



Wound Healing

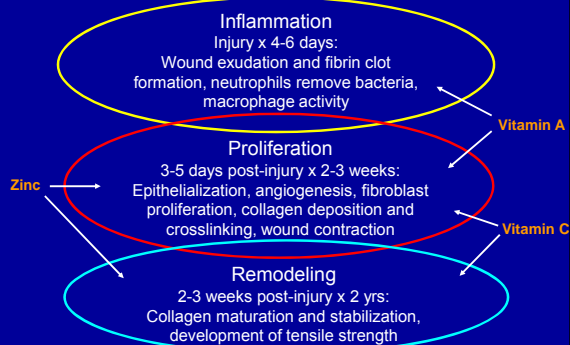
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Outline

- Wounds and nutrition refresher
- UPHS evidence-based guideline for nutrition support of patients with wounds

Normal Wound Healing



Thompson et al, NCP, 2005;20:331-347

Nutritional Risk Factors for Development of Pressure Ulcers

- Malnutrition related to
 - Poor appetite
 - Needs assistance with eating
 - Impaired sense of taste and smell
 - Inadequate intake of protein, energy, fluid, micronutrients
 - Weight loss



Risk Factors for Impaired Wound Healing

- Significant weight loss
- Inadequate protein intake
- Inadequate nutrient intake
- Extreme body mass index (BMI) – low or high with limited mobility
- Hypoalbuminemia

– Dorner B et al. Adv Skin Wound Care. 2009;22:212-221.

Nutrients for Wound Healing

- Provide adequate energy
 - Calorie needs: 30-35 kcal/kg
 - May need to be individualized based on:
 - Age
 - Comorbidities
 - Body weight
 - Activity level
 - Severity, size, and number of wounds
 - Stage in the healing process

Nutrients for Wound Healing

- Carbohydrate
 - Stimulates insulin production, release
 - Anabolism
 - May suppress gluconeogenesis if stress not severe
 - Adequate kcal add layer of padding to reduce pressure on skin

Glycemic Control

- Hyperglycemia
 - Reduced granulocyte function
 - Increased infectious complications
- Contributors to hyperglycemia
 - Corticosteroids
 - Antibiotics
 - IV fluids with dextrose
 - Physiological stress, counter regulatory hormones
 - Diabetes, insulin resistance

Nutrients for Wound Healing

- Fat
 - Provides energy
 - Spares protein for wound healing
- Aids in absorption of vitamin A
- Essential fatty acid deficiency may adversely affect wound healing

Nutrients for Wound Healing

- Protein roles
 - Collagen synthesis
 - Angiogenesis
 - Fibroblast proliferation
 - Tissue remodeling
 - Wound contraction
 - Maintenance of oncotic pressure
 - Hypoalbuminemia: tissue edema
 - Skin structure

Protein Goals

- Older adult (>65 years):
 - 1 g/kg for most
 - Stage I – III: 1.3 -1.5 g/kg
 - Stage IV – V: 1.5 – 2 g/kg
 - Needs may be >2 g/kg with severe wounds
- Protein deficiency impairs all stages of wound healing
 - Reduced immune function
 - Use protein for energy if inadequate calories provided

Transport Proteins

- Albumin, prealbumin
 - Albumin strong prognostic indicator in many populations
 - Predictor of pressure ulcer risk vs. due to pressure ulcer inflammation
 - Monitor trends
 - Albumin half-life almost 21 days
 - Prealbumin 3 days
 - Consider checking CRP to evaluate inflammation

Fluid Function and Goals

- Maintain skin turgor, perfusion, and oxygenation of healthy tissue
- Dehydration:
 - Impairs oxygen delivery to wounded tissues
 - Risk factors for dehydration:
 - Fever, diarrhea, vomiting, diuresis, draining or open wounds, fistulae, air fluidized bed
- Goal: 1 mL of fluid intake per kcal/day

Role of Vitamins

- Vitamin A
 - Deficiency impairs wound healing
 - Impaired collagen synthesis and cross-linking
 - Indication for supplementation:
 - Vitamin A deficiency
 - Glucocorticoid administration
 - Radiation or chemotherapy
 - Diabetes
 - Contraindications:
 - Renal or liver failure
 - Protein deficiency

Vitamin A Recommendations

Stage I-II:

- Replete only if deficient
- 10,000 – 25,000 IU x 10 days

Stage III-IV:

- 5000 IU per 1000 kcal
- Concomitant glucocorticoid use:
 - 10,000-15,000 IU x 7 days

Role of Vitamins

- Vitamin C
 - Deficiency: impaired collagen cross-linking, reduced wound tensile strength, increased wound dehiscence
 - Elderly at risk for deficiency
 - Poor dietary intake and malnutrition decrease vitamin C level
 - Indication for supplementation:
 - Deficiency : difficult to determine , expensive to test
 - Baseline repletion dosage unclear
 - Higher doses for increased wound severity

