

Nutrition and the Internal Medicine Patient

GIM Unit 59

Rockyview General Hospital

Jeffrey P Schaefer, MSc, MD, FRCPC

Objectives

- Nutritional Demand
- Nutritional Supply
 - enteral
 - parenteral
 - electrolytes
 - refeeding syndrome

Nutritional Demand

- What do we need?
 - energy (carbohydrate and lipids mainly)
 - building blocks (protein)
 - electrolytes
 - vitamins
 - water

- chocolate and coffee

Energy

- Units of Measurement

- kilojoules (kJ)
- kilocalories (kcal)
- Calories (Cal)

$$1 \text{ kcal} = 1 \text{ Calories} = 4.19 \text{ kilojoules}$$

1 calorie is the energy needed to raise the temperature of 1 gram of water by 1 degree Celsius (inconveniently small)

Energy Requirements

- Harris Benedict Equation for Basal
 - Men: $66 + (13.7 \times W) + (5 \times H) - (6.8 \times A)$
 - Women: $665 + (9.6 \times W) + (1.8 \times H) - (4.7 \times A)$
- World Health Organization

Age (Yr)	Male	Female
0-3	$(60.9 \times W) - 54$	$(61.0 \times W) - 51$
3-10	$(22.7 \times W) - 495$	$(22.5 \times W) + 499$
10-18	$(17.5 \times W) + 651$	$(12.2 \times W) + 746$
18-30	$(15.3 \times W) + 679$	$(14.7 \times W) + 996$
30-60	$(11.2 \times W) + 879$	$(8.7 \times W) + 829$
>60	$(13.5 \times W) + 987$	$(10.5 \times W) + 596$

Energy Requirements

FORGET THIS NOW!!!

Energy Requirements

Basal Energy Needs: 1 kcal / kg / hour

- 25 kcal / kg / day: inactive medical patient
- 30 kcal / kg / day: moderate severity illness
- 35 kcal / kg / day: catabolic burn / trauma

Carbohydrates

- primarily a source of energy
- some building block component
- no absolute requirement but...
 - carbohydrates reduce protein and fat breakdown

Lipids

- triglycerides (fat), sterols, and phospholipids
 - sources of energy
 - precursors for steroid hormone, prostaglandin
- Essential Fatty Acids
 - Linoleic acid (C18:2, n-6) should constitute at least 2% and linolenic acid (C18:3, n-6, 9, 12) at least 0.5% of the daily caloric intake to prevent the occurrence of essential fatty acid deficiency (EFAD)

Building Blocks

- Amino Acids
 - 20 amino acids (10 we can't make 'essential')
 - chains of amino acids form proteins
- Proteins
 - structural
 - collagen, elastin, albumen, immunglobulin
 - insulin, binding proteins, hemoglobin
 - enzymes
 - alkaline phosphatase
 - creatinine kinase

Protein Demand

- 0.6 g/kg/d: ultra low (research study in renal failure)
- 0.8 g/kg/d: low but enough in health
- 1.0 g/kg/d: medium, moderately ill medical patients
- 1.2 – 1.7 g/kg/d: high protein for severe illness

Vitamins

- RDA's are available for all vitamins
- usually RDA's are well above any threshold for clinical disease
- e.g. Vitamin C (ascorbic acid)
 - to get scurvy (< 2 mg / day)
 - RDA 60 mg / day (100 mg / day in smokers)
 - average diet ~ 60 mg / day
 - Linus Pauling recommended 2,000 mg / day

Minerals / Electrolytes

- Sodium ~ 0.5 - 1.0 mmol / kg / day
- Potassium ~ 0.5 - 1.0 mmol / kg / day
- Calcium
- Magnesium

- Chloride
- Bicarbonate

- Trace (copper, zinc, selenium, dirt)

Water

- How much per day?
 - I don't know.
 - Satisfy your thirst.
 - Perfuse your kidneys
 - Probably too much variation on earth to make a suggestion such as 8 x 8 oz / day.
 - Water intoxication can happen!

Nutritional Demand

- Energy
 - Carbohydrates, Lipids, Protein
- Building Blocks
 - Protein (amino acids), Carbohydrates, Lipids
- Vitamins
 - vitamins
- Minerals and Electrolytes
 - minerals and electrolytes
- Water
 - water and catabolism

Energy Supply

- Carbohydrates: 4.1 kcal / gram
- Protein: 4.5 kcal / gram
- Fat 9.3 kcal / gram

Roughly: 4c 4p 9f

Nutritional Support

- Decision usually is more about patient setting than nutritional status.
- Factors:
 - what is the current nutritional status?
 - how does the patient derive nutrition?
 - what is the expected clinical course?
 - what are the co-morbidities?
 - what are the patient / family wishes?
 - what are the risks?

How to Support?

