Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

A Midday Symposium and Live Webinar conducted at the 2018 ASHP Midyear Clinical Meeting and Exhibition

Tuesday, December 4, 2018
11:30 a.m. – 1:00 p.m. PT
Room 257, 200 Level, ACC North
Anaheim Convention Center
Anaheim, California

AGENDA

11:30 a.m. – 11:35 a.m.
Welcome and Introduction
Phil Ayers, Pharm.D., BCNSP, FASHP

11:35 a.m. – 11:55 a.m.
When Is PN Appropriate?
Angela L. Bingham, Pharm.D., BCCCP, BCNSP, BCPS

11:55 a.m. – 12:45 p.m.
Clinical Case Scenarios: Applying Best Practices to Ensure Safe and Appropriate Use of Parenteral Nutrition Therapy
Phil Ayers, Pharm.D., BCNSP, FASHP, and Angela L. Bingham, Pharm.D., BCCCP, BCNSP, BCPS

12:45 p.m. – 1:00 p.m.
Faculty Discussion and Audience Questions
Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

Disclosures

In accordance with ACCME and ACPE Standards for Commercial Support, ASHP policy requires that all faculty, planners, reviewers, staff, and others in a position to control the content of this presentation disclose their financial relationships. In this activity, only the individual below has disclosed a financial relationship. No other persons associated with this presentation have disclosed any relevant financial relationships.

- Phil Ayers, Pharm.D., BCNSP, FASHP
  - Fresenius Kabi USA, LLC: speakers bureau
  - Janssen Pharmaceuticals: speakers bureau

Please be advised that this activity is being audio and/or video recorded for archival purposes and, in some cases, for repurposing of the content for enduring materials.
Learning Objectives

At the conclusion of this activity, participants should be able to

- Review basic concepts in parenteral nutrition (PN), including identifying patients at high risk for malnutrition, assessing nutritional status, and interpreting clinical and laboratory data.
- Explain best practices for pharmacists with regard to PN order review, compounding, labeling, and dispensing.
- Using clinical cases, illustrate best practices related to PN management in a variety of clinical situations.

When is Parenteral Nutrition Appropriate?

Angela L. Bingham, Pharm.D., BCPS, BCNSP, BCCCP
Philadelphia College of Pharmacy
University of the Sciences
Philadelphia, Pennsylvania
Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

Background

- Parenteral nutrition (PN) represents one of the most notable achievements of modern medicine
- PN can serve as a therapeutic modality for all age groups across the healthcare continuum
- PN offers a life-sustaining option when intestinal failure prevents adequate oral or enteral nutrition (EN)
- However, providing nutrients intravenously (IV) is an expensive form of nutrition support, and serious adverse events can occur

Challenges: Identifying Evidence-Based Indications for PN Therapy

- Well-designed, randomized controlled trials are scarce
- Much of the available data are older
- Results may reflect outdated clinical practices (glycemic control, overfeeding, care of central line)
- Little data with newer products
- Data insufficient regarding competency and outcomes

Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

ASPEN Consensus Recommendations

- Developed in the absence of high-quality, grade level evidence
- Designed to provide guidance in clinical decisions to
  - Identify best practices
  - Reduce variations in practice
  - Enhance patient safety
  - Provide day-to-day guidance for clinical decisions; minimize risks


Appropriate PN Use

| Identifying Candidates for PN | • Question of PN use based on diagnostic categories  
• Clinical indications for PN administration  
• Evaluating GI function: continuum of intestinal failure  
• Timing of PN initiation |
| PN Use in a Variety Clinical Situations | • Selecting vascular access device  
• Peripheral PN, intradialytic PN, perioperative PN  
• PN in palliative care  
• Home PN |
| Promoting Optimal PN Outcomes | • Strategies to reduce complications  
• Assessing progress toward therapeutic goals  
• Managing transitions, weaning PN  
• Tracking and monitoring PN |
| Research | • Questions requiring further study |

Identifying Candidates for PN

- Evaluate clinical factors from history, physical examination, and diagnostic evaluations in determining if EN is contraindicated
- Do not use based solely on medical diagnosis or disease state
- Consider baseline nutritional and metabolic status, anticipated duration of PN therapy, and goals of care
- PN and EN may become necessary together or sequentially along the continuum of care

Clinical Factors Assessed for EN vs. PN Eligibility

- Functional status of GI tract
  - Evidence from history, physical, and diagnostic studies
- Failed EN trial
- Hemodynamic instability
- Failure to achieve/maintain enteral access
- Contraindications to enteral access
  - Active GI bleeding
  - Uncontrolled peritonitis
  - Ischemic bowel
- Intolerance of EN (e.g., intractable vomiting or diarrhea)
Indications for PN: Impacted by Clinical Factors

