NUTRITION GUIDELINES ON THE NEONATAL UNIT

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There has been an increased emphasis on standardised feeding regimes in neonatal units in recent years. Although there is still much research needed on optimal feeding regimes, standardised feeding regimes have been found to reduce rates of necrotising enterocolitis (NEC), a potentially devastating complication of prematurity which can lead to gut necrosis, gut resections and even death.

Where standardised feeding regimes have been introduced, NEC rates have reduced and NEC has been virtually eliminated in some centres[1]. As a result, neonatal networks have worked to develop enteral feeding guidelines to use across their networks, the most well-known of which is the East of England Network guideline[2]. The Welsh Neonatal Network - which I work within - has recently finished an enteral feeding guideline for our preterm infants, which is based on this guideline. This launched in October 2014 at the Wales Neonatal Network Audit Day and Wales Health Boards are now working on implementation. A key factor is ownership and some of the lessons we have learned are the following:

1. It is helpful to have a well-respected consultant to champion the guidelines.
2. The support of the Network is key.
3. Involvement from the multidisciplinary team makes implementation more successful.
4. A clear process for implementation is needed from management downwards. We:
   a. made presentations at different forums from the Network Audit Day to a Dietetic Managers' meeting;
   b. developed and piloted a pathway on two units;
   c. held a champions' study day where we presented the process used to produce the guideline, the guideline itself, a version of the pathway and led a discussion on implementation.

The Guidelines are to be used in their original form across the Network, but health boards are adapting the pathway to fit local circumstances. Some of the key features of the guideline are discussed below.

NUTRITIONAL REQUIREMENTS

The nutritional requirements of preterm infants are higher than for infants born at term and the reasons are multifactorial:

- Low nutritional reserves/stores.
- Immature organ systems - leading to increased work of breathing and reduced digestion and absorption of nutrients, for instance.
- Increased risk of infection (due to immature immune system).

Care on the neonatal unit is designed to minimise the impact of these deficits; for instance, ventilation supports immature lungs where necessary and babies are nursed in incubators or hot cots to minimise the heat loss from immature skin. However, comparison of nutritional requirements (see Table 1), demonstrates that, despite these measures, nutritional requirements are significantly higher in preterm infants relative to size, with additional difficulties in meeting these requirements.

Embleton et al[6] established that preterm infants accrue an inevitable protein deficit that is strongly correlated with postnatal growth retardation on the neonatal unit. Poor growth velocity in preterm neonates has been related to risk of cerebral palsy, subnormal mental development

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index and neurodevelopmental impairment[7]. Neurological examination performed at 5.4 years by a neurologist blinded to perinatal outcome, found cognitive deficits were associated with intrauterine growth retardation (measured as weight at birth), poor neonatal weight gain and lower post-discharge head circumference[8]. Improved protein and energy intakes in just the first week were associated with improved neurodevelopmental scores at 18 months[9]. Time taken to stabilise respiratory status, delays in starting and increasing parenteral and enteral feeds and episodes of sepsis leading to feeds being stopped, all contribute to deficits in nutritional status for preterm babies while on neonatal units.

Most infants under <1500g will not tolerate full nutritional requirements enterally from day 1 and will need parenteral nutrition; this too will take several days to meet the infant's full nutritional requirements. The immaturity of the preterm gut means that enteral feeds need to be advanced cautiously. However, it is important that enteral feeds are introduced as early as possible to prevent gut atrophy, leading to an increased risk of infection via the gut. However, advancing enteral feeds too fast risks NEC. Therefore, trophic feeding (up to 24mls/kg/d) is increasingly standard practice on neonatal units; giving small amounts of feed enterally to keep the gut patent while building up parenteral feeds, until the infant is stable enough to increase enteral feeds. A recent large prospective study[10] found that early introduction of enteral feeds in growth-restricted preterm infants, results in earlier achievement of full enteral feeding and does not appear to increase the risk of NEC. However, concerns regarding the risk of NEC mean that any change in practice around early feeding is likely to be viewed very conservatively. A new large multi-centred trial in the UK and Ireland undertaken by SIFT group (Speed Increasing Feeds Trial) aims to recruit 2500 very preterm or VLBW infants to compare advancement of feeds at either 30ml/kg/day or 18ml/kg/day. This trial will recruit infants who are fed either human or formula milk. Initial results are awaited.

BREAST MILK

Use of breast milk has been well recognised to decrease the risk of NEC. Prospective, longitudinal nutritional studies in preterm infants started in the 1980s[11], evaluating the influence of early dietary practices on clinical and neurodevelopmental outcomes. In these early studies, any breast milk (MEBM or donor breast milk (DBM)) was shown to reduce the incidence of NEC by up to tenfold[12].

The protective effects of breast milk have been correlated with its anti-inflammatory components (IL-10), growth factors (EGF), erythropoietin, lysozymes and immunoglobulins, as well as pre- and probiotics which favourably affect gut microflora[13]. Mothers should be given all necessary support to start expressing breast milk within a few hours of birth and encouraged to express at least eight times a day including at night. Techniques, such as 'hands-on' pump expression, can help to maximise volumes and suitably trained midwives and neonatal nurses should provide ongoing support to ensure volumes are maintained and breasts are emptied so that the calorie rich hind milk is expressed.

