ONTOGENY OF STOOL PASSAGE IN LOW BIRTH WEIGHT INFANTS ≤1500 GRAMS

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ABSTRACT

The onset of stool passage, timing of transition to yellow stools and the pattern of stooling frequency over the first 4 weeks were studied in infants <1500 g at birth. The time of passage of the first stool (median, 19) correlated with birth weight and gestational age but not with presence or severity of respiratory distress; fourteen per cent passed stool after 1st 48 hours. Transition to yellow occurred at 17.6±6.4 days and was related to the onset of feeding and birth weight. Stooling frequency was similar in Wk 2 as Wk 1, increased in Wk 3 and plateaued on Wk 4. Volume of feeding/day increased each week over that of preceding week but stooling frequency was not related to the increased volume or any of the other variables.

Key words: *Low birth weight, Stool passage, Preterm.*

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Received for publication: July 20, 1992;
Accepted: August 12, 1992

Abdominal distension in premature infants ≤1500 g, with consequent withholding of feedings, is often attributed to lack of stooling and generates enough concern to attract some form of prophylactic rectal stimulation. In our nursery, rectal suppositories or some type of rectal stimulation has been used in asymptomatic babies who have not passed any stool in more than two days. The need and therapeutic value for such intervention is questionable since there are no norms for stooling frequency in VLBW (<1500 g) infants. Moreover, probes have been reported to cause rectal perforation(1) and fissures.

The ontogenetic development of the indices of gastrointestinal (GIT) maturation and adaptation in newborn infants have been the subject of several studies (2-7). Specific time sequences have been demonstrated for the maturation of gastrointestinal enzymes(2) and digestive functions(4,5), colonic motility and the recto-sphincteric reflex activity(6). Some of the hormonal factors associated with the induction of these maturational processes have been described(7).

The clinical correlates of these maturational/adaptational events have not been received the same kind of attention. Stooling frequency should be an appropriate clinical index of the dynamic balance between the small intestinal motor activity and the anal sphincteric tone. Therefore, studies in cohorts of premature infants at different gestational ages or longitudinally in the same cohort, could be used as a reflection of the maturational time sequence demonstrated manometrically. To the best of our knowledge, this has not been done.

This study was done to: (*i*) understand the natural pattern of stooling frequency in infants <1500 g over a 4-week period; (*ii*) identify a parallel, if any, between this

clinical index and the maturational sequence of myo-electric activity indices; and (*iii*) evaluate the contribution of some identifiable postnatal influences on the stooling pattern.

Material and Methods

The case records of babies ≤1500 g admitted to the NICU of Cook County Hospital were reviewed. Babies born between January 1986 and June 1987, who had uninterrupted feeding for at least 4 weeks and had complete medical records available, were included in the analysis. There were 51 infants who met this inclusion criteria. The following information was extracted: maternal drug therapy during labor, presentation and mode of delivery, Apgar scores at 1 and 5 minutes, birth weight (BW), gestational age (GA), initial respiratory distress status [no distress, transient tachypnea (TTN), HMD], based on clinical and radiological features; and indices of the severity of their subsequent respiratory disease (number of days on O_2 and mechanical ventilation).

The following data were also collected: time of onset of feeding, volume of daily milk intake, time of passage of first stool, total number of stools passed/day and color of stool. Stools are recorded by amount (small, medium, large), color (meconium, green, transitional or yellow) and consistency.

Statistical Analysis

Paired comparisons of continuous variables over the 4-week period were done by the paired 't' test. Discrete variables were compared using the χ^2 analysis.

Stepwise forward multiple regression analysis was carried out using a Tektronix statistical package(8). The dependent variables and their corresponding independent variables are as follows: (*i*) Time of passage of 1st stool versus birth weight (BW), gestational age (GA), Apgar scores, onset of feeding, presentation and mode of delivery, maternal drung therapy during labor, and initial respiratory distress status; (*ii*) Time of switch to yellow stools versus the above independent variables; (*iii*) Change in stool frequency between 2 week sets versus onset of feeding, change in weighted average volume of feeding, birth weight, gestational age, Apgar scores, initial respiratory distress status, number of days on oxygen and mechanical ventilation.

The standard partial regression coefficients (b')(9) are shown to allow for comparisons of the relative magnitude of the contribution of significant independent variables.

Results

The clinical characteristics of the study population are shown in *Table I.*

The first stool was passed at a mean age of 20.1±16 hours (median = 19 h). The cumulative percentage over time is shown in *Table II.* Eighty four per cent of the infants passed stool by 48 hours; 13.6% did not pass stool in the first week. There were no differences between infants who passed stool before or after 7 days. The time of 1st stool passage showed a significant relationship with BW (r^2 = 0.23, b' = –0.48, $p<0.001$) and GA (r^2 = 0.22, b' = –0.47 $p<0.001$) when included in the regression equation separately. They are not in the equation simultaneously because of their linear dependence on each other (r^2 = 0.77). The other independent variables: Apgar scores, presentation and mode of delivery, maternal drug therapy during labor and initial respiratory distress status did not contribute significantly to the explained variance (r^2).

