



Postnatal Growth Pattern of VLBW Infants Admitted at Patan Hospital - A Prospective Observational Study

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Abstract

Introduction: Very low birth weight (VLBW) infants (birth weight < 1500 g) comprise about one-third of neonatal deaths. Regular growth monitoring of these infants helps in assessing their nutritional status and identifies those with inadequate weight gain. Studies on postnatal growth velocities in VLBW infants have not been published so far in Nepal. Hence, this study aimed to describe postnatal growth pattern of VLBW infants admitted at Patan Hospital.

Methods: It is a prospective observational study on VLBW infants admitted at Patan Hospital between March 17, 2021 and March 16, 2022. Weight, length, and head circumference (HC) were recorded and plotted on Fenton growth chart regularly until discharge. Data was entered into Microsoft Excel and analysed with SPSS version 25.

Results: Seventy-two VLBW infants were admitted during the study period. Fifty-seven infants survived till they regained their birth weights and were included in final analyses. The mean weight gain velocity calculated from birth until discharge was 10.72 ± 2.98 g / kg / d and that after regaining birth weight was 17.33 ± 4.67 g / kg / d. These infants gained their length and HC on an average of 1.21 cm / week and 0.79 cm / week respectively. The incidence of postnatal growth failure at the time of discharge was 61.40%.

Conclusions: The growth velocities in our VLBW infants is comparable to the standard recommended intrauterine rates. A large multi-centre prospective study is recommended to validate findings of this study.

Introduction

Very low birth weight (VLBW) infants have a high incidence of growth problems from multiple reasons, including extra-uterine environment, varied nutritional requirements and complications of both prematurity and low birth weight.¹ Regular and consistent growth monitoring helps in assessing the nutritional status and adequacy of feeding in VLBW infants. Weight, length and head circumference (HC) are three principle anthropometric parameters based on which monitoring of the growth pattern can be done in preterm VLBW infants.² Fenton growth charts, which are intrauterine charts, are widely used to monitor and assess the growth of preterm and VLBW infants.³⁻⁵ The newborns tend to lose weight (about 10% in term and 15% in preterm) in the first seven days of life and regain their birth weight by 10 - 14 days. After regaining the birth weight, the goal is to achieve a postnatal growth rate that approximates that of a normal fetus (i.e. the intra-uterine growth).⁶ Postnatal growth failure, defined as a discharge weight less than the 10th percentile for the postmenstrual age is a universal

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problem in preterm VLBW infants.⁷

Only a few studies have dealt with postnatal growth velocity of VLBW infants. Mathew et al¹ from India, showed a mean growth rate (\pm SD) of 16.2 ± 2.4 g / kg / d and average time to gain birth weight of 14.2 days (Range 12.0 – 17.6). A study in VLBW infants in Saudi Arabia showed that 68% had discharge weight at \leq 10th percentile; 42% had HC \leq 10th percentile and 62% and linear length \leq 10th percentile.⁸ There are limited data regarding postnatal growth of VLBW infants in South Asian countries and none from Nepal. Hence, this study aims to provide current information on the postnatal growth of VLBW infants admitted at Patan Hospital.

Methods

This is a prospective observational study conducted at neonatal unit, Department of Paediatrics, Patan hospital, Lalitpur, Nepal from 17 March 2021 to 16 March 2022. Study commenced after ethical approval from Institutional Review Committee (IRC) of Patan Academy of Health Sciences (Ref no: PMP2103161495). Sample size (SS) was calculated based on the prevalence of VLBW infants in another study done at Patan Hospital which was 6.7% of live births, using formula $SS = [Z^2 \times P \times (1 - P)] \div C^2$; where: SS = required sample size; Z = 95% confidence interval (standard value of 1.96); P = estimated prevalence of VLBW infants in the project area; and C = 10% margin of error (standard value of 0.1).⁹ A sample size of 59 infants was calculated. However, all VLBW infants during the study period were approached for the study. All babies whose birth weight was less than 1500 gm were included in the study. Those VLBW infants who were either discharged or died or transferred to the other hospital before regaining birth weight were excluded from the study. According to our hospital protocol, all the VLBW infants are admitted in neonatal care unit. Consent were taken from the parents of babies by on duty doctor. On admission weight, length and HC were measured. Thereafter, weight was measured daily, length and head circumference were measured weekly for enrolled VLBW babies from admission until discharge, transfer or death. Nude baby weight was taken by duty doctor using a digital weighing scale with sensitivity of 5 g (Model name / number: EBSA-20). Length was measured using an infantometer (Model name / number: VSDID 201) to the nearest 0.1 cm with the baby supine, knees fully extended and soles of feet held firmly against and head touching the fixed board. HC was measured using a non-stretchable tape to the nearest 0.1 cm. Data was collected on a predesigned proforma over one-year study period. Weight, length and HC was plotted on the Fenton growth chart for preterm boys and girls in terms of completed weeks of gestation. Growth velocity (GV, g / kg / d) was calculated by 2-point exponential model, as shown in the following formula.⁶ The two points being birth

