Wound Care and Hyperbaric Medicine

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Wound Care
Hyperbaric Medicine

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Hyperbaric Medicine
DHMC Opening New Wound Care Center
Case #1

- 80 year old male with lower extremity arterial occlusive disease.
- November, 2012, spontaneously developed ulcerations to right plantar heel, lateral second and third toes.
- Ulcers were painful with direct pressure and did not awaken him at night.
- He was seen by his PCP and referred to a vascular surgeon and wound center.
Problem List

- Peripheral Vascular Disease
- Abdominal Aortic Aneurysm
- HTN
- Hyperlipidemia
- Spinal Stenosis
- Bilateral Hip Replacement
- Type 2 Diabetes Mellitus
- Prostate cancer
- Dementia
- Social History: Smoked for 40 yrs; Quit smoking 20 yrs ago
Ankle Brachial Index

- January 2010  Right-0.56  Left-0.6
- January 2013  Right-0.36  Left-0.56
- \(< = 0.5\)  \((0.56 \text{ L})\)  Severe ischemia
- \(< = 0.4\)  \((0.36 \text{ R})\)  Limb threatened

**ABI Interpretation 2013-**

**Right:** Moderately severe to severe lower extremity arterial occlusive disease

**Left:** Moderate to moderately severe lower extremity arterial occlusive disease
Case #1: Lower Extremity Arterial Disease

- January, 2013: Seen at wound center and by a vascular surgeon.
- Physical Exam: **Palpable** pulses > radial, femoral and left popliteal.
- **Non-palpable** pulses > right popliteal, posterior tibial and dorsalis pedis.
- Full thickness ulcers right medial heel with a smaller ulcer to lateral right heel.
- Open wound to lateral right third toe with a smaller wound to lateral second toe.
ARTERIAL ULCER
Wound Care Principles

- Debride devitalized tissue
- Control infection
- Maintain moisture balance
- Correct hypoxia
Wound Care Principles
Arterial Ulcers

• Debride devitalized tissue
  • Remove infected necrotic tissue-surgical consult
  • Non-infected, Non-fluctuant, dry necrotic tissue-protective covering. Paint 3 x week betadine. Removal creates larger wound
Wound Care Principles

Control infection

- Systemic antibiotics with cellulitis/infection
- Consider antimicrobial dressings-reduce bacterial load
- Silvadene used in this case
Wound Care Principles

• Maintain Physiological Wound Environment
  • Arterial ulcers> dry, minimal exudate
  • Provide moisture> Ex. Hydrogel impregnated gauze
  • Silvadene provided moisture with antimicrobial activity
• Protect wound
• Manage pain
Wound Care Principles

• Correct hypoxia
  • Revascularization—not possible
  • Pharmacology-statins, vasodilators-Trental, anti-platelets
  • Hyperbaric oxygen?
LOWER EXTREMITY NEUROPATHIC DISEASE

CASE REVIEW #2

DIABETIC NEUROPATHIC ULCER
Case #2: Lower Extremity Neuropathic Ulcer

• 75 year old male with 35 year history of Type 1 Diabetes Mellitus.
• May 2003-developed ulcer to left foot that did not heal.
• August-October 2003- Several surgeries for removal of 2nd digit right foot, 1st and 5th digits left foot.
• Since second surgery, poor healing of ulcer to lateral aspect left foot.
• Wound therapy- daily dressing changes with Santyl (removes necrotic debris), Granulex spray.
Lower Extremity Neuropathic Ulcer

PMH:

- **Coronary Artery Disease, Inferior MI.**
- Seizures- occurred in setting of heart block. Pacemaker placed.
- **Type 1 Diabetes Mellitus**
- Right total knee replacement
- Pneumothorax after pacemaker insertion
- Amputation of left great toe and fifth toe, amputation of right third toe
- History of tobacco and occasional alcohol use.

