

Nutrition & Wound Healing

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Points to Ponder

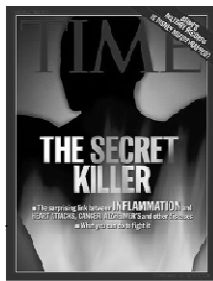
- Identify major nutrition issues associated with wounds.
- Examine factors that contribute to IWL & slow healing wounds.
- Discuss current clinical nutrition practice recommendations for wounds.
- Discuss NPUAP nutrition interventions to standardize care.

Burning Issues

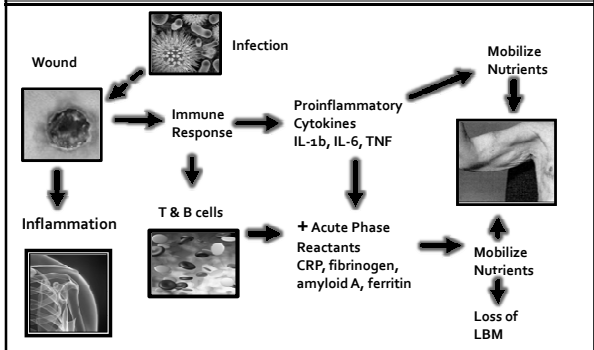
- Why is my patient losing weight?
- Why won't my patient eat?
- Why is my patient so tired?
- Why won't this wound heal?



The Good, The Bad & The Ugly... Inflammation



Why is My Patient Losing Weight? Inflammatory Response



Positive Acute Phase Reactants


- ↑ inflammatory response → concentration ↑ by at least 25%
- Examples: CRP, hs-CRP, fibrinogen, plasminogen, plasminogen-activator-inhibitor 1 (PAI-1), serum amyloid A, ferritin, ceruloplasmin, haptoglobins, orosomucoids


Negative Acute Phase Reactants


- ↑ inflammatory response → concentration ↓ by at least 25%
- Examples: albumin, prealbumin, transferrin (serum Fe), insulin-like growth factor 1, retinol binding protein

Proinflammatory Cytokines

- ↑ inflammatory response → concentration ↑
- Examples: interleukin-1b (IL-1b), interleukin-6 (IL-6), tumor necrosis factor (TNF)

 Cytokines & Metabolic Meltdown		
Organ System	Cytokine Modulated Behavior	Nutritional Outcomes
Brain	Sickness syndrome (fatigue, apathy, cognitive dysfunction, anorexia, sleepiness)	↓↓ Food intake ↓↓ Weight loss
Endocrine	Euthyroid Sick Syndrome ↑ Metabolic Rate Anorexia	↓↓ Food intake ↑ Muscle wasting

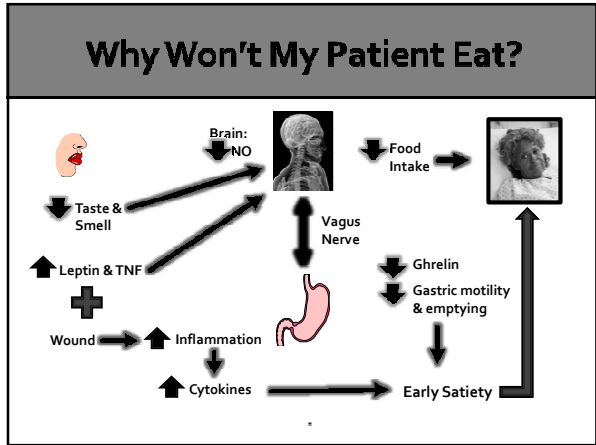
 Cytokines & Metabolic Meltdown		
Organ System	Cytokine Modulated Behavior	Nutritional Outcomes
Liver	↑ Synthesis of Positive Acute Phase Reactants ↓ Synthesis of Negative Acute Phase Reactants ↑ Fatty acid synthesis ↑ Lipolysis ↓ LPL	↓↓ Food intake ↓↓ Weight loss
Muscles	↑ Insulin resistance	Hyperglycemia

 Cytokines & Metabolic Meltdown		
Organ System	Cytokine Modulated Behavior	Nutritional Outcomes
Blood	↓ Production RBC Redistribution of albumin, pre-albumin and iron	↑ Anemia ↑ Edema
GI Tract	↓ Gastric Secretion ↓ Gastric Motility ↓ Gastric Emptying Time ↑ Protein Degradation	↓↓ Food intake ↓↓ Weight loss ↓ Protein reserves

Relationship Between IWL/LBM & Morbidity & Mortality

% Loss LBM	Response	Predicted Outcomes
10%	Impaired immunity ↑ Infections (especially pneumonia)	Mortality 10%
20%	↓ Wound Healing Weakness & Fatigue Thinning of Skin ↑ Infections	Mortality 30%
30%	↑ Skin failure, No healing & Infections Too Weak to Sit or Stand	Mortality 50%
40%	Death, usually from Pneumonia	Mortality 100%

Demling, 2009. Nutrition, Anabolism, and the Wound Healing Process: An Overview. ePlasty.



What Does My Patient Need to Eat?