Breast milk from the mothers of preterm infants is known to be higher in protein than the milk of term infants, helping to provide the necessary extra protein intake (Table 2); although, after the first few weeks, protein levels start to fall towards term levels. Where MEBM is not available, donor breast milk is thought to be helpful in reducing the risk of NEC in high risk infants (<28 weeks; <1000g; IUGR). However, this milk is often drip milk - so called because it drips from one breast while the baby feeds from the other. As a result, donor breast milk can be much lower in calories and protein than standard breast milk, which has adverse consequences for growth. More recently, preterm donor milk has become available from some milk banks, which should be used whenever possible. In addition, some breast milk banks are making nutritional analyses of their donor milk available, which makes it easier to assess the nutritional adequacy of the milk that is being provided.

As a result of the desire to use breast milk to minimise the risk of NEC and also maximise cognitive outcome, breast milk fortifiers (BMF) have been developed, which add calories, protein and vitamins to breast milk, while enabling the full volume of breast milk to be given (see Table 2). Cochrane[14] found evidence of improved short-term weight gain, linear growth and head growth with the use of BMF and no evidence of increased risk of NEC. Nevertheless, care should be taken with addition of breast milk fortifier to minimise any risk of NEC. BLISS recommends that breast milk fortifier is used in infants <1500g at birth and <34 weeks once they are on full feeds and serum urea is <4.0mmols/l and falling[15]. This is because there is a correlation between serum urea and protein content of milk[16].

ESTABLISHING FEEDS

Enteral feeding will usually be established using orogastric or nastogastric tubes. Oral feeding starts to develop from 32 weeks; however, because of immature suck-swallow-breathe, most infants will not be able to breast or bottle feed totally until somewhere between 35 and 40 weeks gestation. Some units will send infants home while still tube fed, or on oxygen or both; policies differ locally depending on the services and support available to families in the community.

DISCHARGE PLANNING

Adequate nutritional intake should be assessed as part of thorough discharge planning. For a baby who has been on breast milk fortifier and is moving on to breastfeeding, they need to be able to take enough milk from the breast to support growth. Since breast milk fortifier is not prescribable in the community, there are limited options available if the infant does not thrive. Some units will supply breast milk fortifier for parents to mix with some expressed breast milk, alternatively families may be advised to add formula powder to breast milk or give top up feeds of post discharge or nutrient dense formula. For infants who have been on preterm formula on the unit, they will typically be discharged on a nutrient enriched post discharge formula (NEPDF), which is typically half way in composition between a preterm and standard formula (see Table 2). These also contain higher concentrations of vitamins and minerals to meet the ex-preterm infant's continuing higher requirements. If an infant is breast milk fed or has a standard term formula, they will need additional vitamin and iron supplements.

If an infant is unable to take sufficient volume of breast milk or a NEPDF to gain weight satisfactorily and is at or close to their due date, a term nutrient dense formula may be used (90-100kcals/100mls; 2.0-2.6g protein/100mls). These are not entirely suitable for preterm infants, but may be useful where infants are struggling to manage volumes, in conjunction with vitamin and iron supplements.

Preterm infants are born at a nutritional disadvantage and the current evidence suggests that current neonatal care is not successful in helping them to overcome those early disadvantages. However, much work is going on to improve this situation in the future. Dietitians are not currently universally members of the neonatal team, despite the role of therapists - including dietitians - clearly being recognised in standards and guidelines for neonatal units in England[17, 18, 19], Wales[20] and Scotland[21]. Certainly within the Wales Neonatal Network plans are underway to ensure that these standards are met in the future. The involvement of suitably trained dietitians at clinical and policy level will help to ensure that, in the future, robust, standardised evidence based enteral feeding guidelines will help to ensure that preterm infants receive the best possible nutrition from their first day of postnatal life.

Table 1: Nutritional requirements of preterm infants vs term infants

Nutrient	Term infant[3]	Preterm infant Koletzko 2014[4]	Preterm infant 1000g–1800g ESPGHAN 2010[5]
Energy (kcal/kg/day)	95-115	110-130	110-135
Protein (g/kg/day)	2.0	3.5-4.5	4.0-4.5 (<1000g) 3.5-4.0 (1000-1800g)
Sodium (mmol/kg/day)	1.5	3.0-5.0	3.0-5.0
Potassium (mmol/kg/day)	3.4	1.9-5.0	2.0-3.5
Calcium (mmol/kg/day)	3.8	3.0-5.0	3.0-3.5
Phosphate (mmol/kg/day)	2.1	1.9-4.5	1.9-2.9

Table 2: Nutritional content of milks and fortifiers

	Energy (kcals/100mls)	Protein (g/100mls)
Preterm breast milk	70	1.8
Preterm breast milk - >2 weeks postpartum	70	1.3
Term breast milk	69	1.3
Term breast milk + BMF	85 - 86	2.3-2.5
C&G Nutriprem 1	80	2.6
SMA Gold Prem 1	82	2.2
C&G Nutriprem 2	75	2.0
SMA Gold Prem 2	73	1.9
C&G Hydrolysed Nutriprem	80	2.6

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