Home Parenteral Nutrition (HPN)

Sara Bonnes, M.D., M.S.
General Internal Medicine
Home Parenteral Nutrition Program
Mayo Clinic, Rochester, MN
Objectives

• At the end of this presentation you will be able to:
  – Identify common indications for HPN
  – Discuss the hospital to home transition
  – Identify common acute HPN complications
  – Determine strategies to assess and manage long term HPN
Outline

• Indications for/ overview of HPN
• Qualifying for HPN
• The transition from hospital to home
• Acute complications
  – Psychological
  – Metabolic
  – Thrombosis
  – Infectious
• Long term management
  – Transition off HPN
  – Annual evaluation
    • Metabolic bone disease
    • IFALD
  – Planning for the future
What does home parenteral nutrition look like?

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN administers</td>
<td>Patient/ family administers</td>
</tr>
<tr>
<td>24 hr infusion</td>
<td>12-24 hr infusion</td>
</tr>
<tr>
<td>Portable on a pole</td>
<td>Portable in a backpack</td>
</tr>
</tbody>
</table>
When do we consider HPN?


Who is on HPN?

Table 2.—Primary Diagnosis, Age, and Duration of Treatment in 225 Patients Who Received Home Parenteral Nutrition*

<table>
<thead>
<tr>
<th>Primary diagnosis</th>
<th>Patients</th>
<th>Age (yr) at start of HPN</th>
<th>HPN duration (mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Median</td>
<td></td>
</tr>
<tr>
<td>IBD (short bowel)</td>
<td>50</td>
<td>37</td>
<td>62.2</td>
</tr>
<tr>
<td>Cancer (nonterminal)</td>
<td>39</td>
<td>57</td>
<td>5.1</td>
</tr>
<tr>
<td>Ischemic bowel</td>
<td>35</td>
<td>50</td>
<td>19.7</td>
</tr>
<tr>
<td>Radiation enteritis</td>
<td>32</td>
<td>55</td>
<td>9.1</td>
</tr>
<tr>
<td>Chronic pseudo-obstruction</td>
<td>26</td>
<td>58</td>
<td>14.4</td>
</tr>
<tr>
<td>Mechanical obstruction (adhesions)</td>
<td>18</td>
<td>54</td>
<td>10.8</td>
</tr>
<tr>
<td>Other†</td>
<td>25</td>
<td>49</td>
<td>5.6</td>
</tr>
</tbody>
</table>

*HPN = home parenteral nutrition; IBD = inflammatory bowel disease.
†Sprue, pancreatic and intestinal fistula, lymphangiectasia, dumping syndrome, amyloidosis, protein-losing enteropathy, jejunoileal bypass, and Crohn’s enteritis.

HPN indications in the UK

Patient Selection for HPN

• Key questions to ask:
  – Indication?
  – Duration of need?
  – Life expectancy?
  – Performance status and ability to administer?
  – Family support?
  – Psychosocial evaluation
    • Safe at home?
    • History of drug or alcohol abuse?
  – Insurance coverage?

HPN coverage

• Estimated cost $150,000-200,000/year
• Frequently strict coverage criteria
• Covered under the prosthetic device act for Medicare
• 35% of all Medicare part B expenditures

Medicare Decision Tree

TPN Decision Tree
Directions: Start in the far left column and examine medical records as you check for a covered situation. Keep going down the tree as long as you can answer "Yes" to a criterion. If/When the answer is "No" move one column to the right and begin going down that column. Continue checking the medical records against the criteria until you verify that the patient’s condition meets a covered situation or you determine that the patient does not qualify for home TPN.

http://www.nhia.org/members/documents/CIGNATPNDecisionTree050306.pdf
TPN Decision Tree

SITUATIONS G/H

Pt. had 10% wt. loss in \( \leq 3 \) months

\AND\n
Serum Albumin \( \leq 3.4 \) gm/dl

\AND\n
Altering the nutrient composition of an enteral diet will not maintain the patient's health status

\AND\n
The patient's health status cannot be maintained by administering medications to treat the etiology of the malabsorption

\YES\n
Pt. has moderate abnormality such as:

- \( 72^\circ \) fecal fat study shows fecal fat is > 25% of oral/enteral intake on a diet \( \geq 50 \) gm fat/day

\OR\n
- Dx of malabsorption with objective confirmation by methods other than \( 72^\circ \) fecal fat test (Sudan stain of stool, d-xylene, etc).