- Non-functional GI tract (failed or inadequate EN)
  - Impaired absorption of nutrients
    - Short bowel syndrome, fistula, reduced absorptive capacity
  - Mechanical bowel obstruction
    - Peritoneal carcinomatosis, severe adhesive disease
- Motility disorders
  - Pseudo-obstruction, prolonged ileus
- Need for “bowel rest”
  - Ischemic bowel, neutropenic colitis, severe pancreatitis
- Inability to achieve enteral access

PN Timing Considerations

- Well nourished stable adult patients: After 7 days of inadequate oral intake or EN
- Nutritionally-at-risk and unlikely to achieve nutrition goals: Within 3-5 days
- Baseline moderate or severe malnutrition when oral intake not feasible or sufficient: As soon as feasible
- Severe metabolic instability: Delay until condition has improved
**Clinical Conditions Warranting Cautious Initiation of PN in Adults**

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Suggested Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperglycemia</td>
<td>Blood glucose &gt; 180 mg/dL</td>
</tr>
<tr>
<td>Azotemia</td>
<td>Blood urea nitrogen &gt; 100 mg/dL</td>
</tr>
<tr>
<td>Hypertriglyceridemia</td>
<td>Serum triglycerides &gt; 200 mg/dL</td>
</tr>
<tr>
<td>Hypo- or hypernatremia</td>
<td>Serum sodium &lt; 130 mEq/L or &gt; 150 mEq/L</td>
</tr>
<tr>
<td>Hypokalemia</td>
<td>Serum potassium &lt; 3 mEq/L</td>
</tr>
<tr>
<td>Hypomagnesemia</td>
<td>Serum magnesium &lt; 1.3 mEq/L</td>
</tr>
<tr>
<td>Hypocalcemia</td>
<td>Ionized calcium &lt; 4.5 mg/dL</td>
</tr>
<tr>
<td>Hypophosphatemia</td>
<td>Serum phosphorus &lt; 2 mg/dL</td>
</tr>
</tbody>
</table>


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**Monitoring PN**

- Provide interprofessional monitoring of clinical status and response to PN therapy
- Modify the PN prescription as indicated based on ongoing evaluation of GI function and nutrition status


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### Monitoring Parameters: Baseline

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitoring Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical assessment</td>
<td>• Physical assessment, weight/height, intake and output, vital signs</td>
</tr>
<tr>
<td>Blood glucose</td>
<td></td>
</tr>
<tr>
<td>Comprehensive metabolic panel</td>
<td>• Serum creatinine, BUN, electrolytes, LFTs</td>
</tr>
<tr>
<td>CBC with differential</td>
<td></td>
</tr>
<tr>
<td>Coagulation parameters</td>
<td>• PTT, PT, INR</td>
</tr>
<tr>
<td>Triglycerides</td>
<td></td>
</tr>
</tbody>
</table>

BUN = blood urea nitrogen, CBC = complete blood count, INR = international normalized ratio, LFTs = liver function tests, PT = prothrombin time, PTT = partial thromboplastin time


### Monitoring Parameters: Daily Until Stable

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitoring Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical assessment</td>
<td>• Physical assessment, weight, intake and output, vital signs, vascular access device, response to therapy</td>
</tr>
<tr>
<td>Blood glucose</td>
<td>• Every 1-24 hr depending on clinical status</td>
</tr>
<tr>
<td>Basic metabolic panel</td>
<td>• Serum creatinine, BUN, electrolytes</td>
</tr>
<tr>
<td>CBC with differential</td>
<td></td>
</tr>
</tbody>
</table>


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Monitoring Parameters: Ongoing Therapy and Stable Inpatients

1-2 Times per week
- Glucose
- Serum creatinine, BUN
- Electrolytes
- CBC with differential

Weekly
- LFTs
- PT, PTT, INR
- Triglycerides

Monitoring Parameters: As Clinically Indicated

- Iron indices
- Trace elements
- Vitamins
- Thyroid function tests

Which of the following parameters is least useful to monitor a critically ill adult patient’s response to PN therapy?

a. Functional status  
b. Post-surgical healing  
c. Prealbumin  
d. Stamina

Monitoring General Response to PN Therapy

- Optimal parameters
  - Functional status  
  - Post-surgical healing  
  - Stamina  
- Visceral protein concentrations, such as prealbumin, are unreliable markers of nutrition status, especially in patients with inflammation

Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

Weaning PN

• Wean PN when oral intake and/or EN achieves 50-75% of daily requirements for energy, protein, and micronutrients, unless impaired GI function precludes 100% absorption of nutrient needs
• Consider using a weaning protocol during the transition from PN to EN


Clinical Case Study:
End-Stage Renal Disease (ESRD)

Phil Ayers, Pharm.D., BCNSP, FASHP
Baptist Medical Center
University of Mississippi School of Pharmacy
Jackson, Mississippi
Case Study: TT

TT is 61-year-old African American male with ESRD on PD admitted with peritonitis. TT has failed enteral feedings and NSS consulted to initiate PN. HD will be initiated 3 times a week.

