CRITICAL ISSUES IN NUTRITION SUPPORT

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OBJECTIVES

- 1.

Case Study #1

- R.B. is a 59 y.o. male
- Alcoholic found down by friends
- Significantly hypothermic
- Rhabdomyolysis and ARF
- Decubitus ulcers on back, coccyx, and bilateral heels
- Time down unknown
- Cachectic with muscle wasting, covered with fecal matter and thick dry skin (physician exam)

Case Study #1

- Mechanical ventilation
- Initial labs:
  - Sodium 153
  - Potassium 4.7
  - Albumin 3.6
  - pH 7.21
  - HCO3 13

  BUN 125
  creatinine 6.6
  total bilirubin 0.8
  pCo2 34
- Height unknown
- 53.9 kg

Acid/Base disorder

- 1. pH: less than 7.4 = acidotic (pCo2)
  greater than 7.4 = alkalotic (bicarb)

2. pC02: greater than 45 respiratory acidosis; less than 35 respiratory alkalosis
3. HCO3: greater than 26 = metabolic alkalosis; less than 26 = metabolic acidosis

Acid/Base Disorders

- pH and $PaCO_2$ should move in opposite directions.
- pH and HCO_3 should move in the same direction

Case Study #1

- Continuous infusions:
  - D5 ½ NS 200 mL/hour
- Medications:
  - Zosyn, ativan, dilaudid, naloxone, vanco, carafate, heparin, synthroid, medium SSI, folic acid, thiamine

Case Study #1

- Nutrition Assessment:
  - Orally intubated and sedated.
  - No family/friends present to obtain nutrition history information.
  - IV fluid with 5% dextrose providing 816 dextrose calories.
  - Necrotic pressure sores on back, coccyx and heels.
  - Nepro enteral formula ordered to start after Miller-Frederick feeding tube placement.

Nutrition Assessment

- Labs reviewed:
  - Sodium 153
  - Potassium 4.7
  - Creatinine 6.6
- Estimated energy needs:
  - 1350 calories (25 kcal/kg)
  - 65-80 grams protein (1.2-1.5/kg)

Nutrition Diagnosis

- 1. Increased nutrient needs (protein) related to skin breakdown as evidenced multiple necrotic pressure ulcers requiring protein needs above RDI.
- 2. Increased nutrient needs (thiamine, folic acid) related to and as evidenced by history of alcohol abuse.
- 3. Altered nutrition-related lab value (sodium) related to water deprivation.

Monitor

- 1. Protein intake: total protein provided in enteral formula and protein modular.
- 2. Nutrition-related physical exam: skin condition.
- 3. Vitamin intake: folic acid, thiamine, MVI.
- 4. Electrolyte and renal profile: sodium, potassium, phosphorus, magnesium, creatinine.
- 5. Enteral nutrition: access, formula, rate, tolerance, duration.

Nutrition Interventions

- 1. Enteral nutrition: initiate.
  - Nepro formula 30 mL/hour: 720 mL
    - 1296 calories and 57.6 grams protein
- 2. Nutrition-related medication management: recommend decrease IV fluid dextrose content to avoid overfeeding (816 dextrose calories currently in IV fluid).

Nutrition Interventions

- 3. Medical Food Supplement: 1 tube prostat 64 protein supplement daily to boost protein intake by 15 grams.
- 4. Vitamin and mineral supplements: recommend daily prenatal MVI, discontinue folic acid and administer 100 mg IV thiamine daily for 3 days.
- 5. Coordination of nutrition care: collaborate/refer to physician for desire fluid goals to control hypernatremia and hemodynamic status.

GI Complications

- Diarrhea
  - Tube feeding often blamed.
    - High osmolar formulas may cause intolerance when fed into small bowel only; stomach serves as reservoir and can dilute the tube feeding formula
  - Hypertonicity of medications.
    - Drugs high in sorbitol: acetaminophin elixirs, amantadine, calcium carbonate, cimetadine, digoxin, doxycycline, iron sulfate, lasix, codeine, reglan, electrolyte replacements
  - Causes metabolic acidosis due to large losses of bicarb from GI tract (replace electrolytes as acetate salts not chloride salts)

GI Complications

- Delayed gastric emptying
  - EN intolerance in up to 50-60% of patients
  - Common with burns, advanced age, trauma and sepsis.
  - Affects 80% of head injury patients.
  - Hyperglycemia in any patient population.
  - Causes nausea and vomiting

GI Complications

- How and what to feed your patient during hypotensive state.
  - Low dose pressor agents
  - High dose pressor agents
  - Effect on GI tract
  - Bowel ischemia common in setting of hypovolemia and hypotension

Should we rely on GRV's?

