Neonatal Parenteral Nutrition (PN)- Summary Clinical Guideline Derby & Burton

Reference No: CG-NICU/3181/22

Indications for Parenteral Nutrition (PN)

PN should be considered for any premature or low birth weight infant, either as a nutritional supplement or total parenteral nutrition for infants who are nil by mouth (NBM) or receiving trophic feeds. If the preterm infant fits the criteria below, PN should be started as soon as possible, within at least 8 hours.

Particular indications include:

- Prematurity: Gestational age -<31/40
- Prematurity: Gestational age ≥31/40 where sufficient progress is not made with enteral feeding in the first 72 hours after birth
- Intrauterine growth restriction (IUGR) with absent or reversed end diastolic flow (AREDF)
- NBM due to *e.g.* suspected necrotising enterocolitis (NEC)
- Infants not tolerating enteral feeds or enteral feeds stopped for ≥48 hours

Exclusions for Pre-term Parenteral Nutrition

Infants >28 days after birth. This guideline covers babies born preterm, up to 28 days after their birth date and babies born at term up to 28 days after their birth.

Access and Administration of Neonatal PN

Starter aqueous PN is kept as stock on NICU and is for central line use (umbilical venous catheter (UVC) or long line (LL)) only due to the high concentration of glucose (15%) and resulting high osmolality. Starter PN does not contain sodium and no lipid is provided. This can be used for up to 72 hours after which the neonate should be switched to preterm standard PN which should also be administered via a central line.

Standard preterm PN will be supplied as two components: the aqueous bag (containing amino acids, glucose, electrolytes and trace elements) and the lipid formulation containing lipids and vitamins. Sodium, potassium and phosphate may be added to the aqueous phase if the infant's blood results indicate that this is necessary. Where this is required, it will be outsourced, i.e., ordered on a named-patient basis from an external supplier (ITH Pharma). For same-day delivery the prescription needs to be completed by 10am (or for next day delivery, 11am).

The aqueous bag can be infused for up to 48 hours if run through a 0.22-micron filter; the lipid component must be used with a filter size of no less than 1.2 microns to allow lipid molecules to pass through. The lipid component must be changed every 24 hours.

PN should be administered using light-protective giving sets, light-protective lines and lightprotective bags; white or silver for the aqueous bag and brown or black for the lipid component unless the lipid is supplied in amber-tinted 50mL UV-protect syringes.

Per 100ml PN (inc. lipid portion where appropriate)	Starter PN	Standard preterm PN (with 3g/kg/day lipid ¹)	Peripheral PN (outsourced) (with 3g/kg/day lipid ²)	Numeta G13% ³	
Amino acids	3.9g	3.0g ⁴	1.9g	3.1g	
Glucose	15g	13.7g	9.4g	13.3g	
Lipid	×	2.5g	2.5g	2.5g	
Sodium	×	2.9mmol	2.5mmol	2.2mmol	
Potassium	1	2.1mmol	2.1 mmol	2.1mmol	
Calcium	1	1.7 mmol	0.84 mmol	1.3mmol	
Magnesium	0.2	0.16 mmol	0.17 mmol	0.16mmol	
Phosphate	1	1.7 mmol	0.85 mmol	1.3mmol	
Acetate	×	2.1 mmol	×	2.4mmol	
Chloride	×	0.48 mmol	3.4 mmol	3.1mmol	
Further electrolyte additions permitted	×	only by outsourcing	×	×	
Vitamins	×	✓ in lipid phase	✓ in lipid phase	×	
Trace elements	×	✓	\checkmark	×	
Stock on NICU	\checkmark	×	×	×	
Route of administration	Central	Central	Peripheral	Central	
Aqueous bag total volume	160ml	610ml	500ml	300ml	
Lipid component	×	✓ (separate)	✓ (separate)	√(3CB)	
Maximum rate (inc lipid portion where appropriate)	80ml/kg/day	120ml/kg/day	120ml/kg/day	127.9ml/kg/day	
When to be used	Up to 72 hours of age	From 24 hrs of age	From 24 hrs of age	From 24 hours of age	

Table: PN Regimens at a glance

Numeta is a licensed neonatal PN product. It is not routinely used at Derby but is included in this guideline as an alternative PN if Preterm standard PN ever ceases to be available from ITH. Numeta is presented as a three-chamber bag, which is rolled (by production staff in CASU) to combine the chambers resulting in a single 300ml bag containing all components of the PN.

