Nutrition Support

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Metabolic Response Following Trauma, Sepsis & Critical Illness,

• Shift from an anabolic state to catabolic state
• Hypermetabolism
• Release of counterregulatory hormones and cytokines
• Immunosuppression
Metabolism

- Glycogen stores are depleted 24-36 hours after a major catabolic insult.
- Increased protein catabolism leads to loss of lean body mass.
- Nitrogen losses can exceed 15-20 grams/day in the early stages of sepsis and trauma.
- During prolonged starvation, the brain switches from glucose to ketones as a fuel source.
Patient Selection

- Unable to meet nutrient needs orally
- Extended time frame NPO or inadequate intake
- Severe dysphagia
- Critically ill patients who can not take PO for several days/weeks/months
- Early enteral support ideal in ICU patients
Energy Requirements

- Hundreds of predictive equations
- Variables in equations: height, weight, age, gender
- Harris Benedict commonly used
- 25-30 kcal/kg/day meets the needs of most patients (70kg = 2100Cal/day)
- Indirect Calorimetry--- “Gold Standard” unwieldy, not clinically applicable
Energy Requirements

- Hundreds of predictive equations
- Variables in equations: height, weight, age, gender
- Harris Benedict commonly used
- Men: BEE=65+(6.2xW)+(12.7xH)-(6.8xA)
Indirect Calorimetry
‘Metabolic Cart’

• Measurement of gas exchange across the lung to determine REE
• Respiratory quotient can assist with adjusting substrate provision
• RQ is calculated from the ration of CO2 produced over O2 consumed
Interpretation

- RQ > 1.0: excess kcal provision
- RQ = 1.0: decrease CHO
- RQ < 0.82-0.85: increase kcal
- Physiological range: 0.67-1.3
Accuracy Indirect Calorimetry

• Only reflects energy needs for a specific time frame
• Need to be in steady state
• $\text{FiO}_{2} \geq 80$: Not Accurate
• Dialysis treatment
• Leaking chest tube
Estimating Energy Needs

Factors that influence predictive equations

- Sedation
- Intubation
- Obesity
- Accuracy weight
- ??? Actual body weight vs adjusted body weight vs IBW
- Degree of Stress
- Predicts Needs, Not Debt
Increased Kcal needs

Increased Stress, Debt

Protein/Cal ‘Sink’

- Severe burns
- Sepsis
- Dialysis
- Pressure ulcers
- Non-healing wounds
Conservative Kcal Provision

- Morbidly obese population
- Paraplegic & quadriplegic patients
- Patients on paralytic agents
- Special Cases: Liver/Kidney Failure
Inadequate Nutrition Support

- Increased muscle wasting & ventilatory dysfunction
- Impaired wound healing
- Compromised immunity
- Persistent negative nitrogen balance
Overfeeding Problems

• Hepatic dysfunction/steatatisos
• Hyperglycemia
• Increased infection risk
• Prolonged Intubation
• Risk refeeding syndrome
Refeeding Syndrome

- Consequences of depletion, repletion, and compartmental shifts of glucose, fluid, potassium, phosphorous, & magnesium
- May occur with aggressive kcal provision in malnourished patients
- Low phosphorous level is the hallmark symptom
Minimizing Complications

- Recognize patients at risk
- Replete potassium, magnesium, and phosphorous levels PRN
- Monitor levels closely
- Avoid overfeeding: start low & go slow
- Initial nutrition support goal conservative
Protein Requirements

- Dependent on disease, treatment plans & nutritional status
- 1.5-2.0 g/kg/day for critically ill patients
- Avg: .8g/kg/day (~60 gm/day)
- Severely injured trauma/burn patients may require up to 2.5 g/kg/day
Hepatic Proteins

- Albumin, Prealbumin, Transferrin
- Hepatic re-prioritization due to stress
  - $\uparrow$ Inflammatory markers (CRP)
  - $\downarrow$ Visceral proteins
- Increased visceral protein levels if nutrition provision adequate with resolution stress, inflammation
Serum Proteins

- In critical illness, low levels of albumin & prealbumin reflect severity of illness
- Inflammatory metabolism results in decrease synthesis
- Low albumin levels predictive of post-operative morbidity and mortality
Nitrogen Balance
Nitrogen IN – Nitrogen OUT + 4

EXAMPLE:
100 g protein via TF = 16 g nitrogen IN
24 hr UUN= 10 (+ 4 g) = 14 g nitrogen OUT

16 – 14 = + 2

Note: each gram of UN= 6.25 gm degraded protein: Protein In/6.25-(UN+4) = NB gms
Limits to Study

- Accuracy 24 hr urine collection
- Renal failure
- Abnormal losses
  - excessive diarrhea
  - fistula output
  - wound & CT drainage
Enteral Support