Elevated GRV's

- Appropriate response:
  - Maintain HOB 30-45 degrees
  - Clinically assess fro abdominal distention/discomfort; bloating/fullness; nausea/vomiting
  - Review and minimize ALL fluids given enterally
  - Minimize use of narcotics and avoid constipation
  - Switch from bolus to continuous infusion
  - Initiate prokinetic agent
  - Position patient on right side for 15-20 minutes while maintaining HOB greater than 30 degrees to promote gastric emptying before checking next residual.

Permissive Underfeeding

- Attenuate protein losses and support the patient nutritionally and metabolically.
- Potential benefit of caloric restriction:
  - Minimizes cytokines & inflammatory response
  - Delays deterioration of physiologic functions
  - May improve stress response

Permissive Underfeeding

- Possible protective mechanisms:
  - Less omega-6 FAs for eicosanoid synthesis
  - Less carbohydrate intake for improved glycemic control.
  - Lower nutrient oxidation

Permissive Underfeeding

- There have been no RCT
- Metabolic benefits have been demonstrated when patients are underfed for a short period of time during stress states.
- Preliminary research indicates there may be clinical benefits.

Permissive Underfeeding

- General Approach Strategy in Critical Care
  - Initiate early EN when feasible
  - Provide 50-65% of estimated needs
  - Advance to goal as condition improves

  - Means to attenuate protein loss and avoid overfeeding: less than 20 kcal/kg actual body weight and 1.5-2.0 gram protein/kg IBW

Minute Ventilation

- Assess patient's minute ventilation daily to monitor for over- or under-feeding.
- Look for trends.

ARDS/ALI

- Severe form of hypoxic respiratory failure.
- Proinflammatory cytokines initiate and amplify
- Oxidative stress and local inflammatory response in the lungs
- Causes respiratory acid/base disorders

ARDS/ALI

- Avoid overfeeding.
- Less than 4 mg/kg/minute glucose infusion rate.
- Omega-3 fatty acids to promote anti-inflammatory response.
- Fluid overload common.
- Monitor electrolytes closely
  - Phosphorus role in lung function

ARDS/ALI

- EN preferred to maintain gut integrity and reduce risk of sepsis.
- Monitor sedatives containing LCT
  - Diprivan/propofol
  - Limit to 1 gram/kg/day or 0.125 gram/kg/hour
- Choose a formula with omega-3 FAs (EPA and GLA)
  - Optimal time to initiate: immediately after diagnosis and throughout diagnosis.

Skinny on Fat

Skinny on Fat: EN

- Critical illness:
  - Catabolism
  - Lipolysis
  - Hyperglycemia
  - Dyslipidemia

Skinny on Fat: EN

- Benefits of providing lipids:
  - 1. Prevent EFA deficiency
  - 2. Spare protein and enhance nitrogen
  - balance
  - 3. Concentrated energy source
  - 4. Improve respiratory function parameters
  - 5. Modulate host response to inflammation, alter immune function, platelet aggregation, and vasoconstriction/dilation

Skinny on Fat: EN

- Omega-6 FA
  - corn, soybean, sunflower, safflower
  - LCTs
  - Advantages include rich source of EFAs and trophic effect on intestinal mucousa compared to Omega-3 FA
  - Disadvantages include form metabolites that upregulate vasoconstriction, inflammation, platelet aggregation and are immunosuppressive.

Omega-6 FA

- Linoleic acid is metabolized into arachidonic acid.
  - AA metabolites include prostaglandin-2 series, thromboxane and leukotriene-4 series.
    - Highly vasoactive, proinflammatory and immune suppressive

Skinny on Fat: EN

- Omega-3 FA
  - Fish, borage, flaxseed
  - LCT
  - Advantages include rich source of ALA, EPA, DHA, and GLA; enhance vasodilation, suppress inflammation, slow platelet aggregation.
  - Disadvantages include increased risk of bleeding at extremely high doses

Omega-3 FA

- Metabolites of alpha-linolenic acid include EPA and DHA that form prostaglandin-3 series and leukotriene-5 series which up-regulate vasodilation and immune enhancement.
  - Suppress inflammation

Skinny on Fat: EN

- MCT
  - Coconut or palm kernal oil
  - Advantages include do not require bile salts or pancreatic lipase for absorption, do not require carnitine for entry into mitochondria, absorbed directly into portal circulation
  - Useful in cases of fat malabsorption, pancreatitis, SBS and IBW
  - Disadvantages include DO NOT supply EFAs

Skinny on Fat: EN

- High fat formulas were developed to reduce carbon dioxide production and RQ in patients with respiratory failure.
- Amount of total calories has greatest influence on carbon dioxide production.
- Insufficient evidence to recommend use of high fat, low carbohydrate nutrition formulas in critically ill patients.

