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 defined as a prolonged conjugated bilirubin level ≥ 2 mg/dL. Risk factors for PNALD include prematurity, short bowel syndrome (SBS), growth restriction, infection/number of days on antibiotics, and lack of enteral feedings. Of note, PNALD is a diagnosis of exclusion, and infants with conjugated hyperbilirubinemia should receive a thorough evaluation for other etiologies of neonatal cholestasis.

The pathophysiology of PNALD is thought to be related to a combination of hepatic immaturity, inflammation, bacterial endotoxins, lack of enteral feeding, and TPN/lipid toxicity. For most infants, PNALD will resolve spontaneously as enteral feeds advance and TPN/lipids are weaned. A small percentage of infants with PNALD, especially those who remain TPN dependent, will develop liver failure resulting in the need for liver transplant.

Infants with PNALD may benefit from Omegaven® as an alternative to soybean-based lipid emulsions (Intralipid). Omegaven® is fish oil based, so it has a predominance of omega 6 fatty acids as opposed to the omega 3 fatty acids in Intralipid.

The data supporting TPN cycling for PNALD are sparse. Thus, TPN cycling should primarily be considered for infants being discharged on TPN and for infants whose developmental care would be facilitated by time off TPN. TPN cycling should be reserved for infants at low risk for hypoglycemia.

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:

- In the setting of PNALD, consider other management approaches before cycling TPN including Actigall, Omegaven® (1 g/kg/day), and maximal 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 and lipids.
- 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 / Omegaven):

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	**TWO hour window off TPN**	**FOUR hour window off TPN**
Full rate = TPN volume ÷ 20	Full rate = TPN volume ÷ 19	Full rate = TPN volume ÷ 17
¾ rate = full rate × 0.75	¾ rate = full rate × 0.75	¾ rate = full rate × 0.75
½ rate = full rate × 0.5	½ rate = full rate × 0.5	½ rate = full rate × 0.5
¼ rate = full rate × 0.25	¼ rate = full rate × 0.25	¼ rate = full rate × 0.25

SCHEDULES:

TPN runs for 23 hrs / 1 hr off	*TPN runs for 22 hrs / 2 hrs off*	*TPN runs for 20 hrs / 4 hrs off*
2300: TPN starts at ¼ rate	2300: TPN starts at ¼ rate	2300: TPN starts at ¼ rate
2400: TPN runs at ½ rate	2400: TPN runs at ½ rate	2400: TPN runs at ½ rate
0100: TPN runs at ¾ rate	0100: TPN runs at ¾ rate	0100: TPN runs at ¾ rate
0200-1859: TPN at full rate	0200-1759: TPN at full rate	0200-1559: TPN at full rate
1900: TPN runs at ¾ rate	1800: TPN runs at ¾ rate	1600: TPN runs at ¾ rate
2000: TPN runs at ½ rate	1900: TPN runs at ½ rate	1700: TPN runs at ½ rate
2100: TPN runs at ¼ rate	2000: TPN runs at ¼ rate	1800: TPN runs at ¼ rate
2200-2259: TPN off/rest	2100-2259: TPN off/rest	1900-2259: TPN off/rest

GLUCOSE MONITORING

@ 2000 prior to ½ rate	@ 1900 prior to ½ rate	@ 1700 prior to ½ rate
@ 2100 prior to ¼ rate	@ 2000 prior to ¼ rate	@ 1800 prior to ¼ rate
@ 2200 prior to turning off TPN	@ 2100 prior to turning off TPN	@ 1900 prior to turning off TPN
@ 2230 (30 mins into rest period)	@ 2200 (1 hr into rest period)	@ 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 **≥ 40 mg/dL:** continue blood glucose monitoring as scheduled

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