Policy

Policy Title: Total Parenteral Nutrition (TPN) – 3 in 1 Solution
Document Number: LH_PD2014_C03.54
Functional Sub-Group: Clinical
Summary: There are two standard 3in1 PN solutions available at Liverpool Hospital; Olimel N7 and Olimel N9. TPN is administered via a central line only and only prescribed by Parenteral Nutrition (PN) team.

Approved by: Director of Medical Services
General Manager
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Next Review Date: December 2017
Related Standards:
- Standard 4 Medication Safety
- Standard 12 Provision of Care

Related Liverpool Policies:
- C03.30 – Parenteral Nutrition - 2 in 1 Solution (SDE)
- C03.16 – Central Venous Access Devices: Care and Management
- C03.12 – Intravenous (IV) therapy and Medication Administration

Replaces Existing Policy: LH_PD2011_C03.54 Parenteral Nutrition – 3 in 1 Parenteral Solution

Previous Review Dates: 04/2010

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1. **Introduction:**
   The risk addressed by this policy:

   Clinical and patient safety

   **The Aims / Expected Outcome of this policy:**

   To administer Total Parenteral Nutrition (TPN) in a safe manner to appropriate patients at Liverpool Hospital

2. **Policy Statements**
   - This policy DOES NOT address intra-dialytic TPN – please contact renal team.
   - TPN is administered to patients whose nutritional requirements cannot be met as a result of a non-functioning or dysfunctional gastrointestinal tract.
   - TPN must be commenced by the Parenteral Nutrition (PN) team only. The PN team consists of:
     - Staff Specialist/Advanced Trainee - ICU
     - CNC – Central Venous Access and Parenteral Nutrition
     - PN Dietitian
     - PN pharmacist
   - TPN is administered via a central line only, continuously, over a 24 hour period.
   - TPN should be commenced during normal working hours only i.e. Monday to Friday 0800 – 1630 (excluding public holidays).
   - For after hours problems contact the ICU Advanced Trainee on speed dial 2930.
   - There are two standard 3in1 PN solutions available at Liverpool Hospital; Olimel N7 and Olimel N9. They have a shelf life of 90 days refrigerated and 48 hours at room temperature
   - Lipid free and electrolyte free solutions are available

3. **Principles / Guidelines**

   3.1 **INDICATION:**
      - TPN is indicated in patients who do not have a functioning GI tract, or who have disorders requiring complete bowel rest. The main indications include:
        - Inadequate absorption resulting from short bowel syndrome
        - Gastrointestinal fistula
        - Bowel obstruction
        - Prolonged bowel rest
        - Severe malnutrition, significant weight loss and/or hypoproteinaemia when enteral therapy is not possible
        - Other disease states or conditions in which oral or enteral feeding are not an option

   3.2 **COMMENCING TPN:**

      3.2.1 **INITIAL CONSULTATION:**
      - A consultation request should be submitted by the treating team, to the PN team, using the standard consult form and should include the following information:
        - Brief patient history
        - Indication for PN
        - Anticipated duration of PN therapy

      The treating team will inform the TPN dietitian or ward dietitian that a consult is required
• PN consults will only be done during normal working hours i.e. Monday to Friday, 0800 – 1630. PN should NOT be commenced outside of these hours.

• The patient MUST have a full dietary assessment completed by the ward dietician or the PN team dietician to calculate the patient’s dietary requirements.

• Diabetic patients MUST have an Endocrine Consult prior to commencing PN

3.2.2 BASELINE INVESTIGATIONS:

• The patient must have the following baseline bloods completed (organised by the treating team or the PN team):
  o Electrolytes, Urea, Creatinine, Calcium, Magnesium, Phosphate
  o Liver Function Tests, Albumin, Protein
  o Cholesterol and triglycerides
  o Full Blood Count
  o Coagulation Studies (PT/APTT)
  o Iron studies
  o Selenium, Zinc, Vitamin B12,

• The patient must be weighed prior to commencement and the weight documented in the patient’s notes.

• N.B. Significant electrolyte abnormalities must be corrected prior to commencing TPN.

