

Effect of body position on gastric emptying in the neonate

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Yu, V. Y. H. (1975). *Archives of Disease in Childhood*, 50, 500. **Effect of body position on gastric emptying in the neonate.** The effect of body position on gastric emptying was investigated in 48 neonates. The rate of gastric emptying is the same for healthy term, preterm, and small-for-dates infants. Infants with respiratory distress syndrome have delayed gastric emptying and a high incidence of abdominal distension and pooling of feeds in the stomach in the supine position. The stomach empties more rapidly in the prone and right lateral positions than in the supine and left lateral positions.

These findings indicate that the prone or right lateral positions are to be preferred for nursing neonates, especially those in whom intolerance to the volume of feeds is likely to be a problem. Supine or left lateral positions have little merit in helping gastric emptying and should not be used routinely in hospital nurseries.

The optimum sleeping position of the neonate has still to be determined. Paediatric nurseries in the United States favour the prone position, but in Europe, the Near East and Far East, the supine position is used (Brackbill, Douthitt, and West, 1973). The reasons for preferring the supine or prone positions have not been clearly expressed and seem to be based on custom rather than reason. As Gellis (1974) pointed out, comparisons between positioning the infant on left or right sides with the other positions have not been made. Research on the physiological and behavioural effects of body position in the neonate is required to justify the recommendation of one position rather than the other.

In a low birthweight or sick neonate, this consideration may be particularly vital as the disturbance necessitated by feeding, even with gavage, and the subsequent distension of the stomach can compromise cardiorespiratory function (Wilkinson and Yu, 1974) or lead to inhalation pneumonia (Wharton and Bower, 1965). Though early feeding of low birthweight infants is now an established routine in most special-care nurseries (Davies *et al.*, 1972), the success of this in a group of high-risk neonates depends not only on the amount, frequency, and method with which feeds are given but

probably also on the management of the neonates between feeds. Body position may be of considerable importance in this connexion no matter how carefully the feed is given.

In this study, the rate of gastric emptying in healthy term, preterm, and small-for-dates (SFD) infants and infants with idiopathic respiratory distress syndrome (RDS) is related to the sleeping position of the infant.

Patients and methods

Forty-eight infants born in the John Radcliffe Hospital, Oxford, were studied. 12 were term infants admitted to the special-care nursery for short periods of observation but who subsequently proved to be well. 12 were healthy preterm infants, born before 37 weeks' gestation with birthweights appropriate for gestational age. 12 were SFD infants, those whose weight was below the 5th centile for gestational age and sex according to the data of Thomson, Billewicz, and Hytten (1968). The remaining 12 infants had classical clinical and radiological evidence of RDS.

All the infants studied were being fed in the special-care nursery routinely via indwelling polyvinyl nasogastric tubes (Bardic No. 5 French) every 2 hours. The method of serial test-meals used in adults (Hunt, 1951) has been modified for study of gastric emptying in the newborn (Husband and Husband, 1969). The stomach was initially washed out with water so that it was free of large curds. Test-meals were given 1½ hours

after the last feed in the volume of 7 ml/kg over a period of 3-4 minutes. After an interval of 30 minutes, the gastric contents were aspirated. The stomach was then washed out with 20 ml water to recover any remaining contents. The test-meals were 10% glucose (556 mOsm/kg) with added phenol-red, 0.24 mg/100 ml. The latter acts as a marker as it is not absorbed from the stomach and has no effect on gastric emptying (Hunt, 1956). The volume of the original test-meal which is still in the stomach can then be calculated from the total gastric content recovered, independent of added gastric secretions and saliva (Hunt and Knox, 1962). The concentration of phenol-red was measured by spectrophotometry (wave length 550 μ) in the original test-meal (a), the gastric aspirate at 30 minutes (b), and the washout (c).

EXAMPLE

	Volume (ml)	Optical density
(a) Original test-meal	21.0	0.28
(b) Aspirate at 30 min	7.5	0.25
(c) Washout	20.0	0.02

Vol. of original meal in (b) = $(7.5 \times 0.25) / 0.28 = 6.7$ ml

Vol. of original meal in (c) = $(20 \times 0.02) / 0.28 = 1.4$ ml

Vol. of original meal remaining in stomach at 30 min = 8.1 ml

% retention of original meal at 30 min = $(8.1/21) \times 100 = 38.6\%$.