\OR\n
- Gastroparesis demonstrated by study that shows the isotope, barium or pellets failed to reach the rt. colon in 3-6 hr or results of manometric motility study was consistent with abnormal gastric emptying that was unresponsive to prokinetic medication

\OR\n
- Small bowel motility disturbance which is unresponsive to prokinetic medication, demonstrated with a gastric to rt. colon transit time between 3-6 hrs

\OR\n
- Small bowel resection that left > 5 ft of small bowel beyond the ligament of Treitz

\OR\n
- Short bowel syndrome not as severe as Situation B

\OR\n
- Mild to moderate exacerbation of regional enteritis or enterocutaneous fistula

\OR\n
- Partial mechanical small bowel obstruction where surgery is not an option

\YES\n
\DOWN\n
Medical Records document a failed Tube Trial

\YES\n
\DOWN\n
Patient meets Medicare coverage criteria for home TPN therapy under Situations G/H

Patient does not meet Medicare coverage criteria for home TPN therapy.
Table 2
Cause of removal for Hickman™ catheters and peripherally inserted central catheters (PICCs), respectively. Figures are given as incidences (per 1000 catheter days). Statistically significant results are represented with * and written in bold.

<table>
<thead>
<tr>
<th>Cause of removal</th>
<th>Hickman catheter (N = 169)</th>
<th>PICC (N = 126)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local infection*</td>
<td>0.24</td>
<td>1.00</td>
<td>0.0000</td>
</tr>
<tr>
<td>CRBSI^a,*</td>
<td>0.57</td>
<td>1.63</td>
<td>0.0001</td>
</tr>
<tr>
<td>Thrombosis</td>
<td>0.06</td>
<td>0.13</td>
<td>0.3945</td>
</tr>
<tr>
<td>Mechanical Cause*</td>
<td>0.60</td>
<td>1.50</td>
<td>0.0011</td>
</tr>
<tr>
<td>Finalized treatment</td>
<td>0.22</td>
<td>0.44</td>
<td>0.1597</td>
</tr>
<tr>
<td>Mortality*</td>
<td>0.44</td>
<td>1.57</td>
<td>0.0000</td>
</tr>
<tr>
<td>Other*</td>
<td>0.80</td>
<td>1.75</td>
<td>0.0019</td>
</tr>
<tr>
<td>Unknown*</td>
<td>0.16</td>
<td>0.50</td>
<td>0.0284</td>
</tr>
</tbody>
</table>

^a Catheter-related blood stream infection.

Time to first bloodstream infection

Cycling

• Transition from 24 hrs → 12 hrs takes several days
• Closely monitor
  – Volume overload
  – Electrolyte abnormalities (glucose)
• Traditional cycle
  – 24 hrs → 20 hrs → 16 hrs → 12 hrs
• Fast track cycle
  – 24 hrs → 18 hrs → 12 hrs vs
  – 24 hrs → 12 hrs – careful patient selection

How do we get patients home?