3.2.3 INTRAVENOUS ACCESS:

• TPN must be administered via a CENTRAL line only.

• A central venous catheter, preferably subclavian or PICC should be inserted. A minimum of TWO lumens are required.

• The CVC/PICC is NOT to be removed without the CNC/PN team authority.

3.2.4 PRESCRIBING TPN

All patients are reviewed by the dietician or Intensivist.

• Initial rate is 0.2 to 0.3 ml/kg.

• Patients at risk of refeeding (see below) should have all electrolytes normalised and thiamine 300 mg IV before commencing TPN.

• The TPN should be increased on an individual basis to goal rate if the electrolytes are normal.

• In Patients not at risk of refeeding should have their rate increased to goal rate of 1-1.2 ml/kg/hour over 48 hours.

• PN and maintenance fluid are prescribed on the TPN fluid chart by the PN team on a daily basis.

• Orders for Saturday and Sunday will be completed by the PN team on the Friday before.

• The ICU Advanced Trainee can be contacted on speed dial 2930, outside of normal working hours if problems with PN orders arise.

• If appropriate, the following medications should be commenced and charted on the patient’s medication chart:
  o Vitamin K  10mg IV weekly
  o Thiamine  300mg IV daily (if the patient is at risk of refeeding syndrome)
### 3.2.5 STANDARD SOLUTIONS

The standard 3 in 1 PN solutions stocked at Liverpool Hospital are:

<table>
<thead>
<tr>
<th>Nutrient component</th>
<th>Olimel N7 2000mL</th>
<th>Olimel N9 2000mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total calories</td>
<td>2270 kcal</td>
<td>2140 kcal</td>
</tr>
<tr>
<td>(Kilojoules- kJ)</td>
<td>(9489 kJ)</td>
<td>(8945 kJ)</td>
</tr>
<tr>
<td>Amino Acids</td>
<td>88.6 grams</td>
<td>113.9 gm</td>
</tr>
<tr>
<td>Glucose</td>
<td>280 grams</td>
<td>220 grams</td>
</tr>
<tr>
<td>Lipid</td>
<td>80 grams</td>
<td>80 grams</td>
</tr>
<tr>
<td>Indications for use</td>
<td>Renal impairment eGFR &lt;60 not on dialysis</td>
<td>Standard solution</td>
</tr>
<tr>
<td></td>
<td>Estimated protein needs not elevated beyond normal range approximating to &lt;= 0.8 to 1g/kg/day</td>
<td></td>
</tr>
</tbody>
</table>

- N9 is the standard solution prescribed.
- N7 is used if a lower protein requirement is necessary for example low body weight patients or patients with liver disease.
- Additives to PN solutions are always undertaken or organised by the pharmacy department.
- Additives are NOT to be injected into the PN solution on the ward under any circumstances.
- Multivitamins (Cernevit®) and trace elements (with iron) are preloaded into the N9 TPN bag only.
- Patient’s commenced on N7 solution will receive a plain bag (i.e. no multivitamins or trace elements) on commencement. Preloaded bags containing multivitamins and trace elements will be ordered for continuation.
- Customised TPN solutions without electrolytes or free of lipids may be ordered if required. This should be done by the PN team only.
- Ward staff are not to add anything else to the premade bags

### 3.2.6 NUTRITION PRESCRIPTION³

- The estimation of the nutrition requirement will be conducted by the ward dietitian or ICU Specialist
- TPN will only commence without dietitian consultation in the ICU

#### 3.2.6.1 Determine appropriate weight for prescription:
- Underweight or those within healthy weight range (BMI <25) use **actual weight**
- Overweight: use **adjusted ideal body weight** targeted at metabolically active proportion of weight
3.2.6.2. Determine target volume
   - A suitable target would be equivalent to 25kcal/kg
   - This equates to approximately 1ml/kg/hr as the hourly target infusion rate
   - For example, for a 60kg patient, goal = 60ml/hr.

