Limb Salvage.  
A Team Approach.

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Disclosures

- I have nothing to disclose
Objectives

- History of Wound Care
- Case Presentation
  - Diabetic foot wounds
- Future of Wound Care in Central Oregon
- Questions...

History of Wound Care

- Probably the second oldest branch of medicine
- Goals were similar across ancient cultures
  - Pain control
  - Hemorrhage control
  - Restoration of skin and tissue substance
  - Spiritual treatment
- Wound care parallels advances in surgical care and warfare
History of Wound Care

- **Sumerians**
  - 2400 BCE Ashurbanipal’s library clay tablets
    - Wash with water, milk or beer
    - Apply a plaster (salve of plant extract, resins or spices)
    - Apply a bandage (boiled wool)
    - Incantation

- **Egyptians**
  - 1500 BCE – Edwin Smith Papyrus
    - Noted closed wounds healed faster
    - Invented band-aids
      - Tree sap and linen
    - Cautery
    - Honey, Lard and Copper
    - Incantations

- **Greeks**
  - 800 BCE
    - Washed and dressed wounds
    - Incantations
    - Borrowed heavily from Egypt after 500 BCE

Hippocrates (460-377 BCE)
- Wounds
  - Wash with wine or vinegar
  - Honey or oil (Salves)
  - Removal of necrotic material
  - Bandages...but not too tight...
  - Balance humors
  - Nature would then best heal the wound
- Visit to Temples of Asklepios (Asclepius)
  - Tame snakes would lick wounds
  - Incubation then awake cured

Hermes and the Caduceus - two snakes or serpents with wings on the staff
History of Wound Care

• Early Middle Ages
  • Galen
  • Cobwebs, writing ink and Lemnian clay
  • 15 centuries of influence

• Late Middle Ages
  • Creation of medical schools in Europe
  • Theodoric Borgognoni (1205-1298)
  • Remove necrotic tissue, avoid pus, control bleeding, carefully apply dressings
  • Guy de Chauliac (1300-1368)
  • “pus bonum et laudabile” – laudible pus
  • Restablished 500 more years of Galenic rule
  • Physical contact with sick was abhorrent

• Dark Ages of Medicine

• Renaissance 1400-1700’s
  • Questioning Galen
  • Vesalius (more accurate anatomy)
  • Pare (ligating vessels and suturing closed wounds... again)
  • Hunter (angiogenesis, anatomy)
  • Pierre Desault (coined term debridement - “brider” check or curb)


History of Wound Care

- Late 1800’s
  - Pasteur (germ theory)
  - Lister (asepsis)
  - Halsted (rubber gloves)

- Early 1900’s
  - Fleming (antibiotics)
  - Wound physiology (cell types, cytokines, growth factors...) 1908, 1946, and 1986 Nobel Prizes for Medicine

Modern Management and Therapies

- Hyperbaric oxygen therapy (HBOT)
  - John Haldane - Royal Navy
  - Developed Dive Tables
  - Father of Oxygen Therapy
  - Dr. Orville Cunningham
  - Hyperbaric Hotel

- Dressings
  - > 5000 wound care products commercially available
    - Medihoney
    - Alginate
    - Silver

- Negative Pressure Therapy (Wound VAC)

- Nutrition

- Advanced surgical techniques (free flaps, angioplasty)

- Biological Dressings (Placenta, Porcine bladder, Fetal foreskin)

- Wound Care Centers

Diabetic Foot Wound - Case Presentation

• JC - 54 year-old female tripped over dog 1/31/16
  • Multiple fractures in the right foot
  • Placed in walking boot with air bladder
• Past Medical History
  • Type II diabetes x 15 years
  • End stage renal failure on hemodialysis x 2 years
  • Hypertension
  • Hyperlipidemia
  • Obesity
  • Peripheral vascular disease
  • Peripheral neuropathy
Diabetic Foot Wound?

- 15-25% of Diabetics
- $9-13 billion of direct yearly costs associated with diabetes
- Burden
  - Average 155% more hospital days
  - Average 157% more home health days
  - Average 75% more ED visits
  - Average 38% more office visits
- RR of death 2.39 for diabetics with ulceration

Diabetic Foot Wounds - Risk Factors

- Risk Factors
  - Local and Systemic Factors

- Etiology
  - Ischemia
  - Neuropathy
  - Impaired inflammatory response


Diabetic Foot Wounds - Pathophysiology
Diabetic Foot Wound - Evaluation

• History
  - JC History and Exam
  - DM x 15 years
  - ESRD on HD
  - Obesity
  - Neuropathy with fractures
  - Pulses not palpable
  - Full thickness but not probing to bone...yet

• Exam
  - Pressure points
  - Shoes
  - Walking boots
  - Neuropathy
  - Depth of wound
  - Bone involvement?
  - Pulses

  - Positive correlation between depth and stage and amputation

  - OR: 31.5 midfoot or higher amputation
  - OR: 89.6 midfoot or higher amputation

Infection and Ischemia


Diabetic Foot Wound - Team

• Medical Management
• Offloading
• Infection Control
• Revascularization
• Debridement
• Wound Care
• Hyperbaric Oxygen Therapy
Diabetic Foot Wound - Management

• Medical Management
  • Blood sugar control (HgbA1c 6-7.5%)
    • 35% RR reduction for amputation with intensive therapy
    • Slows decline in sensory loss