weight and discharge weight; $GV = [1000 \times (W_n - W_1)] \div \{(D_n - D_1) \times [(W_n + W_1) / 2]\}$; where: W = weight in grams; D = day; 1 = beginning of time interval in days (birth / regain); n = end of time interval in days (Discharge time). Length increment in cm / wk = (discharge length in cm – birth length in cm) / mean duration to reach discharge length in days. HC increment in cm / wk = (discharge HC in cm – birth HC in cm) / mean duration to reach discharge HC in days. Data was entered in Microsoft excel and analysis was done using statistical package for social sciences (SPSS) version 25. Categorical variables were described using frequency and percentage, while continuous variables were described using mean and standard deviation or median and range, depending on the distribution of the data. Appropriate parametric and non-parametric statistical tests were used to evaluate significance among the selected variables. Chi-square was used to evaluate categorical variables in relation to outcome and P value of < 0.05 was considered statistically significant.

Results

During study period, VLBW infants accounted for 30.63% of total 235 babies admitted at the neonatal units of Patan Hospital. Out of total VLBW infants, 57 (79.17%) survived till the age they regained their birth weight and were included in the final analysis. Among those VLBW babies who survived till they regain their birth weights, 51 (70.83%) of total live born VLBW infants survived to discharge and six infants expired before discharge from hospital. A flow diagram of the study selection process is presented in Fig. 1.

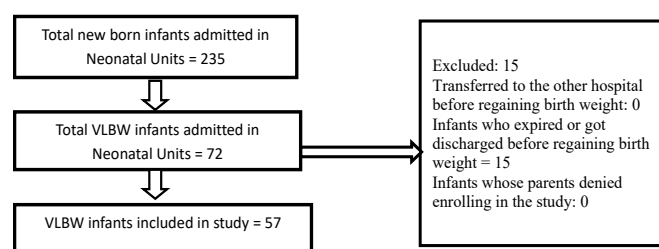


Figure 1 : Flow diagram depicting flow of the study

Distribution based on weight, gestational age and size for gestational age is shown in Table 1.

Table 1: Characteristics of VLBW infants (N = 57)

Variable	N (%)
Birth weight	
• ≤ 1000 g	4 (7.02)
• 1001 – 1250 g	20 (35.09)
• 1251 – 1500 g	33 (57.89)
Gestational age	
• ≤ 28 weeks	2 (3.51)
• > 28 – 30 weeks	19 (33.33)
• > 30 – 32 weeks	18 (31.58)
• > 32 – 34 weeks	11 (19.30)
• > 34 weeks	7 (12.28)
Size for gestational age	
• Small for gestational age	16 (28.07)
• Appropriate for gestational age	40 (70.18)
• Large for gestational age	1 (1.75)

The average hospital stay was 31.58 ± 12.42 days for all infants. Table 2 shows the mean growth parameters of VLBW infants.

Table 2: Mean growth parameters of VLBW infants

Variables	Means
Birth weight (grams)	1271.75 ± 156.10
Gestational age (weeks)	31.23 ± 2.15
Head circumference at birth (cm)	27.82 ± 1.44
Length at birth (cm)	37.96 ± 2.24
Initial weight loss (% of birth weight)	8.92 ± 4.67
Age at lowest weight (days of life)	4.63 ± 2.83
Age to regain birth weight (days)	10.98 ± 5.85
Discharge weight (grams)	1780.70 ± 198.03
Discharge length (cm)	42.96 ± 2.68
Discharge head circumference (cm)	30.98 ± 1.56

Table 3: Time to regain birth weight, percentage of initial weight loss, average growth velocity and postnatal growth failure based on gestational age