Skinny on Fat: IV

- Only 100% soybean oil emulsion (Intralipid) or 50:50 soybean/safflower (Liposyn) emulsion available in the U.S.
- Available in 10%, 20% and 30% concentrations.
- Emulsifier is egg phospholipid.
- Contain 15 mmol/liter of phosphorus
- Contain vitamin K

Skinny on Fat: IV

- Be aware that 10% lipid emulsion concentration is the delivery medium for diprivan (propofol).
- Vasoactive, proinflammatory, immune suppressive
- Each mL contains 100 mg soybean oil, 22.5 mg glyerin and 12 mg egg lecithin
- 15 mmol phosphorus per liter
- Delays gastric emptying
- Less than 1 gram/kg/day or 0.125 gram/kg/hour

Skinny on Fat: IV

- IVFE-induced hyperlipidemia rarely leads to pancreatitis unless serum TG exceeds 1000 mg/dL
- In humans, IVFE does not increase pancreatic enzyme secretion
- IVFE is considered safe in acute pancreatitis when serum TG less than 400 md/dL

Skinny on Fat: IV

- Phospholipid to triglyceride ratio highest in 10% concentration and least in 30% concentration.
- Minimum lipids to prevent EFA while on nutrition support:
  - 2-4% of total calories as linoleic acid
  - 0.25-0.5% of total calories as linolenic acid
  - 1-2% of total calories from IVFE
  - 1 gram/kg/week IVFE (about 3-4% total calories if feeding 25 kcal/kg)
  - Prevention: 500 mL 20% per week or 500 mL 10% 3 times/week or 250 mL 20% 2 times/week

Case Study #2

- K.K. is a 71 y.o. female
- Respiratory failure due to large pleural effusion.
- Complained of dyspnea 2 weeks prior to admission
- CT scan showed large right-sided pleural effusion and collapse of right middle lobe

Case Study #2

- Patient transfused 2 units of red blood cells.
- Nasal intubation.
- PMH: Type 2 DM, HTN, CAD with stent, CHF, CKD, hypothyroidism, fibromyalgia.
- Temp 102.5

Case Study #2

- Initial Labs:
  - Sodium 130
  - Potassium 4.2
  - BUN 55
  - Creatinine 2.5
  - Magnesium 3.1
  - Albumin (not checked)

lactate 3.3

pH 7.19

pCO2 50

HCO3 17

Case Study #2

- Height: 154 cm
- Weight: 83.1 kg
- BMI: 35

- Abdomen round, hypoactive bowel sounds, passing flatus.

Case Study #2

- Acid/Base disorder
- ? Thiamine deficieny: ATP cycle altered and glucose is converted to lactic acid in ATP cycle instead of pyruvate

Case Study #2

- Day 1 of admission: thoracentesis

Case Study #2

- Nutrition Assessment:
  - Mechanical ventilation. Patient in radiology for feeding tube placement; no family present to obtain subjective nutrition history information. Abdomen round with hypoactive bowel sounds. Per flowsheet patient is passing flatus; no bowel movement.

Nutrition Assessment

- Labs reviewed 05/14:
  - Creatinine 2.5
  - Sodium 130
  - Potassium 4.2
  - Phosphorus 5.1
  - Magnesium 3.1

  - 154 cm 83.1 kg BMI 35 IBW 50 kg
  - Estimated energy needs: 1330-1500 calories (16-18/kg) and 60-70 grams protein (1.2-1.4/kg IBW)

Case Study #2

- Nutrition Diagnosis:
  - Altered nutrition-related lab values (sodium, potassium, magnesium, phosphorus) related to ARF.

Case Study #2

- Monitor:
  - 1. Electrolyte and renal profile: sodium, potassium, phosphorus, magnesium and creatinine values.
  - 2. Enteral nutrition: initiation, formula, rate, tolerance, duration.

Case Study #2

- Nutrition Intervention:
  - 1. Enteral nutrition: initiate: Nepro enteral formula 35 mL/hour to provide 1512 calories and 67 grams protein.

Neurosurgical patients

- ICP: 0-15 normal
  - Increased values cause increased oxygen consumption, protein catabolism and hypermetabolism.
  - Maintenance of ICP is necessary to keep gastric function normal.
- Medications that < energy expenditure:
  - Barbiturates, opioids (morphine), sedatives, beta blockers, neuromuscular blocking agents (vecuronium)
- Delayed gastric emptying common in initial ebb phase which occurs in the first 48-72 hours