

Nutrition following surgery in the preterm infant

Over the last two decades advances in antenatal care and the management of preterm infants have resulted in increasing numbers of preterm babies surviving long term.¹ These infants, however, remain vulnerable to a number of life-threatening conditions, particularly gastrointestinal complications such as necrotising enterocolitis (NEC). Unfortunately as deaths from respiratory diseases become less common, NEC has increased in importance and, combined with sepsis, is now the single most common reason for death after the first postnatal week.² Around half of all infants with clinically diagnosed NEC will require surgery. In most, this results in removal of bowel tissue and/or the formation of a stoma. Careful nutritional management of these infants is important so that survival and long-term outcomes can be optimised.

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The importance of nutrition in the preterm infant

Good quality nutritional management is probably the most important factor in improving the outcome for preterm infants in general and for those undergoing surgery in particular.

Nutrition is integral to long-term metabolic health, cognitive development, the ability to withstand infections and the ability to withstand the stresses of surgery and the post-operative period. Nutritional management is particularly important for infants who have developed NEC as these children are known to have a much worse cognitive outcome than their gestation-matched peers.³ The inflammatory cascade associated with NEC may damage brain tissue directly, leading to cognitive impairment that is likely to be exacerbated by inadequate nutrient intakes before and after surgery.

Most of these infants will already have developed nutrient deficits before they have undergone surgery. Preterm babies are born with inadequate stores of all the major nutrients, including protein, energy, minerals and vitamins.⁴ With only limited amounts of adipose tissue, preterm infants have virtually no stores of energy and must use the protein in their muscles and other organs if they do not receive adequate nutrient intakes.

Malnutrition may be further exacerbated by the infant's subsequent illness and the challenges of providing nutrition in the post-operative period. Total parenteral nutrition (TPN) is vital to long-term survival but there are many challenges with its provision and its composition, and infants are at risk of micronutrient deficits developing. Most babies will spend at least 1-2 weeks nil-by-mouth feeding, followed by a gradual build up to full milk feeds meaning they may be reliant on TPN for 3-4 weeks overall.

Clearly, it is important for the whole multi-disciplinary neonatal team to pay careful attention to the nutritional needs of these infants during the immediate post-operative period.

NUTRITIONAL MANAGEMENT OF POST-SURGERY INFANTS

Nutritional management of post-surgery infants will, to a certain degree, depend on the type of

surgery they have undergone. As a general rule, surgery and intestinal resection higher up in the gastrointestinal tract poses more problems than lower down. Effluent in an ileostomy or jejunostomy is predominantly liquid, compared to the fully formed stools found in a colostomy. This can pose difficulties with fluid balance, mineral, vitamin and electrolyte management. The choice of milk is therefore extremely important and should be tailored to the individual child.

GUIDELINES AND THE EVIDENCE BASE

Unfortunately, there is little research and even fewer guidelines to advise neonatal practitioners on the specific nutritional needs of the post-surgery preterm infant. However, guidelines on the general feeding of preterm babies are available from the Committee of Nutrition of the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN).⁵ These strongly recommend the use of expressed breast milk, supplemented where necessary by a breast milk fortifier (BMF). Where formula feeds are used their nutrient content should correspond as closely as possible to the ideal values shown in *TABLE 1*.

	Daily intake kg/day
Energy	110-135kcal
Protein <1kg bodyweight	4-4.5g
1-1.8kg bodyweight	3.5-4g
Lipids	4.8-6.6g
Carbohydrate	11.6-13.2g
Iron	2-3mg
Vitamin D	800-1000IU/day

TABLE 1. Key ESPGHAN recommendations.

The ESPGHAN guidelines offer specific advice on the provision of:

Protein The guidelines recommend 3.5-4g/kg/day for infants between 1-1.8kg although higher intakes may be required in particularly small



infants. It can be difficult to increase the protein intake of a formula-fed baby without also increasing the energy intake. Some newer preterm formula milks and BMFs have adjusted the protein to energy ratio to address this problem.

Energy A preterm infant needs around 110-135kcal of energy per kg each day. Most of this will be provided by carbohydrates, such as dextrose or lactose, and by dietary lipids.

Minerals Preterm infants are born before they have had a chance to store calcium and phosphate which occurs primarily in the third trimester. However, this mineral accretion can be improved with the use of a BMF in breastfed babies or a modern preterm formula milk.

Vitamin D Preterm infants have little chance to synthesise vitamin D in the skin, so are solely dependent on dietary sources. The ESPGHAN guidelines recommend 800-1000IU/day, although some authorities suggest that slightly lower intakes may suffice. Many infants will therefore require the use of a vitamin supplement.

Iron Most preterm formula milks will meet iron requirements. However, a preterm infant fed solely

on expressed breast milk and who has not recently received a blood transfusion may need additional iron. Remember that most BMFs do not contain iron.

SUPPORT FOR BREASTFEEDING

As with full-term babies, the milk of choice for preterm infants (whether they have undergone surgery or not) is mother's own breast milk. This may be supplemented by a BMF.