Enteral support if GUT deemed functional

- Adequately resuscitated
- Hemodynamically stable
- Ideal to initiate enteral nutrition the first 24-48 hrs
- Advance to goal as able 48-72 hrs
- Enteral v Gastric feeds
Contraindications to Enteral Nutrition

- Paralytic ileus
- Severe short bowel syndrome
- Active GI bleed
- Severe GI malabsorption as evidenced by deterioration nutrition status
- Nonoperative mechanical GO obstruction
Benefits Enteral Nutrition Support

- Maintain gut integrity
- May prevent bacterial translocation
- Decrease in infectious complications
- Nutrients in SB reduces risk of cholecystitis
- Provision of nutrients not available with PN

  Fiber

  SCFA & Glutamine: important fuel sources for large & small bowel

  Intact proteins & peptides

Gastric v Enteral feeds
Enteral Products

Isotonic

Osmolite: Extended time frame NPO or extensive GI surgery
Do not always have to initiate feeds with Osmolite!

Polymeric

Promote & Promote w/fiber
Jevity 1.2
Osmolite 1.5
Specialty Formulas

Disease Specific

- Nepro
- Glucerna 1.2
- Oxepa

Semi-elemental & Immune modulating

- Pivot
- Impact Peptide 1.5

Modulars

- Prosource; 60 kcal & 15 gm protein per packet
TF GOALS

Products range from 1.0-2.0 kcal/cc
16.7 – 25% kcal as protein
Identify goal at start of enteral nutrition

Osmolite: 60 cc/hr x 24 hrs = 1526 kcal & 64 gm protein

Promote: 60 cc/hr x 24 hrs= 1440 kcal & 90 gm protein

Nepro: 60 cc/hr x 24 hrs= 2592 kcal & 117 gm protein
Starting TF

- Usually start 10 cc/hr
- Increase 10ml q 4-8 hrs to goal
- Continuous TF initially
- ? Account for time TF may be held
- Tube feedings ordered vs provided
- May be more reasonable to assume TF provided 20-22 hrs
Indications for TPN

- Diffuse peritonitis
- GI ischemia
- Intestinal obstruction; unable to bypass
- Intractable vomiting/diarrhea
- Decreased intestinal absorptive area
- Ileus
- Nutrient needs exceed what can be met via GI tract
- Unable to obtain access to GI tract
TPN Criteria

- Require therapy 7 days or more
- Able to tolerate fluid volume
- Access available
- Hemodynamically stable
- TPN must be ordered by 1PM
- Can not be altered once made
Challenges

• Shortages
  Substrates
  Electrolytes
  Trace elements
• Must provide 20 grams lipids per liter PN
  Can hold lipids in PN
TPN Calculations

* 3.4 kcal per gm dextrose
* 4.0 kcal per gm protein
* 10 kcal per gm lipid

Example:

115 g protein  (460 kcal)
250 g CHO     (850 kcal)
50 g lipids   (500 kcal)

1810 kcal
Volume Requirements

Make sure it fits!

115 g protein: 767 ml (15% AA)
250 g CHO: 357 ml (70% dextrose)
50 g lipids: 250 ml (20% lipids)
100 ml for additives
TPN Restrictions

- Initial TPN Rx: 150 gm CHO or less
- Standard Low CHO solution usually appropriate for initial TPN
- 3-5 mg CHO/kg/minute (stressed patients)
- Lipids contraindicated if TG > 400
- Lipid content 30% or less total kcal
Monitoring TPN

**Weekly**
- LFT’s
- TG
- Prealbumin

**Daily**
- BMP, Phos, magnesium
- Accu check levels & I/Os
Monitoring TPN

- Adjust based on daily labs
- May need to adjust for acid-base disturbances
- When increasing volume TPN, remember additives are ordered per liter
- If TPN abruptly discontinues, provide D10 to prevent rebound hypoglycemia
TPN Complications

- Liver dysfunction
- Hyperglycemia
- Loss of access
- Infection
- Metabolic bone disease (long-term)
Tapering TPN

- Decrease TPN if TF at 33-50% goal rate
- Typically decrease TPN rate by half when TF at 50% goal
- Decrease volume & macronutrients
- Can D/C TPN if TF tolerated at 75% goal rate

General Guidelines
Modification Nutrition Support

- Renal or liver failure
- CVVHD or HD
- Hyperglycemia
- TF intolerance
- Diarrhea
- Propofol: each ml provides 1.1 lipid kcal
Modification Nutrition

- Non-healing wounds
- Pressure ulcers
- Fistula
- Declining prealbumin
- Negative nitrogen balance
- Start PO

Nocturnal TF
Home Nutrition Support

- Cycled TPN
- Less expensive enteral formula
- Bolus or cycled TF
References