PMH: HTN, ESRD

Height 71”, weight 82 kg

PD = peritoneal dialysis, NSS = nutritional support service, HD = hemodialysis, HTN = hypertension

Protein Requirements in Adults with Kidney Disease

- Nondialysis CKD
  - 0.6-0.8 g/kg/day, 1 g/kg/day in acute illness
- Peritoneal dialysis
  - 1.2 g/kg/day
- Hemodialysis
  - 1.2-1.3 g/kg/day
- Continuous renal replacement therapy (CRRT)
  - 2-2.5 g/kg/day

Energy Requirements

• Requirements
  – Predictive equations
  – Weight-based
  – Measured
• Empiric values will vary depending on the patient
  – 30-35 kcal/kg/day


<table>
<thead>
<tr>
<th>Sodium (135-145 mmol/L)</th>
<th>133</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium (3.6-5 mmol/L)</td>
<td>5.5</td>
</tr>
<tr>
<td>Chloride (98-107 mmol/L)</td>
<td>91</td>
</tr>
<tr>
<td>Carbon dioxide (22-31 mmol/L)</td>
<td>21</td>
</tr>
<tr>
<td>Glucose (70-110 mg/dL)</td>
<td>100</td>
</tr>
<tr>
<td>BUN (7-21 mg/dL)</td>
<td>77</td>
</tr>
<tr>
<td>Creatinine (0.7-1.5 mg/dL)</td>
<td>6.5</td>
</tr>
<tr>
<td>Calcium (8.4-10.2 mg/dL)</td>
<td>9.1</td>
</tr>
<tr>
<td>Magnesium (1.7-2.2 mg/dL)</td>
<td>2</td>
</tr>
<tr>
<td>Phosphorus (2.5-4.5 mg/dL)</td>
<td>4.8</td>
</tr>
</tbody>
</table>
Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin (3.6-5 g/dL)</td>
<td>2.5</td>
</tr>
<tr>
<td>AST (17-59 U/L)</td>
<td>31</td>
</tr>
<tr>
<td>ALT (21-72 U/L)</td>
<td>33</td>
</tr>
<tr>
<td>ALP (38-126 U/L)</td>
<td>124</td>
</tr>
<tr>
<td>Triglycerides &lt; 150 mg/dL</td>
<td>190</td>
</tr>
<tr>
<td>Prealbumin (18-40 mg/dL)</td>
<td>20</td>
</tr>
</tbody>
</table>

AST = aspartate amino transferase, ALT = alanine amino transferase, ALP = alkaline phosphatase

Diagram:
- Compounded
  - Customized
    - 2-in-1
  - Standardized
    - 3-in-1
- Manufactured
  - Standardized
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Preparing the PN

• Compounding PN
  – Automated compounding device
    • Use vendor-validated initial set-up
    • Use barcode technology to verify products
    • Trace tubing from each source container
  – Manual additions
    – Provide independent verification

• Activating multichambered PN product
  – Identify correct product and volume
    • Inspect for damage
    • Completely activate
    • Make necessary additions

Products

• Multichambered PN product
  – Two chambers
  – Three chambers

• Macronutrients
  – Amino acids (AA) – ingredients are product-specific
  – IV lipid emulsions (ILE) – ingredients are product-specific
ILE Products

- First-generation
  - Cottonseed oil-based (e.g., Lipomul)†

- Second-generation
  - Soybean oil-based (e.g., Intralipid, Nutrillipid)

- Third-generation
  - Mixed oils
    - Medium chain-long chain triglycerides (MCT-LCT)
    - Soybean oil-olive oil (e.g., Clinolipid)
    - Soybean oil-MCTs-olive oil-fish oil (e.g., Smoflipid)
  - Modular oils
    - Fish oil (e.g., Omegaven)

†Removed from market.