Table 3. Checklist to Prepare for Home Parenteral Nutrition (HPN)

<table>
<thead>
<tr>
<th>MD/ NP/ PA</th>
<th>Nursing team</th>
<th>PharmD</th>
<th>RD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate indication for HPN</td>
<td></td>
<td></td>
<td>Nutrition Assessment*</td>
</tr>
<tr>
<td>Verification of reimbursement by case management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform psychosocial assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request made to primary service to place consultation to psychiatry liaison? □ Yes/date: □ No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary caregiver identified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Referral to agencies documented and accepted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home infusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home health agency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient education performed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 1: Handwashing, preparation, CVC care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 2: HPN instructions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 3: Self-monitoring, when to call</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordination of discharge date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notified of anticipated discharge date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metabolically stable and PN cycled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medically stable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HPN and lab orders faxed to home infusion provider</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HPN order set faxed to home infusion and home health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verification that home infusion provider has received all necessary orders and can perform required services on date of discharge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verification that home health agency has received all necessary orders and can perform required services on date of discharge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completion of all required documentation in the medical record</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copy of medical records provided to other medical providers, as needed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up appointment(s) scheduled</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What should they do when they get home?

Table 1. Self-Monitoring and When to Call the Home Parenteral Nutrition (HPN) Team/Prescriber

<table>
<thead>
<tr>
<th>Call IMMEDIATELY for any of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Any temperature of 100°F or greater and/or shaking chills.</td>
</tr>
<tr>
<td>• You are not able to infuse HPN due to blockage in the catheter.</td>
</tr>
<tr>
<td>• Swelling in your hand, arm, shoulder, neck, and/or face on the same side as your catheter (this includes legs if your catheter is in your leg).</td>
</tr>
<tr>
<td>• Pain or discomfort in your neck or shoulder, chest swelling, or pain when infusing HPN.</td>
</tr>
<tr>
<td>• Your catheter is accidentally cut or cracked or if you see fluid leaking from the damaged part of the catheter.</td>
</tr>
<tr>
<td>• If you have symptoms of low blood sugar or a finger stick sugar of &lt;60 mg/dL or &gt;300 mg/dL.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Call DURING NORMAL BUSINESS HOURS (7 days/week) for any of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Redness, tenderness, swelling, or pus at the catheter exit site.</td>
</tr>
<tr>
<td>• If you have a finger stick sugar &gt;180 mg/dL or a positive urine test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Call DURING NORMAL BUSINESS HOURS (Monday–Friday) for any of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• You meet resistance when flushing your catheter.</td>
</tr>
<tr>
<td>• You suspect your catheter has been dislodged or pulled out but are feeling no discomfort.</td>
</tr>
<tr>
<td>• Your HPN bag has more than the usual amount of fluid remaining at the end of its cycle.</td>
</tr>
<tr>
<td>• You begin on antibiotics (a pill to treat an infection), diuretics (a pill to treat fluid retention), or steroids.</td>
</tr>
<tr>
<td>• You develop vomiting (new onset) that lasts for more than 1 day.</td>
</tr>
<tr>
<td>• If your urine output is less than 500 mL each day for 2 days in a row.</td>
</tr>
<tr>
<td>• If your stoma (or stool) output</td>
</tr>
<tr>
<td>• Increases by 500 mL from its usual amount each day for 2 days in a row.</td>
</tr>
<tr>
<td>• Decreases by 500 mL from its usual amount each day for 2 days in a row.</td>
</tr>
<tr>
<td>• A weight</td>
</tr>
<tr>
<td>• Gain of 1 or more pounds each day for 2 days in a row.</td>
</tr>
<tr>
<td>• Loss of 1 or more pounds each day for 2 days in a row.</td>
</tr>
<tr>
<td>• If you are seen in an emergency room or admitted to another hospital.</td>
</tr>
<tr>
<td>• If you are released from the hospital.</td>
</tr>
<tr>
<td>• Be sure to notify at least 2 weeks in advance if you are planning a vacation or trip out of town.</td>
</tr>
</tbody>
</table>

Psychological impact

• Depression found in 10-80% of HPN patients
  • More so in females
  • Less in patients supported by an organization
• Anxiety/ Depression reported in 40%
  • Anxiety related to catheter malfunction, etc
• Also improves quality of life for many

Metabolic Concerns

• Re-feeding syndrome
  – May need to initiate TPN in the hospital

• Hypo- and Hyper-glycemia
  – Monitor 1 hr in and 1 hr after
  – May need to taper up and taper down to help stabilize

