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Growth in high risk infants <1500 g birthweight during the first 5 weeks

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Abstract

Background: Growth of very low birthweight (VLBW) infants is used to monitor nutrition and intrauterine velocity is taken as the desired goal.
Aim: We hypothesised that beside nutrition growth failure is caused by disease severity.
Methods: Prospective longitudinal study of 45 VLBW infants undergoing intensive care, mechanical ventilation was used as proxy to disease severity. Nutritional intake, body weight, length, head circumference, and lower leg length (LLL) were measured during the first 5 weeks of life.
Results: Birthweight and gestational age were lower in 22 ventilated than in 23 unventilated infants ($p<0.01$). Median daily intake was 3.2 and 2.8 g/kg for protein (n.s.), 108 and 112 kcal/kg for energy (n.s.), 175 and 160 ml/kg for volume ($p<0.01$) up to day 35, respectively. Chronic lung disease occurred in 12 infants, five of whom were treated with dexamethasone. Artificial ventilation ($p<0.01$) and dexamethasone treatment ($p<0.05$) were independent predictors of weight gain. Median weight gain (8.2 and 9.7 g/kg/d), head growth (0.45 and 0.60 cm/week), and LLL growth (0.28 and 0.35 mm/d) were lower ($p<0.05$) in ventilated than in non-ventilated infants, respectively. The correlation of LLL growth with body length ($r=0.31$, $p<0.05$) and head growth ($r=0.42$, $p<0.01$) was weak. Dexamethasone arrested growth; median LLL gain was 0.21 and 0.31 mm/d in ventilated infants with and without dexamethasone ($p<0.05$).
Conclusion: In VLBW infants, fetal growth rates are not reached with current feeding practice. In addition to inadequate nutrition, factors directly related to disease and treatment contribute to postnatal growth failure.

Abbrevations: VLBW infant, Very low birth weight infant; LLL, Lower leg length; CLD, Chronic lung disease.

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1. Introduction

Growth of very low birthweight (VLBW) infants is used to monitor nutrition. It has been recommended that postnatal weight gain should approach fetal weight gain in the last trimester with 15 g/kg/d [1]. Embleton showed that infants <1000 g birthweight accumulate a nutritional deficit [2]. This may affect later development. Factors such as chronic lung disease (CLD), dexamethasone, and infection may impede growth velocity. On the other hand it has been suggested that overnutrition after birth leads to obesity, diabetes, and other [3]. Length may be a better criterion than weight because it is independent of water retention and excessive fat deposition. As it is difficult to measure body length, knemometry has been used to measure lower leg length (LLL) growth, which during the last trimester approximates 0.43 mm/d [4]. Recently, new intrauterine growth curves for VLBW infants were proposed to monitor postnatal growth [5].

We hypothesised that (1) growth failure is caused by inadequate nutrition and additional clinical factors, (2) that LLL growth is proportional to body length gain, and (3) that impaired LLL growth is an early predictor of growth failure.

2. Patients and methods

This prospective study was carried out at the Department of Neonatology, Charité Virchow Hospital Berlin between September 1999 and December 2000. Inclusion criteria was a birthweight <1500 g. Exclusion criteria were death or leaving our hospital before day 35. Sample size calculation: We used the need for mechanical ventilation (any duration but not CPAP) as a proxy for disease severity and assumed that nutritional intake would be similar in most high risk infants. We further assumed that growth differences of 20% would be relevant and calculated that to find such difference, a minimum of 21 infants in each group was necessary. 51 VLBW infants were included, 2 infants died, 4 infants were discharged earlier. 46 infants completed the study, 22 of whom were ventilated. Target values were arterial pH>7.20, PCO_2 of 45–65 mm Hg and arterial PO_2 of 40–60 mm Hg. The diseases causing intensive care are shown in Table 1. Patent ductus arteriosus was regarded significant when an intervention by drug or operation was performed. Intraventricular hemorrhage was defined using the Papile classification. Nosocomial infection was documented by prospective surveillance. CLD was defined as the need for additional oxygen at a corrected age of >36 weeks. Dexamethasone treatment was initiated if the infant could not be weaned from artificial ventilation at 12 days of life [6] with 0.5 mg/kg/d given intravenously for 3 days, then 0.25 mg/kg/d for 3 days and 0.1 mg/kg/d for a maximum duration of 3 days.

2.1. Nutritional protocol

All infants were fed with their own mothers' milk or donated human milk, fortified with 5% FM 85 (Nestlé, Munich, Germany), or preterm formula (Humana 0, Humana GmbH, Herford, Germany). Parenteral nutrition was started in infants <1000 g on day 3 with aminoacids, lipids (Aminopäd 10%, Intralipid 20%, Baxter, Erlangen, Germany) trace elements and vitamins (Peditrace, Soluvit N, Vitintra, Pharmacia-Upjohn GmbH, Erlangen, Germany). It was stopped when infants tolerated >130 ml/kg/d of enteral feeding. It was re-established or given to infants >1000 g when enteral feeding was insufficient for more than 2 days. The nutritional protocol aimed to reach 115–135 kcal/kg/d and 3.0–4.0 g/kg/d protein by an age of ten days [1]. The intake was calculated daily using human milk data from the literature [7] and manufacturers data. Protein concentration was measured weekly in human milk with the bicinchinonic acid method to calculate the real protein intake at the end of the study. As shown in Fig. 1, 78% of the infants did not met the goals set by this protocol caused by delayed passage of meconium, distended abdomen, gastric residuals, suspected NEC and sepsis.

During the first 5 weeks were measured: body weight daily using an electronic precision scale (S10-2720, Soenle Waagen GmbH, Murrhardt, Germany), body length weekly using a

Table 1 Clinical data of ventilated and non-ventilated very low birthweight infants during the first 5 weeks of life

Ventilation			
	Yes (n=22)	No (n=23)	p value
Gestational age (wks)	26.5 (25.1, 28.0)	30.0 (28.0, 32.0)	<0.01
Birthweight (g)	848 (735, 966)	1310 (995, 1445)	<0.01
Female (n, %)	13 (57)	11 (50)	n.s.
Singletons (n, %)	12 (52)	20 (91)	<0.05
Umbilical artery pH	7.27 (7.23, 7.31)	7.29 (7.26, 7.32)	n.s.
CRIB score	4.5 (1.8, 10.0)	1.0 (0.8, 1.0)	<0.001
IVH≥II° (n, %)	1 (5)	0	n.s.
Mech. ventilation (d)	4 (1,15)	0 (0,0)	n.s.
CPAP (d)	20 (3, 36)	1 (0, 3)	<0.001
Oxygen at 36 wks (n,%)	12 (54)	0	<0.01
Dexamethasone (n, %)	5 (23)	0	n.s.
NEC≥II° (n, %)	0	3 (13)	n.s.
PDA intervention (n, %)	10 (45)	0	<0.01
Antibiotics (d)	14 (7, 21)	3 (0, 7)	<0.01

Data are median (quartiles) or n (%).