

Newcastle Neonatal Service guidelines

Enteral feeding in preterm infants

These guidelines provide advice on when to start and increase feeds, which milks should be used, how to monitor growth and nutritional status, how to treat mineral bone disease and indications for specialised post-discharge formula. It is based on a review of the literature and represents consensus opinion on ward 35. It does not represent an exclusive approach and individual variations are frequently required. Term babies have differing requirements and management should be individualised and discussed with senior nurses and consultant staff where uncertainties exist. Cross reference with the following guidelines may be useful: *Fluids and TPN; Hypoglycaemia*.

Summary recommendations for infants ≤ 34 weeks and ≤ 1750 g birthweight

- **Start feeds on day 1-2** in all infants except where there are particular concerns.
- Babies who are born with Absent or Reversed End Diastolic Flow may also be suitable for early feeds although their risk of feed intolerance and NEC is increased
- Ventilation or the presence of umbilical catheters *per se* are not contraindications.
- **Start at a volume of 10-20mls/kg/day**, if tolerated advance at 24mls/kg/day (= increase of 1ml/kg/hour every day or 0.5ml/kg/hour twice a day).
- **Encourage the use of expressed breast milk (EBM)**. Speak to all mothers and emphasise the numerous benefits of EBM.
- If there is no EBM a partially-hydrolysed term infant formula (such as Pepti-Junior, PJ) should be used to initiate feeding.
- Use breast milk (or PJ) as the only milk until full enteral feeds are tolerated
- Infants <30-32 weeks and/or <1750g are likely to benefit from breast milk fortifier (BMF)
- Bigger babies may grow fine on EBM alone (without BMF) but watch weight gain carefully and consider need for supplemental sodium and phosphate.
- **Start BMF where indicated** after the baby has tolerated full feeds of 175ml/kg/day: in general this will be at about 10-14 days of age.
- In babies where there have been significant feeding problems or the risk of NEC is considered particularly high (e.g. very IUGR) then feeding with 200mls/kg/day of un-fortified breast milk for a further few days before commencing BMF may be helpful.
- Use oro-gastric tubes in preference to nasogastric tubes
- Use continuous feeds until 30-33 weeks corrected gestation
- Consider infants who were ≤ 34 weeks and ≤ 1750 g and not wishing to breast feed for a specialised formula on discharge.

Background

These guidelines primarily relate to infants ≤ 34 weeks and ≤ 1750 g birthweight but are not an exclusive course of management, and, as with all guidelines, variations that incorporate individual circumstances may be appropriate. They should be used in conjunction with the guidelines on TPN and early fluid management. Adequate nutrition, with appropriate amounts of protein and energy and sufficient micronutrients (vitamins, minerals and trace elements), is essential for any infant to grow and

maximise neuro-developmental potential. Enteral nutrition (EN) is the best way to nourish infants but there are situations where full (or partial) enteral nutrition is not possible and in these circumstances parenteral nutrition (PN) will often be necessary.

When should enteral feeds be started?

Fasting is associated with reduced intestinal motility, intestinal mucosal atrophy, and prolongs the time taken to establish full enteral feeds. In addition, the introduction of enteral nutrition results in surges of gut hormones important for postnatal adaptation. However, concerns over necrotising enterocolitis (NEC), mean that the decision to start feeds is often delayed.

Withholding enteral nutrition does not seem to prevent NEC but the ADEPT study is aiming to see whether it has any role in high risk infants: those with AREDF + SGA <10c + preterm <35 weeks. Minimal enteral nutrition provides small amounts of nutrients that nourishes the GI tract directly. It improves later GI tolerance and decreases time to full feeds.[1] **Start feeds on day 1-2 except where there are particular concerns.** Feeds should not be withheld simply because of the presence of an umbilical arterial catheter.

Situations when early enteral feeds are sometimes delayed

Systemically unstable e.g. high inotrope requirements, sepsis

Abdominal distension

Antenatal reversed umbilical arterial end-diastolic flow (REDF)

Large PDA with ductal 'steal'^{*} (small-moderate PDAs are usually

OK)

*It is possible to detect absent or reversed end-diastolic flow in the mesenteric and coeliac blood vessels in some of these babies

Rates of increase, types of milk and growth assessment

Studies give conflicting results on speed of increase.[2, 3] **Start feeds on days 1-2 at 10-20mls/kg/day. If tolerated, advance at <30mls/kg/day.** For many this means beginning at 0.5-1ml/kg/hr and advancing at 0.5ml/kg/hr twice a day. Well infants ≥30 weeks without significant IUGR or AREDF can probably have their feeds advanced more quickly.

Always use expressed breast milk (EBM). If this is not available, a partially-hydrolysed term infant formula such as Pepti-Junior[®] (PJ) should be used. EBM is the best milk to initiate enteral nutrition. Tolerance is better and the incidence of NEC is lower than with a LBW formula.[4] Consider delaying the first feed whilst waiting for the mother to produce EBM. PJ may be better tolerated than LBW milks.[5] Dextrose solutions are not appropriate. Maternal medications are almost never a contra-indication to using breast milk (see Neonatal Formulary).

