Transpyloric feeding in the very low birthweight (1500 g and below) infant

One year's experience in an intensive care neonatal unit

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SUMMARY The success of transpyloric feeding in a group of babies weighing 1500 g or less was evaluated. This method was successful for most well babies but for many of those who required respiratory assistance (usually by face mask) it was not.

Although babies weighing < 1500 g at birth represent only 1% of the total live births in the United Kingdom, they now present the biggest management problem in intensive care baby units. The importance of early feeding and the provision of adequate calories in the first weeks of life has been emphasised (Smallpeice and Davies, 1964; Winick, 1969; Lubchenco *et al.*, 1972). Milk feeding via nasogastric tube is not always satisfactory in the very low birthweight infant, mainly because of the dangers of regurgitation and aspiration. The introduction of jejunal feeding (Rhea and Kilby, 1970; Cheek and Staub, 1973), and the greater use of IV feeding (Shaw, 1973) have, to some extent, made it easier to provide an adequate calorie intake for very small babies. Although there is no controlled evidence, greater experience with total parenteral nutrition may be one of the important factors associated with a higher survival rate of the most immature. Nevertheless milk feeding is likely to have greater application in units with limited laboratory and staff resources as it does not require such frequent monitoring. We report our experience from a neonatal referral unit during a 12-month period when milk feeding was electively practised whenever possible, in the hope that it may help others. This paper presents details of methods of feeding in 69 babies weighing < 1500 g at birth who were admitted to the Hammersmith Hospital between 1 January and 31 December 1977.

Patients and methods

During 1977, 95 babies of birthweight 1500 g or less

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were admitted to the intensive care baby unit. 28 (29%) were born in the hospital, the others were admitted from other units in and near London. The overall survival rate was 53%. In Table 1, the 95 babies are grouped according to birthweights (< 1000 g, and 1000-1500 g) and gestational ages (28 weeks or less, 29-30 weeks, 31-32 weeks, and > 32 weeks). The number who needed respiratory assistance (RA) (either intermittent positive pressure ventilation (IPPV) or continuous inflating pressure (CIP)) in each subgroup is also shown.

Feeding data on 69 of the 95 babies are presented. The remaining 26 are excluded for the following reasons: 22 died within 4 days of admission (all were ventilated from the time of admission); 3 were admitted when > 2 weeks old; one had congenital heart disease and was admitted for a short period only.

The policy in the unit during the period of the study was to feed all babies if possible with milk, expressed breast milk if available otherwise low

Table 1 *Survival rates of all babies weighing 1500 g or less at birth admitted to the unit during 1977*

	Babies		Respiratory assistance	No assistance	Survivors*
	No.	(%)			
<i>Birthweight (g)</i>					
< 1000	32	(34)	28	4	7
1000-1500	63	(66)	32	31	43
<i>Gestational age</i>					
28 weeks and less	43	(45)	37	6	9
29-30 weeks	26	(27)	16	10	17
31-32 weeks	18	(19)	5	13	16
> 32 weeks	8	(8)	2	6	8
Totals	95		60 (63%)	35 (37%)	50 (53%)

*Survival rate for those born at this hospital = 64.3%, for those born outside = 47.8%.

solute cows' milk. Apart from 3 babies who were fed entirely intravenously, IV feeding was used only when milk feeds could not be established. Jejunal feeding was attempted in all but the healthiest of babies.

Method of passage of jejunal tubes. The jejunal tubes were made of silicone, weighted with an end-hole stainless steel tip. The outside diameter was 1.7 mm and the inside diameter 0.8 mm. The glabella-to-heel distance was measured and the length marked on the tube with a piece of black cotton. During the first 3 months of the study period, all tubes were passed via the nose. Later an increase in nasal resistance was found in babies with nasal tubes in place (J. Stocks, 1977, unpublished), so the tubes were subsequently passed through the mouth. The tube was passed into the stomach, without an introducer, and the baby was then turned on to his right side; the tube was advanced at intervals varying between 20 min and one hour, depending on how well the baby tolerated the procedure. The position of the tube was checked by introducing 2 ml sterile water down the tube and then aspirating via an orogastric polyvinyl feeding tube. If no water was aspirated the tube was assumed to have passed through the pylorus. (It was not possible to suck back directly via the silastic jejunal tube because suction resulted in the lumen collapsing.) If any doubt remained the position of the tube was checked by x-ray.

After feeding had begun the stomach was aspirated every 2–4 hours to ensure that it was free of milk—i.e. the tube had not slipped back.

Attempts were made to pass the tubes as soon as the babies were settled in the unit. IV fluids (5% dextrose in the first 48 hours and dextrose/saline thereafter) complemented the milk intake initially to meet the full daily fluid requirement: 60 ml/kg day 1, 90 ml/kg day 2, 120 ml/kg day 3, 150 ml/kg day 4, increasing to 200 ml/kg at the end of the first week. A supplement of 30 ml/day of water was given to all babies on an open incubator and to those who received phototherapy. No tubes were passed if babies required assisted respiration by face mask, but attempts were made to continue feeding if the tube was known to be in place when the face mask was applied.