It is extremely important that a mother receives support to continue expressing breast milk during the time that her baby is nil-by-mouth. Clearly, a mother with a very sick young infant is likely to be under a great deal of stress and many find it difficult to continue expressing without the feedback of actually feeding their child. Mothers of preterm infants also often have complicated obstetric histories and may have other reasons that make establishing and maintaining lactation challenging. While breastfeeding support and a positive approach among staff must be integral to all neonatal units, careful understanding and appreciation of the reasons for non-initiation or maintenance of lactation is important if mothers are not to feel blamed or guilty.

For those who cannot provide their own breast milk, the next best choice is likely to be donor breast milk, although there is little research on this especially in preterm infants post-surgery.⁶ It is also unclear how long donor milk should be provided before switching to formula milk.

USE OF FORMULA FEEDS

Commercially available formula milks can be considered in two broad categories: full-term and preterm. These can be further divided, for example into hydrolysed or whole protein milks, although other more specific formula milks are also available, eg formula milks for babies with kidney or inherited metabolic diseases.

Preterm infants have higher nutrient requirements than those born at full-term so should always receive a specific preterm formula milk that contains adequate amounts of protein, energy and a high content of long-chain polyunsaturated fatty acids.

Preterm milks are available in ready-to-feed formulations. Department of Health guidelines on the use of formula milk in care settings recommend that powdered feeds “should only be used when there is no suitable alternative sterile feed available.”⁷ They should be made up with boiled water cooled to 70-80°C. This is not easy to do on neonatal units and it seems possible that some hospitals may not be fully compliant with these guidelines.

In the UK there is limited experience in using hydrolysed formula milk for preterm infants as, until recently, there was no widely available preterm-specific product. Nevertheless, hydrolysed formula milks may prove a useful addition as they provide the optimal nutritional composition and increase the options available for feeding vulnerable infants post-surgery. Experiences suggest that hydrolysed formula milk may be better tolerated by some preterm infants following surgery, and may allow better progress to full milk feeds. This evidence is largely anecdotal, but is in line with other research in very low birthweight infants (who have not undergone surgery), which shows a link between hydrolysed formula milks and more rapid intestinal transit.⁸

LOCAL PROTOCOLS

Due to the limited evidence base and lack of guidelines on the nutritional needs of the post-surgery preterm infant, there is a wide variation in practice between different centres. There is a danger that this could lead to lack of consistency in care.

However, as long as each centre remains consistent within its own practice, variation

between centres need not necessarily be a problem. Indeed there is evidence that in many areas of feeding and nutrition practice, that local or network protocols can improve practice. If properly audited, these protocols can allow the collection of data that will strengthen the basis on which evidence-based guidelines are produced.

CONCLUSION

Unfortunately the evidence base for the nutritional management of preterm infants after surgery is not sufficient to allow the development of robust guidelines. Variability in practice between hospitals is therefore both inevitable and legitimate as the limited data can be interpreted in a number of different ways.

Indeed it is important that neonatal teams are allowed the flexibility to individualise treatments to the needs of the infants in their care. This requires the provision of sufficient and appropriately trained staff, including paediatric dietitians and nutritional support teams, access to the facilities to prepare, store and deliver feeding products safely and the provision of a wide range of feeding products so that nutritional management may be tailored to the infant's specific needs.

The absence of national guidelines should not mean that neonatal units do not have a responsibility for developing their own local protocols on feeding post-surgery. By providing consistent care, and supporting local, regional and national data collection combined with regular audits of practice, we all have the ability to improve quality and outcomes for these vulnerable infants.

REFERENCES

1. **Field D et al.** Survival of extremely premature babies in a geographically defined population: prospective cohort study of 1994-9 compared with 2000-5. *Br Med J* 2008;336:1221-23.
2. **Berrington JE et al.** Deaths in preterm infants: changing pathology over 2 decades. *J Pediatr* 2012;160:49-53.e1.
3. **Stoll BJ et al** for the National Institute of Child Health and Human Development Neonatal Research Network. Neurodevelopmental and growth impairment among extremely low-birth-weight infants with neonatal infection. *JAMA* 2004;292:2357-65.
4. **Embleton ND.** Optimal protein and energy intakes in preterm infants. *Early Hum Dev* 2007;83:831-37.
5. **Agostoni C et al.** Enteral nutrient supply for preterm infants: commentary from the European Society of Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. *J Pediatr Gastroenterol Nutr* 2010;50:85-91.
6. **ESPGHAN Committee on Nutrition et al.** Donor human milk for preterm infants: current evidence and research directions. *J Pediatr Gastroenterol Nutr* 2013;57:535-42.
7. **HM Government.** *Guidelines for Making Up Special Feeds for Infants and Children in Hospital* [Online]; 2007. Available from: <http://multimedia.food.gov.uk/multimedia/pdfs/publication/babypowdertoolkit1007> [Accessed 23 July 2014].
8. **Mihatsch WA et al.** Hydrolysed protein accelerates the gastrointestinal transport of formula in preterm infants. *Acta Paediatr* 2001;90:196-98.

Conflict of interest statement

Dr Embleton strongly supports the use of breast milk and does not endorse any specific nutritional product. He has conducted research that has received funding support from manufacturers of nutritional products. He has donated the honorarium for the writing of this article to charity.