When enteral nutrition is established growth should aim to approximate that of the in-utero reference fetus,[6] but you will also need to consider how far they are below their birth centile. Whilst there are neuro-developmental advantages for EBM, most preterm infants will require supplementation with either a preterm formula (PTF) or a breast milk fortifier (BMF) if adequate growth is to be achieved.[7, 8] **Use EBM as the only**

milk until full enteral feeds (175ml/kg/day) are tolerated. Start supplemental vitamins to ensure satisfactory Vitamin D intake (we currently use Dalivit) when full feeds are reached.

Breast milk and fortification:

Most babies <1750g will need more nutrients than can ever be provided with EBM alone (even at volumes of >200ml/kg/day). Infants <30-32 weeks and/or <1750g are likely to benefit from breast milk fortifier (BMF). Start BMF where indicated after the baby has tolerated full feeds of 175ml/kg/day: in general this will be at about 10-14 days of age. For the first 24-48 hours add BMF to alternate feeds. After that add BMF to all feeds. BMF should not be prescribed on the drug kardex (it is a food supplement not a drug) but the infant case notes should clearly document the decision to start (taken on a ward round). The nursing documentation should be annotated so that the use of BMF is clearly documented.

In babies where there have been significant feeding problems or the risk of NEC is considered particularly high (e.g. very IUGR) then feeding with 200mls/kg/day of un-fortified breast milk for a further few days before commencing BMF may be helpful. Start Dalivit when full feeds are established.

Babies on all EBM who are >1500g: some of these babies may grow adequately on EBM if given in sufficient volume. It may be appropriate to consider increasing EBM to 200ml/kg/day and monitoring weight, sodium and phosphate first.

Babies on EBM +PJ or just on PJ: These babies should be fed at 175ml/kg/day and LBW added to replace all the PJ. Start on 25%, then increase over next 4-6 days to full LBW. If there is some EBM continue as 50:50. Do not continue to give PJ if there is 'insufficient EBM'. In these babies the 'shortfall' should be given as LBW. **If EBM represents more than 25% of the total it is probably worthwhile adding BMF to it (if EBM only makes up a very small amount there is probably no benefit in trying to add fortifier).**

Which LBW formula: There is little to choose between the different manufacturers. We currently stock C&G and SMA.

If weight gain remains poor, consider whether the infant will tolerate a larger volume of milk (200ml/kg/day). Examine the milk intakes on the nursing charts - how often were feeds interrupted? Did the infant actually receive an intake of 175ml/kg/day? Remember that most more mature infants require no more than 150ml/kg/day. After the first month post-term most infants only need ~120ml/kg/day.

Growth charts are the simplest way of assessing growth in the first few weeks, and head circumference and weight should be plotted at least weekly. Growth rates vary and are greatest during the last trimester. Aim to follow the centile curves. Most babies will grow at around 15g/kg/day. For babies after 28 weeks gestation aim for 30g/day but do not restrict intake even if weight gain is <50g/day. More immature infants will often gain weight at 20g/day.

We do not routinely measure length because it is difficult to do accurately without training and requires two people to perform. It is worth considering where there are significant concerns regarding growth and/or nutrition.

Orogastric tubes and continuous v bolus feeds

Assessing readiness to feed. Suck, swallow, and breathing coordination, is usually not fully developed until 35-36 weeks (and sometimes not until term)[9] although some babies can safely take all their feeds by mouth 35 weeks. There is some evidence that oral feeds can be initiated earlier than was originally thought. Most babies will be 34-35 weeks before bottle feeding can be started, but many babies seem able to 'go to the breast' and try and establish feeds as early as 32 weeks. The decision to initiate and increase oral feeds is best taken by an experienced nurse familiar with assessment of preterm babies.

Orogastric tubes and continuous or bolus feeds. Nasal resistance accounts for ~40% of total airway resistance in neonates, and placement of an nasogastric (NG) tube increases this still further. ***Use oro-gastric (OG) tubes in preference to NG tubes for most infants ≤1750g.*** NG tubes are easier to secure, interfere less with oral feeding and are therefore sometimes preferable. Most infants without lung disease >1750g can tolerate an NG tube adequately.

It is unclear whether bolus or continuous feeds should be used[10] ***We currently use continuous feeds until about 32 weeks post menstrual (corrected) age but individualise the approach depending on the infants overall progress.*** More mature infants can be started on bolus feeds from day 1. At 30-33 weeks consider changing to bolus feeds 2 hourly and then 3 hourly as tolerated. Some babies (especially those with CLD) may not tolerate large boluses. Transpyloric feeds are not routinely recommended[11] but there are some infants at risk of aspiration who may benefit. Ensure that these tubes are clearly marked and secured. Check whether any medications should be given transpylorically or intra-gastrically.