- Energy
- Protein
- Fluid
- Vitamin & Minerals

Energy Needs

- Determined by RD
- Energy needed to:
 - Mobilize immune response
 - Overcome hypermetabolism triggered by cytokines
 - Heal wound
 - NPUAP 2010 estimate 30-35 Kcal/kg body wt.

NOTE: some individuals with multiple injuries may need more energy

Relationship Energy Intake & Nitrogen Balance



Dietary Energy (kcal/kg body wt)	Nitrogen Balance (mg N/kg B wt)
<35	-28
35 - 40	-10
40 - 45	-5
45 - 50	-5

Protein & Energy Needs

- Protein requirement is significantly \uparrow if person is in **negative** energy balance.
- Protein requirement is significantly \downarrow if person is in **positive** energy balance.
- Much easier to achieve **+** N balance if overall energy intake is higher.
- May be possible to achieve **+** N balance in patient with **<** optimal PRO intake by \uparrow energy intake.



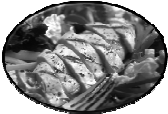
Protein Needs

- Dietary Protein Needed to:
 - Provide IAA- only come from food
 - Synthesize enzymes involved in healing
 - Promote \pm N balance



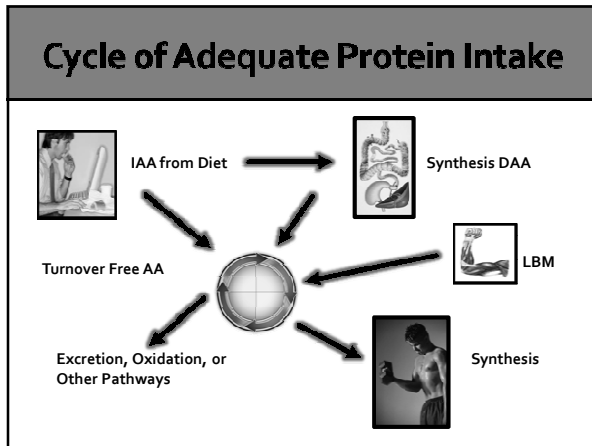
Are All Sources of Protein Nutritionally Equivalent?

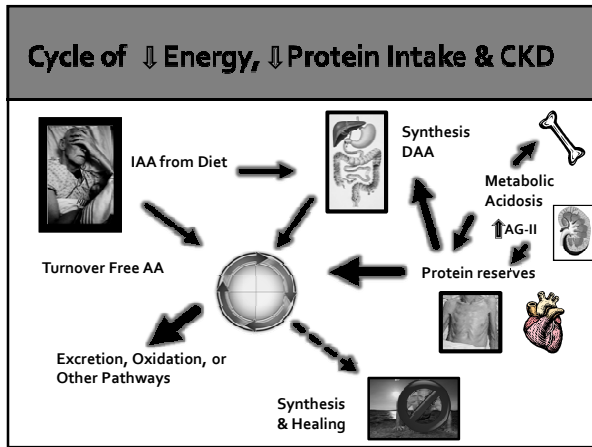
- Food Sources:
 - Animal Protein- complete
 - Animal Protein- incomplete
 - Vegetable Protein- incomplete
 - Vegetable Protein- complete



Human Protein Requirements: Healthy Adults

- IAA requirements
- Non-specific nitrogen donor requirements
- EAR- 0.66 g/kg/body wt
- RDA 0.8 g/kg/body wt
- Proposed : 0.93-1.2 g/kg/body wt





- ### Protein Needs
- Determined by RD
 - NPUAP (2009) recommend 1.25-1.5 g/kg body wt high quality protein to prevent skin breakdown in high risk individuals
 - NPUAP (2009) recommend 1.25-1.5 g/kg body wt high quality protein to treat skin breakdown

WHO: IAA Requirements

IAA	mg/kg body wt/day	mg/g protein
Histidine	10	15
Isoleucine	20	30
Leucine	39	59
Lysine*	30	45
Methionine *+ Cysteine	15	22
Phenylalanine + Tyrosine	25	38
Threonine*	15	23
Tryptophan*	4	6
Valine	26	39

*Most limiting IAA in Western Diet


WHO: IAA Requirements vs. Whey Isolate vs. Fortified Collagen

IAA	WHO: mg/g protein	Whey Isolate mg/g protein	Fortified Collagen mg/g protein
Histidine	15	21	8
Isoleucine	30	58	17
Leucine	59	97	31
Lysine*	45	86	45
Methionine *+ Cysteine	22	43	9
Phenylalanine + Tyrosine	38	67	24
Threonine*	23	61	22
Tryptophan*	6	15	5
Valine	39	56	26
PDCAAS		100%	40%

*Most limiting IAA in Western Diet

Serum Albumin...Nutritional Marker or Inflammatory Marker?

Marasmus




Sx:

- Severe loss LBM
- Skeletal appearance
- Apathetic
- Listless
- Normal albumin

Diet: ↓↓ Kcal & Pro

Kwashiorkor




Sx:


- Edema
- ↑ Rates of infection
- Fatty liver
- Sparse subcutaneous fat
- Low albumin

Diet: Adequate Kcal, ↓↓ or no Pro

Serum Albumin...Nutritional Marker or Inflammatory Marker?