Each infant was given a test-meal in two different positions during the first 24 hours of life. Three study groups were utilized: (1) supine and prone positions, (2) supine and left lateral positions, and (3) supine and right lateral positions. The infants were assigned to each of the study groups by random selection. All were maintained in the required position for at least 3 hours before and for 30 minutes after the feed. The sequence in which the infants were studied in supine or one of the other positions was alternated.

Infants with RDS were not studied in the prone position because this rendered routine clinical and nursing observations difficult. It is not known whether catheterization of umbilical vessels has any adverse effects on intestinal motility or gastric emptying. Since all the infants with RDS studied in the first 24 hours of life had umbilical arterial and venous catheters

in place, the rate of gastric emptying was further compared in 12 infants before and after the umbilical catheters were removed.

Results

Table I shows the values for birthweight, gestation, and postnatal age in the infants studied. The subgroups shown in Table II were analysed to see whether the changes observed for gastric emptying were influenced by birthweight, maturity, or postnatal age when studied.

The results of the test-meals given in the supine position are shown in the Fig. A mean of 41.5%

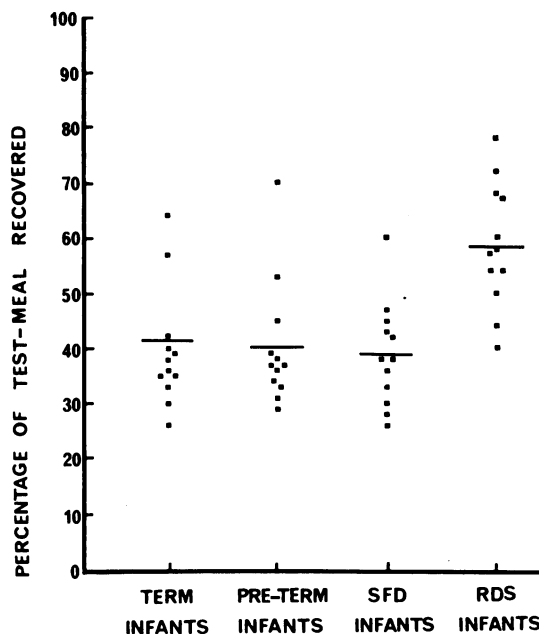


FIG.—Percentage of test-meal recovered 30 minutes after feed in healthy term, preterm, and SFD infants, and those with RDS. Horizontal bar shows mean value for each group.

TABLE I
Characteristics of infants studied

Subjects	No. of infants	Birthweight		Gestation		Postnatal age when studied in supine position
		Mean \pm SEM	Range	Mean \pm SEM	Range	Mean \pm SEM
Term infants	12	3614 \pm 149	2910-4480	39.5 \pm 0.1	39-40	12.3 \pm 1.4
Preterm infants	12	2338 \pm 127	1430-2980	35.3 \pm 0.5	33-37	13.3 \pm 1.5
Small-for-dates infants	12	2228 \pm 51	2005-2480	37.7 \pm 0.3	36-40	12.6 \pm 1.7
Infants with RDS	12	2555 \pm 154	1790-3460	35.8 \pm 0.8	31-39	11.0 \pm 2.0

TABLE II
Characteristics of infants in different subgroups

Subgroups	No. of infants	Birthweight		Gestation		Postnatal age when studied	
		Mean \pm SEM	Range	Mean \pm SEM	Range	Supine (mean \pm SEM)	Test position (mean \pm SEM)
Healthy infants* Supine v. prone	12	2552 \pm 230	1430-3940	37.3 \pm 0.8	33-40	12.8 \pm 1.5	12.9 \pm 1.4
Healthy infants Supine v. left lateral	12	2869 \pm 222	2110-4480	37.4 \pm 0.6	35-40	12.5 \pm 1.6	11.8 \pm 1.6
Healthy infants Supine v. right lateral	12	2758 \pm 212	1960-4100	37.2 \pm 0.2	35-40	12.8 \pm 1.9	13.0 \pm 1.9
Infants with RDS Supine v. right lateral	12	2555 \pm 154	1790-3460	35.8 \pm 0.8	31-39	11.0 \pm 2.0	11.2 \pm 1.8

*Healthy infants include 4 term, 4 preterm, and 4 SFD infants who are clinically well.