Mineral Bone Disease

Mineral bone disease (MBD) is an important problem in preterm infants fed un-supplemented human milk but is usually not a major problem in infants fed LBW formula and receiving 400iu vitamin D daily. Remember that PJ is designed for term infants and contains inadequate amounts of calcium, phosphorus and sodium when used for a prolonged period in preterm babies. Biochemical evidence is usually not present until the baby starts linear growth. Serum levels of both Ca and P only represent <1% of total body content so are a poor indicator of total body stores. High Alkaline Phosphatase (ALP) levels may predict subsequent poor linear growth[12]. If persistently ≥750u then review LFTs and take further advice.

Signs suggestive of metabolic bone disease

Osteopenia* and/or pathological fractures - after 6-8 weeks with accelerating growth

Fraying or cupping of metaphyses indicates severe disease

Abnormal urinary excretion of phosphorus or calcium

Raised Alkaline Phosphatase >750u

Low serum phosphate (<1.6mmol/L) indicates phosphorus deficiency
Low Ca (ionised <1mmol/L, total <2.2mmol/L) may indicate calcium deficiency
High Ca (ionised>1.5mmol/L, total>2.7mmol/L) may indicate phosphorus deficiency

Treatment of mineral bone disease

There is no clear evidence showing long term benefit of mineral supplementation but it seems sensible to treat if there is strong evidence of mineral bone disease i.e. radiological and biochemical signs. Consider whether 'aggravating' factors such as diuretics or dexamethasone can be avoided. If a baby has strong biochemical evidence but no recent chest XR, would this help? Phosphorus depletion is much more common than calcium depletion.

- If the baby is primarily nourished with EBM consider increasing the amount of LBW milk
- Increase vitamin D to 800iu if the baby is primarily on EBM (by increasing the amount of multivitamins)
- Babies who are only on EBM need 1mmol/kg/day of phosphorus extra so start with phosphorus 250micromols twice/day (as most of our infants are also receiving LBW milk or BMF)
- After 1 week repeat the measurements of serum ALP and P and Ca
- If you have started phosphate supplements, consider assessing the response by calculating tubular phosphate reabsorption (TPR %)*
- If the ALP is still high and phosphorus is normal (>1.8mmol/L) or TPR% <95% consider commencing calcium at 250micromol/kg (10mg/kg) twice a day
- If phosphorus remains low increase the supplements to 250micromols four times/day and then 500micromols four times/day if no improvement
- Do not stop phosphorus if the ALP remains high
- Prescribe calcium and phosphorus supplements at different times of day to minimise chances of co-precipitation
- Stop the supplements when the criteria are no longer met
- Discontinue supplements prior to discharge home
- Check the Neonatal Formulary for up to date dosages

$$*TPR \% = 1 - \left(\frac{\text{Urine phosphate}}{\text{Urinary Creatinine}} \right) \times \left(\frac{\text{Plasma Creatinine}}{\text{Plasma phosphate}} \right) \times 100$$

Monitoring on SCBU – bloods and measurements

Infants are weighed Mon/Wed/Friday and intake volumes adjusted. Measure the OFC weekly and plot (along with weight) weekly. Consider measuring crown-heel length where there are growth concerns. Measure FBC, U&E, bone profile and LFT weekly in any infant where there are ongoing medical concerns, although *there is often no need to check 'routine bloods' in well babies tolerating full enteral feeds.*

Why monitor?

- Anaemia impairs adequate tissue oxygen delivery and may prevent successful oral feeding and impair optimal growth.
- Hyponatraemia may cause lethargy and impair neuro-development.[13]
- Persistently low serum urea (<2mmol/L) may reflect inadequate dietary protein especially in those primarily nourished with EBM.
- Mineral bone disease can only be confirmed biochemically - infants need to lose >30% of bone mineral before osteopenia is apparent radiologically.

Post-discharge enteral feeding

There is evidence that weight, length and head growth can be improved by feeding preterm formula (PTF) as opposed to term formula (TF) for the first 6-9 months post term.[14, 15]. **Consider infants who were ≤ 34 weeks and ≤ 1750 g and not wishing to breast feed for a specialised formula (e.g. Nutriprem 2[®]) on discharge.** Other babies may also benefit. All babies discharged on a PTF need consultant follow up. Encourage breast feeding where parents wish and be prepared to accept a lower growth trajectory in those infants. Continue Vitamin supplements in breastfed babies.

Infants (≤ 34 weeks ≤ 1750 g) who may benefit from PTF on discharge

Increased energy requirements e.g. chronic lung disease on home oxygen

Persisting poor weight gain (<30g/day)

Significant early growth retardation (i.e. remain below birth centile)

Significant in-utero growth retardation (IUGR)

There are some infants (≤ 34 weeks) who were not IUGR or especially unwell *and* who have grown well in the immediate postnatal period who have little to gain from a PTF on discharge. These infants should be converted to a standard term milk 5-7 days before discharge. If babies are sent home on a PTF it should be continued until they are on a good weaning diet around 4-6 months post-term. A small group of infants, especially those very preterm and those with chronic lung disease will benefit from longer supplementation, possibly up to 1 year of age. Isolated caloric supplementation of a TF is not recommended except without the involvement of a dietician.

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