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ENTERAL NUTRITION IN PRETERM INFANTS

Premature infants have higher nutritional requirements than term infants,¹ having less nutrient stores due to the fact that they have missed out on the third trimester of pregnancy, an important time of nutrient accretion and growth.² In the UK, no guidelines exist regarding enteral nutrition in premature infants. Therefore, international guidelines are used.^{1,3,4}

WEIGHT AND GROWTH

When calculating nutritional requirements, it is recommended that actual body weight is used.³ However, when this is lower than birthweight or the highest dry weight, then the birthweight or highest dry weight should be used.

For preterms, intrauterine growth rate, at approximately 15g/kg/day, is the most widely used and accepted standard. However, it is often difficult to achieve in practice.¹ It is now widely accepted that accelerated growth in preterm infants should be avoided, having detrimental consequences on long-term health outcomes, e.g. cardiovascular disease.⁵

Meeting both energy and protein requirements will ensure an adequate weight gain.

ENERGY REQUIREMENTS

Preterm infants are estimated to require 110-135kcal/kg/day³ compared to 96-120kcal/kg/day for term infants.⁶

Agostoni et al³ recommend >100kcal/kg/day, as long as adequate protein is provided: 3.0-3.6g/100 kcal.

For infants with intrauterine growth restriction (IUGR), energy requirements

are not necessarily higher, as it will depend on the cause of the IUGR.

PROTEIN REQUIREMENTS

Recommended protein for preterm infants:^{1,3}

- Infant body weight 1-1.5kg - 3.4-4.2g/kg/day
- Infant body weight <1.0kg - 3.8-4.5g/kg/day
- No benefit has been shown for feeding >4.5g/kg/day

As with all infants, protein to energy ratio is pivotal to ensure optimum growth and should be considered for all preterm infants.³ ESPGHAN³ recommends protein to energy ratios as follows:

- Infant body weight 1.0-1.8kg - 3.2-3.6g/100kcal (12.8-14.4%)
- Infant body weight <1.0kg - 3.6-4.1g/100kcal (14.4-16.4%)

CHOICE OF FEED

Breast milk is the first choice for premature infants, with the benefits of breast milk being well documented. Table 1 lists the benefits of breast milk for premature babies.

Table 1: Benefits of breast milk for premature babies

Immune protection, resulting in less sepsis and NEC ⁷
Higher nutrient bioavailability compared to formula milk ⁷
Improved feed tolerance ⁸
Improved long-term health outcomes ^{9,10}
Improved neuro developmental compared to formula-fed infants ^{11,12,13}



Table 2: Outline of the typical composition of a breast milk fortifier

Protein (whole or hydrolysed)
Calcium
Phosphorous
Sodium
Fat soluble vitamins
Water soluble vitamins
Trace elements

FLUID

Preterm infants who are very sick are often fluid restricted, so it is important to ensure that nutrition is optimised within this allowance and the fluid restriction lifted as soon as medically allowed. ESPGHAN³ recommends 135mls/kg/day as a minimum, up to a maximum of 200mls/kg/day. Usually, aiming for at least **150mls/kg**, ideally 180mls/kg/day will meet requirements, with the higher end required for fortified breast milk and the lower for preterm formula. Where growth is poor, volume should be maximised where medically appropriate, before the addition of breast milk fortifier (BMF).³

Growth should then be monitored and BMF added when necessary. When BMF is added, it may be necessary to reduce the volume to prevent overfeeding.

BREAST MILK FORTIFIER

For preterm infants <1.5kg who are stable, BMF can be commenced when 150mls/kg/day EBM has been tolerated, as EBM will not meet their energy and protein requirements. Fortification should continue until thriving. For premature infants >1.5kg, where growth is not as good as expected, BMF can be used if they are still <37 weeks gestation. Standard infant formula powder can be used if they are term and >2.5kg.

SUPPLEMENTATION

When on unfortified EBM, fortification with multivitamins, iron, folic acid, phosphate and sodium will be required, with calcium requiring to be monitored. For preterm infants <1.5kg, fortified EBM will not meet their nutritional needs.⁷ Therefore, they should receive fortified EBM. This will increase protein as well as vitamins and minerals.

When receiving EBM fortified with BMF, multivitamins and folic acid will not need to

be added. Iron will need to be supplemented, but sodium, phosphate and calcium will need to be monitored and supplemented where required.

If supplementary preterm formula is given as well as EBM and BMF, then the BMF should be stopped once 50% of requirements are achieved as formula, otherwise protein intake will be excessive.

Vitamin A

Preterm infants have low Vitamin A status at birth and this has been associated with increased risk of developing chronic lung disease (CLD).¹⁴

There is an ongoing debate regarding the amount of vitamin A required and whilst ESPGHAN³ recommends an intake of 400-1,000 micrograms (1,333-3,330 IU) RE/kg/day, a retrospective case note review and an observational study^{15,16} have both indicated that the vitamin A intake of preterm infants is much lower than the bottom end of the reference ranges recommended by both ESPGHAN³ and Tsang et al.¹

Vitamin D

ESPGHAN³ recommends 20-25 micrograms (800-1,000 IU) daily. However, this is difficult to achieve in practice and it has been documented that prolonged supplementation at this level might be harmful.¹⁷

Realistically, aim to provide at least 10 micrograms (400 IU)/day vitamin D.¹

Iron

Deficiency results in poor neuro-developmental outcome in preterm infants, but excess also needs to be avoided. ESPGHAN³ recommends starting at 2.0-3.0mg/kg/day at two to six weeks of age (two to four weeks in ELBW infants), avoiding >5.0mg/kg/day.