- Oral Support
 - patient can (wants to) chew and swallow
- Enteral Support (tube feed)
 - patient can't chew or swallow
- Parenteral Support (TPN, PPN)
 - patient does not have a functional GI tract

Oral then Enteral then Parenteral
Risk, Cost, Convenience, Efficacy

Oral Support

- Oral Intake
 - ensure diet is adequate, mechanical, appealing
 - supplement with food or prepared supplements
- Flavored Supplements
 - Boost
 - Ensure, Ensure Plus, Ensure High Protein
 - Resource

Enteral Support

- Enteral Support (tube feed, no need to flavor)
 - Ensure, Jevity, Nepro, TwoCal

PARAMETERS

- Caloric density: 1 or 2 Cal / ml
- Protein: usually enough (can add ProMod)
- Vitamins: No Vitamin K (warfarin issue)
- Electrolytes: usually enough, (+/- Potassium)
- Water: often insufficient

Enteral Case

- 50 year old with stroke
 - aspirates, prognosis is optimistic
 - 80 kg
 - diabetic
- What does patient need?
 - energy: $25 \text{ kcal / kg / day} \times 80 \text{ kg (lean)}$
 - 2,000 kcal / day

Enteral Case

- 2,000 kcal/d downgraded to 1,800 kcal/d
- Jevity
 - 233 ml/can x 8 cans per day = 1,864 kcal/d
 - 2 + 2 + 2 + 2 in boluses
 - water flush 200 ml each bolus
 - give insulin at each bolus
 - check electrolytes to ensure enough water!!!!
 - check INR
 - think about drug bioavailabilities

Enteral Case

- Continuous versus Bolus feeds thoughts
 - maybe less aspiration if continuous
 - maybe better tolerated if continuous
 - probably better rehabilitation if bolus
 - probably better for drug interactions if bolus
 - probably better for tube patency if continuous

Special Needs Patients

- Renal
 - Nepro - no potassium, 2 kcal / ml
- CHF
 - Twocal - 2 kcal / ml
- Diarrhea
 - less fiber
 - try elemental supplement

Parenteral Support

- Travasol (yellow bag)
 - Carbohydrates 20 - 25% solution
 - Amino Acids (50 - 100 grams)
 - Electrolytes
 - Trace Minerals
 - Vitamins (not K)
 - additives: insulin, acid base, water
- Intralipid (cream)
 - 10% x 500 ml
 - 20% x 500 ml

TPN Case

- 70 kg with bowel obstruction
 - no end in sight
 - central access in place
 - not bacteremic
- NEEDS:
 - energy: $30 \text{ kcal/kg/d} \times 70 \text{ kg} = 2,100 \text{ kcal / day}$
 - protein: 1 - 1.2 g / day
 - water: 2 - 3 liters per day
 - vitamins, electrolytes, essential fatty acids

TPN

- Travasol
 - 25% glucose per 1 liter = 250 grams carb / liter
 - 250 grams carb x 4 kcal / gram = 1,000 kcal / liter
 - 50 grams / protein per liter (not for energy)
- Lipid
 - 10% lipid / 500 ml bottle = 50 grams lipid / 500 ml
 - 50 grams lipid x 9 kcal / gram = 450 kcal / 500 ml

Rx: 2,000 ml / 24 hr = 83 ml / hour travasol
500 ml bottle Mon - Wed - Friday
roughly gives 2,225 kcal / day

Risks of TPN

- Central Line issues
 - infection
 - clot
 - traumatic insertion
 - air embolism
 - pain
 - 15% of patients have at least one complication

Risks of TPN

- Volume Issues
 - congestive heart failure is too much
 - renal failure if too little

Risks of TPN

- Refeeding Syndrome

- phosphate gets used up
- potassium shifts into cells
- magnesium shifts into cells
- insulin causes salt and water retention --> CHF

Risks of TPN

- Fatty Liver
 - usually transient and mild
 - can lead to fibrosis / cirrhosis in long term

Risks of TPN

- Hypertriglyceridemia
 - may cause pancreatitis
 - insulin infusion may help by activating lipoprotein-lipase enzyme

Risks of TPN

- Electrolyte and Glucose disturbances

Sodium

- Abnormalities of Na^+ usually relate to water!
- Very common with Enteral Feed Patients
- Hyponatremia: too much water
- Hypernatremia: not enough water
- Either is hard on the brain
 - seizures and delirium
 - < 130 or $>$

Potassium

- Hyperkalemia:
 - renal disease (nsaids, diabetes, htn, etc)
 - too much K
 - ACE-I (ramipril), ARB (losartan), spironolactone
- Hypokalemia:
 - diuretics
 - diarrhea or suction
- Either is hard on the heart!

Calcium

- Hypocalcemia
 - pancreatitis, post-parathyroid surgery
 - twitchy
- Hypercalcemia
 - malignancy, hyper-parathyroidism
 - kidney stones, constipation, depressed, coma
 - CORRECTION for ALBUMEN
 - 0.02 mmol Ca for each gram of albumen

Calcium Case

- Calcium: 1.65 mmol
- Albumen: 16 g/l

$$40 \text{ g} - 16 \text{ g} = 24 \text{ g}$$

$$24 \text{ g} \times 0.02 \text{ mmol} / \text{g} = 0.48 \text{ mmol}$$

$$1.65 + 0.48 = 2.13 \text{ mmol (normal)}$$

Phosphate

- Hyperphosphatemia
 - renal disease
 - seldom problematic
- Hypophosphatemia
 - refeeding, treatment of DKA
 - seldom problematic (no problems > 0.30 mmol)
 - DRINK MILK, EAT FOOD

Magnesium

- Hypomagnesemia
 - diarrhea, alcoholics, diuretics, refeeding
 - ? predispose to dysrhythmia
 - twitchy
- Hypermagnesemia
 - rare to see

Stopping TPN

- Hyperinsulinism may support notion of a brief period of weaning (6 hours or so)
- Seldom an issue because patient can eat.

Summary

- Consider Needs
- Consider the least invasive support
- Special Concerns with TPN

- Questions?