

Newborn Critical Care Center Clinical Guidelines

Cycling Total Parenteral Nutrition (TPN)

BACKGROUND

Approximately 40-60% of children exposed to long term (> 2 weeks) parenteral nutrition develop parenteral nutrition associated liver disease (PNALD) which is most often defined as a prolonged conjugated bilirubin ≥ 2 mg/dL. Risk factors for developing PNALD include prematurity, short bowel syndrome (SBS), SGA, infection and number of days on antibiotics, and lack of enteral feedings. The pathophysiology of PNALD is uncertain but is likely related to immature liver, the components of TPN acting as toxins, inflammatory mediators, bacterial endotoxins, and lack of enteral feeding. PNALD in the majority of infants will resolve spontaneously as enteral feeds advance. A small portion of infants with PNALD, especially those who continue on TPN, will progress to liver failure resulting in the need for liver transplant.

There is emerging evidence that alternative lipid emulsions such as SMOFlipid® or Omegaven® may decrease the risk of PNALD compared to soybean only (Intralipid) lipid emulsions. SMOFlipid® is a combination lipid emulsion which includes soybean, MCT, olive, and fish oils. Omegaven® is fish oil based. Due to the fact that SMOFlipid® has both omega 3 and omega 6 fats, it meets infant nutritional requirements for optimal neurological development and to prevent essential fatty acid deficiency.

Criteria for Cycling TPN:

1. Conjugated bilirubin ≥ 2 mg/dL on 2 separate samples and need for TPN/IL > 2 weeks
2. Tolerating constant TPN with an adequate maximum GIR (13-14 mg/kg/min) for at least 2 weeks

Guidelines and Important Points:

- Consider other interventions including Actigall, SMOFlipid® or Omegaven®, and maximizing enteral feedings.
- Avoid any infusion containing glucose/fat/protein during rest period.
- Obtain hepatic function panel (AST, ALT, total protein, albumin, total bilirubin, direct bilirubin, and alkaline phosphatase) and GGT every 2 weeks at a minimum.
- Use the [Microsoft Excel spreadsheet](#) to calculate hourly rates of cycled TPN (fill out boxes in yellow). **Print page 1 for the nurse to hang at the bedside.**
- Start cyclic TPN with a 1 hour rest window off TPN. If this is tolerated for 48 hours, advance to a 2 hour rest window off TPN. If 2 hour window is tolerated for 48 hours, then advance to the goal of a 4 hour rest window off TPN.
- Order heparin flush per unit protocol.
- Monitor bedside serum glucose for 24 hours according to the schedule on the next page with the introduction of change in interval. Thereafter, monitor bedside serum glucose with a change in clinical status, change in dextrose, or **DAILY** at end of window off TPN.

Procedure for Discarding and Starting Infusion (TPN / Intralipid / Omegaven / SMOFlipid):

1. Discard the old infusions and IV tubing during rest period.
2. Flush central line with saline followed by heparin flush.
3. Aim to restart new cycle at 2300 with new infusion.
4. Prime new IV tubing daily with initiation of infusion.
5. Flush central line with normal saline prior to starting new infusion.

CALCULATIONS:

1. Calculate total TPN volume to be given.

ONE hour window off TPN

Full rate = TPN volume \div 20

$\frac{3}{4}$ rate = full rate \times 0.75

$\frac{1}{2}$ rate = full rate \times 0.5

$\frac{1}{4}$ rate = full rate \times 0.25

TWO hour window off TPN

Full rate = TPN volume \div 19

$\frac{3}{4}$ rate = full rate \times 0.75

$\frac{1}{2}$ rate = full rate \times 0.5

$\frac{1}{4}$ rate = full rate \times 0.25

FOUR hour window off TPN

Full rate = TPN volume \div 17

$\frac{3}{4}$ rate = full rate \times 0.75

$\frac{1}{2}$ rate = full rate \times 0.5

$\frac{1}{4}$ rate = full rate \times 0.25

SCHEDULES:

TPN runs for 23 hrs / 1 hr off

2300: TPN starts at $\frac{1}{4}$ rate

2400: TPN runs at $\frac{1}{2}$ rate

0100: TPN runs at $\frac{3}{4}$ rate

0200-1859: TPN at full rate

1900: TPN runs at $\frac{3}{4}$ rate

2000: TPN runs at $\frac{1}{2}$ rate

2100: TPN runs at $\frac{1}{4}$ rate

2200-2259: TPN off/rest

TPN runs for 22 hrs / 2 hrs off

2300: TPN starts at $\frac{1}{4}$ rate

2400: TPN runs at $\frac{1}{2}$ rate

0100: TPN runs at $\frac{3}{4}$ rate

0200-1759: TPN at full rate

1800: TPN runs at $\frac{3}{4}$ rate

1900: TPN runs at $\frac{1}{2}$ rate

2000: TPN runs at $\frac{1}{4}$ rate

2100-2259: TPN off/rest

TPN runs for 20 hrs / 4 hrs off

2300: TPN starts at $\frac{1}{4}$ rate

2400: TPN runs at $\frac{1}{2}$ rate

0100: TPN runs at $\frac{3}{4}$ rate

0200-1559: TPN at full rate

1600: TPN runs at $\frac{3}{4}$ rate

1700: TPN runs at $\frac{1}{2}$ rate

1800: TPN runs at $\frac{1}{4}$ rate

1900-2259: TPN off/rest

GLUCOSE MONITORING

@ 2000 prior to $\frac{1}{2}$ rate

@ 2100 prior to $\frac{1}{4}$ rate

@ 2200 prior to turning off TPN

@ 2230 (30 mins into rest period)

@ 1900 prior to $\frac{1}{2}$ rate

@ 2000 prior to $\frac{1}{4}$ rate

@ 2100 prior to turning off TPN

@ 2200 (1 hr into rest period)

@ 1700 prior to $\frac{1}{2}$ rate

@ 1800 prior to $\frac{1}{4}$ rate

@ 1900 prior to turning off TPN

@ 2030 (1.5 hrs into rest period)

@ 2200 (3 hrs into rest period)

- For glucose **< 25 mg/dL**: give 2 mL/kg D10W & start D10W at 60 mL/kg/day; notify MD/NNP; repeat glucose in 30 mins
- For glucose **25-39 mg/dL**: start D10W at 60 mL/kg/day; notify MD/NNP, repeat glucose in 30 mins
- For glucose **\geq 40 mg/dL**: continue blood glucose monitoring as scheduled

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