Nutrition from A to Zinc

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Session Objectives

- Describe the nutritional components necessary to fuel the wound healing process.
- Understand how poor nutritional status impacts the body's ability to heal a wound.
- Implement at least 2 new nutritional strategies to enhance wound healing.

Facts About Malnutrition[1]

- Defined as a lack of adequate calories, protein, or other nutrients needed for tissue maintenance and repair
- Occurs along a continuum of inadequate intake and/or increased requirements, impaired absorption, altered transport, and altered nutrient utilization
- Until 2012, no consensus was available on how to diagnose malnutrition.
  - Electronic health records and interoperability made this evident and necessary.

The New Definition of Malnutrition[1]

- The new definition:
  - Provides a standardized set of diagnostic characteristics used to identify and document malnutrition
  - Is etiologically based diagnostic nomenclature
  - Accounts for what we know about inflammatory response
  - Allows for data collection to add to scientific literature

Risk of Never Events with Preexisting Malnutrition/Weight Loss[2]

- Fry et al. examined more than 880,000 surgical patient cases from 1368 hospitals to describe risks for never events and hospital-acquired infections:
  - Reported as odd ratios (the numbers indicate the increased risk for development of a certain condition with preexisting malnutrition and/or weight loss)
- Results:
  - For patients with malnutrition and/or weight loss, the risk for surgical site infection is 2.5 times greater compared to patients who do not have malnutrition and/or weight loss
  - For patients with mediastinitis after a coronary artery bypass graft (inflammation in the mid chest or mediastinum, either acute or chronic), the risk for infection is 5.3 times greater
  - For patients with a catheter-associated urinary tract infection, the risk is 5.1 times greater
  - For patients with pressure injuries, the risk is 3.8 times greater
- Continuity of care and planning at discharge really can help

Diagnosis of Malnutrition[3]

- Diagnosed when at least 2 or more of the following 6 characteristics are present:
  - Insufficient energy intake

- Weight loss
- Loss of muscle
- Loss of subcutaneous fat
- Localized or generalized fluid accumulation that may sometimes mask weight loss
- Diminished functional status as measured by hand grip strength

Energy Intake[3]

- Malnutrition is the result of inadequate food and nutrient intake compared to estimated requirements:
  - Review food and nutrition history
  - Estimate optimal needs
  - Compare estimates to consumption
  - Report inadequate intake as a percentage of needs
- Report weight change as a percentage lost from baseline

Body Fat[3]

- Loss of subcutaneous fat:
  - Orbital, triceps, fat overlying ribs
- Tools to determine body composition:
  - Skinfold thickness
  - Bioelectrical impedance
  - Bod Pod®
  - Nutrition-focused physical exam:
    - Exam that uses physical assessment and function to help determine nutritional status and diagnose malnutrition
    - Systematic approach (head to toe)

Muscle Mass[3]

- Loss of lean mass at:
  - Temples (temporalis muscle)
  - Clavicles (pectoralis, deltoids)
  - Shoulders (deltoids)
  - Interosseous muscles
  - Scapula (latissimus dorsi, trapezius, deltoids)
  - Thigh (quadriceps)
  - Calf (gastrocnemius)

Fluid Accumulation[3,4]

- Evaluate generalized or localized fluid accumulation
- Weight loss sometimes masked by generalized fluid accumulation
- Intake/output records
- Assessment of edema:
  - Dent depth
  - Duration

Functional Status[5,6]

- Hand grip strength:
  - Measure by dynamometer

- Validated by proxy for lean body mass (LBM)
- Independent predictor of poor nutritional status

- 4-meter/other walk tests
- Stair climbing/chair rising/balance
- Peak expiratory flow
- Measure overall energy, strength, endurance (ability to perform activities of daily living):
  - Consider non-malnutrition causes (e.g., neuromuscular diseases, medication, age-related issues, trauma, activity/mobility)
  - Correlate with other characteristics (weight loss, intake)
- Norman et al. offers strongest correlation to date with muscle mass and nutritional status

Energy (or Calories)

- Insufficient caloric intake=weight loss
- Unintended weight usually is loss of LBM

Relationship Between LBM Loss and Wound Healing[7,8]

- <10%—Wound healing has priority for protein substrate
- >10%—Stimulus to restore LBM competes with the wound for protein
- >20%—Correction of LBM takes precedence, wound healing stops

NPUAP Clinical Practice Guidelines: **Caloric Intake[9]**

- If patient cannot achieve nutritional requirements by dietary intake, offer fortified foods and/or high-calorie, high-protein oral nutritional supplements between meals

Ideas to Increase Calories[10-12]

- Favorite and culturally appropriate foods
- Socialization at meals
- Diet order liberalization
- Multiple smaller meals throughout the day
- Proper mealtime positioning
- Assistance at meals:
  - Cueing
  - Hand over hand
  - Mirroring
- Recipe modification
- Oral nutritional supplements:
  - Try varied forms, including juices, puddings, bars, shakes, cookies, ice creams
- Appetite stimulants

Protein

- Only nutrient containing nitrogen[13]
- Responsible for synthesis of enzymes involved in wound healing and collagen synthesis[13]
- Needed at every step of the healing process[13]

Estimating Protein Needs

- Protein needs assessed as grams of protein per kilogram of body weight (bw) (g/kg body weight)

- Recommended Dietary Allowance (RDA)=0.8 g/kg bw:
  - For 140-lb patient=51 g or 7 oz
- Stressed, malnourished patient=1.2-1.5 g/kg bw:
  - For 140-lb patient=76-95 g or 11-14 oz
- Critically ill or injured patient=1.5-2.0 g kg/bw:
  - For 140-lb patient=95-127 g or 14-18 oz
- Important to:
  - Evaluate renal function
  - Provide adequate fluids