Electrolytes: Adults

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>Maintenance</th>
<th>Maximum Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>1 – 2 mEq/kg/day</td>
<td>150 mEq/L (NS concentration)</td>
</tr>
<tr>
<td>Potassium</td>
<td>1 – 2 mEq/kg/day</td>
<td>240 mEq/day</td>
</tr>
<tr>
<td>Calcium</td>
<td>10 – 15 mEq/day</td>
<td>25 mEq/day</td>
</tr>
<tr>
<td>Magnesium</td>
<td>8 – 20 mEq/day</td>
<td>48 mEq/day</td>
</tr>
<tr>
<td>Phosphate</td>
<td>20 – 40 mmol/day</td>
<td>60 mmol/day</td>
</tr>
<tr>
<td>Chloride/acacetate</td>
<td>Adjust salts to maintain acid base balance</td>
<td></td>
</tr>
</tbody>
</table>

Electrolytes

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>Chloride, acetate, phosphate</td>
</tr>
<tr>
<td>Potassium</td>
<td>Chloride, acetate, phosphate</td>
</tr>
<tr>
<td>Chloride</td>
<td>Sodium, potassium</td>
</tr>
<tr>
<td>Acetate</td>
<td>Sodium, potassium</td>
</tr>
<tr>
<td>Calcium</td>
<td>Gluconate</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Sulfate</td>
</tr>
</tbody>
</table>

- Magnesium sulfate and calcium gluconate are the preferred salts in PN
- 3 mmol of sodium phosphate = 4 mEq sodium
- 3 mmol of potassium phosphate = 4.4 mEq potassium


Standardized PN Order Form

PN Order Verification

- Patient name and other identifiers
- Birth date and/or age
- Allergies and associated manifestations
- Height and dosing weight (metric units)
- Diagnoses
- PN Indication(s)
- Administration route and vascular access device
- Date/time of submission and administration
- Volume and rate of infusion
- Transcription of PN data should require an independent double check

TT’s PN Formulation
Amounts per day

- 71”, 82 kg (BMI 25.1 kg/m²)
- Amino acid 98 g
- Dextrose 147 g
- ILE 36 g
- Micronutrients
  - Sodium chloride 40 mEq
  - Sodium acetate 40 mEq
  - Sodium phosphate 5 mM
  - Magnesium sulfate 8 mEq
  - MVI 10 mL
  - Trace elements 1 mL
    - Cu, Cr, Mn, Se, Zn
  - Folic acid 1 mg
TT’s Case: Day 3

TT becomes hypotensive and is transferred to ICU where a vasopressor is initiated
Meds: Norepinephrine
TT is unable to tolerate HD secondary to hypotension, CRRT will be initiated

What is PN protein goal for patients receiving CRRT?

a. 0.8 g/kg/day
b. 1.0 g/kg/day
c. 1.2 g/kg/day
d. 2 g/kg/day

Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

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<td>98</td>
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<td>Glucose (70-110mg/dL)</td>
<td>97</td>
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<td>BUN (7-21 mg/dL)</td>
<td>88</td>
</tr>
<tr>
<td>Creatinine (0.7-1.5mg/dL)</td>
<td>6.9</td>
</tr>
<tr>
<td>Calcium (8.4-10.2 mg/dL)</td>
<td>9.2</td>
</tr>
<tr>
<td>Magnesium (1.7-2.2 mg/dL)</td>
<td>1.7</td>
</tr>
<tr>
<td>Phosphorus (2.5-4.5 mg/dL)</td>
<td>6</td>
</tr>
</tbody>
</table>

What is the most common acid-base disorder seen in patients with renal insufficiency?

a. Respiratory acidosis  
b. Metabolic acidosis  
c. Respiratory alkalosis  
d. Metabolic alkalosis

Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

What electrolyte is commonly depleted in patients receiving CRRT?

a. Magnesium
b. Phosphorus
c. Potassium
d. Sodium


TT’s PN Formulation

Amount per day

- 71”, 82 kg (BMI 25.1 kg/m²)
- Amino acid 164 g
- Dextrose 227 g
- ILE 62 g
- Micronutrients
  - Sodium chloride 80 mEq
  - Sodium acetate 80 mEq
  - Sodium phosphate 25 mM
  - Potassium acetate 20 mEq
  - Magnesium sulfate 12 mEq
  - MVI 10 mL
  - Trace elements 1 mL
    - Cu, Cr, Mn, Se, Zn
  - Folic acid 1 mg
Clinical Case Study: Critical Care

Angela L. Bingham, Pharm.D., BCPS, BCNSP, BCCCP
Philadelphia College of Pharmacy
University of the Sciences
Philadelphia, Pennsylvania