Results

Three babies received IV feeding only. The other 66 babies are divided into 3 main groups: group 1, babies fed via gastric tube; group 2, babies fed via nasal jejunal tube; group 3, babies fed via oral jejunal tube. Groups 2 and 3 are subdivided into:

(a) those babies requiring no respiratory assistance other than an increase in inspired oxygen; (b) those requiring either IPPV or CIP at some time in the neonatal period.

12 babies were fed via gastric tubes. All but 3 of these were of at least 32 weeks' gestation (mean birthweight 1225 g, mean gestational age 32.4 weeks) and were considered by nursing staff to be well enough to tolerate gastric feeding.

19 babies had jejunal tubes passed via the nose, 35 via the mouth. The mean birthweights of these two groups were 1067 and 1171 g, mean gestational ages 29 and 30 weeks, and the number requiring respiratory assistance was 53 and 57% respectively.

In each case, the time when the feeding tube was first passed, the time taken for it to reach the jejunum, the volumes of milk given, the complications, and the reasons for stopping jejunal feeding were recorded.

Table 2 shows the day on which passage of a feeding tube was first attempted.

The time taken for the jejunal tubes to be satisfactorily positioned is shown in Table 3. Three babies (all <1000 g) in whom jejunal tubes could not be introduced orally because of repeated regurgitation, subsequently had them passed successfully through the nose.

32 babies were fed for at least 3 days and 11 were fed for at least a week. The longest period was 39 days. In 7 babies the jejunal tube was not satisfactorily placed and 6 babies had tubes in place but

Table 2 *Day on which feeding tubes were passed (from day of admission to unit)*

Group	No. in group	Day			
		1	2	3	>4
1	12	6	0	3	3*
2a	9	7	2		
2b	10	7	2	1*	
3a	15	7	3	4	1
3b	20	9	3	3	5*
Total	66	36 (55%)	10 (15%)	11 (17%)	9 (14%)

*Fed after period of respiratory assistance.

Table 3 *Time taken for jejunal tubes to be satisfactorily positioned*

Group	No. in group	<24 hours	24–48 hours	48–72 hours	Not in place
2a	9	7	1	1	
2b	10	6	2		2
3a	15	7	5		3*
3b	20	10	3	2	5
Total	54	30 (56%)	11 (20%)	3 (6%)	10 (19%)

*All 3 babies had nasal jejunal tubes successfully passed eventually and in subsequent results are included in group 2a.

were not fed. The reasons for stopping, or not starting jejunal feeds, are shown in Table 4.

In addition to the 5 babies who developed necrotising enterocolitis during jejunal feeding, 3 other babies developed the condition, one while a jejunal tube was being positioned and one after jejunal feeds had been stopped because of apnoea. The time

of onset in the third case was not known, the diagnosis being made at necropsy.

Intravenous feeding. 22 babies required IV feeding at some time during the neonatal period because of failure to establish milk feeds (6), recurrent apnoea (5), respiratory assistance from birth (6), and necrotising enterocolitis (5). Attempts had already been made in most of these babies to pass jejunal tubes.

In Table 5, a comparison of the mean maximum weight loss, the mean time to regain birthweight, and the mean volume of milk given to the survivors (45 of the 66 babies studied) in the three groups is shown.

Discussion

Until 1975, in this unit, all babies weighing <1500 g at birth, and receiving milk, were fed intragastrically via polyvinyl tubes introduced through the nose. Because of the increasing numbers of small, immature babies, and the impressive success of Rhea and Kilby (1970) with the feeding of babies transpylorically, it was decided to adopt jejunal feeding in preference to IV feeding as we believed that there would be fewer complications.

Because of the association of polyvinyl feeding tubes with perforation (Boros and Reynolds, 1974; Chen and Wong, 1974; Loo *et al.*, 1974), we chose silastic tubing as recommended by Rhea and Kilby (1970). However perforation with a silastic transpyloric tube has recently been described (Pérez-Rodriguez *et al.*, 1978). The silicone paediatric duodenal tubes available on the market are twice the length of our tubes and we felt that this excessive dead space was undesirable, although they are much stiffer and may be easier to pass into the stomach and through the pylorus.

Many babies of birthweights 1500 g or less, will tolerate gastric feeds, and, although this choice of method was purely empirical, the babies fed by gastric tube in this study were healthy, and most were >32 weeks' gestation. We feel it advisable to nurse these babies prone to decrease the risk of aspiration.

