Linear growth in the early neonatal period

N J Bishop, F J King, A Lucas

Abstract

To test the hypothesis that early linear growth is independent of changes in weight we undertook simple anthropometry in 45 term infants daily to day 7 after birth. Linear growth proceeded rapidly and independently of changes in weight variations from the first day after birth; we suggest that this implies 'programmed' continuity of skeletal growth, possibly fuelled at the expense of other body tissues.

The pattern of rapid weight loss, followed by steady weight gain in the first days after birth is well reported.¹ Information documenting changes in linear growth at this time is sparse, however, possibly due in part to the technical difficulties inherent in such measurements.²

We wished to test the hypothesis that changes in early linear growth occur independently of alterations in weight in the early neonatal period, as part of a larger series of studies of body composition and energy metabolism during this period of rapid adaptive change.

Subjects and methods

We studied a total of 45 infants of appropriate size for gestation (mean (SD) birth weight 3370 (420) g) born to mothers attending the Rosie Maternity Hospital, Cambridge, for their delivery.

Where possible (38 of 45) we selected infants of mothers who had undergone caesarean section, in order to ensure at least five days' mea-

surements. The reasons for operative delivery were previous caesarean section, cephalopelvic disproportion, or failure to progress in labour.

The anthropometry comprised crown-heel length to the next succeeding 1 mm using a Holtain neonatometer; ulnar length (distal ulnar styloid to olecranon) to the next succeeding 0.1 mm using a pair of RS precision vernier calipers; weight using Sartorius electronic balance scales to the nearest 10 g; and occipitofrontal circumference to the next succeeding 1 mm using a paper tape measure. All measuring devices were checked against standards daily, and recalibrated where necessary. Weight was obtained at birth; each of the other measurements was made within the first 24 hours, and on successive days thereafter.

The precision (standard error of measurement) for crown-heel length was 0.7 mm ($n=33$), and for ulnar length 0.2 mm ($n=33$). Interobserver variability was 2 mm for crown-heel length ($n=21$); only one observer carried out ulnar length measurements.

Thirty eight infants were breast fed, with four of these receiving 'complementary' formula feeds for one day each.

Results

The results are displayed graphically in figs 1 and 2. The graphs represent the mean incremental changes over successive 24 hour periods for each of the measurements performed. The points are for the group mean over that time period; the error bars are 1 standard error of that mean. No significant differences were

Figure 1 Change in weight (A) and occipitofrontal circumference (B) compared with age.

MRC Dunn
Nutrition Unit,
Downham's Lane,
Milton Road,
Cambridge CB4 1XJ
N J Bishop
F J King
A Lucas

Correspondence to:
Dr Bishop.

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Figure 2 Increase in crown-heel length (A) and ulnar length (B) compared with age.

observed between the sexes, or between feed groups, and the data have therefore been combined.

As crown-heel length, ulnar length, and occipitofrontal circumference were not measured at the time of birth, the graphs for these measurements do not intersect the y axis. Their incremental changes are shown relative to the first measurement, made at a group mean age of 16 hours after delivery.

It can be clearly seen that despite losing weight, and with an initial decrease in head circumference (possibly due to moulding), both crown-heel and ulnar length increased from the first day after birth.

Discussion

We have shown that the linear growth of a single bone and of length overall continues from the first day after birth. The percentage increase in crown-heel length was 2.5%, and in ulnar length 3.0%. The close degree of agreement between these values makes it unlikely that other factors, such as variation in muscular tone, or alterations in soft tissue water content contributed significantly to the observed increase in body length.

The actual rate of growth of 11.5 mm in one week is the most rapid seen ex utero, and is essentially a direct continuation of that observed

in the latter part of the third trimester.³ By contrast, weight falls immediately after birth by an average of 6%, and is not usually regained by the age of 1 week. This implies that skeletal growth is to some extent 'preprogrammed' to continue despite the abrupt alteration in nutrient supply. It is possible that the consequent demand for mineral substrate contributes to the hypocalcaemia commonly observed in the neonatal period.⁴

Total energy requirements increase postnatally,⁵ yet until enteral food intake is established there is negative energy balance. It is interesting that rapid early bone growth is given priority at this stage and is presumably fuelled at the expense of other tissues. Our observations also have important implications for the interpretation and collation of growth and mineral balance data in neonates.

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University Hospital,
Queen's Medical Centre,
Nottingham NG7 2UH,
Department of
Histopathology
J Barlow
M J Wilkinson

Department of
Child Health
C O'Callaghan

Correspondence to:
Dr Wilkinson.

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Neonatal cilia: ultrastructure

J Barlow, M J Wilkinson, C O'Callaghan

Abstract

The number of inner and outer dynein arms and gross ciliary abnormalities of well newborn children and adults were similar. Inability to

see all nine outer dynein arms in healthy adults may be due to technique and not recent infection or congenital ciliary malformation.