• Electrolyte abnormalities
  – Monitor regularly
    • Daily → Weekly → Monthly → Quarterly
    • Replete/ reduce as needed
# Typical HPN Lab Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiation</td>
<td>CBC, Comprehensive metabolic panel (CMP), Mg, Phos, Vitamins A, E, D, Cu, Se, Zn</td>
</tr>
<tr>
<td>Week 1</td>
<td>Basic metabolic panel (BMP), Mg, Phos</td>
</tr>
<tr>
<td>Week 2</td>
<td>CBC, CMP, Mg, Phos</td>
</tr>
<tr>
<td>Week 3</td>
<td>BMP, Mg, Phos</td>
</tr>
<tr>
<td>Week 4</td>
<td>CBC, CMP, Mg, Phos</td>
</tr>
<tr>
<td>Week 6</td>
<td>CBC, CMP, Mg, Phos</td>
</tr>
<tr>
<td>Week 8</td>
<td>CBC, CMP, Mg, Phos, Vit A, E, D, Cu, Se, Zn</td>
</tr>
</tbody>
</table>
NICE criteria for refeeding risk

Box 3 Criteria from the guidelines of the National Institute for Health and Clinical Excellence for identifying patients at high risk of refeeding problems (level D recommendations*³)

Either the patient has one or more of the following:

- Body mass index (kg/m²) <16
- Unintentional weight loss >15% in the past three to six months
- Little or no nutritional intake for >10 days
- Low levels of potassium, phosphate, or magnesium before feeding

Or the patient has two or more of the following:

- Body mass index <18.5
- Unintentional weight loss >10% in the past three to six months
- Little or no nutritional intake for >5 days
- History of alcohol misuse or drugs, including insulin, chemotherapy, antacids, or diuretics

*Recommendations derived from low grade evidence—mainly cohort and case series studies—and from consensus expert opinion

Mehanna et al. Refeeding syndrome: what it is, and how to prevent and treat it. BMJ. June 2008.
Managing Refeeding Syndrome

**Figure 1**
**Guidelines for management.** *if severely malnourished, e.g. BMI less than 14 kg/m or negligible intake for 2 weeks or more, start feeding at maximum of 5 kcal/kg/day.*

Mechanical Complications

• CVC associated thrombosis
  – 17.8% (42/236) in 509 patient-years
  – No standard guidelines for managing HPN CVC thrombosis
  – Thrombosis occluding line, but not in the vein
    • If line won’t flush don’t force it
    • Try alteplase to open the line

Management of thrombosis

– CVC related venous thrombosis
  • May need to remove the line
  • No good data on absorption of novel oral anti-coagulants
  • Recommend injections or warfarin and monitoring INR

– Prevention
  • Catheter tip at SVC/ RA junction
  • Flush daily even if not using the line
Risk factors for thrombosis

Table 4 Association between anticoagulation or potential risk factors and first venous thrombosis during home parenteral nutrition

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted hazard ratio</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (per unit increase)</td>
<td>1.01</td>
<td>0.98–1.03</td>
</tr>
<tr>
<td>Male sex</td>
<td>0.57</td>
<td>0.28–1.14</td>
</tr>
<tr>
<td>Anticoagulation</td>
<td>0.72</td>
<td>0.36–1.44</td>
</tr>
<tr>
<td>Prior thrombosis*</td>
<td>2.22</td>
<td>1.06–4.64</td>
</tr>
<tr>
<td>Cancer†</td>
<td>1.02</td>
<td>0.48–2.16</td>
</tr>
<tr>
<td>Bowel length (&gt;150 cm)</td>
<td>1.54</td>
<td>0.69–3.45</td>
</tr>
<tr>
<td>Inflammatory bowel diseases</td>
<td>1.01</td>
<td>0.46–2.22</td>
</tr>
</tbody>
</table>

Can we prevent thrombosis?