Vitamin C Recommendations

- Stage I-II:
 - 250 mg/day
- Stage III-IV:
 - 1000 mg/day (250 mg – 4x/day)
- Vacuum Dressing:
 - 1000 mg/day (250 mg – 4x/day)
- Renal Failure: 250 mg/day

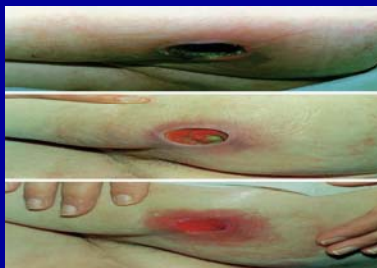
Role of Minerals

- Zinc
 - Deficiency: wound strength reduced, collagen synthesis decreased, slower rate of epithelialization, decreased immunity
 - Indications for supplementation:
 - Replete in deficient state - 220 mg/day
 - Risk Factors for deficiency:
 - Wound vac drainage, ostomy, diarrhea, malabsorption (can discontinue once drainage decreased)
 - Toxicity:
 - Impaired copper status (necessary for crosslinking)
 - Reduced wound healing

Role of Amino Acids

- Arginine
 - Conditionally essential amino acid
 - May influence microvascular perfusion → enhanced collagen production via proline synthesis
 - Stechmiller et al, NCP 2005;20:52-61
 - Stimulation of immune function
 - Recent studies demonstrate ↓ wound area, ↓ exudate, more rapid wound closure
 - Small samples
 - Few randomized-controlled trials
 - Felix Soriano et al, J Wound Care 2004;13(3): 319-22.
 - Heyman et al, J Wound Care 2008;17(11): 476-8.

Oral Supplement with Arginine



Grade IV pressure ulcer - baseline, after 3 weeks, after 9 weeks Heyman H et. al, J Wound Care 2008; 17 (11); 476-8

Role of Amino Acids

- **Glutamine**
 - Primary fuel source for rapidly dividing cells
 - Some data support improved nitrogen balance, improved immune function after surgical stress
 - Contraindicated in patients with liver failure, hyperammonemia, or neurology patients at risk for cerebral edema
 - More research needed for definitive recommendations

Role of Modular Supplement

- **Wound supplement (ArgiMent at)**
- **Provides**
 - 140 kcals/10 grams protein
 - 7 g arginine/7 g glutamine
 - 250 mg vitamin C/12.5 mg zinc
 - Mix with 6-8 oz water/juice per packet
- **Indications:**
 - Use for Stage III-IV pressure ulcers
- **Contraindications:**
 - Necrotic wounds until debridement occurs,
 - Liver failure, hyperammonemia, neurology, pts at risk for cerebral edema, or phenylketonuria



Role of Modular Supplement

- ♦ **Glutamine Supplement (GlutaMent)**
 - Provides 10 g glutamine/packet
 - Optimal dose is 0.5 g/kg
 - Mix with 6-8 oz water/juice per packet
- **Indications:**
 - Use for Stage III-IV pressure ulcers
- **Contraindications:**
 - Liver failure, hyperammonemia, neurology patients at risk for cerebral edema, or phenylketonuria

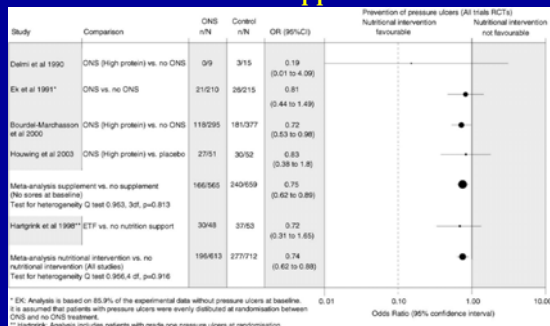


Role of Modular Supplement

- Protein (Prosource)
 - Provides:
 - 60 kcals/15 g protein
 - Mix with warm or cold beverages



Decreased Pressure Ulcer Risk with Oral Nutrition Supplements



Oral Nutrition Supplements

- One oral supplement (250 kcals/20 g protein) may reduce risk for pressure ulcer and improve outcomes in the elderly

Oral Nutrition Supplements



Ensure Plus



Glucerna



Nepro



Magic Cup



Mighty Shake



No Sugar Added
Mighty Shake

Summary: Key Points

- Provide adequate kcals/protein
 - Calorie counts?
 - May require combined therapies (specialized nutrition support + oral diet)
 - High calorie/high protein supplements
- Correction of vitamin/mineral deficiencies
- Adequate glycemic control
- Optimize hydration
- Consider amino acid supplements

1/27/08







Questions?