

Gastric emptying of Caloreen meals in the newborn

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SUMMARY The gastric emptying of 10% solutions of glucose and of Caloreen, a glucose polymer, was compared in 16 newborn infants. Caloreen left the stomach more rapidly than glucose on all but one occasion. This has potential advantages to infant feeding.

In encouraging early feeding for low birthweight infants the paediatrician must take into account the problems that result from immature sucking and swallowing reflexes, an incomplete oesophageal cardiac sphincter, a poor gag reflex, and a small gastric capacity.¹⁻² Hypoglycaemia and jaundice may be prevented but only at the considerable risk of regurgitation and potentially fatal aspiration.³ Although there has long been agreement that early provision of an adequate caloric intake is desirable,⁴ the volume and composition of early feeds are still subjects for debate.

For some years it has been the practice in our special care nursery to provide light-for-dates and other infants at risk from hypoglycaemia with a high-energy diet for the first few days of life. Originally this was achieved by the introduction of glucose-fortified feeds,⁵ but when these were given earlier and in larger volumes it became apparent that they often produced vomiting, abdominal distension, and diarrhoea. Caloreen* was substituted for glucose and it has been our impression that the incidence of these symptoms has decreased. This favourable clinical experience and the dearth of data on the use of Caloreen for newborn infants have prompted us to evaluate the effect of Caloreen on gastric emptying in the newborn period.

Caloreen is a white, slightly sweet powder prepared by the enzyme degradation of corn starch to give a mixture of malto-oligosaccharides containing 3% glucose, 7% maltose, 5% maltotriose, and 85% polysaccharides containing 4 to 15 glucose units (mean 5 units).⁶ After ingestion in adults Caloreen is readily converted to glucose by enzymatic action.⁷

Methods

An attempt was made to study gastric emptying in 18 infants in the first 6 weeks of life. All were patients

in the special care nursery because they were preterm or light-for-dates. Two preterm infants were excluded because of vomiting after the glucose test meal.

All infants were wholly or partially tube fed and each received a total of 4 test meals on 2 consecutive days, one of 10% Caloreen and one of 10% glucose on each day; the content of the first test meal was varied randomly and the meals were given in the reverse order on the second day. Tube-fed infants were given test meals over a period of 3 to 4 minutes. Those who could suck were given as much of the test meal as they could take by bottle; a study was considered unsatisfactory if the infant failed to consume the test meal within 5 minutes or regurgitated any portion of it. There is no agreement on the effect of posture on gastric emptying;⁸⁻¹⁰ throughout our study all infants were nursed prone.

Gastric emptying was assessed using Husband and Husband's modification⁸ of the method described by Hunt and Spurrell.¹¹ Phenol-red 0.24 mg/100 ml was added to the meals; this dye which is unabsorbed acts as a marker and has no effect on gastric emptying.¹² Before feeding the infant's stomach was washed out with water so that it was free of large curds. Test meals were given at room temperature 3½ hours after the last routine feed in a volume of 14 ml/kg to infants in the first 4 days of life, and 21 ml/kg to those aged 5 days or more. After an interval of 30 minutes the gastric contents were aspirated and the stomach washed out with water to recover any remaining part of the feed. As phenol-red is a pH indicator, the pH was kept constant by mixing an equal volume of barbitone buffer (pH 8.7) with the fluid tested before measuring its optical density by spectrophotometry at 548 nm. By measuring the optical density of the original feed, the gastric aspirate, and the washout, it was possible to calculate the proportion of the original feed recovered, independently of added gastric secretion and saliva.⁸

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Results

The percentage of gastric retention after Caloreen and glucose meals is presented in the Table and the Figure. Gastric emptying was faster after Caloreen than after glucose in all but one of the 32 studies. Gastric retention of more than 30% of the test feed at 30 minutes was seen after only 7 (22%) of the Caloreen feeds compared with 25 (78%) of the glucose feeds. Caloreen solution thus clearly left the stomach much more rapidly than the glucose solution.

Table Gastric emptying in 16 newborn infants after 2 test meals each of 10% Caloreen and 2 test meals each of 10% glucose solutions

	Gestation at birth (weeks)	Birth weight (g)	Age at first study (days)	Percentage of test meal recovered from stomach after 30 min	
				Caloreen	Glucose
Range	29-37	1240-2690	2-37	5-69	9-84
Mean	33.8	1842	14	20	44
SEM	0.62	98	2.4	2.6	3.5

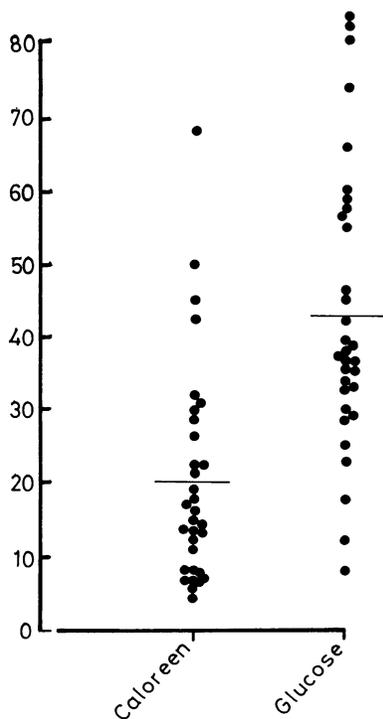


Figure Percentage of test meal recovered 30 minutes after meals of 10% glucose and 10% Caloreen solutions in water. The means for the solutions are shown.

Discussion

In adults the duodenum contains osmoreceptors; a high osmolality in the duodenal contents delays gastric emptying.¹² Husband and Husband⁸ concluded that these osmoreceptors were functional within the first few days of life by demonstrating that a 10% glucose solution emptied from the stomach at a slower rate than a 5% glucose solution. It has also been shown that a starch solution emptied from the stomach of the newborn infant more rapidly than a glucose solution of comparable energy content,¹³ whereas in the adult Hunt and Pathak¹⁴ found that starch and glucose solutions left the stomach at about the same rates. The post-pyloric osmoreceptors apparently respond to starch only after conversion to maltose and glucose by pancreatic amylase and intestinal maltase, and Husband *et al.*¹³ attributed the more rapid gastric emptying in the newborn after starch feeds to the relative deficiency of pancreatic amylase, previously demonstrated during the first few months of life by Andersen.¹⁵ Similar rapid emptying of starch meals has been demonstrated in patients with deficient pancreatic secretion.¹⁶ As Caloreen is also converted to glucose by amylases, this would explain the rapid emptying of Caloreen from the infant's stomach.

Glucose is widely used as a first feed and as an energy supplement in the neonatal period. Experience with Caloreen is limited but it has some theoretical advantages over glucose because of its lower osmotic activity (a 10% solution has an osmolality of 120 mosmol/l compared with 555 mosmol/l for a glucose solution of similar strength and energy content) and our results indicate that it leaves the stomach much more rapidly than glucose. Since the danger of regurgitation with subsequent aspiration into the lungs is a limiting factor in prescribing the volume of enteral feeds for low birthweight infants during the early days of life, there may be some advantage in using Caloreen rather than glucose or other simple sugars. However, if we are correct in our speculation that Caloreen empties rapidly from the stomach not only because of its low osmolality in solution but also because it is not digested in the newborn period, it is possible that it might not be absorbed; if this were so there would be no nutritional benefit in using it. However, tolerance tests comparing Caloreen with glucose show that Caloreen produces a sustained rise in the plasma glucose concentration.¹⁷ It is therefore concluded that Caloreen has significant advantages over glucose as a carbohydrate supplement in infant feeding.

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