... it is recommended that weaning is considered between five and eight months' uncorrected age and that they should be at least three months' corrected age so allowing for adequate motor development.

Folic acid

ESPGHAN³ recommends 35-100mg/kg/day.

Sodium

ESPGHAN³ recommends 69-115mg/kg/day, but serum/urinary sodium should be monitored and sodium supplementation adjusted accordingly.

Phosphate and calcium

ESPGHAN³ recommends 120-140mg/kg/day calcium and 60-90mg/kg/day phosphorus. As calcium to phosphorus ratio is an important determinant of calcium absorption and retention, ESPGHAN³ recommends calcium to phosphorus ratio between 1.5 and 2.

Vitamin E

Routine supplementation of vitamin E is not recommended.¹⁸

GROWTH MONITORING

The UK-WHO Neonatal and Infant Close Monitoring Growth Charts should be used and corrected for gestation:^{19,20}

- Gestation ≥ 37 weeks - no correction
- Gestation 32 to 36+6 correct until age one year
- Gestation 23 to 31+6 correct until age two years

An average weight gain of 15g/kg/day should be aimed for.¹

Maintaining the infant on the centile to which they have initially dropped, not their birth centile, is a satisfactory target. Inadequate growth can be indicated:

- by consistent weight loss over several days (other than when fluid overloaded and diuresis is expected);
- when weight, length and/or head circumference velocity decreases over one week;
- when weight velocity, i.e. growth at a slower rate required to follow the centile line, alone decreases over two weeks.

PRETERM FORMULA

All premature infants < 2.0 kg and < 35 weeks, not receiving breast milk, should receive a preterm formula. There are three preterm formulas available in the UK: SMA Gold Prem Pro preterm formula (partially hydrolysed formula), Cow and Gate Nutriprem 1 (whole protein formula) and Hydrolysed Nutriprem (partially hydrolysed formula). Infants receiving 150mls/kg/day preterm formula do not require additional vitamin and mineral supplementation.

Practice varies as to the age and weight when a preterm fed is stopped. It has been suggested that preterm formula should be continued until the infant is thriving, i.e. 2.0-2.5kg and/or discharged home. A post discharge formula can then be used.

Table 3: Cues to consider for introduction of complementary food

Oral skills, e.g. demonstrates an up and down/munching jaw movement when introducing non-food items, started to explore fingers/toys in mouth.
Behaviour, e.g. alert and appears ready for a new type of feeding, shows interest in others eating.
Positioning, e.g. some head control and a stable head position with/without support, supported easily in a sitting position.

Partially hydrolysed formula (PHF), extensively hydrolysed formula (eHF) and amino acid formula (AAF)

For those requiring a PHF, SMA Gold Prem Pro can be used. If a more hydrolysed feed is required, then term formulas can be used, as there are no preterm eHF or AAF available in the UK. However, these formulations do not meet the needs of preterm infants, even at 180mls/kg/day. Therefore, close nutritional monitoring is required to assess intakes of energy, protein, fat soluble vitamins, phosphate, calcium and sodium and growth. Concentrating the formula is an option and the addition of supplements which maybe lacking.

POST DISCHARGE NUTRITION

Breastfeeding should be encouraged for as long as possible post discharge. For exclusively breastfed babies, they will require a multivitamin which contains vitamin D. This needs to continue for as long as breast milk remains the main drink. Iron will also need to continue until one year of age, unless sufficient is supplied in the diet. Breastfed babies do have a risk of slower growth²¹ and often end up going onto formula milk. However, it has been demonstrated that if BMF is continued at home, this leads to improved growth at one year of age.²² However, BMF is not prescribable in the UK and it would depend on the neonatal unit to provide it.

For those on formula (or who require top-up with formula feed) post discharge formulas (PDF) are available on prescription. They do not require vitamin or mineral supplementation as their nutritional analysis are between preterm and term formulas. High energy formulas for

term infants are not to be recommended for preterm infants, having a lower nutrient density per kcal compared to a PDF, thus risking lower nutrient intakes. They are prescribable to six months corrected age.

COMPLEMENTARY FEEDING

At present, there are no national guidelines for preterm infants. However, there is a consensus statement,²³ verified by a review of the literature.²⁴ To summarise, it is recommended that weaning is considered between five and eight months' uncorrected age and that they should be at least three months' corrected age so allowing for adequate motor development. The actual timing of introduction of complementary foods should be based on each infant individually. Table 3 suggests some cues to consider.

SUMMARY

It is essential that preterm infants meet their higher nutritional requirements right from the start to ensure that optimal nutritional status and growth are achieved. With its proven advantages, breast milk should be encouraged for all preterm infants. However, if this is not available, then there are a number of preterm formulas available in the UK. BMF is also available for use, where indicated. Although breast milk is to be encouraged for as long as possible, post discharge formulas are available on prescription. General guidelines exist for the timing of introduction of solid food. However, the introduction of complementary food needs to be assessed individually.

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