(SEM \pm 3.3) of the original test-meal was recovered in 12 term infants, 40.2% (SEM \pm 3.1) in 12 preterm infants, and 38.8% (SEM \pm 2.6) in 12 SFD infants. The differences are not significant by Student's 't' test. In contrast, the mean for the test-meal recovered in infants with RDS was 58.3% (SEM \pm 3.2). The differences between this and the other 3 groups of healthy infants are significant ($P < 0.001$). Furthermore, 5 of the 12 infants with RDS developed abdominal distension and required temporary cessation of oral feeds in the first 48 hours of life while nursed in supine position.

The effect of body position on gastric emptying is shown in Table III. In the healthy infant group, comprised of clinically well term, preterm, and SFD infants, there was less retention of the test-meal 30 minutes after the feed in the prone position compared with the supine ($P < 0.05$ by the 't' test for pairs). No difference was observed

between infants in the supine position and those on their left sides. Comparison between right lateral and supine positions showed less retention in the former position both in clinically well infants ($P < 0.05$) and in those with RDS ($P < 0.01$). Results of 4 studies in infants with RDS positioned on their left sides showed a mean of 77% recovery of the test-meals 30 minutes after feeds, compared with 60% when tested in supine position. This, together with the clinical impression in the nursery that infants with RDS while nursed on their left sides tend to develop more abdominal distension and pool their feeds in the stomach, made us reluctant to continue to study ill infants in the left lateral position.

Gastric emptying studies were carried out in 12 infants with RDS immediately before the removal of umbilical arterial and venous catheters which had been *in situ* for between 10 and 96 hours. Results showed 42.9% (SEM \pm 3.3) retention in

TABLE III
Gastric emptying in different body positions

Subgroups	No. of infants	Percentage retention of feeds in 30 min		Significance level
		Supine	Test position	
Healthy infants Supine v. prone	12	39.0 \pm 2.8*	33.3 \pm 2.9	$P < 0.05$
Healthy infants Supine v. left lateral	12	40.3 \pm 2.9	41.1 \pm 2.1	NS
Healthy infants Supine v. right lateral	12	39.3 \pm 3.0	33.9 \pm 3.8	$P < 0.05$
Infants with RDS Supine v. right lateral	12	58.3 \pm 3.2	46.6 \pm 3.6	$P < 0.01$

*Mean \pm SEM.

the stomach 30 minutes after the feed. Test-meals were repeated 6–8 hours after the umbilical catheters were removed and the results showed 39.2% ($SEM \pm 3.2$) retention. The difference is not significant and it is unlikely that umbilical catheterization by itself has any effect on gastric emptying.

There was no correlation observed in rate of gastric emptying with the following variables: (1) birthweight of infant, (2) gestation, (3) postnatal age when studied.

Discussion

All earlier studies of gastric emptying in the newborn were by means of radiological techniques (Smith and LeWald, 1915; De Buys and Henriques, 1918; Bouslog *et al.*, 1935; Henderson, 1942; Miller and Ostrum, 1945; Schell, Karelitz, and Epstein, 1963). Disadvantages include the hazards of radiation which limited comparison within subjects of the emptying rate in different situations. The volume of a barium meal may be steadily increased by gastric secretions themselves (Liebowitz *et al.*, 1957) and hyperosmolar radio-opaque meals were shown to inhibit gastric peristalsis and stop emptying (Shay and Gershon-Cohen, 1934). Differences in character and quantity of barium in the test-meals were also thought to be sources of errors (Silverio, 1964). Vendel's (1948) nonradiological study of gastric emptying in infants involved aspiration of gastric contents at regular intervals after a feed, measuring the volume, and returning the contents into the stomach. However, the quantity of added gastric secretion and saliva was unknown and it was not possible to avoid stimulation of peristalsis with the changes in volume during repeated aspirations. The present method of study is safe and reasonably reliable and causes no evident clinical disturbance to the infants or to the nursing routine. It is not the aim of this study to determine the end-point of gastric emptying but only the comparison of the rate of emptying in the 30 minutes after the test-meal. Clinical impressions on the degree of pooling of milk by the time of the next feed in these infants who are fed 2-hourly nevertheless appeared to be consistent with the results obtained in this study.