Gestational age	Mean \pm SD birth weight (g)	Mean time to regain birth weight (days)	Percentage of initial weight loss (% of birth weight)	Average weight gain from birth to discharge (g / kg / day)	Average weight gain after regaining birth weight to discharge (g / kg / day)	Number (% of Postnatal growth failure)
≤ 28 weeks	1080 ± 226.27	9 ± 4.24	8.91	6.53 ± 2.75	14.03 ± 6.07	0 (0)
> 28 – 30 weeks	1218.42 ± 163.68	15.37 ± 6.94	11.08	10.08 ± 1.94	16.60 ± 3.90	8 (42.11)
> 30 – 32 weeks	1290 ± 125.10	9.67 ± 4.16	8.99	11.10 ± 3.28	18.54 ± 5.59	11 (61.11)
> 32 – 34 weeks	1335 ± 172.24	8.27 ± 3.41	6.48	11.70 ± 3.47	17.99 ± 4.01	9 (81.82)
> 34 weeks	1325 ± 108.78	7.29 ± 2.69	6.74	11.16 ± 3.22	16.14 ± 4.95	7 (100)
Average	1271.75 ± 156.10	10.98 ± 5.85	8.92	10.72 ± 2.98	17.33 ± 4.67	35 (61.40)

Table 3 shows different growth patterns of VLBW infants based on gestational age. The mean weight gain velocity (g / kg / day) calculated from birth until discharge was 10.72 ± 2.98 g / kg / day. Average weight gain after regaining birth weight was 17.33 ± 4.67 g / kg / d. The highest weight gain velocity after regaining birth weight until discharge was observed in > 32 – 34 weeks gestational age. 61.40% of total enrolled babies had postnatal growth failure at the time of disposition

from hospital.

Table 4 shows the length and the HC growth pattern in VLBW infants. Average length and HC growth was higher in > 32 – 34 weeks' gestational age babies. For the VLBW infants born less up to 34 weeks of gestation, a gradual increment on both the length growth velocity and the HC growth velocity (cm / week) was observed with increasing gestational ages

Table 4: Length and head circumference (HC) growth pattern in VLBW infants

Gestational age	Mean birth length \pm SD (cm)	Average length growth (cm / week)	Mean birth HC \pm SD (cm)	Average HC growth (cm / week)
≤ 28 weeks	35 \pm 0	1.25 \pm 0.35	26 \pm 1.41	0.59 \pm 0.12
> 28 – 30 weeks	37.16 \pm 2.57	1.18 \pm 0.25	27.26 \pm 1.49	0.75 \pm 0.27
> 30 – 32 weeks	38.25 \pm 1.14	1.18 \pm 0.38	27.94 \pm 1.25	0.77 \pm 0.30
> 32 – 34 weeks	39.27 \pm 1.95	1.29 \pm 0.35	28.55 \pm 1.31	0.89 \pm 0.24
> 34 weeks	38.14 \pm 2.91	1.21 \pm 0.25	28.43 \pm 1.27	0.88 \pm 0.33
Average	37.96 \pm 2.24	1.21 \pm 0.31	27.82 \pm 1.44	0.79 \pm 0.28

Table 5: Comparison of growth failure in VLBW infants (N = 57) based on co-morbidities

Comorbidities	Yes	Growth failure		P value
		No	Yes	
RDS	Yes	27	18	0.673
	No	8	4	
hs-PDA	Yes	3	3	0.544
	No	32	19	
IMV	Yes	19	14	0.486
	No	16	8	
Sepsis	Yes	10	5	0.626
	No	25	17	
NEC \geq Stage 2	Yes	9	4	0.509
	No	26	18	
BPD	Yes	2	1	0.847
	No	33	21	
PVL	Yes	4	2	0.78
	No	31	20	
IVH	Yes	7	9	0.087
	No	28	13	
ROP	Yes	1	1	0.736
	No	34	21	
PN	Yes	7	3	0.539
	No	28	19	

Although among the comorbidities studied, none were significantly associated with postnatal growth failure (Table 5). The number of infants surviving without significant neonatal morbidity is low.

