Iodine deficiency associated with parenteral nutrition in extreme preterm infants

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**PATIENTS AND METHODS**

Thirteen consecutive inborn infants were recruited; male/female ratio, 6:7; gestation mean, 26.8 weeks (range 24–29); birth weight mean, 926 g (range 570–1260). All had intensive care support and survived at least 28 days.

On day 1 of life all infants had parenteral dextrose/electrolyte/amino acid solution (Yaminolact; Fresenius Kabi, Runcorn, Cheshire, UK) with a phosphate supplement (Addiphos; Fresenius Kabi). On day 2, and thereafter, this solution was supplemented with water soluble vitamins (Solvito N; Fresenius Kabi) and trace elements (Pedirace; Fresenius Kabi). In tandem, a fat emulsion (Intralipid 20%; Fresenius Kabi) with added fat soluble vitamins (Vitlipid; Fresenius Kabi) was infused, initially at 8 ml/kg/day; increasing maximally to 18 ml/kg/day by day 5. Enteral feeds were started as hourly boluses, 0.5–1 ml, increased as determined by the infants’ clinical condition, with reciprocal reductions in parenteral solutions infused. No infant progressed beyond hourly bolus feeds.

A 24 hour iodine balance was calculated for each infant at days 1, 6, 13, and 27. The types and volumes of all enteral and parenteral fluids used were recorded, and the iodine contents determined. Urine volumes per 24 hours were collected, and an aliquot used for iodine estimations. No iodine-containing skin disinfectants were used. All iodine determinations were performed using the method described for serum but with minor modifications depending on the type of sample.

The Tayside Medical Research ethics committee approved the study protocol. Informed written parental consent was obtained.

**RESULTS**

The volumes and energy intakes of parenteral and enteral feeding solutions were within the ranges expected for extreme preterm infants (table 1). Iodine intakes were calculated from contents of solutions used; dextrose/electrolyte/amino acid solution on day 1, mean 0.9 µg/dl (range 0.4–2.0), n = 11; on days 2–28, mean 1.6 µg/dl (range 0.4–11.2), n = 37; fat emulsion, mean 4.1 µg/dl (range 1–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range 4–28), n = 28; expressed breast milk, mean 10.1 µg/dl (range 4–28), n = 13; Cow and Gate Nutriprem 1, mean 20.2 µg/dl (range
0.8–10.4), n = 8; Abidec (Warner Lambert), 8 µg/dl, n = 1; benzylpenicillin (Biochemie Gmbh), mean 9.6 µg/dl, n = 5; caffeine (Tayside Pharmaceutical), mean 10.2 µg/dl, n = 6; ceftazidime (Glaxo Wellcome), 10 µg/dl, n = 1; dopamine (Abbott), 10 µg/dl, n = 1; frusmide (Martindale Pharmaceuticals), 7.5 µg/dl, n = 2; gentamicin (Hoechst Marion Roussel), 11.3 µg/dl, n = 4; indomethacin (Merck Sharp and Dohme), 10 µg/dl, n = 1; insulin (Novo Nordisk), 9 µg/dl, n = 1; Sytron (Link Pharmaceuticals), 1 µg/dl, n = 1; midazolam (Roche Products Ltd), 13 µg/dl, n = 1; vancomycin (Faulding), 7 µg/dl, n = 1.

Mean iodine intake (µg/kg/day) increased with postnatal age, as did mean urinary iodine output (table 2), paralleled by increased enteral nutritional intakes as parenteral nutrition volumes decreased (table 1). Parenteral nutrition supplied 100% of energy intake at day 1, 70% at day 6, 58% at day 13, and 28% at day 27. All 13 infants were in negative iodine balance on day 1, and 12 remained in negative balance at day 6. By day 13, six infants were in negative balance, but by day 28 only three infants remained in negative balance (table 2).

**DISCUSSION**

The parenteral nutrition solutions used were made by the pharmacy from the component parts, according to the manufacturer’s recommendations. Although different batches of both dextrose/electrolyte/amino acid solution and fat emulsion were used, most had iodine contents within a limited range of values. The parenteral trace element additive was Peditrace solution, which contains potassium iodide. The manufacturer’s recommended dosage for infants and children weighing 15 kg or less, and 2 days old or older, is 1 ml/kg/day of Peditrace parenteral solution, which contains 1.3 µg/ml potassium iodide equivalent to 1 µg iodide/kg/day.

The recommended enteral intake of iodine for preterm infants based on balance studies is 30 µg/kg/day.4 The main route of excretion of excess absorbed iodine is through urinary output. Stools were not collected for iodine content because a previous study had shown that faecal iodine outputs were relatively small, about 6% and 10% of intake for term and preterm infants respectively.4 Iodine absorption by the gastrointestinal tract is high, suggesting that there should be a near equivalence of iodine dosage, whether this is by the enteral or parenteral route.

Iodine deficiency contributes to about 30% of the hypothyroxinaemia in enterally fed preterm infants of 27–30 weeks gestation.5 The percentage contribution of iodine deficiency to hypothyroxinaemia may be greater in our more immature infants who have a very low parenteral iodine supply. We are currently testing the following hypothesis. If extreme preterm infants are supplemented from the first day of life with parenteral iodine to recommended intakes (30 µg/kg/day), this will improve iodine balance and more importantly postnatal serum iodothyronine levels.

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