhibited by the VLBW infants in this study revealed that, compared with infants fed *Nan*, the infants fed EBM from their own mothers, regained birthweights earlier and had higher rates of postnatal weight gain. There was a modest but non-significant increase in the growth velocity of head circumference and linear length among infants fed preterm mothers' milk. These results are similar to the findings from recent studies.[6 7] We agree with the suggestion by Atkinson *et al*[6] that the improvement in growth of preterm infants fed their own mothers' milk over those fed mature milk (eg *Nan*), may be due to the higher protein and mineral to energy ratio in the preterm mother's milk. Other nutritional qualities of preterm mother's milk not yet identified may also play a role in this improved growth.

This study thus suggests that compared with the available modified cow's milk formula,

TABLE III

Comparison of the Clinical Data and Growth Pattern among VLBW Infants fed Nan and Preterm Mother's Milk

Clinical Data	*Group I** (*N* = 7)		*Group II*** (*N* = 7)		*P*
	Mean	*SD*	*Mean*	*SD*	
Birth weight (kg)	1.32	0.12	1.30	0.13	>0.5
Gestation (wks)	30.2	1.4	30.6	1.4	>0.5
OFC (cm)	27.2	1.2	27.4	1.7	>0.5
HC (cm)	38.9	2.9	38.6	2.4	>0.5
Time to regain birthweight (days)	10.6	2.6	13.3	1.9	<0.05
Milk intake 13th–15th day of life (ml/kg/day)	188	7	194	8	>0.2
Weight gain (g/kg/day)	16.9	2.6	13.7	2.6	<0.05
CH increase (cm/wk)	1.04	0.18	0.98	0.22	>0.5
OFC increase (cm/wk)	0.92	0.1	0.84	0.22	>0.2
Days spent in hospital	26.7	5.2	33.6	7.8	>0.05
Serum Protein (g/100ml)	5.6	0.7	5.4	0.4	>0.5
Serum Albumin (g/100ml)	3.7	0.9	3.1	0.7	>0.1

* Group I consisted of those fed preterm mothers' milk

** Group II consisted of those fed *Nan*

SD = Standard deviation

OFC = Occipito frontal circumference

CH = Crown-heel length

preterm mothers' milk produces better weight gain, which is similar to intrauterine growth rate,[2] in VLBW infants. If the findings are confirmed by other and larger series, the achievement of intrauterine growth rate pattern by preterm infants, fed human milk would be a major advance in feeding preterm infants. Other reasons for encouraging mothers of preterm infants to give their infants EBM rather than artificial milk, include the well known immunological, economic and health promoting benefits of breast feeding.

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