Case Study: Jane

- 45-year-old Caucasian female
  - Admitted to the medical intensive care for septic shock with high nasogastric output and abdominal distension
  - Subsequent work-up reveals small bowel obstruction
  - Diet: NPO
Jane’s Case

- **Past medical history**: Malnutrition
- **NKDA**
- **Current medications**
  - Cefepime 2 g IV every 8 hr
  - Vancomycin 750 mg IV every 12 hr
  - Norepinephrine 30 mcg/min IV continuous infusion
  - Hydrocortisone 50 mg IV every 6 hr
  - Pantoprazole 40 mg IV every 24 hr
  - Heparin 5000 units subcutaneously every 8 hr

Jane’s Case

- **Vitals**:
  - RR: 18/min
  - Pulse: 98-104 bpm, sinus tachycardia
  - BP: 70/60 mm Hg
  - Temp: 101.5°F
- **Weight**: 50 kg
- **Height**: 5’7” (170.2 cm)
- **Body mass index**: 17.2 kg/m²
- **Triglycerides**: 123 mg/dL
Jane’s Case

- Laboratory data
  - WBC: 19.1 x 10^3 cells/mm^3
  - Arterial blood gas (ABG)
    - pH 7.35
    - pCO_2 40 mm Hg
    - pO_2 90 mm Hg
    - HCO_3 24 mEq/L
  - Phosphorus: 3.8 mg/dL
  - Magnesium: 2 mg/dL

The team will initiate PN. What is your recommendation for ILE in the first week of PN therapy?

- a. Withhold ILE
- b. Limit soybean oil-based ILE to 100 g/week
- c. Provide soybean oil-based ILE as daily macronutrient
- d. Provide four oil alternative ILE as daily macronutrient
Current Guideline Recommendations for Adults

• Withhold or limit soybean oil-based ILE during the first week following initiation of PN in the critically ill patient to a maximum of 100 g/week if concern for essential fatty acid deficiency [Quality of Evidence: Very Low]

• Alternative ILEs (SMOF [soybean oil, MCT, olive oil (OO), and fish oil (FO) emulsion], MCT, OO, and FO) use may be considered in the critically ill patient who is an appropriate candidate for PN [Expert opinion]


ILE Survey with Gap Analysis: Critically Ill vs. Non-critically Ill Adults

<table>
<thead>
<tr>
<th>ILE Provided in First 7 Days</th>
<th>Critically Ill Adults</th>
<th>Non-critically Ill Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always or most of the time</td>
<td>53.3%</td>
<td>80.7%</td>
</tr>
<tr>
<td>Rarely or never</td>
<td>24%</td>
<td>8.2%</td>
</tr>
</tbody>
</table>

• Significant variation in practice identified by this 2016 survey conducted by the ASPEN PN Safety Committee

## Jane’s PN Formulation
### Amounts per Day

- **Amino acids**: 90 g
- **Dextrose**: 370 g
- **ILE**: 50 g
- **Micronutrients**:
  - Sodium chloride: 80 mEq
  - Sodium phosphate: 25 mmol
  - Potassium acetate: 40 mEq
  - Magnesium sulfate: 12 mEq
  - MVI: 10 mL
  - Trace elements: 1 mL
  - Cu, Cr, Mn, Se, Zn

## Jane’s Case Continues

### Current ABG
- **pH**: 7.30
- **pCO₂**: 55 mm Hg
- **pO₂**: 99 mm Hg
- **HCO₃⁻**: 31 mEq/L

### Blood glucose concentrations in past 24 hr
- 208 mg/dL, 232 mg/dL, 240 mg/dL, 253 mg/dL
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Which of the following is the most appropriate recommendation for Jane’s PN order at this time?

a. Add 50 units of regular human insulin  
b. Decrease amino acids to 45 g per day  
c. Increase acetate to 120 mEq per day  
d. Decrease dextrose to 130 g per day

Overfeeding

- Overfeeding
  - 90 g amino acids x 4 kcal/g = 360 kcal
  - 370 g dextrose x 3.4 kcal/g = 1258 kcal
  - 50 g ILE x 10 kcal/g = 500 kcal
  - Total kcal: 2118 kcal = 42 kcal/kg (Jane: 50 kg)

- Acid-base manifestation
  - Respiratory acidosis
    - Treat by addressing the underlying problem: Adjust PN formulation to provide appropriate calories
Exceeding Glucose Utilization Rate

