Nutrition For Pediatric Wound Healing

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Objectives

• Understand the stages of wound healing and nutrients that impact the various phases

• Identify patient populations at risk for poor wound healing

• Develop/Demonstrate appropriate nutrition assessment/intervention/plan for pediatric patients with non healing wounds

• Distinguish when and how to supplement specific nutrients
Wounds in Pediatric populations

• Complex wounds:
  – Pressure ulcers (II, III, IV)
  – Non-healing surgical incisions w/dehiscence
  – Open and/or infected wounds
  – Vacuum assisted closures (VACs)

• Prevalence Pressure ulcers:
  – Up to 27% in Pediatric intensive care units
  – Up to 23% in NICU

• Consequences/Impact:
  – Increased hospital LOS
  – Decreased QOL and comfort
  – Financial burdens: Annual cost of tx pressure ulcers in the US = $11 Billion
Trivia

Phases of wound healing?

a) Inflammation, proliferation, hemostasis, remodeling
b) Proliferation, granulation, remodeling
c) Hemostasis, Inflammation, proliferation, remodeling

Functions of the Skin?

a) Protective, immunologic, social-interactive, Metabolic
b) Thermoregulation, Neurosensory, fluid/electrolyte homeostasis
c) Protective, immunologic, Neurosensory, fluid/electrolyte homeostasis
d) Thermoregulation, Neurosensory, fluid/electrolyte homeostasis, Protective, immunologic, social-interactive, Metabolic
Skin Layers: Pressure Ulcer Staging
Stage 1

Stage 2
Stage 3

Stage 4
Phases of Wound Healing

- **Phase 1**: Hemostasis
  - **Day 1 to 3**: Stop Bleeding
    - Arginine

- **Phase 2**: Inflammation
  - **Day 3 to 20**: New frame work for blood vessel growth
    - Omega 3, Se, VitC, VitE, Zn
    - Vit A

- **Phase 3**: Proliferation or Granulation
  - **Week 1 to 6**: and closed
    - Vit C, Vit A, Arginine

- **Phase 4**: Remodeling or Maturation
  - **Week 6 to 2 Years**: Final proper tissue
RELATIONSHIP BETWEEN NUTRITIONAL STATUS, WOUNDS AND METABOLIC NEEDS

- Increased requirements
- Malnutrition
- Poor healing
- Infection
- LOS
Nutrition Therapy Goals

- Optimal nutrition status
- Promote wound healing
- Adequate Oral intake
- Adequate protein and calories
# Nutrient functions in wound healing

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Function</th>
</tr>
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<tbody>
<tr>
<td><strong>Energy</strong></td>
<td>CHOs → principle energy source, helping to sustain high metabolic activity required for regeneration. lipids/EFAs → energy for proliferation, building blocks for epidermal and dermal tissues.</td>
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<tr>
<td><strong>Protein</strong></td>
<td>Collagen synthesis, epidermal growth, keratinization, scar formation, immune response, etc...</td>
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<tr>
<td><strong>Vitamin C</strong></td>
<td>Collagen synthesis, wound strength, electron donor for enzymes</td>
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<tr>
<td><strong>Zinc</strong></td>
<td>Protein synthesis, cellular growth/proliferation, deficiency impairs healing</td>
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<tr>
<td><strong>Vitamin A</strong></td>
<td>Promotes epithelial cell differentiation. Increases collagen cross-linkage. Suggested benefit in enhancement of early inflammatory phase.</td>
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<tr>
<td><strong>Arginine</strong></td>
<td>Semi essential AA- improves protein anabolism and cellular growth. Donor of NO which increases tissue blood flow.</td>
</tr>
<tr>
<td>Nutrient</td>
<td>Requirement</td>
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<tr>
<td><strong>Energy</strong></td>
<td>Increased based on assessed needs (RDA, Schofield x Stress factor) *Ideal IC</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td>Minimum 1.5 g/kg or 1.5-2 x RDA or per disease specific condition (Renal or liver failure)</td>
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<tr>
<td>Vit C</td>
<td>5x RDA for age in 2 doses (250mg BID) Renal/kidney stones: no more than 2x RDA Test Serum Vit C and start empiric supplementation while awaiting result. Continue supplementation only if deficiency is confirmed</td>
</tr>
<tr>
<td>Zinc</td>
<td>2x RDA for age divided in 2 doses (elemental); 1-2mg/kg/d repletion Test serum Zinc and start empiric supplementation while awaiting result. Continue supplementation only if deficiency is confirmed</td>
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<tr>
<td>Vit A</td>
<td>Supplementation suggested for chronic corticosteroid users, DM pts, those on chemo/radiation tx</td>
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Adequate hydration is essential to wound healing which means a warm, damp environment is ideal for the growth of new tissue.

