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

Inflammation
Injury x 4-6 days:
Wound exudation and fibrin clot formation, neutrophils remove bacteria, macrophage activity

Proliferation
3-5 days post-injury x 2-3 weeks:
Epithelialization, angiogenesis, fibroblast proliferation, collagen deposition and crosslinking, wound contraction

Remodeling
2-3 weeks post-injury x 2 yrs:
Collagen maturation and stabilization, development of tensile strength


Vitamin A

Vitamin C

Zinc
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

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: 1.5 - 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
    - Stachniulzer et al. JCP 2002;20:52-61
  - Stimulation of immune function
    - Recent studies demonstrate ↓ wound area, ↓ exudate, more rapid wound closure
  - Small samples
  - Few randomized-controlled trials

**Oral Supplement with Arginine**

Grade IV pressure ulcer - baseline, after 3 weeks, after 9 weeks Hayman 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

- **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

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<th>Study</th>
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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