Wound Healing Society
Bedside to Bench

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Disclosures

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  – Nothing to disclose

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• Harvey N. Himel, MD, MPH, FACS

• None of these disclosures will impact our discussion today
Pressure Ulcers:
When Stage 4 ≠ Stage 4
A Tale of 2 Patients
Team Approach
Indications for Debridement
Diagnosis and Treatment of Pelvic Osteomyelitis
Nutrition and Wound Healing
DTPI and Unstageable: When and If?

- Bariatric Surgical Patient
  - Surgical complication
- Acute wound
  - Exact event unknown
    - Probable hypotension
    - Multiple operations, ICU, poor nutrition
    - Appears to have demarcated
- Sensate, mobile
- Goals of care:
  - Reduce pain
  - Prevent infection
  - Rapid healing
Who Is the Team for This Patient?

- Bariatric Surgeon
- Plastic/Wound Surgeon
- Interventional radiology
- Wound Nurse
- Nutrition/dietician
- Hospitalist(s)
- ICU team
- Other considerations?
  - Discharge planning
  - Home health/Visiting nurses
  - Family
Is Nutrition to Blame?
Malnutrition as a Precursor of Pressure Ulcers

• **Recommendations** for individuals with preexisting pressure ulcers or at risk for ulcer development.

• Malnutrition is a major contributor
  – Decreased functionality
  – Decreased quality of life
  – Increased morbidity and mortality.

• Describes approach to diagnose malnutrition
  – Facilitate better correlation between best practices related to nutrient needs and the prevention and treatment of pressure ulcers.

• Recommends diagnostic characteristics for malnutrition
  – Focuses care on the patient and nutrition intervention to promote positive outcomes.

• Early nutrition intervention
  – Supports lean body reserves by
  – Prevents or delays protein and energy deficits and their impact on pressure ulcers

Mary D. Litchford, Becky Dorner, and Mary Ellen Posthauer
ADVANCES IN WOUND CARE, VOLUME 3, page 54, 2014
Risk Factors for Protein-Calorie Malnutrition

- Acutely ill, catabolic state
- NPO for surgical procedures
- NPO due to gastric leak
- Malabsorption
Initial Debridement

• Nutrition marginal
• Impaired mobility
• Pain
• Wound characteristics
  – Patchy bleeding
  – Gluteal muscle involved
    • Necrotic fibers
  – No bone exposed
  – No purulence
• Apparent excellent prognosis!

…but, not fully demarcated
Serial Surgical Debridement

- Nutrition improving
  - Tube feeds
- Mobility poor
- Bone exposed, cortex intact
- Tunneling along gluteal muscle
Stage 4 Pressure Ulcer
No Osteomyelitis

6 weeks after operative debridement

3 months after operative debridement
Completely healed 2 months later
Contrast:
Stage 4 Pressure Ulcer with Osteomyelitis

- 41 y/o s/p GBP with neuropathy due to spinal stenosis
- Fell on ice in March.
- 5 months later noted drainage and sought medical care
- Exam under anesthesia by colorectal surgeon - referred to plastic/wound surgeon for further care
- Appearance 7 months after initial injury
Who Is the Team for This Patient?

- Plastic/Wound Surgeon
- Infectious Disease
- Primary Care
- Home health/VNA
Operative Debridement

- *Chronic* wound
- Coccygeal fracture with *osteomyelitis*
- Surgical debridement with ostectomy
Is Serum Albumin a Good Marker of Nutrition?

![Graph showing the relationship between Serum Albumin and Nutrition over 90 days for two series: Series 1 and Series 2.](chart)
Acute vs Chronic Disease-related Malnutrition

Hypothetical patients with inflammation-related malnutrition. ADRM, acute disease-related malnutrition; CDRM, chronic disease-related malnutrition (under-nutrition).