TABLE I—*Perinatal and Postnatal Variables of 51 Infants*

Parameter	Value
Birth weight (g)	1123±226* (721-1474)
Gestational age (wks)	30±2.5
Apgar scores (1 min, 5 min)	4±2 : 7±2
Presentation	
Vertex	69%
Breech	31%
Mode of delivery	
Vaginal	65%
LSCS	35%
Maternal drug	
No drugs	49%
Gen. anesthetic and/or $MgSO_4$	29%
$MgSO_4$	16%
Ritodrine	6%
Initial respiratory distress status	
No distress	6%
TTN	16%
HMD	78%
Subsequent respiratory status	
Duration of oxygen (days)	16.6±11.9
Duration of mechanical ventilation (days)	13.8±12.2
Onset of feeding	
Time of onset (days)	6.9±3.9
1st week - % of infants	55
2nd week - cumulative %	94
3rd week - cumulative %	100

*Mean ± S.D.

The change in stool color to yellow occurred at 17.6±6.4 days. This was significantly related to onset of feeding (r^2 = 0.52, b' = 0.54, $p<0.001$) and BW as shown by the increment in variance due to the added effect of BW (r^2 = 0.07; b' = –0.32, $p<0.01$). Apgar scores, presentation and mode of delivery, maternal drug therapy during labor, initial respiratory distress status and severity of subsequent respiratory disease did not contribute significantly to the variance.

The pattern of stool passage over the 4-week period is shown in the *Fig.* There were significant increases in volume of feeding each week over that of the preceding week during the 4-week period ($p<0.001$). Despite the increase in volume

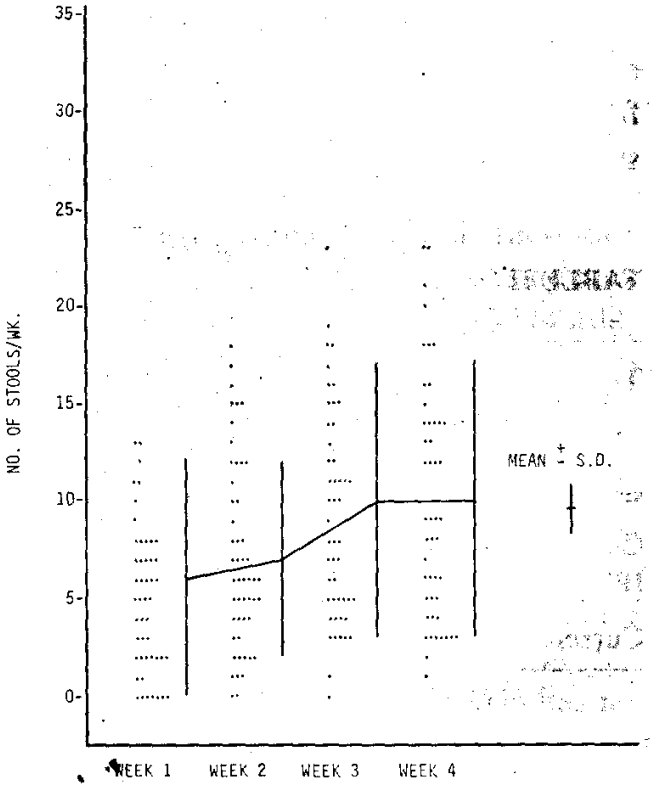

Fig. Pattern of stool passage. Each dot represents the number of stools passed per week per infant.

of feeding from week 1 to week 2, there was no difference in the number of stools/week in week 2 compared to week 1. Similarly, there was no difference in the number of stools/week in week 4 compared to week 3 despite a significant increase in volume of feeding during the same span of time. However, there was a significant increase in the number of stools/week in weeks 3 and 4 compared to 1 and 2.

The increase in stooling frequency with postnatal age was not significantly related to any of the independent variables studied.

Sixty to seventy per cent (60-70%) of the infants passed <1 stool/day during the first 2 weeks. There was no difference in the proportions in week 2 compared to week 1. This proportion significantly dropped tc 30-40% during the later 2 weeks: W3>W1 ($p<0.01$); W3>W2 ($p<0.05$); W4>W1 ($p<0.001$) and W4>W2 ($p<0.025$). There was no difference in week 4 compared to week 3. This finding corroborates the pattern seen with stooling frequency over the 4-week period.