Medications:

- Nexium, Lipitor, Lotensin, Multi-vitamin, Insulin, ASA
Diabetic Ulcer

**Typical location:** Increased pressure points on plantar surface of feet.

**Appearance:** Borders are punched out, surrounding skin often calloused.
Wound Care Principles

• Debride devitalized tissue
  • **Know perfusion status before debridement**
  • In this case, surgical debridement essential
  • Santyl, a daily enzymatic debridement agent, cover with a secondary dressing. Discontinue when necrotic tissue debrided.
Wound Care Principles

- Control infection
  - Avoid increase in wound bio-burden
  - Use non-occlusive dressings (foam)
  - Systemic antibiotics with or without topical antimicrobials (Ex. Honey, cadexomer iodine, silver impregnated dressings, silvadene)
Wound Care Principles

• Maintain moisture balance
  • Exudative wound- foams, alginates, hydrofiber dressings.
  • Wounds that require moisture-add hydrogel or hydrogel impregnated gauze.
• Protect foot
• Offload pressure
Wound Care Principles

- Correct hypoxia
  - Hyperbaric oxygen as adjunct to wound care?
Dr. Ite Boerema

- Pig placed in hyperbaric chamber breathing oxygen under pressure
- Red cells removed in increments, but plasma returned to the pig
- At 3 ATA of oxygen, hemoglobin concentration could be lowered to essentially zero.

Venous Hb sat at almost arterial levels at 3.5 ATM of oxygen.

### Table 5. Effects of O₂ Inhalation at 3.5 ATM upon Blood O₂ and CO₂ Transport (Group III, 12 Subjects)

<table>
<thead>
<tr>
<th>BLOOD MEASUREMENTS</th>
<th>1 Atm Air</th>
<th>3.5 Atm Oxygen</th>
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<tbody>
<tr>
<td></td>
<td>Arterial</td>
<td>Internal Jugular</td>
</tr>
<tr>
<td></td>
<td>Arterial</td>
<td>Internal Jugular</td>
</tr>
<tr>
<td>O₂ Content (vols. %)</td>
<td>18.7</td>
<td>12.6</td>
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<td>Hb Sat (%)</td>
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<tr>
<td>P₅O₂ (mm Hg)</td>
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<tr>
<td>CO₂ Content (vols. %)</td>
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<td>pH</td>
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<tr>
<td>pCO₂ (mm Hg)</td>
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<td>50.0</td>
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<td></td>
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<td>17.8</td>
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<td></td>
<td>100.0</td>
<td>89.3</td>
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</table>
Löndahl et al., Curr Diab Rep, 2011
Tongue pre-HBO
Tongue post-HBO
Main HBO effect

• Greatly increases the amount of oxygen dissolved in plasma
• Increases the oxygen content of blood reaching the tissues
Kessler et al. Study

• Kessler et al. enrolled 28 patients with Wagner grade 1-III foot ulcers. 15 randomized to HBO + standard treatment, 13 to standard treatment
• Both groups hospitalized for 2 weeks for optimal blood sugar control
• HBO group received HBO twice a day for 2 weeks
Ulcers healed faster with HBO (white bars)

Kessler, et al., Diabetes Care, 2003
Löndahl et al. Study

- Randomized, single-center, double-blinded, placebo-controlled clinical trial
- 94 patients with Wagner grade II, III, or IV ulcers present for > 3 months
- HBO given 5 days a week for 8 weeks (40 treatments), control subjects received hyperbaric air
- Patients followed for 1 year, blinding not broken until last patient completed 1 year follow-up.
Healing rates in patients completing >35 HBO sessions (dark grey bars) (** p<0.01)
Proper Patient Selection is Essential

• Wagner grade III with no improvement despite 30 days of appropriate wound care
• Other reasons for poor healing investigated and controlled (proper footwear, good diabetic control, vascular problems corrected if possible)
HBO summary

• HBO speeds healing of diabetic foot ulcers
• Also, indicated for arterial ulcers based on TCO2 outcomes
• Recent randomized trial shows better outcomes for diabetic ulcers in HBO group
• Further trials in work, data on amputation rates, patient selection needed
• Covered by Medicare and private insurance (Anthem, Cigna, Harvard Pilgrim, etc.)
Use of HBO

• Usual treatments are at 2.0-2.4 atmospheres absolute for 90 minutes. Treatment course usually 20-40 treatments.