**Consequences of dehydration:**
- Lack of moisture at the wound’s surface will halt cellular development and migration.
- Decreased oxygen perfusion.
- Poor delivery of essential nutrients to wound surface.
- Evaluate for *signs/symptoms* of dehydration:
  - Wt loss (in conjunction with I/Os)
  - Skin turgor
  - Sunken fontanels
  - Dry mucosal membranes
Labs: How to evaluate & what to look for/order?

- Optional: Albumin, Prealbumin
  - Alb and Prealb: Negative acute phase reactant $\rightarrow$ multifactorial
- Inflammatory Markers: WBC, Sed rate, Glucose, CRP
- If deficiency is suspected: Vit C, Zinc, Vit A (also may consider iron, Vitamin D, and copper levels)
  - May take $>7$ days to result
- BUN/Cr (to monitor adequacy and tolerance of protein load)
  - Special considerations: pts prone to kidney stones or w/renal insufficiency (avoid Vit C $>2x$ RDA and use Renal vit + supp Zn to avoid A toxicity)
Immunonutrition?

**Glutamine:** utilized by immunologically active cells and those involved in wound repair

**Supplementation has not been shown to benefit wound healing**

**Arginine:** rapidly depleted during periods of severe stress; utilized in the synthesis of collagen (precursor to proline), thus increasing collagen deposition in wounds

- OligoElement trial (2015), multicenter, randomized controlled, blinded trial
- Supplemented w/energy dense, high protein, arginine, zinc, and antioxidant rich oral supplement (Cubitan, Nutricia)

**RESULTS:** Greater reduction in PU area (40% at 8 weeks)

*No specific dosing guidelines for arginine currently exist*
Unit/Disease Specific Considerations

- **Malnutrition** is #1 !!! We all know this 😊
- Patients on long-term/chronic corticosteroids - induces inhibition of cutaneous wound healing → Rheumatoid arthritis, Lupus, Pulmonary diseases, UC/Crohns, Leukemia/Lymphomas, etc.
  - May require supplemental Vitamin A, dose/replete based on levels
- Immunocompromised patients: Heme/Onc, BMT, HIV/immune dz, premature infants, etc.
- Ortho/Surgical patients, particularly the CP kiddos needing pre-op nutrition assessments
- Hx of bowel resections and/or other possible malabsorptive conditions
- Diabetes - those with poor glycemic control
Nutrition support

What and when?

SCH protocol → 5% “dry” weight loss, BMI or Wt/Lt <10% or >95%, or <90% IBW, failure to grow

→ Starts MVI and offers oral supplement/shakes
→ If unable to tolerate PO, initiate EN/PN as indicated

A word about products in the world of WOUNDS:
Arginaid and Arginaid Extra
Juven
Beneprotein, ProMod, ProStat
Boost HP, Boost Compact
Immunomodulating marketed formulas: Perative, Pivot, Impact, etc.
Monitoring and Follow up

• Ideally:
  – Nutrition consult either on admit or upon discovery of wound
  – Reassessments q7 days→
    • including status of the wound (ex: TIME acronym for: Tissue characteristics, infection, moisture, and edges of the wound)
    • nutritional adequacy from PO/EN/PN
    • Labs + micronutrient supplements as indicated
Take-home messages

• Research is still inconclusive regarding the use of Immunonutrition.

• Malnutrition = poor outcome/higher risk.

• Do not forget the limitation of common Nutritional markers.

• Multidisciplinary team work is essential.

• Increase LOS and Cost.

• It could be preventable.


THANK YOU

Any questions?