- Dextrose infusion rate (mg carbohydrate/kg/min)
  - Dextrose g/kg body weight/1440 x 1000
- Jane’s case
  - 370 g dextrose/50 kg/1440 x 1000 = 5.14 mg/kg/min
  - Exceeded the maximum rate of glucose utilization for a stressed patient

Hyperglycemia in PN Patients: Prevention

- Dextrose initiation and limits
  - Initiation for first 24 hours
    - General patients: 150 – 200 g/day
    - Patients who are critically ill or who have diabetes mellitus: 100 – 150 g/day or 2 mg/kg/min
  - Increase dextrose to goal when blood glucose <180 mg/dL
  - Avoid exceeding maximum rate of glucose utilization
    - Non-stressed: 6 mg/kg/min
    - Stressed: 3-5 mg/kg/min

**Hyperglycemia in PN Patients:**
**Impact of Dextrose Infusion Rate in Adult Patients Without Diabetes**

Note: Hyperglycemia defined as >200 mg/dL in this study

- >5 mg/kg/min (n=37)
- 4.1-5 mg/kg/min (n=46)
- ≤4 mg/kg/min (n=19)

**Hyperglycemia in PN Patients: Management**

- Reassess caloric goals to ensure not overfeeding
- Perform indirect calorimetry to ensure not overfeeding
- Modify macronutrients in PN
  - Decrease carbohydrate
  - Consider increasing ILE (no more than 60% of kcal/day)


Jane’s Case Continues

• Despite adjusting the PN formulation, Jane’s hyperglycemia persists with blood glucose concentrations in the last 24 hours:
  204 mg/dL, 225 mg/dL, 230 mg/dL, 238 mg/dL

Hyperglycemia in PN Patients: Causes

• Patient-specific factors predisposing to hyperglycemia
  o Diseases that alter insulin’s effects (e.g., diabetes mellitus)
  o Elderly
  o Receipt of medications that alter glucose metabolism (e.g., corticosteroids, vasopressors) or contain dextrose
  o Stress (e.g., critical illness, sepsis)


Hyperglycemia in PN Patients: Insulin Management

- Subcutaneous injection: Sliding scale insulin if needed
- PN solution (regular human insulin)
  - Initially: 0.05 - 0.1 units insulin per g of dextrose (e.g., 0.1 units insulin/g dextrose = 15 units/150 g dextrose)
  - Increase or decrease based on patient blood glucose, sliding scale insulin requirements in previous 24 hr, and dextrose concentration
- IV continuous infusion: Consider if patient unstable with high or changing insulin requirement


Jane’s triglyceride concentration was normal at the time of PN initiation. While stable on PN, how often should Jane’s triglyceride concentration be reevaluated?

a. Daily
b. Every 3 days
c. Every 7 days
d. Every 2 weeks
Triglyceride Monitoring with PN

- Optimal monitoring
  - Baseline prior to administration of ILE in PN
  - Weekly
- Frequency of monitoring adjusted per the acuity of illness and clinical stability of the patient
- Acceptable triglyceride concentrations: <400 mg/dL


Clinical Case Study: Home PN

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Case Study: DA

- DA is 67-year-old white male, 65”, 62 kg, DX bowel dysmotility
  - Initiated PN in hospital Feb 2
  - For discharge on home PN Feb 16: amino acid/dextrose with electrolytes (E) 5/15 at 50 mL/hr
- PMH: AF, gout, BPH, Graves disease, Ogilvie syndrome, post-op ileus, ischemic bowel, GI bleed
- PSH: Cholecystectomy, bilateral hip replacement, sigmoidectomy with ileal anastamosis, subtotal colectomy, thyroidectomy

DA’s Case

- DA is discharged on home PN 2/16 : amino acid/dextrose E 5/15 at 50 mL/hr
- PN providing
  - 60 g/day protein (~1 g/kg/day)
  - 852 kcal/day (13.7 kcal/kg/day)
Practical Approaches to Safe and Appropriate Use of Parenteral Nutrition Therapy

**Concerns**

- Does the patient qualify for home PN (indications, length of time on therapy)
- Lack of ILE provision as part of the prescription
- Baseline laboratory values not measured?
- Whether the home setting adequate for safe provision
- Need for patient and caregiver education

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**CMS Reimbursement for Home PN**

- Calorie levels
  - 20-35 kcal/kg/day
- Protein
  - 0.8-1.5 g/kg/day

Indications for Home PN

- Intestinal failure or dysfunction
- Short bowel syndrome
- Malabsorptive disorders
- Chronic bowel obstruction
- Crohn’s disease
- Radiation enteritis
- Intestinal and pancreatic fistulae
- Pancreatitis
- Severe life-threatening malnutrition