• Complications include claustrophobia, oxygen seizures (rare), difficulty clearing ears.

• Contraindications: Current doxorubicin use, history of bleomycin use, disulfiram use, current cisplatinum use, pneumothorax

• Relative contraindications: chronic sinusitis, seizures, emphysema with CO2 retention, history of thoracic surgery, surgery for otosclerosis, history of optic neuritis, poor cardiac function.
Case #1

- Patient wanted alternative to surgery.
- Not an ideal candidate for surgery.
- Referred for Hyperbaric Medicine consult to determine if hyperbaric oxygen would be a reasonable treatment option for ulcers.
- Transcutaneous oxygen (TCO2) measurement mid foot was 23 mmHG and increased to 40 mmHG after breathing 100% O2. (TCO2-non-invasive measure of oxygen diffusion in the skin. Values less than 40 mm Hg reflect tissue hypoxia and delays in healing)
- Hyperbaric oxygen treatments were initiated.
TCM400
The information you need to make the right decision

The TCM400 monitor is used in wound care and hyperbarics, where transcutaneous measurements are an effective diagnostic tool in the detection and treatment of critical limb ischemia. It is the only portable monitor that provides up to six simultaneous measurements of transcutaneous oxygen tension (tcpO₂). Together, these measurements allow an accurate mapping of the site and thus a better foundation for diagnosis and treatment.

- Up to six simultaneous measurements of tcpO₂
- Calculate regional perfusion index
- Integrated and automatic calibration

Simpler, faster, better
Hyperbaric Treatment

• The patient received 40 treatments, however some were not complete 90 minute sessions.
• Some treatments were terminated early due to confinement anxiety as well as pain to legs while in a supine position.
Case #2

- Hyperbaric consult - Physical exam of left foot revealed:
  - Ulcer on lateral aspect of left foot.
  - Ulcer on medial aspect of left foot.
  - Small ulcer to plantar surface of left foot second toe.
  - Transcutaneous oxygen measurement lateral aspect left foot was 35-40mm Hg.
Pre initial HBO treatment
Left foot S/P great toe amputation pre-HBOT
Left foot S/P great toe amputation during course of HBO treatment
Left foot end of HBO treatment
January 13, 2004
During course of HBO Treatment
Left lateral foot during course of HBO treatment
Left lateral foot final HBO Treatment
January 13, 2004
SUMMARY

Maintain a physiological wound environment

• Debridement of devitalized tissue
• Prevent and Manage Infection
• Manage exudate, edema & moisture balance
• Eliminate dead space
• Manage pain
• Protect peri-wound
• Correct Hypoxia-Revascularization, Hyperbaric oxygen if indicated
References


Comprehensive Wound Healing Center (CWHC)

4M Faulkner Building
DHMC
653-6000
Staff

- **Gary Freed, MD**
  Medical Director
- **Tim Bray RN, BSN, CWCN**
  Practice Manager
- **Gabrielle Carrier, MBA**
  Associate Practice Manager
- **Nancy Yazinski, APRN**
- **Kathy Kovacs, APRN**
- **Team of Certified Wound Care Nurses & LNAs**
Typical Wounds

• Assessment, Evaluation and Management of:
  • Lower extremity arterial ulcers
  • Venous ulcers
  • Pressure ulcers
  • Neuropathic wounds (diabetic foot ulcers)
  • Traumatic wounds
  • Surgical non-healing wounds
Counseling/Education/Support

- Glucose control
- Smoking cessation
- Weight management
- Exercise/activity
- Nutrition counseling
- Offloading/pressure relief
- Foot care
- Self-care/health maintenance
Comprehensive Care

- Treatment based on evidenced-based clinical practice guidelines
- Interdisciplinary resources at D-H are made available through established care pathways
Opening Date

- Referrals accepted Nov. 4, 2013
- Wound Center opens Nov. 11, 2013
- Call 653-6000 for referral intake
  - OR -
- E-DH ambulatory referral order: MHMH Wound Ctr.
  - Open Mon-Fri 8:00-4:30