Litchford MD et al. Malnutrition as a Precursor of Pressure Ulcers
ADV IN WOUND CARE, VOLUME 3, page 54, 2014
# Nutritional Deficiencies after Gastric Bypass Surgery

<table>
<thead>
<tr>
<th>Dietary Element</th>
<th>Recommended Daily Allowance*</th>
<th>Complications From Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>1000-1300 mg</td>
<td>osteoporosis</td>
</tr>
<tr>
<td>Copper</td>
<td>700 μg</td>
<td>progressive difficulty walking, heart enlargement, neurologic and psychiatric disorders</td>
</tr>
<tr>
<td>Folate/Folic Acid</td>
<td>400† μg</td>
<td>megaloblastic anemia, neurologic and psychiatric problems</td>
</tr>
<tr>
<td>Iron</td>
<td>8-18 mg</td>
<td>iron-deficiency anemia, fatigue, generalized weakness, irritability</td>
</tr>
<tr>
<td>Vitamin B₁₂</td>
<td>2.4 μg</td>
<td>anemia, neuropathy, cognitive difficulties</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>5-15 μg</td>
<td>osteoporosis</td>
</tr>
<tr>
<td>Zinc</td>
<td>8-11 mg</td>
<td>folate deficiency</td>
</tr>
</tbody>
</table>

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*Recommended Daily Allowance
†Recommended Daily Allowance for Pregnant Women

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Vitamin C and Iron are Essential for Wound Healing
“In our study, ascorbic acid depletion and deficiency were prevalent in patients presenting for surgery. We found that a greater BMI was associated with lower ascorbic acid concentrations, an association independent of supplementation, diet, and age. No adverse surgical outcomes were attributable to the low ascorbic acid concentrations.”

Ascorbic acid deficiency in bariatric surgical population.
In this study it appears there is a trend for reduced serum Vitamin C during the post-op period despite supplementation.
Role of Copper in Collagen Synthesis

The Enzyme Lysyl Oxidase requires Copper as a Co-Factor

What about Zinc??
Clinical Course

1 month after presentation
Some bone still exposed – episodic debridement in clinic

4 months after debridement
Culture guided antibiotics x 12 weeks per ID
Granulation over bone
Persistently elevated inflammatory markers
Diagnosing Pelvic Osteomyelitis

- Presence of open wound
- Pain, fever – may be absent
- Exposure of bone
- Bone biopsy – reliable if properly done
  - Culture and sensitivity
  - Histopathology
- Laboratory
  - WBC
  - ESR
  - CRP

Imaging Studies

- Plain radiograph – Sens 18% - Spec 100%
- Bone scan – Sens 81% - Spec 28%
- WBC scan – Sens 74% - Spec 68%
- CT – Sens 67% - Spec 95%
- MRI – Sens 90% - Spec 79%

Lewis et al – Plast Reconstr Surg 1988 Feb: 81(2)229-32
Treating Pelvic Osteomyelitis

• Comparative effectiveness studies lacking
• Surgical options must be individualized clinically
• Empirical choice of antibiotics:
  • No clear consensus
  • Culture directed antibiotic if possible
• Duration of antibiotic treatment not well studied
  • Ranges from 2 weeks to 42 weeks reported
  • All results were comparable
  • No studies on the efficacy of locally applied antibiotics

Published online (www.interscience.wiley.com)
International Working Group on the Diabetic Foot
Inflammatory markers, Pressure Ulcers and Osteomyelitis

![Graphs showing changes in acute and chronic CRP and ESR levels over time.

- CRP Acute and CRP Chronic levels decrease from initial measurements.
- ESR Acute peaks around 30 days before decreasing, while ESR Chronic levels remain relatively stable.]
Monitoring Treatment

- ESR, CRP – monitor after 4 weeks treatment
- Repeat imaging studies
  - Only if clinical response unfavorable
- Closely follow progress of associated wound

Conclusions

- Current staging system does little to inform about prognosis of Stage 4 pressure ulcers
- Multi/Interdisciplinary approach required for successful outcomes
- Principles of comprehensive care translate to all sites (heels, elbows, sacrum, etc)
- Pressure Ulcer specific research is needed