3.2.6.3 Initial dose and escalation
   - Start at 25-30% of the target rate especially for those at risk of refeeding syndrome start at 10 – 15%
   - For example, 20ml/hr of choice of appropriate solution for a target of 60-80ml/hr
   - Progress daily via the same increments (25-35%),
     - electrolytes are stable within normal range or improving if mildly abnormal (Specifically K, Mg, PO4)
     - There is no evidence cardiac decompensation with feeding
     - There is no significant fluid overload coinciding with feeding commencement

A Metabolic Cart measuring Basal Energy Expenditure should be available to estimate energy requirements in critically ill patients.

3.2.6.4. Maximum infusions

The PN infusion shall not exceed the following upper limits³:

<table>
<thead>
<tr>
<th>Nutritional component</th>
<th>Maximum dosage</th>
<th>Associated risks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Calories</strong></td>
<td>35kcal/kg/d</td>
<td>Overfeeding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypertriglyceridemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fatty liver</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased respiratory demand</td>
</tr>
<tr>
<td><strong>Lipid</strong></td>
<td>2g/kg/d</td>
<td>Fat overload syndrome</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lipaemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypertriglyceridemia</td>
</tr>
<tr>
<td>NB: In severe liver or renal dysfunction:</td>
<td>1g/kg/d</td>
<td></td>
</tr>
<tr>
<td><strong>Glucose</strong></td>
<td>6mg/min/kg = 5-10g/kg/d</td>
<td>Hyperglycaemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fatty liver</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypertriglyceridemia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiratory compromise</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td>2g/kg/d</td>
<td>Elevated urea concentration</td>
</tr>
</tbody>
</table>

3.3 TPN ADMINISTRATION:
- TPN must be administered via a CENTRAL line only.
- A volumetric pump MUST be used for PN administration.
- A lumen dedicated to PN administration only must be used. No other IV fluids or medications are to be administered via this lumen.
- NO burettes are to be used on the TPN administration set.
- An administration set that does NOT have sided injection ports (i.e. non-ported administration set or epidural administration set) MUST be used.

3.3.1 BAG CHANGES
- PN solutions MUST be changed every 24 HOURS.
- Maintenance fluids should be changed at the same time as PN solutions to prevent confusion in daily fluid prescriptions.
- PN solutions are dispensed by pharmacy on a daily basis. Weekend bags are supplied on Friday and should be stored in the ward fridge.
- PN solutions MUST be protected from light, using the over pouch provided.
3.3.1.1 Equipment
- Personal Protective Equipment – apron, eye shield
- Sterile gloves
- Dressing trolley
- Sterile work area surface
- 0.5% chlorhexidine in 70% alcohol
- New PN / IV fluid bags
- New administration set
- Central Venous Access Line Label

3.3.1.2 Procedure
- Wash hands with appropriate antiseptic solution
- Set up work area and equipment
- Remove the TPN bag from the light-protective over pouch
- Gently agitate the solution to mix thoroughly.
- Continue with administration connection procedure
- Wash hands – 2-minute scrub
- Put on sterile gloves
- Assemble administration sets on sterile field
- Spike connection port with administration set spike
- Prime administration set with PN solution
- Using strict aseptic technique, connect new administration set to distal lumen of CVC or PICC
- Make sure dressing to CVC/PICC is intact and there is no traction on CVC/PICC at entry site
- Place Central Line label on new administration line close to port/ dressing
- Replace light-protective over pouch before commencing infusion
- Discard disposables and remaining solution appropriately
- Document on PN order form and patients fluid balance chart/ICU flowchart.