Discussion

This study has provided current information on the postnatal growth pattern of VLBW infants at Patan Hospital. In this study, the mean weight gain velocity of VLBW infants calculated from birth until discharge was 10.72 \pm 2.98 g / kg / d and that after regaining birth weight was 17.33 \pm 4.67 g / kg / d. Both of the weight growth velocities were comparable with other studies. This finding is similar to the study done by G Mathew et al¹ where the average weight growth velocity was 9.30 \pm 1.83 g / kg / d and average weight gain per kg per day after regaining birth weight was 16.24 \pm 2.37 g / kg / d. Similarly, in another study done by Saluja et al¹⁰ average daily weight gain after regaining birth weight was 15.18 \pm 1.7 g / kg / d. In a study conducted by Mudahemuka JC et al⁶ the mean growth velocity was 13.2 g / kg / d. Similarly, our findings can be compared with other studies done by Kumar et al¹¹, Rathore et al¹² and Pawale et al.¹³

Infants in our study gained their length on an average of 1.21 cm / week and the average increase in their HC was 0.79 cm / week. These results are similar to the rates of intrauterine length and HC increase reported by Lubchenco et al between 26 and 36 weeks of gestation (1.1 cm / wk and 0.7 cm / wk respectively).¹⁴ The average weekly increments in length (0.9 cm / wk) and HC (0.9 cm / wk) were reported by Richard AE et al.¹⁵ In a study by Saluja et al¹⁰ the increase in HC and length were 0.48 \pm 0.2 cm / week and 0.60 \pm 0.4 cm / week, respectively. Rathore et al¹² found the average weekly increment in length and HC was 0.52 and 0.39 cm / wk respectively, not comparable to intrauterine growth. According to Pawale et al¹³ the rate of growth for length and HC in hospital was 0.8 \pm 1 cm / week and 0.7 \pm 0.4 cm / week respectively. If it turns true as stated by in Sohn JA et al¹⁶ in their study that earlier catch-up growth of head circumference was more critical for neurodevelopment than weight and length.

In our study, the percentage of initial weight loss in VLBW infants was 8.92 \pm 4.67%. Average time for these babies to re-gain their birth weights was 10.98 \pm 5.85 days. It was 15.37 \pm 6.94 days for infants born from > 28 – 30 weeks' gestation, and for those infants born > 34 weeks gestation

this time was 7.29 ± 2.69 days. In the study conducted by G Mathew et al, mean age to regain birth weight ranged from 12.0 days for 33 weeks' gestation to 17.6 days for 28 weeks' gestation.¹

In this study the average percentage of initial weight loss was 8.92% which occurred on an average of 4.63 ± 2.83 days and they regained their birth weight on an average of 10.98 ± 5.85 days of age which is almost similar to that of Bertino et al.¹⁷ The rate of postnatal growth failure in our VLBW infants is high. IUGR is the most significant determinant of postnatal growth failure. In addition, AGA-VLBW infants are at significant risk of postnatal growth failure which is supposed to be either due to inadequate nutritional support or due to morbidities of prematurity. Among the VLBW infants included in this study 70.83% of the cohorts survived to discharge. Overall, mortality of VLBW neonates remains higher than those reported from neonatal networks in developed countries it is still comparable with the global average.¹⁸

Among the comorbidities studied in our study that included RDS, hs-PDA, sepsis, NEC \geq stage 2, CLD, PVL, IVH, ROP, requirement of IMV and PN, none were found to be significantly associated with postnatal growth failure. In contrary to these findings, study by Richard AE et al showed that AGA infants who survived till hospital discharge without developing comorbidities gained weight faster than similar comparable infants with co-morbidities. Same study also showed that more rapid weight gain was also associated with a shorter duration of parenteral nutrition, an earlier age at the initiation of enteral feedings, and an earlier age at achievement of full enteral feedings.¹¹ The difference in our study might be because of small sample size. Similarly, study done by Khasawneh et al¹⁹ showed that although prematurity-related co-morbidities contribute to the occurrence of postnatal growth failure, inadequate nutritional support remain the major predisposing factor.

With adequate nutrition and better weight gain, premature infants could be discharged home earlier, a more cost-effective strategy that should be highlighted at a national level. This is a single centre study with a limited sample size. All the enrolled infants were not discharged at the same postmenstrual gestational age. Moreover, all the VLBW babies discharged at different postmenstrual age were not followed till they attain pre-fixed post menstrual gestational age. Similarly, the nutritional practices for VLBW in our study weren't specified example whether the infants were on prolonged NPO without PN, formula feed or expressed breast milk feeding with or without fortification.

Acknowledgment

This study is a part of the thesis submitted for the Masters Degree in Paediatrics

Conclusions

Our study showed high rate of postnatal growth failure. There seems to be a need to optimize nutrition among VLBW babies to achieve acceptable postnatal growth rate.

Conflict of Interest: None

Funding Source: None

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