Table 4 Reasons for stopping or not starting jejunal feeds

Group	No.	Reason	Outcome
2a	12 (3 previously attempted through the mouth)	Electively stopped	5
		Pulled out by baby	3
		NEC	1
		Tube in place but not fed (1 abdominal distension, 2 apnoea)	3
2b	10 (7 passed before RA)	Not in place	2
		Bile-stained aspirate	1
		Aspiration before IPPV	1
		Aspiration during CIP	1
		Apnoea	1
		Oral feeds continued until death	1
	1 passed during RA	Bile-stained aspirate	1
	2 passed after RA	Electively stopped	2
3a	15	Not in place (transferred to 2a)	3
		Electively stopped	3
		Pulled out by baby	4
		NEC	2
		Out of position after initial satisfactory placement	2
		Tube in place but not fed (apnoea)	1
3b	20 (9 passed before RA)	Not in place	1
		Apnoea	5
		Aspiration during RA	1
		NEC	2
	7 passed during RA	Not in place	4
		Pulled out by baby	1
		In place but not fed (poor condition of baby)	1
		Feed continued until death	1
	4 passed after RA	Electively stopped	1
		Pulled out by baby	2
		Out of position after initial satisfactory placement	1

NEC = necrotising enterocolitis, RA = respiratory assistance (IPPV or CIP).

Table 5 Comparison of mean maximum weight loss, mean time to regain birthweight, and the mean volume of milk (ml/kg per day) received on days 1, 2, 3, 4, 7, and 14 between the survivors of groups 1, 2, and 3

Group	No.		Birthweight (g)		Mean maximum weight loss (g)	Birthweight regain (day)	Vol. milk feed (ml/kg per day)					
	AGA	SGA	Mean	Range			1	2	3	4	7	14
1	7	4	1372	(1080-1500)	78 (5.7%)	9	36	58	89	138	167	211
2	9	3	1139	(780-1380)	113 (9.9%)	16	30	73	90	107	149	184
3	18	4	1227	(760-1500)	146 (11.9%)	17	11	35	59	76	108	150
Total 45												

AGA = appropriate for gestational age, SGA = small for gestational age.

The results suggest that we were able to position the jejunal tubes more quickly and satisfactorily when they were passed through the nose, although the figures do not reach statistical significance. Silastic tubes are very compliant and when the oral route was used, the tubes tended to loop out of the mouth and were more liable to be pulled back during suction. Because of the increased nasal resistance (J. Stocks, 1977, unpublished) when tubes are passed through the nose, it was felt that oral tubes were preferable, particularly in the first days of life when very preterm babies are more likely to suffer respiratory disorders. The delay in correct positioning of the tubes by the oral route may explain why babies in group 3 received less milk during the first 14 days than those in group 2.

Overall, 81.5% of jejunal tubes were *in situ* within 72 hours; these figures compare with those of Cheek and Staub (1973) in which 61% of 36 infants were being fed by jejunal tubes within that time, and those of Wells and Zachman (1975) who reported 100% of 18 infants having jejunal tubes in place in less than 48 hours. Rhea *et al.* (1975) found little difficulty in introducing weighted tubes in a large number of infants of varying weights and gestational ages. Rhea and Kilby (1970) found that steel-weighted jejunal tubes were too light to pass through the pylorus and it may be that heavier, gold-weighted tubes would pass more quickly.

32 of 54 babies were fed for at least 3 days and 11 were fed for more than a week, the longest period being 39 days. Difficulties in feeding by jejunal tube were encountered, particularly in the group requiring IPPV or CIP. In most of these, this was administered by the face mask. Nasopharyngeal suction, not only in this group but also in those babies with recurrent apnoea, appeared to play a part in tubes becoming dislodged and this may have accounted for aspiration in 3 babies. Although attention should be paid to the volume of gastric aspirate in all babies, those who require nasopharyngeal suction are particularly at risk of aspirating gastric contents.

During the period of this study 8 babies developed necrotising enterocolitis, 5 while being fed by jejunal tube, one during the time that a jejunal tube was being advanced, one a few days after jejunal feeding had been stopped; in the last case, the diagnosis was made at necropsy. The part played by jejunal feeding in a condition of probable multiple aetiology is difficult to assess although alteration of bacterial flora in the jejunum with jejunal tubes (Challacombe, 1974) or local irritation may predispose to the condition.

We suggest that jejunal feeding is best used for as short a period as possible because not only is this method of feeding unphysiological but it also has

recognised complications. In addition, continuous infusion of milk directly into the jejunum may alter the intestinal bacterial flora. Oral feeding with umbilical arterial catheters in place may also predispose to necrotising enterocolitis (Lehmiller and Kanto, 1978).

Babies with birthweights of 1500 g and less admitted to this unit between 1965–70 were fed by gastric tubes only (Davies and Davis, 1970; Davies and Tizard, 1975) and it is interesting to note that although those babies received a greater volume of milk/kg per day in the first 14 days of life compared with ours, the percentage weight loss and time to regain birthweight were similar. However, the much better survival rate in 1977, in addition to the use of IV feeding, and a number of other factors, all make direct comparison difficult.

This study shows that naso- or orojejunal feeding can be successfully carried out in well babies of birthweights <1500 g. However, this method of feeding for babies requiring respiratory assistance almost entirely by face mask was not successful, and such babies may benefit from a period of IV feeding until respiratory assistance is no longer required. Only 2 out of 24 babies were successfully fed while receiving respiratory assistance. Our principal complication was aspiration (3/54) but it is impossible to know if this would have been more or less with gastric feeds. It should be emphasised that intravenously feeding very low birthweight babies is not without difficulties and is best carried out in the specialised units experienced in the procedure.

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