3.4 MONITORING

<table>
<thead>
<tr>
<th>MONITORING GUIDELINES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nursing:</strong></td>
</tr>
<tr>
<td><strong>BSL</strong></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
</tr>
<tr>
<td><strong>Fluid Balance</strong></td>
</tr>
<tr>
<td><strong>Medical:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Test</strong></th>
<th><strong>Baseline</strong></th>
<th><strong>Initially (or during acute illness)</strong></th>
<th><strong>Stable</strong></th>
<th><strong>Test</strong></th>
<th><strong>Baseline</strong></th>
<th><strong>Initially (or during acute illness)</strong></th>
<th><strong>Stable</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UEC</strong></td>
<td>Yes</td>
<td>Daily</td>
<td>2 x weekly</td>
<td>Lipids</td>
<td>Yes</td>
<td>Weekly</td>
<td>weekly</td>
</tr>
<tr>
<td><strong>Ca, Mg, PO</strong></td>
<td>Yes</td>
<td>Daily</td>
<td>Weekly</td>
<td>Zn, Se</td>
<td>Yes</td>
<td>Weekly</td>
<td>weekly</td>
</tr>
<tr>
<td><strong>LFT</strong></td>
<td>Yes</td>
<td>2 x weekly</td>
<td>2 x Weekly</td>
<td>Cu</td>
<td>No</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Weekly</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Weekly</td>
</tr>
<tr>
<td><strong>FBC</strong></td>
<td>Yes</td>
<td>Daily</td>
<td>2 x Weekly</td>
<td>25&lt;sup&gt;OH&lt;/sup&gt; Vitamin D, Cr</td>
<td>No</td>
<td>Monthly</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; monthly</td>
</tr>
<tr>
<td><strong>INR, PT, aPTT</strong></td>
<td>Yes</td>
<td>2 x weekly</td>
<td>2 x Weekly</td>
<td>Iron studies</td>
<td>Yes</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Weekly</td>
<td>Monthly</td>
</tr>
<tr>
<td><strong>CRP</strong></td>
<td>yes</td>
<td>Weekly</td>
<td>weekly</td>
<td>Osmolality</td>
<td>Yes</td>
<td>Weekly</td>
<td>cease</td>
</tr>
</tbody>
</table>

Compliance with this policy directive is mandatory.

Total Parenteral Nutrition (TPN) – 3 in 1 Solution

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3.5 COMPLICATIONS

3.5.1 Hyperglycaemia
- As blood glucose rises, it may lead to glycosuria giving an increase in urine output, secondary to osmotic diuresis. The patient may become dehydrated. BSLs need better control e.g.: decrease rate of PN infusion or give insulin - check with PN team first. Diabetic patients on TPN MUST have an Endocrine Consult.

3.5.2 Hypoglycaemia
- If solutions that are running are stopped suddenly or if too much insulin is given, the patient's BSL can fall rapidly.
- Call MET if BSL low and/or alteration in level of consciousness occur.
- Additional information contained in Liverpool Policy P05.03 Hypoglycaemia Management: Adult Inpatient

3.5.3 Electrolyte Imbalances
- Mainly related to the patients underlying condition, not the PN solution. The most important relates to potassium. Potassium (K+) <3.0mmol/L or >5.0mmol/L should be treated urgently - ring patient’s treating team (see corporate policy C3.53 Administration of Intravenous Potassium).
- Any major electrolyte imbalances should be noted and acted on quickly. This is organised by the patients treating team.
- Far more common fluid problems relate to inadequate or incorrect type of fluid. Fluid overload problems, e.g.: pulmonary edema is uncommon with PN.

3.5.4 Refeeding Syndrome
- Prolonged NBM or nil gastrointestinal use, with or without malnutrition, can cause secondary gastrointestinal functions such as impaired pancreatic secretions, large bowel mucosal atrophy along with maldigestion, malabsorption and risk of diarrhoea with enteral feeding.
- In this case, there is a risk of Refeeding Syndrome. This will often be identified by the Dietitian. When this is the case, sodium and water content should not be excessive but extra potassium, magnesium and phosphate should be given to avoid clinically dangerous reductions in plasma concentrations as avid cellular uptake of these elements follows from the restoration of substrate supply. The problem is particularly acute with parenteral nutrition.2

4. Performance Measures
Incidents are reported using the Incident Information Management System (IIMS) which is monitored and reviewed by the relevant department and the Drug Policy and Practice Review Committee.

5. References, Standards and links
3. Agency for Clinical Innovation, Parenteral Nutrition Pocket Book for Adults 2010

Reviewers: ICU Staff, Liverpool Hospital
Dietetic department
Pharmacy Department, Liverpool Hospital
Drug Policy and Practice Review Committee

Endorsed by: Liverpool Policy and Guideline Committee – December 2014