Discussion

The cumulative frequency for the passage of the first stool (*Table II*) is consistent with the only comparable study of infants <1500 g(10) and further emphasizes the differences between these infants and full-term babies(11). The significant negative correlation between time of passage and BW/GA also confirms previous observations(10,12). We did not find any significant relationship with indices of respiratory distress and the time of the first enteral

TABLE II—*Passage of the First Stool in 51 Infants in this Study as Compared to Previous Study of Jhaveri and Kumar(10).*

Time (h)	0–12	12–24	24–48	>48
No of infants (%)	17 (33.3)	12 (23.5)	14 (27.5)	8 (15.7)
Cumulative %	33.3	56.8	84.3	100.0
Cumulative % [Previous study (10)]		57.9	79.5	100.0
Current *vs* Previous study	(p)	NS	NS	NS

TABLE III—*Pattern of Stool Passage and Weighted Average Volume of Feeding over the 4-Week Period.*

Week (W)	1	2	3	4
Volume of feeding (ml/day)	20±25	72±60	112±80	143±83
Volume of feeding (ml/kg/day)	16±18	59±43	93±57	125±58
		W4 > W3 > W2 > W1 $p<0.001$		
No. of stools/week*	6±6	7±5	10±7	10±7
		W1 = W2; W3 = W4		
		W3/W4 > W1/W2 $p<0.01$		
No. of infants with <1 stool/day	36	32	22	19

W1 = W2; W3 = W4
W3 > W1, $p<0.005$; W3 > W2, $p<0.05$
W4 > W1, $p<0.001$; W4 > W2, $p<0.025$

feeding in contrast to the study by Jhaveri and Kumar(10). This may be due to the homogeneity of our population, *i.e.,* 78% had HMD. The effects of an overall smaller sample size and the marked variability in time of passage of stool when examined in hours cannot altogether be ruled out.

A significant increase in stool frequency occurred at 3 seeks postnatal age that reached a plateau at 4 weeks. This increase could not be explained by any of the perinatal variables and postnatal factors studied but might represent an ontogenetically programmed maturational sequence of stool passage in LBW infants.

Stooling frequency is a reflection of the dynamic balance between gastrointestinal motility and the anal sphincteric activity. Ontogenetically programmed sequence of maturation of intestinal myo-electric activity has been demonstrated by Mills and Fenton(5) using a single constantly perfused jejunal catheter in 6 preterm infants studied longitudinally from 27-35 weeks post-conception. They showed 3 stages of spiking activity: (*i*) at 27-30 weeks, a disorganized pattern which was not associated with lumenal transit, (*ii*) at 30-32 weeks, repetitive groups of contractions, the "fetal complex", characterized by slow transit, and (*iii*) at 34-35 weeks, an MMC (migrating, myoelectric complex) pattern that produces a faster transit. In the three full term infants studied, a well established MMC pattern was seen. This is in accordance with a previous study(13) using contrast amniography and has been confirmed by Morriss *et al.*(14).

Similarly, progressive physiologic maturation of the anal sphincter has been described in a manometric study of 60 children including 5 premature infants, 3 of whom were studied longitudinally(6). The premature infants, <2500 g and 33-38 weeks gestation studied at 2-10 days of age had a mean resting sphincteric tone of 18 cm H_2O, virtually no rhythmic activity and consistently absent recto-sphincteric reflex as opposed to term infants with a mean resting tone of 45 cm H_2O, average rhythmic contractions of 13/min and consistently present recto-sphincteric reflex. Repeated testing of the premature infants showed progressive maturation with the achievement of term anal physiologic indices after 2 weeks of age.

Stool frequency in relation to gestational age and postnatal age will, therefore, depend on the relative speed and timing of attaining maturation of intestinal motility and sphincteric functions. Thus, if motility matures faster and earlier than sphincter functions, then stooling frequency should increase with age up to a maximum and then decrease to an intermediate basal frequency. On the countrary, if frequency should decrease to a minimum and then increase to an intermediatte basal frequency. This temporal relationship has not been worked out manometrically.

Our results could provide clinical correlates of what this temporal sequence might be; the sudden increase in stooling frequency from week 2 to week 3 might suggest faster and earlier maturation of colonic motility. The maturation of the anal sphincter then seemed to have caught up by the 4th week resulting in no further increase in stooling frequency. What happens subsequently cannot be determined since we stopped data collection after 4 weeks.

The results on the proportion of infants passing 1 stool/day or less is consistent with the pattern of stooling frequency. The majority of the infants <1500 g pass less than 1 stool/day during the 1st 2 weeks

of life. This is not related to delayed onset or reduced quantity of feeding. It would seem, therefore, that infrequent passage of stool in babies <1500 g is a common occurrence and should not by itself generate enough concern to warrant intervention.

Acknowledgement

The authors are indebted to the nursing staff in the NICU for their meticulous recording of vital information in these infants.

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