• Offloading
  • Prevent further damage
  • Most efficient method unknown
  • Low quality evidence for:
    
    total contact casting (TCC) > removable total contact casting (RCC) > shoes > nothing


Diabetic Foot Wound - Infection

• ALL diabetic foot wounds are colonized
• NOT all diabetic foot wound are infected
• Infection Defined by \( \geq 2 \) classic findings:
  • Inflammation
  • Purulence
• When to culture
  • Do not swab uninfected wound
  • Obtain deep culture after debridement with biopsy or curettage
Diabetic Foot Wound - Infection

- Classification of Diabetic Foot Infections
  - Mild
    - Superficial
    - GPCs (Oral abx)
  - Moderate
    - Deeper and more extensive
    - GPCs and GNRs (Oral or IV)
  - Severe
    - Systemic symptoms
    - GPCs and GNRs (IV broad spectrum)

  Close Follow-up

  Admission and Consultation

Diabetic Foot Wound - Revascularization

- Will it heal?
  - Palpable pulses with in-line flow
  - Angiosome directed revascularization

- Studies
  - Ankle-brachial indices
  - Toe-brachial indices
  - Toe pressures
  - Transcutaneous oxygen tension
  - Laser Doppler not available here

- Admission and Consultation
  - Ankle pressure (>50% of wound healing)
  - >60 mmHg PAD
  - >80 mmHg PAD + DM
  - TcO2
    - <40 mmHg not reliable for wound healing
  - Laser Doppler
    - <30 mmHg not reliable for wound healing
Diabetic Foot Wound - Revascularization

- No palpable pulse
- Borderline pressures for healing
- Tibial disease
  - Most commonly affected vessels with DM
- 1\textsuperscript{st} Revascularize
- 2\textsuperscript{nd} Debride
Adjunctive therapy

• Wound Vac Therapy
  • Black sponge
  • 125 mmHg
  • 2x closure rate
  • ½ as many amputations¹

• Hyperbaric Oxygen Therapy
  • 45 dives at 2.0 ATA for 90 minutes

• EpiFix
  • Amniotic Membrane Allograft (Placenta)
  • 92% wound healing at 6 weeks⁴
  • 3X faster time to healing compared with Apligraf and SOC⁴

¹ Blume et al. Comparison of negative pressure wound therapy with advanced moist wound therapy in treatment of diabetic foot ulcers. Ostomy Wound Manage. 2014; 60(1):4-9
² Kranke et al. Hyperbaric oxygen therapy for chronic wounds. Cochrane Database Systematic Review 2004; Issue 2, CD004123

Week 1
Week 20

Week 22
Team Approach

- Infectious Disease
- Podiatry
- Orthopedic Surgery
- Vascular Surgery
- Nephrology
  - HBOT
  - Primary care physician
- Wound-Ostomy Nurses
- Patient’s Family

Multidisciplinary Centralized Wound Care Programs:
- Decrease rate of major amputation > 50%
- Significantly reduce systems costs:
  - Early referral
  - Education
  - Efficiency
- Improve patient quality of life
  - QALY much lower than other interventions
- Allow providers to do what they do best!


The Case for a Centralized Wound Care Program
Centralized Wound Care Program - Need

- 2-3% of the US population have a chronic wound (Sen et al. 2009)
- 2016 - 221,005 - 4420 patients
- 2025 ~ 265,104 - 5300 patients

Centralized Wound Care Program - Scope

- Wounds encompass vast array of etiologies
  - Diabetes
  - Trauma
  - Venous disease
  - Ischemia
  - Pressure
  - Infection
  - Autoimmune disease
  - Coagulopathies
  - Radiation
  - Renal failure on dialysis
  - Malignancies
Centralized Wound Care Program - Efficiency

- Dedicated providers “woundists”
  - Caring for wounds on weekly basis
  - Wound-Ostomy Nurses (12)
- 40% of patients require referral to specialists
- 36% of patient require admission and surgical interventions
- 12-15% require hyperbaric oxygen therapy


Centralized Wound Care Program - Outcomes

- Worldwide development of wound care centers
  - Comprehensive Systematic Approach
    - Multidisciplinary team approach
    - Evidence based treatment protocols
    - Efficient clinic structures
    - Supportive hospital systems
- Sequelae of untreated, delayed or inappropriate wound care
  - Amputation rates > 60% (Larson et al 1995)
  - Higher health care costs (Driver et al 2010)
  - Decreased quality of life (Franks and Morgan 2003)

Centralized Wound Care Program - Result

- Healed wounds
  - Healthier community
- Caregivers with gratifying practices
  - Caregivers doing what they do best
- Health care system with lower costs
  - 20% of readmissions are wound related (Merkow et al 2015)
- Steady influx of complex patients
  - Increases surgical volume

Centralized Wound Care Program - Future

- June 2017
  - Moving to Pilot Butte Medical Center
    - 4 exam rooms
    - 1 procedure room
    - 2 offices
    - Hyperbaric oxygen therapy
  - Full-time Nurse Practitioner
  - Improved Website with Rapid Referral Ability
  - Inpatient Wound Ostomy Service Physician and Consult Rounds
  - Intensive Outreach and Education Programs
  - Central Oregon Wound Care Symposium
    - Available CME credit
    - Local and Regional Speakers
  - Joint Commission Disease Specific Certification in Wound Care
Questions?