Conditions Warranting Caution When Initiating PN at Home

- Medical condition
  - Diabetes
  - Heart failure
  - Pulmonary disorder
  - Severe malnutrition
  - Hyperemesis gravidarum
- Electrolyte disorder
  - Hyponatremia
  - Hypokalemia
  - Hyperchloremic metabolic acidosis
  - Hypophosphatemia
  - Hypochloremic metabolic alkalosis
Table 2. Medicare Criteria for HPN.7

A. Massive small bowel resection within 3 mo of initiating HPN
   HPN therapy needed >90 d
   ≤5 ft (153 cm) of small bowel distal to the ligament of Treitz

B. Short bowel syndrome
   HPN therapy needed >90 d,
   Enteral intake of 2.5–3 L, Enteral losses exceed 50% of enteral intake, and
   Urine output is <1 L per 24 h

C. Bowel rest for at least 3 mo
   HPN therapy needed >90 d.
   Symptomatic pancreatitis with without pseudocyst,
   Severe exacerbation of regional enteritis, or
   Proximal enterocutaneous fistula where distal enteral tube feeding
   is not possible

D. Complete mechanical small bowel obstruction
   HPN therapy needed >90 d
   Inoperable

E. Malabsorption and malnutrition
   HPN therapy needed >90 d
   10% weight loss over ≤3 mo
   Serum albumin ≤3.4 g/dL
   Severe fat malabsorption
   ● Standard 72-h fecal fat test
   ● Fecal fat exceeds 50% of oral/enteral intake on a diet of at least
   50 g/d of fat

F. Severe motility disorder (of small intestine and/or stomach) and malnutrition
   HPN therapy needed >90 d
   10% weight loss over ≤3 mo
   Serum albumin ≤3.4 g/dL
   Unresponsive to max doses of prokinetic medication
   (presence of daily nausea/vomiting)
   Motility disorder demonstrated via
   ● Solid meal gastric emptying study or barium/radiopaque
   pellets that do not reach the right colon by 6 h

G/H: Above condition with malnutrition and failed enteral tube feeding trial
10% weight loss within 3 mo + serum albumin ≤3.4 g/dL + failed tube feeding trial + > 90 d HPN + 1 condition below:
   ● Moderate fat malabsorption (fecal fat 25% of enteral intake on a diet of 50 g/d of fat measured with a 72-h fecal fat test)
   ● Malabsorption as confirmed by Sudan stain or d-xylene stool test
   ● Gastroparesis as described in scenario F where isotope or pellets fail to reach the jejunum in 3–6 h, manometric motility studies
   with results consistent with abnormal gastric emptying, unresponsive to prokinetic medication
   ● Small bowel dysmotility with gastric to right colon transit between 3 and 6 h, unresponsive to prokinetic medication
   ● Small bowel resection leaving >5 ft of small bowel beyond the ligament of Treitz
   ● Short bowel syndrome not as severe as scenario B
   ● Mild to moderate exacerbation of regional enteritis or enterocutaneous fistula
   ● Partial mechanical small bowel obstruction and surgery is not an option

HPN, home parenteral nutrition.


<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline</th>
<th>Week 1,2,3</th>
<th>Week 4</th>
<th>Every 3 months and prior to MD office visit</th>
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<tbody>
<tr>
<td>Glucose, BUN, SCR, electrolytes, Ca, Mg, Phos</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>CBC with differential and reticulocyte count</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Total and direct bilirubin, AST, ALT, LDH, Alk Phos, TG</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Serum proteins</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Vitamin B12, RBC folate, iron indices, trace elements, 25-OH vitamin D</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Trace Element Deficiencies

<table>
<thead>
<tr>
<th>Element</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium</td>
<td>Glucose intolerance, peripheral neuropathy</td>
</tr>
<tr>
<td>Copper</td>
<td>Neutropenia, hypochromic anemia, paresthesias in extremities</td>
</tr>
<tr>
<td>Manganese</td>
<td>Congenital abnormalities in offspring, growth retardation, defects in lipid/CHO metabolism</td>
</tr>
<tr>
<td>Zinc</td>
<td>Diarrhea, acrodermatitis, dementia, alopecia, alteration in taste and smell, impaired wound healing</td>
</tr>
<tr>
<td>Selenium</td>
<td>Myopathy, cardiomyopathy</td>
</tr>
<tr>
<td>Iodide</td>
<td>Hypothyroid goiter, hypothyroidism</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>Tachycardia, altered mental status, visual changes, nausea, vomiting</td>
</tr>
</tbody>
</table>