Schell *et al.*, (1963), whose work was done exclusively on preterm infants, found no correlation of gastric emptying time with either postnatal age of the infants or with their weights. The present observations confirm this, and similar rates of gastric emptying were obtained in term, preterm, and SFD infants.

Infants with RDS, however, were found to have delayed gastric emptying. Hypoxaemia is known

to prolong gastric emptying time in both animals (Van Liere, Crisler, and Robinson, 1933) and human subjects (Van Liere, Lough, and Sleeth, 1936). Another explanation may be that infants with respiratory distress accumulate excessive air in the stomach which may influence gastric emptying. Infants are notoriously aerophagic (Smith and LeWald, 1915; Henderson, 1942; Miller and Ostrum, 1945), especially while crying, yawning, or bottle-feeding, and it is likely that with the increased respiratory effort in RDS, the stomach can easily be filled with air.

Smith and LeWald (1915) first stressed the importance of body position of the newborn as regards gastric functioning. More specifically, a study in older infants and children (De Buys and Henriques, 1918) showed that barium emptied from the stomach faster in the right lateral than in other positions. We also have found gastric emptying to be more rapid in right lateral than supine or left lateral positions but similar to that in the prone position. Miller and Ostrum (1945) reported that gaseous distension of the gastrointestinal tract in infants can be relieved by placement for several hours in the semirecumbent prone position and recommended the procedure as a prerequisite for radiological investigations in suspected hypertrophic pyloric stenosis in infants. In a recent study (Brackbill *et al.*, 1973), it was found that when prone, infants sleep more, cry less, and have more regular respirations, all of which may result in less air actually introduced into the stomach while in this position.

A study of fluid-gas relations in the stomach in young infants in different positions (Hood, 1964) showed that when supine, fluid accumulates in the fundus which is the most dependent position of the stomach; and the air bubble rises to the highest part, the pyloric antrum. The fluid-filled fundus acts as a barrier to prevent eructation and hence the supine position may predispose to regurgitation and inhalation. Retention of feeds occurs as a result of air accumulating at the pyloric end. With the passage of this swallowed air into the small intestine, gaseous distension of the duodenum can further inhibit gastric emptying (Miller and Ostrum, 1945).

Thus it is desirable to limit the amount of swallowed air and to confine what is ingested to the fundus to facilitate its return. Gastric emptying is quicker after tube-feeding (Hunt, 1956) because it was thought that the large influx of air into the stomach, as with bottle feeding, does not occur (Hood, 1964). Nevertheless, gaseous distension of the stomach often occurs in tube-fed infants, particularly those ill with respiratory distress and it

may be advisable to perform routine gastric aspiration before each feed or to adopt the practice of leaving the indwelling nasogastric tube unspigotted and open to the atmosphere between feeds. It is probably as necessary to 'burp' infants after tube-feeds as after bottle-feeds.

Most of the discussion about the relative merits of nursing infants prone or supine have been concerned with motor and sensory effects. The supine position favours the development of sensory perception particularly of the eyes but at the expense of the motor aspect such as control of the neck muscles (*British Medical Journal*, 1961). In Europe, the supine position is more popular probably because of fears that the prone infant might suffocate with his face in regurgitated milk or in a pillow. However, prone infants were thought to be more contented (Brackbill *et al.*, 1973), which in turn can help the development of a good mother-child relationship (Bell, 1971). This study gives a further reason why the prone position, or alternatively the right lateral position, should be used for nursing neonates.

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