



Metabolic Effects of Cyclical Parenteral Nutrition

Deborah Pfister, M.S., R.D., C.N.S.C.
Director of Nutrition, ThriveRx

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Program Objectives



- 1 Describe potential metabolic effects of cyclical parenteral nutrition.
- 2 Discuss strategies to monitor and prevent potential complications.



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Home Nutrition Support Statistics




On Top of the World


Rick Davis: Me "taking a drink" in the Grand Canyon through my g-tube with a 2 oz syringe. (from www.oley.org)

- 40,000 people receive parenteral nutrition in their homes in the U.S.
- 152,000 people receive enteral nutrition in their homes in the U.S.

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Parenteral Nutrition Formulation






I have never felt so strong in my life! What are you slipping into my bag?


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What's In The Bag?




Parenteral Nutrition Consists Of:

- 3 Main Calorie Sources (3-in-1 solution)
 - dextrose (carbohydrate source)
 - amino acids (protein source)
 - lipids (fat source)
- Electrolytes
- Vitamins & Minerals
- Other additives





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Administration of HPN



- Infused on Pump
- Usually initiated as continuous infusion
- Transitioned to cycled infusion
- Factors for cycling success
 - Age
 - IDDM/NIDDM
 - Medications
 - Disease states ie: pancreatitis, cardiac or renal insufficiency

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Cost/Benefit Analysis of Cycling



Cost of Cycling

- Concentrated dextrose load
- Concentrated electrolyte load
- Potential to exceed electrolyte infusion rates

Benefits of Cycling

- Quality of Life
- Mimics oral feeding
- Hepato-biliary health

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Cycling Protocol



Goal is for a 10 to 16 hour infusion time

Program pump to ramp up and down over 1 hour

Extend ramp time depending on risk factors

Check blood sugars and s/s of hypo- and hyper-glycemia to monitor tolerance

Reduce by 4 hours per day to goal of 10 to 12 hours as tolerated

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Parenteral Nutrition Complications and Outcomes



Parenteral Nutrition primarily treats nutrient deficiencies and malnutrition.

Parenteral Nutrition has little impact on the underlying disease which is often progressive.

Mortality related to the disease is higher than PN-related mortality.

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Summary of TPN Outcome



Diagnosis	Survival	On PN at 1 year	Complication TPN	Complication Non-TPN
Cancer	20%	0.4%	1.1	3.3
GI/SBS	88%	4-34%	1.22	1.16
AIDS	10%	2%	1.6	3.3
Pancreatitis	90%	6%	1.2	2.5
Hyperem	100%	0%	1.5	3.5

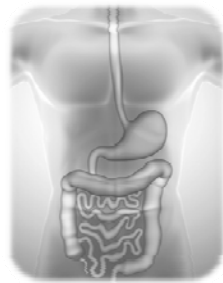
Lyn Howard, JPEN 26:5, 2002

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Common Complications in HPN



- Blood glucose abnormalities
- Fluid and electrolyte alterations
- PN-related liver disease
- Metabolic bone disease



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Blood Glucose Abnormalities



Hyperglycemia

- Etiology: IDDM/NIDDM, Carbohydrate overfeed, Medications
- Outcome: Morbidity/Mortality, Bacteremia

Hypoglycemia

- Post-infusion
- Related to dextrose load and insulin secretion
- Managed with ramping the infusion down
- 1-hour vs. 2-hour ramp
- Oral glucose intake

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Monitoring and Interventions for Hyperglycemia



Blood Sugar Goals

- ICU goal: 80-120 mg/dl
- Non-acute goal: 140-180 mg/dl
- Home Infusion: Between 150 and 180 mg/dl

Intervention

- Monitoring: 2 hours into infusion and 1 hour post-infusion
- Decrease dextrose load
- Treatment:
 - Sliding scale
 - Insulin added to PN bag: 50% of previous day's requirement via sliding scale or 0.2 units regular insulin/g. dextrose

ASPEN Clinical Guidelines, McMahon, JPEN, June 2012

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Fluid and Electrolyte Abnormalities



High Risk Conditions

- Vomiting
- Gastric suctioning/decompression
- Diarrhea
- High-output ostomies
- Enterocutaneous fistulae



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Monitoring for Fluid/Electrolyte Abnormalities





Monitoring

- Lab Values
 - Routine labs: Comprehensive Metabolic Panel with Calcium, Phosphorus and Magnesium
 - Weekly to start and taper to monthly draws
- Intake / Output Measurements
- Physical Assessment
 - Vitals
 - Postural blood pressure assessment
 - Signs and symptoms of over- or under-hydration
 - Signs and symptoms of electrolyte alterations



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Signs and Symptoms of Dehydration

- ✓ Increased thirst
- ✓ Dry mouth
- ✓ Sudden weight loss >2 lbs in less than 24 hrs (Note: 1 L of water weighs 2.2 lbs)
- ✓ Urine output less than minimal requirement according to body size
- ✓ Dark, concentrated urine with a strong odor
- ✓ Weakness, chronic fatigue, low endurance
- ✓ Muscle cramps
- ✓ Cracked lips
- ✓ Postural dizziness
- ✓ Low blood pressure

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Signs and Symptoms of Electrolyte Issues



	High Levels	Low Levels
Sodium (Na)	Thirst, irritability	Confusion, lethargy, seizures, hypotension
Potassium (K)	Diarrhea, paresthesia, tachycardia, oliguria	Nausea, vomiting, confusion, arrhythmias
Calcium (Ca)	Confusion, weakness, nausea, vomiting, coma	Tetany, irritability, seizures
Phosphorus (Phos)	Paresthesia, paralysis, confusion	CHF, arrhythmia, lethargy, confusion
Magnesium	Respiratory paralysis, lethargy, hypotension, coma	Arrhythmia, tetany, convulsions

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Types of PN-Associated Liver Disease



Steatosis

- fat accumulation in the liver
- occurs predominately in adults
- occurs without significant alterations in hepatic function

Cholestasis

- bilirubin excretion is compromised resulting in excess bilirubin in the blood and decreased bile salts in the GI tract
- occurs primarily in infants and children
- jaundice occurs as a result of high bilirubin levels

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Etiology of PN-Associated Liver Disease



- Age ie: neonates
- Medication profile
- Catheter related septic events
- Recurrent bacterial overgrowth
- Enteral feeding history
- Parenteral Nutrition Factors
 - High calories
 - High carbohydrate
 - High fat and type of fat
 - Nutrient deficiencies



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Monitoring and Intervention for PNALD



Monitoring

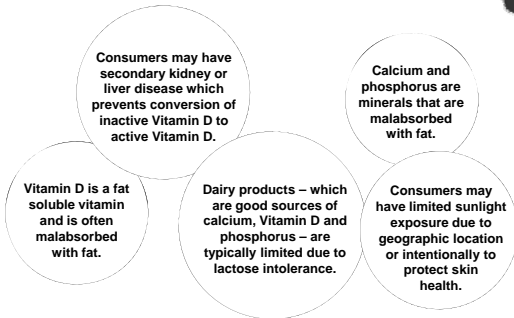
- Labs: AST, ALT, ALP, Total Bilirubin
- Biopsy – more accurate predictor of extent of involvement

Intervention is aimed at cause

- Feed enterally when possible
- Optimize HPN components
- Cycling HPN
- Minimize septic events
- Medication/supplement review
- Manage bacterial overgrowth

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Etiology of Metabolic Bone Disease



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What are the symptoms of Vitamin D deficiency?



Consumers with a Vitamin D deficiency are typically **not symptomatic** but can develop the following with a chronic deficiency:

- Bone pain
- Muscle weakness
- Unexpected bone fracture



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Monitoring of Bone Health Status



Since consumers with a Vitamin D deficiency are typically not symptomatic in the early stages of a deficiency, routine monitoring of the following is required to properly evaluate bone health:

Test	When to check	What its checking	Is it low or high with a Vitamin D deficiency?
25-hydroxy Vitamin D	Every 6 months	The amount of Vitamin D circulating in your blood	Low
Ionized calcium	Every 6 months	Most accurate measurement of calcium in your blood	Low
Phosphorus	Routine & every 6 months	Amount of phosphorus in your blood	Low
Alkaline phosphatase	Routine & every 6 months	An enzyme made in liver and bone which increases when liver or bone health is compromised	High
PTH (Parathyroid Hormone)	As directed by doctor	The amount of parathyroid hormone in your blood	High
DEXA (Dual Energy X-Ray Absorptiometry) scan	Once per year	Actual bone density	Bone density decreases with chronic Vitamin D deficiency

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Intervention to Optimize Bone Health

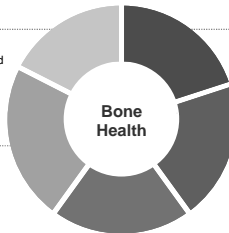


Food Sources

- Vitamin D is found in fortified foods

Intravenous

- MVI- 200-400 IU Vitamin D per day
- No other IV form available



Other Medications - bisphosphonates

Sunlight

- Natural – arms and face 20 minutes per day
- Sunlamps

Supplements

- 1,000 IU Vitamin D per day for maintenance
- 50,000 IU Vitamin D twice weekly for 8 weeks
- Adequate calcium, magnesium and phosphorus

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Summary



- Parenteral Nutrition and cycling can have metabolic side effects including: glucose fluctuations, fluid and electrolyte imbalances, liver and bone involvement.
- The therapeutic approach is aimed at identifying high risk patients, modifying the solution and administration technique, and monitoring tolerance.

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