Protein Distribution[14]

- Optimal protein distribution:
  - Breakfast=≈30 g protein
  - Lunch=≈30 g protein
  - Dinner=≈30 g protein
- Skewed protein distribution:
  - Breakfast=≈10 g protein
  - Lunch=≈20 g protein
  - Dinner=≈60 g protein

How to Get More Protein to Your Patient

- Food:
  - Eggs, beef, chicken
  - Nuts, legumes
  - Protein shakes
  - Recipe modifications
- Modular protein supplements:
  - Added to food
  - Given between meals or with medications

Modular Protein Supplement Choices

- Whey:
  - High biological protein source
  - Formulated from cow's milk
- Casein:
  - Milk protein extract
  - Less bioavailable than whey
- Soy or vegan:
  - Good biological legume
- Collagen:
  - Natural to the body
  - Main component of cartilage, ligaments, tendons, bones, and teeth

Deciding on a Protein Supplement

- Form:
  - Liquid
  - Powder
- Final volume

- Nutrient density
- Palatability
- Ease of administration
- Use of tube feedings
- Digestibility
- Cost

Amino Acids

- When protein is consumed:
  - The digestive system breaks it down into individual amino acids
  - The body's cells then combine the amino acids and link them together to form a new protein within the body

Classification of Amino Acids[15]

- Indispensable amino acids:
  - Histidine
  - Isoleucine
  - **Leucine**
  - Lysine
  - Methionine
  - Phenylalanine
  - Threonine
  - Tryptophan
  - Valine
- Dispensable amino acids:
  - Alanine
  - Aspartic acid
  - Asparagine
  - Glutamic acid
  - Serine
- Conditionally indispensable amino acids:
  - **Arginine**
  - Cysteine
  - **Glutamine**
  - Glycine
  - Proline
  - Tyrosine

Arginine[16]

- Nitrogen-rich—32% nitrogen
- Helps support immune function
- Precursor to proline
- Improves IGF-1
- Precursor to polyamines
- Substrate for nitric oxide synthesis:
  - Activates macrophages
  - Improves vasodilation

- Increases collagen formation

Glutamine[17,18]

- Most abundant amino acid in the body:
  - >20% total circulating amino acids
  - >60% intracellular amino acids
- Increased needs in trauma and sepsis
- Benefits of supplemental glutamine include:
  - Stimulating collagen synthesis
  - Regulating nitrogen metabolism in catabolic states
  - Supporting immunity
  - Supporting gut integrity

NPUAP Clinical Practice Guidelines: **Protein Intake**[9]

- When an adult patient with a pressure ulcer Category/Stage 3 or 4 or multiple pressure ulcers cannot meet nutritional requirements with traditional high-calorie and protein supplements, supplement with high protein, arginine, and micronutrients

Diabetic Foot Wounds[19]

- Targeted amino acid supplementation on diabetic foot wounds
- Results of this pilot data and review of the literature show:
  - Administration of a simple amino acid supplement may improve the healing of diabetic foot wounds via increased collagen

Leucine[20,21]

- Branched chain amino acid
- Stimulates mTOR signaling
- Stimulates muscle protein synthesis under both in vitro and in vivo experimental conditions
- 5% of leucine is converted to β-hydroxy-β-methylbutyrate (HMB)

HMB[22-25]

- Is a metabolite of the amino acid leucine
- Precursor for the manufacture of cholesterol:
  - Helps maintain muscle membrane integrity
  - Slows muscle tissue breakdown
- Helps support immune system
- Anabolic support:
  - Reduces the inflammatory process
  - Decreases muscle breakdown
  - Builds LBM
  - Protects muscle from stress-related damage

Vitamins and Minerals

- Can meet needs with a healthy diet[9]
- Elderly, sick, infirm many not have optimal diet[9]
- Consider heavily draining wounds[9]
- Reasonable to give multivitamin daily[9]

- "Offer vitamin and mineral supplements when dietary intake is poor, or deficiencies are confirmed or suspected."—NPUAP[9]

Vitamin C[26]

- Works with proline and lysine during collagen synthesis
- Needed for carnitine production for fatty acid metabolism
- Tensile strength
- Body does not store vitamin C

Zinc[27]

- Needed for all enzymatic reactions
- In deficiency state, may find low rate of epithelialization
- Deficiency causes decreased wound and collagen strength
- Urinary losses increase with stress and weight loss
- Body stores may become depleted in patients with malnutrition, chronic diarrhea, and chronic corticosteroid use
- Zinc overload:
  - Above 40 mg/day
  - Excess may interfere with wound healing via affecting lysyl oxidase, an enzyme involved in collagen synthesis
  - Excess interferes with copper and iron absorption and metabolism

Copper[27]

- Cofactor for connective tissue proliferation
- Collagen polymerization
- Formation of cross linkages to enhance scar strength
- Erythrocyte formation

Fluids (Hydration)

- 1 mL fluid/calorie[9,28]
- 30 mL/kg body weight [9,28]
- Additional fluids for dehydration, fever, vomiting, profuse sweating, diarrhea, heavily exuding wounds [9,28]
- Evaluate the need for additional fluids for patients on air-fluidized therapy surface [9,28]

Your Plan

- Step 1: Evaluate for malnutrition
- Step 2: Add the right amount of:
  - Calories
  - Protein
  - Amino acids
  - Vitamins and minerals
  - Fluids
- Step 3: Monitor closely and refer to a registered dietitian nutritionist if necessary

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