Catheter Related Bloodstream Infection (CRBSI)

• Most serious complication risk of HPN

• Monitoring
  – Temperature before start and 1 hr in
    • If >1.5°F rise, or >100°F call infusion company, or present to ER for evaluation
  – If any symptoms of infection call HPN team or infusion company
    • Obtain blood cultures
    • Start empiric antibiotics
Factors Associated with Increased CRBSI risk

• Medications or blood work through catheter
• Implantable port > tunneled catheter
• Multiple lumens
• Training quality
• Presence of a stoma*
• No available experienced HPN center

What organisms?

- Gram positive: 61%
- Gram negative: 23%
- Fungi: 8%
- Polymicrobial: 4%
- Other: 4%

How to manage infections?

What is the chance of salvage?

Table 3. Catheter Salvage Rates by Infected Organism.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gram-positive bacteria</strong></td>
<td></td>
</tr>
<tr>
<td>Coagulase-negative staphylococci</td>
<td>123/158 (77.8%)</td>
</tr>
<tr>
<td>MRSA</td>
<td>4/15 (26.7%)</td>
</tr>
<tr>
<td>MSSA</td>
<td>33/38 (86.8%)</td>
</tr>
<tr>
<td><em>Enterococcus</em> sp</td>
<td>4/6 (66.7%)</td>
</tr>
<tr>
<td><em>Streptococcus</em> sp</td>
<td>4/5 (80.0%)</td>
</tr>
<tr>
<td><strong>Gram-negative bacteria</strong></td>
<td></td>
</tr>
<tr>
<td><em>Klebsiella</em> sp</td>
<td>21/36 (58.3%)</td>
</tr>
<tr>
<td><em>Pseudomonas</em> sp</td>
<td>3/8 (37.5%)</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>12/20 (60.0%)</td>
</tr>
<tr>
<td><em>Acinetobacter</em> sp</td>
<td>5/9 (55.6%)</td>
</tr>
<tr>
<td><em>Enterobacter</em> sp</td>
<td>4/5 (80.0%)</td>
</tr>
<tr>
<td><em>Micrococcus/Kocuria</em> sp</td>
<td>4/4 (100%)</td>
</tr>
<tr>
<td><em>Serratia</em> sp</td>
<td>4/6 (66.7%)</td>
</tr>
<tr>
<td><em>Stenotrophomonas</em> sp</td>
<td>3/5 (60.0%)</td>
</tr>
<tr>
<td><em>Citrobacter</em> sp</td>
<td>4/4 (100%)</td>
</tr>
<tr>
<td>Unspecified gram-negative rods</td>
<td>12/14 (85.7%)</td>
</tr>
<tr>
<td>Mycobacteria</td>
<td>0/3 (0.0%)</td>
</tr>
<tr>
<td><em>Candida</em> and other fungal pathogens</td>
<td>6/42 (14.2%)</td>
</tr>
<tr>
<td>Polymicrobial</td>
<td>37/75 (49.3%)</td>
</tr>
<tr>
<td>Other rare single organisms</td>
<td>5/12 (41.7%)</td>
</tr>
</tbody>
</table>

MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-sensitive *Staphylococcus aureus*; sp, species.

*Values are number of catheters salvaged/number of infections (%).
Locks to prevent CRBSI

• Have been shown to be beneficial in several studies
• Controversy over whether to use in all or just some patients
• Antibiotic locks
  – If recurring infections with the same organism
  – May rotate antibiotics
• Ethanol locks
  – ESPEN officially recommends against
  – Both bactericidal and fungicidal properties
  – Degrade polyurethane catheters over time
    • Most PICCS and “Power” access devices
  – Compatible with silicone

CRBSI Prevention

Figure 1. Rates of infection per 1000 catheter days before and after locking.

Impact of ethanol on catheters

Crnich et al. The effects of prolonged ethanol exposure on the mechanical properties of polyurethane and silicone catheters used for intravascular access. Infection Control and Hospital Epidemiology, 2005.