Minnesota Starvation Study
1944



NEW STARVING IN MINNESOTA
UNIDENTIFIED MEDICAL PATIENTS IN 1944. COURTESY OF THE NATIONAL LIBRARY OF MEDICINE

Parameter	Baseline	6 months on semi-starvation diet
BMI	21.7	16.4
Body comp: LBM	39.9%	29.2%
Fat	9.8%	3.1%
Serum albumin	4.3	3.9

Kalm L M , Semba R D J. Nutr. 2005;135:1347-1352

Can Nutritional Interventions Raise Serum Albumin in Undernourished Patients?

- Most of studies are unblinded, randomized studies, and small sample size
- Non-CKD populations:
 - ~ half found no statistical improvement
- CKD populations
 - ~ half found no statistical improvement

Assessment Tools: Severe & Non-Severe Malnutrition

AND (ADA) & ASPEN Tools

Characteristics	Characteristics
Evidence of Reduced Dietary Intake	Changes in Body Composition: Loss of Subcutaneous Fat
Unintended Weight Loss	Changes in Body Composition: Loss of Muscle
Reduced Grip Strength	Changes in Body Composition: Fluid Accumulation

Must meet 2 or more criteria

ADA. Nutrition Care Manual, 2011; NPPA: Making Clinical Connections, 2012

Fluid Needs

- Determined by RD
- Needs may ↑ with high protein intakes
- Needs may ↑ with draining wounds & other losses
- Use labs & nutrition focused physical assessment to determine hydration status

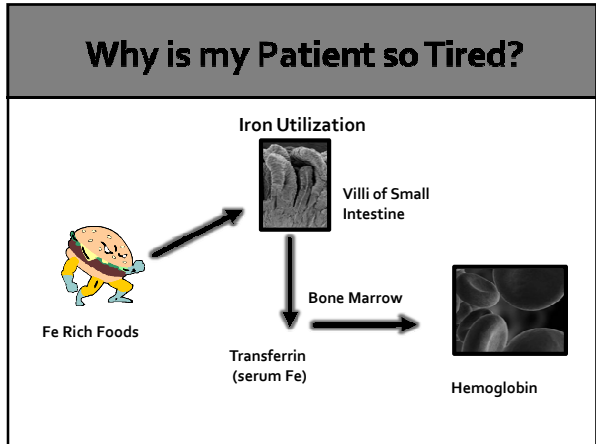


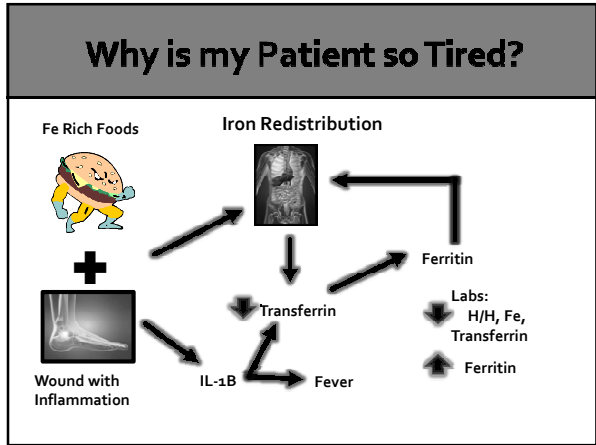
Vitamin Mineral Needs

- Determined by RD
- Based on current nutritional status
- Goal to meet vitamin mineral needs from food or nutrition support
- Use labs & nutrition-focused physical assessment to determine nutrient deficiencies

Vitamin Mineral Needs

- NPUAP: Offer complete multiple vitamin with minerals for individuals with poor dietary intake or when deficiencies are confirmed or suspected.
 - Zinc & copper
 - Vitamin C
 - Nutritional anemias






- ### Continuum of Care
- Food First
 - Fortify Foods- energy & complete protein
 - Taste test all fortified products
 - Monitor acceptance & intake
 - Med pass
 - Add oral nutritional supplements providing complete protein

Continuum of Care

- **Nutrition Support**
 - Tubefeeding
 - Fortify tubefeeding
 - IDPN
 - TPN
- **Exercise**
 - Improvement is not consistently observed



Continuum of Care

- **Anabolic Agents**
 - Significant improvements in body composition & physical function have been reported in HD patients given nandrolone decanoate (*J Am Soc Nephrol.* 2006;17:2307-2314).
 - Resistance exercise + nandrolone did not improve the beneficial effects of the drug.
- **Appetite Stimulants**
 - Improvement noted in other catabolic illnesses, no studies in CKD

Clinical Nutrition Pearls

- News is filled with hype about nutrition... some facts, some fibs & some half truths
- Protein quality is determined by IAA distribution not total grams protein
- Protein adequacy is determined by meeting RDAs for IAA not total grams of protein
- RDAs for V/M may not be enough for everyone
- Criteria for assessing malnutrition has changed!

<p>Nutrition & Wound Healing</p> <p>Questions?</p>
<p>Mary D. Litchford PhD, RD, LDN</p>
