Policy
Policy Title: Total Parenteral Nutrition (TPN) – 2 in 1 Solution
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General Manager
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Replaces Existing Policy: LH_PD2010_C03.30 Parenteral Nutrition – 2 in 1 Parenteral Solution (SDE)
Previous Review Dates: 09/97; 11/04; 02/07; 04/10; 12/14
Related Standards
Standard 4 Medication Safety
Standard 12 Provision of Care
Related Liverpool Policies:
C03.54 – Parenteral Nutrition - 3 in 1 Solution
C03.16 – Central Venous Access Devices: Care and Management
C03.12 – Intravenous (IV) therapy and Medication Administration

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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**

   • 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:
     o Staff Specialist/Advanced Trainee - ICU
     o CNC – Central Venous Access and Parenteral Nutrition
     o PN Dietitian
     o 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.
   
   • For after hours problems contact the ICU Advanced Trainee on speed dial 2930.
   
   • This policy DOES NOT address intra-dialytic TPN

3. **Principles**

   **3.1 INDICATION:**

   The prescription of 2 in 1 solution which contains no lipids is indicated in patients with:

   • A significant hypertriglyceridemia
   
   • Egg allergy
   
   • 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:
     o Inadequate absorption resulting from short bowel syndrome
     o Gastrointestinal fistula
     o Bowel obstruction
     o Prolonged bowel rest
     o Severe malnutrition, significant weight loss and/or hypoproteinaemia when enteral therapy is not possible
     o 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:
     o Patient history
     o Indication for PN
     o 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 outside of ICU.
• 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.
• 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) must have thiamine 300 mg IV and significant electrolyte abnormalities corrected 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 prescribed 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 SOLUTION
The standard 2 in 1 TPN solutions stocked at Liverpool Hospital:

<table>
<thead>
<tr>
<th>Nutrient component</th>
<th>2 in 1</th>
<th>2000 mls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total calories</td>
<td>1900 Kcal</td>
<td></td>
</tr>
<tr>
<td>Kilojoules (KJ)</td>
<td>7942 kj</td>
<td></td>
</tr>
<tr>
<td>Amino Acids</td>
<td>100 grams</td>
<td></td>
</tr>
<tr>
<td>Glucose</td>
<td>500 grams</td>
<td></td>
</tr>
</tbody>
</table>
• Multivitamins (Cernevit®) and trace elements (with iron) will be prescribed by the TPN team and added in pharmacy.
• Additives to PN solutions are only undertaken or organised by the pharmacy department.
• Additives are NOT to be injected into the PN solution on the ward under any circumstances.

3.2.6 NUTRITION PRESCRIPTION

• 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:
  o Underweight or those within healthy weight range (BMI <25) use actual weight
  o Overweight: use adjusted ideal body weight targeted at metabolically active proportion of weight

3.2.6.2 Determine target volume
  o A suitable target would be equivalent to 25kcal/kg
  o This equates to approximately 1ml/kg/hr as the hourly target infusion rate
  o For example, for a 60kg patient, goal = 60ml/hr.

3.2.6.3 Initial dose and escalation
  o Start at 25-30% of the target rate especially for those at risk of refeeding syndrome start at 10 – 15%
  o For example, 20ml/hr of choice of appropriate solution for a target of 60-80ml/hr
  o Progress daily via the same increments (25-35%), if
    ▪ 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 Chart 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 limits:

<table>
<thead>
<tr>
<th>Nutritional component</th>
<th>Maximum dosage</th>
<th>Associated risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Calories</td>
<td>35kcal/kg/day</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>Glucose</td>
<td>6mg/min/kg = 5-10g/kg/day</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>Protein</td>
<td>2g/kg/day</td>
<td>Elevated urea concentration</td>
</tr>
</tbody>
</table>

3.3 TPN ADMINISTRATION:
• TPN must be administered via a CENTRAL (CVAD) line only.
• A volumetric infusion 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
• Dressing trolley
• Sterile work area surface
• 0.5% chlorhexidine in 70% alcohol solution
• Sterile gloves
• New PN / IV fluid bags
• New administration set

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
• 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>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Nursing:</strong></td>
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<tr>
<td><strong>TEST</strong></td>
<td><strong>BASELINE</strong></td>
</tr>
<tr>
<td>BSL</td>
<td>Yes</td>
</tr>
<tr>
<td>Weight</td>
<td>Yes</td>
</tr>
<tr>
<td>Fluid Balance</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

Compliance with this policy directive is mandatory.
MONITORING GUIDELINES

<table>
<thead>
<tr>
<th>Medical:</th>
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</thead>
<tbody>
<tr>
<td>UEC</td>
<td>Yes</td>
<td>Daily</td>
<td>2 x weekly</td>
<td>Lipids</td>
<td>Yes</td>
<td>Weekly</td>
</tr>
<tr>
<td>Ca, Mg, PO₄</td>
<td>Yes</td>
<td>Daily</td>
<td>Weekly</td>
<td>Zn, Se</td>
<td>Yes</td>
<td>Weekly</td>
</tr>
<tr>
<td>LFT</td>
<td>Yes</td>
<td>2 x weekly</td>
<td>2 x Weekly</td>
<td>Lipids</td>
<td>Yes</td>
<td>2&quot;nd Weekly</td>
</tr>
<tr>
<td>FBC</td>
<td>Yes</td>
<td>Daily</td>
<td>2 x Weekly</td>
<td>25&quot;OH Vitamin D, Cr</td>
<td>No</td>
<td>Monthly</td>
</tr>
<tr>
<td>INR, PT, aPTT</td>
<td>Yes</td>
<td>2 x weekly</td>
<td>2 x Weekly</td>
<td>Iron studies</td>
<td>Yes</td>
<td>2&quot;nd Weekly</td>
</tr>
<tr>
<td>CRP</td>
<td>Yes</td>
<td>Weekly</td>
<td>weekly</td>
<td>Osmolality</td>
<td>Yes</td>
<td>Weekly</td>
</tr>
</tbody>
</table>

3.5 COMPLICATIONS

3.5.1 Hyperglycaemia
- As blood glucose rises, it may lead to glucosuria causing an increase in urine output, secondary to osmotic diuresis. The patient may become dehydrated. Normoglycaemia is maintained either by decreasing the rate of PN infusion or by giving insulin - check with PN team first. Diabetic patients on TPN MUST have an Endocrine Consult. This is more of an issue with the 2 in 1 solution due to the higher glucose concentration.

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.

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

3.5.5
- Abnormal liver function secondary to the larger glucose load but cholestasis and sepsis are other causes to consider.²

4. Performance Measures
Incidents are reported using the Incident Information Management System (IIMS) which is monitored and reviewed by the relevant Department Manager and PN Team.
5. **References, Standards and links**


3. Agency for Clinical Innovation, Parenteral Nutrition Pocket Book for Adults 2010

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**2015 Reviewers:**
- ICU Staff, Liverpool Hospital
- Dietetic department
- Pharmacy Department, Liverpool Hospital
- Drug Policy and Practice Review Committee

**Endorsed by:**
- Liverpool Policy and Guideline Committee – February 2015