FIGURE 5. Modulus of elasticity (in megapascals [MPa]) of catheter segments at various exposure intervals for (A) polyetherurethane and (B) silicone catheters. Data are the mean modulus of elasticity (MPa) of catheter segments tested (the table contains the number of segments tested at each exposure interval). Vertical bars represent standard error. *P < .05; **P < .01; and ***P < .001.
Transitioning off

• Depends on indication
  – Helps if goals are clarified at initiation of HPN
  – If short bowel:
    • Consider bowel rehabilitation potential
    • Optimize strategies to reduce output
      – Low osmolality diet
      – Oral rehydration solutions
      – Medications
        » Loperamide, Atropine / Diphenoxylate, Tincture of opium, Teduglatide
Regardless of indication:
- Work on strategies to reduce wean TPN dependence
  - Slowly reduce calories and volume while closely monitoring intake and weight
  - Dietitians are invaluable in this process
    - Oley.org has great resources
    - “A patient’s guide to managing a short bowel” by Carol Rees Parrish, MS, RD
      » Can get a copy from shortbowelsupport.com
Routine evaluations

- Per Medicare guidelines:
  - Patients need to be re-evaluated at the time of anticipated HPN completion
- If on long term HPN
  - Annual exam to assess:
    - Complications with infusion or access
    - Weight gain /loss
    - CVC location (Chest x-ray)
      - Osmolarity of formula
      - Future access sites if needed
    - Bone density
    - Medication use
    - Micronutrients
    - General health
      - New heart, liver, renal disease, etc
Metabolic bone disease

- At increased risk because of malabsorption, inflammation, medications
  - Possibly TPN contamination (Aluminum)
- Recommend monitoring DEXA yearly
  - ESPEN found 41% of HPN patients had osteoporosis
  - Start evaluation at initiation of TPN

Figure 2. Bone aluminum (Al; μg/g) as a function of years receiving parenteral nutrition (PN). Green bar indicates control population (n = 18); blue and red bars, individual PN patients. Error bars are standard deviations of Al measurements for each sample.
Management of metabolic bone disease

• Aggressive treatment
  – Calcium and Vitamin D repletion
    • May need to give IV Vitamin D
    • Or bite capsules prior to swallowing
  – Consider IV bisphosphonate
    • Warn of side effects
      – May mimic symptoms of CRBSI
Intestinal failure associated liver disease (IFALD)

- Impacts up to 15-40% of adults on HPN
  - Even higher in children
- Spectrum varies
  - Hepatic steatosis, cholestasis, fibrosis
- Etiology is unclear
  - Soybean oil lipids are pro-inflammatory
  - Change in bowel flora
    - TPN related
    - Small intestinal bacterial overgrowth
  - Lack of enteral reabsorption of bile salts

Liver enzymes >1.5 x Upper limit of normal (ULN) for 2 consecutive draws

Assess for causes:
- any acute infection
- hepatitis
- medications

No alternate etiology found.

Probable etiology ID’d:
- Adjust meds
- Continue to monitor

LFTs still elevated:
- Refer to GI
- Ultrasound to assess structure
  - Review PN formula
    - Ensure not overfeeding
    - Decrease lipid frequency
    - Consider alternate lipid

LFTS improve
- continue to monitor long term.
Planning for the future

• 5 year survival on HPN 60-79%
• Cause of death on HPN
  – 37% primary disease other than cancer
  – 23% Complications of advanced cancer
  – 3.9% related to HPN (infection, IFALD)
• Only 48% of our patients on TPN had an advanced directive
  – Only ~1/3 of those discussed the TPN
  – HPN is a life saving therapy, but we need to plan for the future

Take Home

• Planning for HPN needs to start early
• A multidisciplinary team is very helpful in meeting the complex needs of these patients
• Anticipate and plan for complications
• Plan ahead for the future
Questions and Discussion?
bonnes.sara@mayo.edu