Facilitating Discharge for Home PN

- Perform diagnostic testing and procedures, verify insurance
- Establish long-term vascular access
- Establish tolerated PN formula
- Assess patient
  - Activities of daily living, caregiver, home setting, determine patient buy-in
  - Begin patient education
- Identify outpatient management
Evaluation of Suitability for Home PN

- Is home accessible to home health provider?
- Is environment clean with reliable utilities?
- Can patient move around home safely?
- Is the patient willing to learn proper operation of equipment?
- Is a caregiver available and willing to provide additional assistance?
- Are the patient and caregiver willing to learn to identify problems and contact appropriate services?
- Is laboratory monitoring available as needed to prevent complications?

Key Takeaways

- Facilities should develop polices and procedures to ensure appropriate use of PN
- PN requirements are determined by the patient’s condition and treatment modalities
- Communication with care providers is important at transitions of care
Which of these practice changes will you consider making?

- Assess nutrition status before recommending PN therapy
- Review current practice and policies in light of guidelines and clinical consensus recommendations available through ASPEN
- Review and adjust macronutrients and micronutrients within parenteral nutrition
- Communicate at transitions of care across the healthcare continuum
- Serve as a champion to ensure that appropriate patients receive PN therapy

Selected Resources

Thank You for Joining Us

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✓ Deadline: January 31
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Questions? Contact EducServ@ashp.org!
ABOUT THE FACULTY

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Phil Ayers, Pharm.D., BCNSP, FASHP, is a clinical specialist in nutrition support and serves the Department of Pharmacy at Baptist Medical Center in Jackson, Mississippi, as Chief of Clinical Pharmacy Services. He also is Clinical Associate Professor with the School of Pharmacy at the University of Mississippi. In addition, Dr. Ayers is the Interim Executive Director for the Mississippi Pharmacists Association (MPhA).

Dr. Ayers received his Bachelor of Science and Doctor of Pharmacy degrees from the University of Mississippi. He is board certified in nutrition support and has published in the areas of parenteral nutrition, fluid-electrolyte management, and acid-base balance. He leads a clinical pharmacy department with patient care services that include anticoagulation, antimicrobial stewardship, critical care, diabetes, nutrition support, and pharmacokinetics. These services have been recognized for excellence at the state level, and the Diabetes Management Team received the ASHP Best Practices Award in 2012.

Dr. Ayers is a member of ASHP and currently serves the American Society for Parenteral and Enteral Nutrition (ASPEN) on the Board of Directors as Secretary-Treasurer and Chair of the Parenteral Nutrition Safety Committee. He also is a member of the USP Healthcare Quality and Safety Committee and Chair of the Parenteral Nutrition Expert Panel. On the state level, Dr. Ayers is a member of MPhA, Mississippi Society of Health System Pharmacists (MSHP), and Mississippi Society for Parenteral and Enteral Nutrition (MSPEN) and has served as President of all three of these organizations. In 2012, he was named a Fellow of ASHP.

Angela L. Bingham, Pharm.D., BCCCP, BCNSP, BCPS, is Associate Professor of Clinical Pharmacy at the Philadelphia College of Pharmacy at University of the Sciences in Philadelphia. She also is a critical care and nutrition support clinical pharmacy specialist at Cooper University Hospital in Camden, New Jersey, where she also serves as Director of the PGY2 Critical Care Residency Program and Chair of the Parenteral Nutrition Task Force.

Dr. Bingham earned her Doctor of Pharmacy degree from South Carolina College of Pharmacy in Columbia. She completed her PGY1 pharmacy practice residency training at The Johns Hopkins Hospital in Baltimore, Maryland, and PGY2 critical care residency training at the University of Tennessee Health Science Center in Memphis, Tennessee. She is board certified in nutrition support, critical care, and pharmacotherapy.

Dr. Bingham was a member of the Parenteral Nutrition Appropriateness Consensus Task Force of the American Society for Parenteral and Enteral Nutrition (ASPEN) and co-authored consensus recommendations regarding appropriate use of parenteral nutrition published in the Journal of Parenteral and Enteral Nutrition in 2017. She also has served ASPEN as a member of the Standards of Practice for Nutrition Support Pharmacists Task Force, Clinical Nutrition Week Monitoring Committee, and Leadership Council for the Pharmacy Practice Section and as chair of the Membership Committee. On the state level, Dr. Bingham was President of the Philadelphia Area Society for Parenteral and Enteral Nutrition. She has presented numerous oral and poster presentations regarding parenteral nutrition and conducts research in the area of nutrition support.

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