

Nutrition in the Hospitalized Patient

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Objectives

- assess nutritional status
- order enteral nutrition
- order parenteral nutrition
- recognize and treat common electrolyte problems

Nutritional Assessment

- Risk of malnutrition?
 - 134 admissions to a general medical service
 - 69% had worsening of their nutritional status
 - high nutritional risk had a mortality of 13%
 - lost nutritional risk had a mortality of 4%



Malnutrition

- Impacts
 - Increased susceptibility to infection
 - Poor wound healing
 - Increased frequency of decubitus ulcers
 - Overgrowth of bacteria in the GI tract
 - Abnormal nutrient losses through the stool
- Hypoalbuminemia predicts for mortality

Nutritional Assessment - Clinical

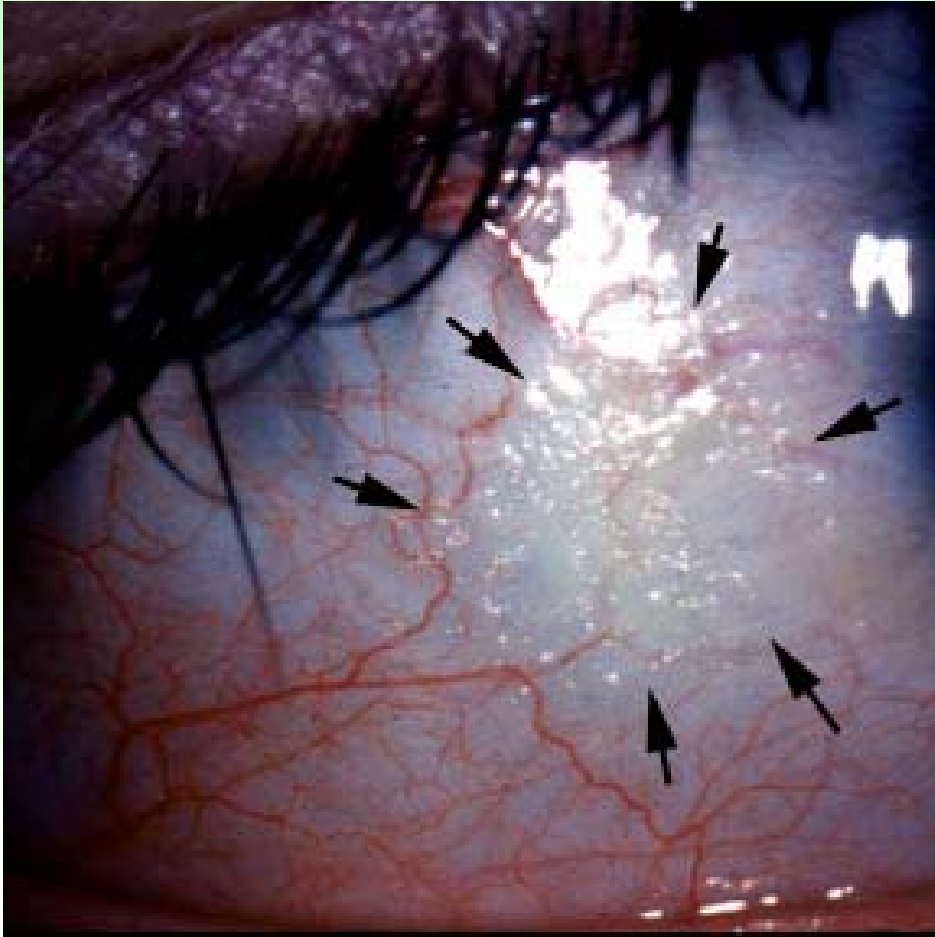
- History
 - pre-morbid nutritional status
 - past medical and surgical history
 - medications
 - social history
 - focused dietary and weight history
- Physical Examination
 - Body Mass Index (kg / m^2) → ideal 19 - 25
 - temporal muscle wasting
 - sunken supraclavicular fossae
 - decreased adipose stores

