

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

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.

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.

- 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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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 | | 75-120 kcal/kg/day | 75-120 kcal/kg/day |
| Glucose | 6-9 g/kg/day | Gradually, for example over 4 | 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**
 - Give 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 30 to 40 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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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) | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • If levels have been outside the normal range • Clinical concerns |

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