Peripheral PN may be appropriate in specific circumstances - see full guideline for further information.

² 100ml peripheral PN includes 85.4ml aqueous & 14.6ml lipid component when on 3g/kg lipid per day

³ Numeta can be used as a 2-chamber bag (2CB) or a 3-chamber bag (3CB); this guideline assumes it is being used as a 3CB. See Numeta section for more info. Addition of extra electrolytes, and vitamins/trace elements, is theoretically possible <u>but not at UHDB</u> as there is no mechanism for doing so.

¹ 100ml standard preterm PN includes 85.4ml aqueous & 14.6ml lipid component when on 3g/kg lipid per day

⁴ The formulation stability matrix necessitates a slightly lower (~10%) nitrogen content, if outsourcing for additional electrolytes to be added. NICE guideline recommends a maintenance range of 3 to 4 g/kg/day of amino acids per day [Neonatal parenteral nutrition (NG154) 9 Feb 2020]. When on full rate preterm PN (120ml/kg/day of which 17.5ml/kg/day is lipids) the baby receives 3.6g amino acids, or, if the formulation is outsourced for tailored electrolytes, 3.3g amino acids.

Term PN

Term PN is no longer provided at UHDB since keeping it in stock has resulted in a lot of waste due to low usage. Term babies are less nutritionally compromised at birth and have sufficient reserves (compared with a preterm or low birth weight infant) to withstand periods of suboptimal feeding. In addition, term infants in need of PN are frequently in need of surgery, which is not provided at UHDB. These infants are usually transferred to another centre within a day or two. In certain circumstances it may be possible to use preterm PN for a term infant (see information in appendix 1 of full guideline)

Ordering Process for PN

Once the neonate is ready to move from Starter to Preterm PN, the ward pharmacist for NICU should use the appropriate prescription, which routinely covers a 48-hour period. Once the prescription is agreed with the neonatal registrar or consultant on the ward, the prescription requires printing and delivering to CASU at RDH.

The RDH pharmacy central aseptic unit (CASU) will supply Standard Preterm PN required for babies on NICU on same day as requested, so long as the PN prescription is received by 1pm.

Where meeting individualised electrolyte requirements is necessary the PN will be supplied by an external manufacturer. The prescription needs to be received by CASU before 10am and handed to the chief technician to organise ordering. The order is received by 6pm that day and on receipt will be checked against the prescription by the CASU team and NICU contacted to arrange collection.

Component to be measured		Daily	Twice weekly	Weekly	Monthly	Specifically
Phosphate (serum or plasma)	Initiation	✓				
	Maintenance			~		More frequently where there is clinical concern or a previous result outside the normal range or those born at 32 ⁺⁰ weeks
Iron					✓	Once baby is on PN for more than 28 days
Liver function tests				~		More frequently where there is clinical concern or previous deranged LFTs
Serum triglycerides	Initiation	✓				
	Maintenance					More frequently where level is elevated or there is risk of hypertriglyceridemia
Blood pH, potassium, chloride and calcium	Initiation	~				More frequently where there is clinical concern or a result(s) outside the normal
	Maintenance			~		range, or whereby doses of IV components have been changed
Blood glucose		~				Every 1-2 hours after first initiation and change of nutritional bag or more frequently with previous hyper/hypoglycaemia or clinical reasons for concern e.g. sepsis/seizures

Monitoring requirements