Neonatal parenteral nutrition for preterm babies, up to 28 days after their due birth date

Indications for starting NPN

For newborn preterm babies start NPN in

- Babies born before 31+0 weeks
- Babies born at or after 31+0 weeks if sufficient progress is not made with enteral feeding in the first 72 hours after birth
- Babies who are unlikely to establish sufficient enteral feeding, for example, babies with a congenital gut disorder or critical illness such as sepsis.

For preterm babies who have previously established some enteral feeds start NPN in

- Babies whose enteral feeds have to be stopped and it is unlikely they will be restarted within 48 hours
- Babies whose enteral feeds have been stopped for >24 hours and there is unlikely to be sufficient progress with enteral feeding within a further 48 hours.

When a preterm baby meets the indications for parenteral nutrition, start it as soon as possible, and within 8 hours at the latest.

Administration of NPN

Venous access

- Use a central venous catheter to give neonatal parenteral nutrition. Only consider using peripheral venous access to give neonatal parenteral nutrition if:
  - it would avoid a delay in starting parenteral nutrition
  - short-term use of peripheral venous access is anticipated, for example, less than 5 days
  - it would avoid interruptions in giving parenteral nutrition
  - central venous access is impractical.
- Only consider surgical insertion of a central venous catheter if:
  - non-surgical insertion is not possible
  - long-term parenteral nutrition is anticipated, for example, in short bowel syndrome.

Protection from light

- Protect the bags, syringes and infusion sets of both aqueous and lipid parenteral nutrition solutions from light.

Standardised bags

- When starting neonatal parenteral nutrition for preterm babies, use a standardised parenteral nutrition formulation ('standardised bag').
- Continue with a standardised bag unless an individualised parenteral nutrition formulation is indicated, for example, if the baby has:
  - complex disorders associated with a fluid and electrolyte imbalance
  - renal failure.
- Standardised neonatal parenteral nutrition ('standardised bags') should be formulated in concentrated solutions to help ensure that the nutritive element of intravenous fluids is included within the total fluid allowance.

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Starting, increasing and maintaining NPN

Amounts for constituents of neonatal parenteral nutrition

	If starting NPN in the first 4 days after birth			If starting NPN more than 4 days after birth
	Starting range on first day	Increasing from starting to maintenance	Maintenance range	Give
Energy	40-60 kcal/kg/day	Gradually, for example over 4 days	75-120 kcal/kg/day	75-120 kcal/kg/day
Glucose	6-9 g/kg/day		9-16 g/kg/day	9-16 g/kg/day
Amino acids	1.5-2 g/kg/day		3-4 g/kg/day	3-4 g/kg/day
Lipids	1-2 g/kg/day	Gradually, for example in increments of 0.5-1 g/kg/day	3-4 g/kg/day	3-4 g/kg/day

	If starting NPN in the first 48 hours after birth			If starting NPN more than 48 hours after birth
	Starting range on first day	Increasing from starting to maintenance	Maintenance range	Give
Calcium	0.8-1 mmol/kg/day	After 48 hours	1.5-2 mmol/kg/day	1.5-2 mmol/kg/day
Phosphate	1 mmol/kg/day	After 48 hours	2 mmol/kg/day	2 mmol/kg/day

Other constituents of neonatal parenteral nutrition – general principles

Iron	• Do not give intravenous parenteral iron supplements to preterm babies <28 days old. • For preterm babies 28 days or older, monitor for iron deficiency and treat if necessary.
Vitamins	• Give daily fat-soluble and water-soluble vitamins (in the intravenous lipid emulsion) from the outset or as soon as possible after starting parenteral nutrition.
Electrolytes	• Give sodium and potassium in parenteral nutrition to maintain standard daily requirements.
Magnesium	• Give magnesium in parenteral nutrition from the outset or as soon as possible after starting parenteral nutrition.
Trace elements	• Give daily trace elements from the outset or as soon as possible after starting parenteral nutrition.
Lipid emulsions	• For preterm babies with parenteral nutrition-associated liver disease, consider giving a composite lipid emulsion rather than a pure soy lipid emulsion.
Phosphate	• Giver higher dosage if indicated by serum phosphate monitoring.

Ratios of non-nitrogen energy to nitrogen, and carbohydrates to lipids

- Use a non-nitrogen energy to nitrogen ratio range of 20 to 30 kcal of non-nitrogen energy per gram of amino acids (this equates to 23 to 34 kcal of total energy per gram of amino acid).
- Provide non-nitrogen energy as 60% to 75% carbohydrates and 25% to 40% lipid.

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Monitoring NPN

General principles for monitoring NPN

- When taking blood samples to monitor neonatal parenteral nutrition:
  - collect the minimum blood volume needed for the tests, and liaise with the local clinical laboratory to retrieve as much information as possible from the sample
  - coordinate the timing of blood tests to minimise the number of blood samples needed.

Minimum blood monitoring requirements

Test	Starting	Maintenance	Increased frequency
Glucose	1-2 hours after first starting NPN	1-2 hours after each change of NPN bag (usually 24-48 hours)	• Previous hypoglycaemia or hyperglycaemia • Dosage has been changed • Clinical reasons for concern, for example, sepsis or seizures
Blood pH, potassium, chloride, and calcium	Daily when starting and increasing NPN	Twice weekly after reaching a maintenance NPN	• If levels have been outside normal range • Dosages have been changed • Clinical reasons for concern, for example, critically ill babies
Serum triglycerides	Daily while increasing lipids	Weekly after reaching maintenance lipid dosage	• If level is elevated • Clinical reasons for concern, for example, critically ill babies or babies with a lipaemic blood sample
Serum or plasma phosphate	Daily while increasing phosphate	Weekly after reaching maintenance phosphate dosage	• If level has been outside normal range • Clinical reasons for concern, for example, metabolic bone disease • Born <32 weeks
Iron status	Measure ferritin, iron and transferrin saturation if a preterm baby is on parenteral nutrition for >28 days		
Liver function	Weekly		• If levels have been outside the normal range • Clinical concerns

Stopping NPN

Factors to take into account when deciding when to stop parenteral nutrition

- Tolerance of enteral feeds
- Nutrition being delivered by enteral feeds (volume and composition)
- Relative contribution of parenteral nutrition and enteral nutrition to baby's total nutritional requirement
- Likely benefit of nutritional intake compared with risk of venous catheter sepsis
- Individual baby's circumstances, for example, a baby with complex needs such as short bowel syndrome, increased stoma losses or slow growth, may need long-term parenteral nutrition.

Depending on the above factors, consider stopping parenteral nutrition within 24 hours once the following enteral feed volumes are tolerated.

- For preterm babies born before 28 weeks: 140 to 150 ml/kg/day
- For preterm babies born at or after 28 weeks: 120 to 140 ml/kg/day

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