Physical Signs of Nutritional Deficiency

	Signs	Deficiencies
Hair	Alopecia Brittle Color change Dryness Easy pluckability	Protein-calorie malnutrition Biotin Zinc Vitamins E and A Zinc (?)
Skin	Acneiform lesions Follicular keratosis Xerosis (dry skin) Ecchymosis Intradermal petechia Erythema Hyperpigmentation Scrotal dermatitis	Vitamin A Vitamin A Vitamin A Vitamin C or K Vitamin C or K Niacin Niacin Niacin
Eyes	Angular palpebritis Bitot's spots Conjunctival xerosis	Vitamin B2 Vitamin A Vitamin A
Mouth	Angular stomatitis Atrophic papillae Bleeding gums Cheilosis Glossitis Magenta tongue	Vitamin B12 Niacin Vitamin C Vitamin B2 Niacin, folate, vitamin B12 Vitamin B2
Extremities	Genu valgum or varum Loss of deep tendon reflexes of the lower extremities	Vitamin D Vitamins B1 and B12

Adapted from Bernard, MA, Jacobs, DO, Rombeau, JL. Nutrition and Metabolic Support of Hospitalized Patients. WB Saunders, Philadelphia, 1986.

Bitot's Spots – Vitamin A deficiency



Bitot's spots are superficial, irregularly-shaped, foamy gray or white patches that appear on the conjunctiva.

Nutritional Assessment - Paraclinical

- **Laboratory Indicators of Nutrition**

- serum albumin concentration

- < 22 g/l → generally reflects severe malnutrition
 - half-life is 14 to 20 days
 - influenced by volume status, sepsis, trauma, liver disease, albumin infusion

- prealbumin (transthyretin)

- reference range 0.2 – 0.4 g/l
 - half-life is 24 to 48 hours
 - influenced by renal and liver disease

- transferrin

- reference 2.0 – 3.6 g/l
 - half-life is 9 days

Nutritional Demand

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- What do we need?

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 - carbohydrates

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 - protein

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- What do we need?
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 - lipid

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- What do we need?
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 - electrolytes

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Nutritional Demand

- What do we need?
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 - protein
 - lipid
 - electrolytes
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 - water

Nutritional Demand

- What do we need?
 - carbohydrates
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 - lipid
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 - 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



Scurvy

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

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- How much per day?

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 - I don't know.

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 - Satisfy your thirst.

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 - 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?

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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

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Enteral Case

- 50 year old with stroke
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- How much energy is required?
 - energy: $25 \text{ kcal / kg / day} \times 80 \text{ kg}$ (lean)

Enteral Case

- 50 year old with stroke
 - aspirates, prognosis is optimistic
 - 80 kg
 - diabetic
- How much energy is required?
 - 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

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- 70 kg with bowel obstruction

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- **NEEDS:**
 - energy: $30 \text{ kcal/kg/d} \times 70 \text{ kg} = 2,100 \text{ kcal / day}$

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- **NEEDS:**
 - energy: $30 \text{ kcal/kg/d} \times 70 \text{ kg} = 2,100 \text{ kcal / day}$
 - protein: 1 - 1.2 g / day

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 - water: 2 - 3 liters per day

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 - 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

- Hypernatremia: not enough water
- Hyponatremia: too much water

- Either is hard on the brain
 - seizures and delerium
 - < 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.

Practice Cases

- 21 year female with Anorexia Nervosa
 - 32 kg
 - referred to IM for tube feeding



What is your approach?

- establish goals
- legal and ethics
 - review status under Mental Health Act
 - document voluntary vs involuntary
- medical goals
 - achieve ‘safe weight’
 - 2 - 3 lbs wt gain per week
 - start at 30 - 40 kcal / kg / day and progress to 1000 to 1600 kcal / day
 - how would you do this?

Small bowel resection...

- 80 kg male infarcts bowel
- What is your approach?

Tough Decisions...

- 89 year old female
- advanced dementia
- admitted with cellulitis
- family concerned about nutrition
- patient vegetative...

Summary

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

- Questions?