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.

Revised September 2018 – Nail / Aliaga / McNeair
CALCULATIONS:

1. Calculate total TPN volume to be given.

<table>
<thead>
<tr>
<th>ONE hour window off TPN</th>
<th>TWO hour window off TPN</th>
<th>FOUR hour window off TPN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full rate = TPN volume ÷ 20</td>
<td>Full rate = TPN volume ÷ 19</td>
<td>Full rate = TPN volume ÷ 17</td>
</tr>
<tr>
<td>¾ rate = full rate × 0.75</td>
<td>¾ rate = full rate × 0.75</td>
<td>¾ rate = full rate × 0.75</td>
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<tr>
<td>½ rate = full rate × 0.5</td>
<td>½ rate = full rate × 0.5</td>
<td>½ rate = full rate × 0.5</td>
</tr>
<tr>
<td>¼ rate = full rate × 0.25</td>
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<td>¼ rate = full rate × 0.25</td>
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</tbody>
</table>

SCHEDULES:

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

GLUCOSE MONITORING

- @ 2000 prior to ½ rate
- @ 2100 prior to ¼ rate
- @ 2200 prior to turning off TPN
- @ 2230 (30 mins into rest period)
- @ 2000 (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
References:


