Artificial Nutrition Support for Adults through the Continuum of Care Part II- Parenteral Nutrition Webinar

Live Webinar: Thursday, November 14, 2024 (1:30-2:30pm EST) Convert to your own time zone

Join Advanced Clinical Specialist, ***Elizabeth Wall, MS, RDN-AP, CNSC****, and learn how RDNs can provide excellent nutrition care in all settings.*

Description and Speaker:
This webinar will focus on the practice guidelines required for safe provision of parenteral nutrition (PN) across the continuum of patient care settings. The RDN will learn to use estimated macro- and micronutrient needs for initiation of PN and formula advancement to meet patient goals. The presentation will include a discussion of monitoring parameters and new practice guidelines to ensure patient safety. Uses of pre-mixed PN formulas and various lipid emulsions will be discussed. The presentation will conclude with recommendations for smooth transitions of patients requiring PN into their next phase of care.

Objectives:
After completing this continuing education course, the learner should be able to:

1. Know the indications for use of parenteral nutrition (PN) support.
2. Discuss how to safely initiate and advance the PN to meet established nutrient requirements.
3. Utilize published guidelines for monitoring patients on long term PN support.

Disclosures: Beth is a consultant to Zealand Pharma, however, certifies that no conflict of interest exists for this program.

Funding has been provided through an independent medical educational grant from Baxter Healthcare Corporation.

Funding from non-CPE revenue for CPE planning, development, review, and/or presentation has been provided by Becky Dorner & Associates.

Professional Approvals:
Becky Dorner & Associates, Inc. has been providing continuing professional education (CPE) since 1993 (Commission on Dietetic Registration provider number NU004).

Intended Audience: RDNs and NDTRs	**CPE:** 1.25 Live 1.25 Recorded	**Expiration Date**: Live webinar:October 9, 2025 Enduring Activity: October 8, 2027
CDR: Activity Type: 172 Live webinar Activity number: **185601** Activity Type: 741 Enduring Activity Activity number: **185602**		
Suggested CDR Performance Indicators: 11.5.1, 11.5.2, 11.5.3, 11.5.4		

Note: Numerous Other Performance Indicators May Apply.

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Questions? Please contact us at info@beckydorner.com

Artificial Nutrition Support for Adults through the Continuum of Care Part II- Parenteral Nutrition Webinar

Today's Webinar
- Please refer to your handout for an overview of the program

Handouts
- Live: Emailed to the person who registered for the program, and posted in the Go To Webinar System
- Recording: Available on our website with the recording

Questions
- Live: Use GoToWebinar to ask questions
- Recording: Email info@beckydorner.com

Credit Hours/Certificate
- Please refer to handouts for details

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Elizabeth is a consultant to Zealand Pharma however, she certifies that she has no conflicts of interest for this program.

Elizabeth Wall, MS, RDN-AP, CNSC

- Senior member, Adult GI/Nutrition Support Service, University of Chicago Medicine
- Specialty areas: Management of short bowel syndrome and other malabsorptive disorders; management of home PN patients; troubleshooting mechanical tube problems or enteral feeding intolerance for patients on long-term home enteral feedings
- Active participant in several human research protocols
- Active member of the Short Bowel Syndrome subgroup of DMNT
- Author of multiple book chapters, journal publications, and has presented at FNCE, ASPEN, and ESPEN symposia

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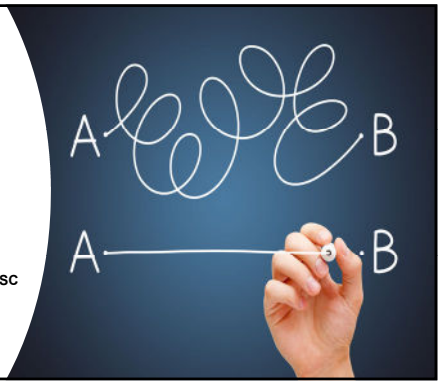
Artificial Nutrition Support for Adults through the Continuum of Care

Part II- Parenteral Nutrition

Elizabeth Wall, MS, RDN-AP, CNSC



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Learning Objectives

After completing this continuing education course, the learner should be able to:

1. Describe the indications for use of parenteral nutrition (PN) support.
2. Recommend how to safely initiate and advance the PN to meet established nutrient requirements.
3. Utilize appropriate tools to monitor patients on long term PN.

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Outline

I. Indications for use of PN support
   a. Evaluation for PN support
   b. Needs assessment
II. Initiating and advancing the PN to meet established nutrient requirements
   a. Venous access
   b. Refeeding risk
   c. Initial PN order
   d. Advancing PN to goal
III. Recommendations for smooth transitions of patients requiring PN into their next phase
IV. Monitoring parameters and new practice guidelines to ensure patient safety
   a. PN monitoring for long term support
   b. Potential complications of long term PN
V. Questions and Answers

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Indications for PN Support

- Patients unable to meet their nutrition requirements with an oral diet or enteral nutrition and are malnourished or have risk of malnutrition
- Bowel obstruction
- Ileus (pseudo-obstruction)
- Enterocutaneous fistula*
- Malabsorption syndromes
- Critical illness with inability to advance TFs, non-functioning GI tract
- Pre-operative repletion of severely malnourished patients
- Severe malnutrition with inability to use or access the GI tract

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Contraindications for PN Support

- Lack of venous access/catheter malposition
- Blood infection
- Severe metabolic derangement
  - Hypokalemia: K+ <3 mEq/L
  - Hypophosphatemia: Phos <2 mg/dL
  - Hypomagnesemia: mg++ <1 mg/dL
  - Hyperglycemia: Glucose >300 mg/dL
  - Azotemia: BUN >100 mg/dL

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Inappropriate Use of PN

- Anticipated bowel rest <5 days
- Functioning GI tract
  - Pt just isn't eating enough
  - Partial bowel obstruction
- Peripheral PN >10 days due to lack of central venous access
- Grim prognosis

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Assessment for PN Administration

- Indications
- Venous access
- Medical/nutrition history
- Height, weight, and age
- Nutrition focused physical exam
- I & O data, body temperature
- Laboratory data and point of care glucose
- Medications and IV fluids
- Allergies

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Venous Access Concerns

Peripheral
- Appropriate for short term support (<2weeks)
- Patient must have "good" veins
- Limited concentration of PN (need more volume)
- Must have a dedicated IV line

Midline
- More stable than peripheral IV
- May have more than one lumen
- Limited concentration of PN

Central
- Catheter tip is in the superior vena cava (SVC) or right atrium
- Required for support >2 weeks
- Can infuse highly concentrated solutions

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Nutrition Focused Exam

Weight history
- Loss
  - Intentional vs unintentional
  - How much over what amount of time
- Gain
  - Edema in extremities, back/sacrum, or anasarca

Body composition
- Muscle or fat loss
  - Look for muscle wasting: temples, clavicles, deltoids, scapula, thigh, calf, interosseous
  - Look for loss of fat pads: orbital, triceps, ribcage

Strength or physical endurance
- How is the patient's strength?
  - Ability to sit up in bed or rise from a chair
  - Hand grip strength
  - Able to perform ADLs

Appetite
- Eating what percent of usual intake?
  - Duration of reduced intake
- Taste perception (COVID-19)

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Screen for Malnutrition Risk

Malnutrition Screening Tool (MST)[1]

Risk Indicator	Response	Points
Recent weight loss?	No Unsure 2-13 pounds 14-23 pounds 24-33 pounds 34 or more pounds	0 2 1 2 3 4
Weight loss score		
Eating poorly because of decreased appetite?	No Yes	0 1
Appetite score		
MST score	Wt loss + Appetite	

MST Score
0-1: Not at risk
Rescreen if stay exceeds 7 days

≥2: At risk
Full assessment and nutrition intervention

Position of the Academy, J Acad Nutr Diet. 2020
[1]Ferguson, Nutrition 1999

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GLIM Criteria

Phenotypic and etiologic criteria to diagnose malnutrition

Phenotypic Criteria

Classification	Weight loss (%)	Body mass index (kg/m2)	Muscle mass deficit
Moderate	>5% within 6 months or 10-20 % beyond 6 months	<20 if <70 years or <22 if ≥70 years	Mild to moderate
Severe	>10% within 6 months OR >20% beyond 6 months	<18.5 if <70 years <20 if ≥70 years	Severe deficit

Etiologic Criteria

Food Intake	Inflammation
≤50% of ER >1 week, or any reduction for >2 weeks, or any chronic GI condition that adversely impacts food assimilation or absorption	Acute or chronic disease or injury

Cederholm, Clin Nutr 2019

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Refeeding Syndrome

- Constellation of physiologic findings after abrupt, aggressive introduction of nutrients to patients in a starved or semi-starved state
- Complications
  - Electrolyte shifts
  - Fluid retention
  - Weakness
  - Arrhythmias
  - Organ failure
  - DEATH

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Refeeding Syndrome Risks

- Severe malnutrition
- Acute illness with inadequate PO/EN/PN >5-7 days
- Chronic poor intake - anorexia nervosa, chronic alcohol use
- Elderly patients
- Clinical diagnoses
  - AIDS
  - Cancer
  - Chronic nausea and vomiting
  - Dysphagia
  - Hyperemesis gravidarum
  - Malabsorption syndromes
  - Neurologic impairments
  - Post bariatric surgery
  - Protracted critical illness

da Silva, Nutr Clin Prac 2020

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Laboratory Data:

Prior to Initiation of PN

- Comprehensive metabolic panel (CMP)
  - Na, K, Cl, CO_2, BUN, Cr, liver function tests, glucose
- Inorganic phosphate and magnesium
- Triglyceride
- CBC

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Medications

- IV fluid contents & volume (rate)
  - Dextrose, sodium, potassium, bicarbonate
- IV medications
  - Volume
  - Dextrose, saline, sterile water
- Vitamin/mineral supplements
- Insulin
- Warfarin
- Acid blockers

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Allergies

Lipids
- Soybean oil emulsions
  - Soybeans, legumes (peanut)
  - Egg
- Emulsions made with soybean, medium chain triglyceride, olive, and fish oils
  - Soybeans, legumes (peanut)
  - Egg
  - Fish

PN Solutions
- Preservatives
- Multivitamin and trace mineral packets

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Assessment of Energy Needs

- Indirect calorimetry
- Predictive equations
  - Mifflin-St. Jeor or Harris-Benedict: stable patients
  - Ireton-Jones or Penn State: critical care
  - 20-35 kcal/kg
- Obesity
  - <20 kcal/kg actual weight
  - 22-22 kcal/kg healthy weight

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Assessment of Protein Needs

- Stable, well-nourished patients
  - RDA : 0.8-1 g protein/kg/d
- Obese patients
  - BMI 30-40: 2 g protein/kg IBW/d
  - BMI >40: 2.5 g protein/kg IBW/d
- Recovering from critical illness/ sarcopenia
  - 1.2-1.5 g protein/kg/d
- Wounds/ enterocutaneous fistulas/ inflammation
  - 1.2 – 1.5 – 2.0 – 2.5 g protein/kg/d

- CKD
  - Predialysis: 0.6-0.8 g/kg/d
  - Peritoneal dialysis/hemodialysis: 1.2-1.8 g/kg/d
  - Continuous renal replacement therapy: 1.5-2.5 g/kg/d
- Hepatic failure
  - 1.2-1.5 g/kg/d
- Assessment
  - Nitrogen balance study using urine urea nitrogen
    - Nitrogen in – (nitrogen out + [2 to 4]) = nitrogen balance

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Fluid Requirements

- Accurate weights
- 20-40 mL/kg/d
- Must know intake & output data
  - Intake: PO, enteral, IV fluids/ medications
  - Output: Urine, stool/ostomy effluent, gastric secretions, wounds, and drains
    - Goal urine output >1200 mL daily
- Medications
  - Diuretics and volume of IV meds
- Physical assessment
  - Edema, ascites, skin turgor

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Daily Electrolyte Requirements

- **Sodium:** Dependent on total volume
  - Dose as a percent of normal saline (154 mEq Na+/L)
  - Think about fluid losses
- **Potassium:** 1-2 mEq/kg (watch renal function)
- **Calcium:** 10-15 mEq/d
- **Phosphate:** 20-40 mmol/d
  - 1 mmol KPhos = 1.45 mEq K+
  - 1 mmol NaPhos = 1.3 mEq Na+
- **Magnesium:** 8-20 mEq/d
- **Acetate/Chloride:** Varies depending upon acid-base balance

Consider calcium-phosphate solubility: pH based on dextrose and amino acid concentrations; total volume

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Poll #1

Under which clinical condition will a patient need more sodium in the parenteral nutrition solution?

a. Congestive heart failure
b. High volume output from a nasogastric tube
c. High urine output
d. All of the above

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Electrolyte Content of Body Fluids

Fluid Type	Volume (mL/d)	Na^+ (mEq/L)	K^+ (mEq/L)	Cl^- (mEq/L)	HCO_3^- (mEq/L)
Saliva	1200	10	26	10	8
Gastric	2000-2500 pH <4 pH >4	 60 100	 10 10	 90 100	 0 0
Small bowel	3000-4000	100-140	15	100	25
Colon	Variable	60	30	40	0
Pancreatic	1000	140	5	75	90
Bile	1500	140	5	100	35

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PN Macronutrients

- Dextrose
  - 70% stock solution (70 g/100 mL)
  - 3.4 kcal/g
  - Max 5-7 g/kg/d
- Crystalline amino acids
  - 10-15% stock solution (10-15 g/100 mL)
  - 4 kcal/g
  - >1.5 g/kg/d can lead to an osmotic diuresis
- Lipids
  - 10% fat emulsion, 1.1 kcal/mL
  - 20% fat emulsion, 2 kcal/mL

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Lipid Emulsion Calories:

Lipid emulsions contain 20 kcal/100 mL from glycerol emulsifier

- **10% lipid emulsion**
  - 100 mL x 10% (emulsion concentration) = 10 g fat
  - 10 g fat
  - x 9 kcal/g fat
  - 90 Kcal
  - +20 kcal glycerol
  - 110 kcal/100 mL = 1.1 kcal/mL

- **20% lipid emulsion**
  - 100 mL x 20% (emulsion concentration) = 20 g fat
  - 20 g fat
  - X 9 kcal/g fat
  - 180 kcal
  - + 20 kcal glycerol
  - 200 kcal/100 mL = 2 kcal/mL

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Pre-Mixed PN Formula Examples

Pre-Mix Formulas
- Fixed ingredients
- With or without electrolytes

Components	4.25/10	5/15	Standard Additives
Amino acid concentration	4.25%	5%	
Dextrose concentration	10%	15%	
g amino acid/L	42.5	50	
g dextrose/L	100	150	
			Na^+ mEq/L 35
			K^+ mEq/L 30
			Mg^{++} mEq/L 5
			Ca^{++} mEq/L 4.5
			Phos mmol/L 15
Acetate mEq/L	37	42	
Chloride mEq/L	17	20	
Kcal/L	510	710	

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IV Vitamin Preparations

Vitamin	DRI	Adult MVI*/Infuvit†
Ascorbic acid (C)	65-90 mg	200 mg
Retinol (A)	700-900 mcg	1 mg (3300 IU)
Ergocalciferol (D)	15-20 mcg	5 mcg (200 IU)
Thiamin	1.0-1.2 mg	6 mg
Riboflavin	1.0-1.3 mg	3.6 mg
Pyridoxine	1.2-1.7 mg	6 mg
Niacinamide	14-16 mg	40 mg
Dexpanthenol (PA)	5 mg	15 mg
Alpha Tocopherol (E)	15 mg	10 mg (10 IU)
Biotin	25-30 mcg	60 mcg
Folic acid	400 mcg	600 mcg
Cyanocobalamin	2.4 mcg	5 mcg
Phylloquinone	75-120 mcg	150 mcg

*Hospira, †Baxter

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Trace Mineral Packets

Trace Element	DRI	Tralement
Zinc (mg)	5-15	3
Copper (mg)	0.7-0.9	0.5
Manganese (mg)	1.8-2.3	0.5
Chromium (mcg)	20-35	0
Selenium (mcg)	55	60
Iron (mg)	8-18	0

American Reagent

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Prevention of Refeeding Syndrome

- Correctly identify malnourished patients
- Initiate feeding slowly (including all sources of energy)
  - Energy 25-50% goal
  - IV dextrose ~ 1.4 g/kg/d
  - 1 g protein/kg/d
  - Minimize fluid
- Slow advancement of nutrition support
  - Check electrolytes q 12 hr (or more frequently if needed)
  - If electrolytes stable, increase by 33% daily
- Thiamine supplementation prior to initiation of IV dextrose or enteral feeding
  - 100-200 mg PO/IV prior to start and for 5-7 days
- Monitoring
  - Vitals q 4hr, daily weights, I/O data

da Silva, JPEN 2020

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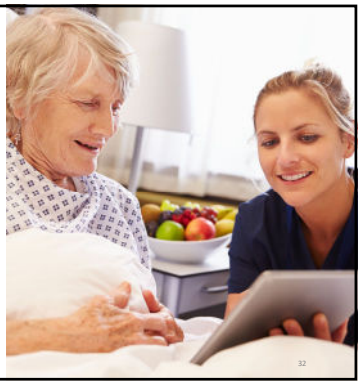
Patient TG

- 65 y/o female admitted with an enterocutaneous fistula
- Past medical history: Crohn's disease
- Plan: Complete bowel rest and PN support until the fistula seals; transfer to an LTAC.
- Access: Left single lumen PICC (tip in the SVC)



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TG's Objective Data

- Adm weight 70 kg (stable)
  - BMI 21 kg/m^2
  - Mild temporal and scapular wasting
- I/O: 3200/2375
  - 2200 urine, 175 fistula
  - No stool output
- IVF: D5W+ 0.45 NS @ 125/hr (150 g dextrose/d)
- Medications
  - Vancomycin 1 g q12 hr (500 mL/d)
  - Pepcid 20 mg BID
  - Insulin sliding scale, 2 units last 24 hr

- Laboratory Values
  - Na+ 135
  - K+ 3.7
  - Cl- 99
  - CO2 23
  - BUN 10
  - Cr 0.9
  - Glucose 154 (H)
  - Ca++ 8.7
  - Phos 3.2
  - Mg++ 1.6

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Poll #2

Is TG at risk of developing Refeeding syndrome when the PN hangs?

a. Yes

b. No

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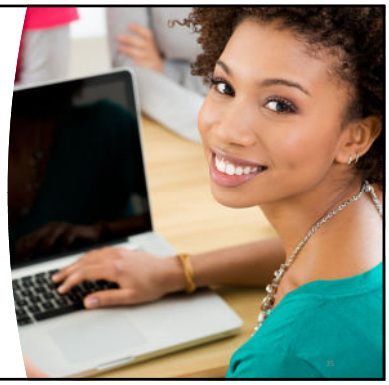
TG's Nutrient Requirements

- Total Calories: 1865 kcal/d (BEE x 1.4)
- Protein: 100 g/d (1.4 g/kg/d)
- Fat: 70 g/d (~1g/kg/d)
- Fluid needs: 2300 mL/d (30 mL/kg/d + 200 mL/d wound)
  - Subtract IV medication volume
    - IV Vancomycin = 500 mL/24 hr
  - PN volume: 1800 mL/d (2300-500)



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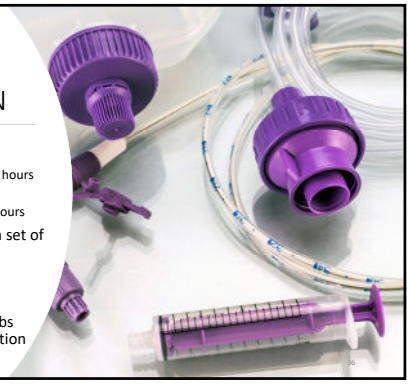
Initiation and Advancement of PN

- Prevent refeeding syndrome and hyperglycemia
  - Usually 100-150 g dextrose the first 24 hours
  - 1 g aa/kg the first day
  - Modest volume: 1-1.5L in the first 24 hours
- Do not advance PN infusion until a set of labs are available and physical assessment completed
- Increase slowly
- Minimum 3-4 days of chemistry labs when advancing the PN concentration



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TG's Initial PN Order

- Mild-moderate malnutrition related to BMI <22 kg/m^2, mild wasting, and acute on chronic inflammatory disease
- Risk of refeeding electrolyte shifts, but not at the time of PN initiation
- Start 1L PN 5/15 (5% amino acids, 15% dextrose)
- Start lipid emulsion 50 g (250 mL, 20%)
- PN will provide
  - 50 g amino acids (200 kcal)
  - 150 g dextrose (510 kcal)
  - 50 g lipids (500 kcal)
  - 1250 mL
- Total 1210 kcal/d, 50 g protein/d
  - 65% energy
  - 50% protein

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PN Monitoring Parameters

- Daily weight
- Intake and output data
- Laboratory data
- Catheter site inspection
- Physical strength and endurance
- Gut function/oral or enteral intake
- Are nutrition goals met?
- Is there an indication for PN?

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Monitoring in Hospitalized PN Patients

Data	Initiation	Once Stable
Serum glucose	daily	daily
Serum electrolytes, BUN, Cr	daily	2x/wk
Ca^{++}, Pi, Mg^{++}	daily	1x/wk
Liver function	1x/wk	1x/wk
Triglyceride	once	1x/wk
Temperature	daily	daily

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Day 2 Monitoring and Advancing PN

- Weight 70 kg, I/O 2600/2800
  - Urine 1800, wound 150
- Laboratory Values
  - Na^+ 140, K^+ 3.5
  - Cl^- 101, CO_2 23
  - BUN 18, Cr 0.9
  - Glucose 123, 143, 135, 199
  - Ca^{++} 8.6, Phos 2.8, mg^{++} 1.3 (L)
  - TG 150
  - T bili 0.5, Alk Phos 97, ALT 40, AST 35

- Maintain current PN infusions

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Day 3 Monitoring and Advancement

- Weight 71 kg
- I/O: 2600/2200
  - Urine 1300, wound 200
- Laboratory Values
  - Na+ 141, K+ 4
  - Cl- 101, CO2 23
  - BUN 22, Cr 0.9
  - Glucose 123, 135, 100, 135
  - Ca++ 8.6, Phos 2.8, mg++ 1.6

- Increase PN to 2L/d
- Decrease lipids to 225 mL/d
- PN will provide
  - 300 g dextrose (1020 kcal)
  - 100 g amino acids (400 kcal)
  - 45 g lipid (450 kcal/d)
- Total 1870 kcal, 100 g protein/d
  - 100% energy and protein
  - ~31 mL/kg/d

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Cycling the PN Infusion

- Disconnected during the day for rehab and long term pts
- Reduce the infusion time by 4 hours each day
  - Include taper ½ rate over 1-2 hours at the end
  - Common goal is 10-14 hour infusions at night
- Monitor heart rate, respirations, glucose during the infusion
- Watch electrolyte infusion rates: K^+, Mg^{++}
  - Without cardiac monitoring: **K+ < 10 mEq/hr**, Mg++ < 8 mEq/hr
- Optimum if cycling allows for at least 4-6 hours of "fasting" daily

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Transition to Home

- A stable home
- Reliable utility services
- Geographical proximity to providers
- Understand the goals of therapy and willingly accept the risks and responsibilities of HPN
- Insurance coverage
- Patient/care partner education prior to discharge
- Stable PN formula

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Transition to LTAC or Sub-acute Facility

- Insurance approval
- Stable PN formula
- Estimated length of need
- Nursing care availability

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Long Term Lab Monitoring

Rehabilitation/skilled nursing

- Weekly BMP, mg++, phos until stable, then monthly
- Monthly triglyceride, liver function tests, and CBC

Home

- Monthly CMP, phos, mg++, CBC, triglyceride
- Bi-annually check vitamin and trace mineral levels
  - Vitamins A, E, D, INR
  - Vitamins B12 and Folate
  - Trace minerals: Cu, Se, Zn
  - Iron studies: Fe, TIBC, %saturation, ferritin
  - Monthly follow-up levels if supplementation is required
  - Monitor for inflammation: CRP, prealbumin

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PN Associated Liver Disease (PNALD)

- Steatosis
  - Primarily in adults as a result of overfeeding
  - Elevated serum aminotransferase levels
  - Can progress to fibrosis or cirrhosis in long term PN pts
- Cholestasis
  - Primarily seen in children
  - Characterized by impaired bile secretion or biliary duct obstruction
  - Elevated conjugated bilirubin and alkaline phosphatase
  - Progresses to cirrhosis and liver failure
- Gallbladder stones/sludge
  - Mostly due to lack of enteral stimulation leading to gallbladder stasis and the formation of sludge and stones
  - Can cause cholecystitis

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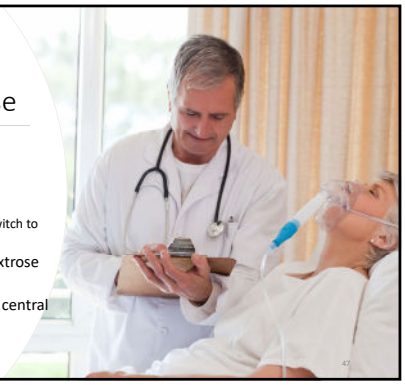
Prevention of PN Related Liver Disease

- Avoid overfeeding
- Maximize enteral intake
- Limit IV fat emulsion to <1 g/kg/d
  - Use less soybean oil lipids and/or switch to fish oil containing fat emulsion
- Balance calorie input between dextrose and fat emulsion
- Prevent bacterial overgrowth and central line infections
- Stimulate the gallbladder



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Poll #3

What can TG's team do to minimize PN associated liver irritation?

a. Avoid overfeeding calories
b. Cycle the PN infusion to 16 hours per day
c. Decrease dextrose with increase of fish oil lipids
d. All of the above

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Vascular Access Device Complications

Infectious
- Blood stream
- Tunnel/insertion site

Occlusion
- Thrombotic
- Intraluminal clots related to inadequate flushing or blood reflux

Migration
- Monitor external length of catheter
- Chest x-ray if concern for confirmation of placement

Catheter damage
- Usually require replacement
- Try to utilize previous insertion site

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Summary

- Evaluate the patient for the appropriateness of PN support
- Start cautiously and avoid over feeding
- Monitor labs, IV site, physical strength, weight, and intake/output data
- Periodic monitoring of vitamin and trace mineral levels
- Wean to enteral feedings or an oral diet as soon as the gut works

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Questions

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Thank you!

- **Credit Hours:** Please watch for a follow up email with detailed information on how to obtain your certificate (instructions are also on the next slide).
- **Please send questions/comments to info@beckydorner.com**

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Artificial Nutrition Support for Adults Through the Continuum of Care Part II: Parenteral Nutrition

Elizabeth Wall, MS, RDN-AP, CNSC

November 14, 2024

References

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