W28
WOUND INFECTION; HOUSTON WE HAVE A PROBLEM
CHUCK GOKOO MD, CWS
CHIEF MEDICAL OFFICER
AMERICAN MEDICAL TECHNOLOGIES

CHUCK GOKOO MD, CWS
AMERICAN MEDICAL TECHNOLOGIES
CHUCK.GOKOO@AMTWOUNDCARE.COM

DISCLAIMER

The information presented herein is provided for the general well-being and benefit of the public, and is for educational and informational purposes only. It is for the attendees’ general knowledge and is not a substitute for legal or medical advice. Although every effort has been made to provide accurate information herein, laws change frequently and vary from state to state. Notwithstanding any educational information provided by American Medical Technologies, please refer to, and follow, your facility’s written policies and procedures.

The material provided herein is not comprehensive for all legal and medical developments and may contain errors or omissions. If you need advice regarding a specific medical or legal situation, please consult a medical or legal professional. Gordian Medical, Inc. dba American Medical Technologies shall not be liable for any errors or omissions in this information.
PROGRAM OVERVIEW AND OBJECTIVES

- Discuss the differences between acute and chronic wound healing models.
- Explain the importance of wound bed preparation to reduce bioburden levels.
- Discuss the recommendations for clean versus sterile technique during wound care.

“Houston we’ve had a problem here”
Jack Swigert, April 13, 1970

ACUTE WOUND MODEL
ACUTE TO CHRONIC WOUND MODEL

Microbial Flora
- Acute wound
  - S. aureus, and Beta-hemolytic Streptococcus
  - 4 weeks
  - Facultative anaerobic gram negative rods
- Chronic wound
- Anaerobes
  - Coifoms (deep)
- Polymicrobial
  - Aerobic and anaerobic organisms
- Houston we have a problem

CHRONIC WOUND MODEL

Chronic Wounds
- Pro-inflammatory cytokines
  - 200 - 300 times higher in chronic wounds
- Neutrophils - release MMP's in excess
  - Digest extracellular matrix
  - Fibronectin (elastase) bind and inactivate growth factors
- Diminished tissue inhibitors of metalloproteases (TIMPs)
  - Connective tissue is degraded
- Houston we have a problem

BIOBURDEN/INFECTION

- Contamination
  - Non replicating bacteria
- Colonization
  - Replicating bacteria without signs or symptoms of infection
  - Polymicrobial (aerobic/anaerobic)
- Critical Colonization
  - Bioburden levels cause a delay in ulcer healing
  - Increased pain
  - No acute host reaction
- Infection
  - Deposition and replication of bacteria in the tissue causing a host reaction
3/18/2015

BIOPHOREN/INFECTION

Infection = Dose x Virulence

Host resistance

- Host resistance
- Degree of chronicity
- Wound area
- Mechanism of injury
- Smoking
- Vascular disease
- Diabetes mellitus
- Poor nutritional status
- Immunosuppression or use of steroid medications

BIOPHOREN/INFECTION

Local Signs and Symptoms of Chronic Infection

- Erythema (Rubor)
- Warmth (Calor)
- Swelling (Tumor)
- Increased pain (Dolor)
- Tenderness
- Foul odor
- Purulent drainage
- Crepitation
- Pus pocketing at the base of the wound
- Bleeding or friable granulation tissue
- Tissue discoloration
- Ulcer breakdown

NERDS

- Nonhealing
  - Decrease in size 20 - 40% in 4 weeks and closed by 12 weeks
  - Bacteria may be causing a chronic wound
  - Biopsy to rule out unsuspected diagnosis
- Exudative ulcer
  - Purulent or sanguineous exudate - bacterial imbalance
- Red and bleeding ulcer
  - Bright red tissue that bleeds - bacterial imbalance
  - Prolonged inflammatory state interferes with normal healing
- Debris in the ulcer
  - Necrotic tissue and debris is a source for bioburden buildup
- Smell
  - Cause of odor
**BIOBURDEN/INFECTION**

**STONES**
- Size change
- Deeper and surrounding tissue damage by bacteria
- Temperature
- SYF between two mirror image areas
- Os probe to exposed bone
- Osteomyelitis
- New or satellite area of breakdown
- Separated from the main ulcer
- Exudate, erythema, edema
  - Frank purulence
  - Smell
  - Putrid smell

**Systemic Effect**
- Bacterial vs. viral
- Leukocytosis
- Hyperthermia, chills, nausea, vomiting
- Altered mental status: confusion
- Elevated pulse
- Multi-organ involvement
- R/O (urosepsis, pneumonia, carcinoma, autoimmune disease)

**Tissue Biopsy**
- Qualitative analysis
- Determine the colony count/g of tissue

**Needle Aspiration**
- Colony-forming units/volume of fluid
- May underestimate bacterial isolates

**Wound Culture**
- Semi-qualitative analysis
- Local signs of infection or if systemic signs resulting in sepsis occur
  - Aerobic and anaerobic
BIOBURDEN/INFECTION

Culture Techniques
- Cleanse
- Debride
- Swab viable tissue
- Planktonic bacteria
- Levine Technique
  - 1 cm² area
  - Extract fluid and tissue
- Aerobes and anaerobes

BIOBURDEN/INFECTION

Biofilms
- 70% - 80% of chronic wounds
- Polymicrobial infections
- Attached to an environmental surface
- Encased in an extracellular polysaccharide or gelatenuous matrix
- Debridement
- Antibiotics
- Topical antimicrobials

BIOBURDEN/INFECTION

Multi-Drug Resistant Organisms (MDROs)
- Non responding infection
- MRSA (HA/CA)
- Vancomycin-resistant enterococci (VRE)
- Assess
  - Length of stay in the facility
  - Multi-patient room
  - Recent hospitalization
  - Previous antibiotic use

MUTI DRUG RESISTANT ORGANISMS (MDROS)
Cellulitis
- Inflammation of the interstitial tissue
  - Warmth, swelling, tautness, erythema, fever
- Rule of 2cm
  - Mild, moderate, severe
  - Group A streptococcus
- Treatment
  - Systemic antibiotic for localized infection
  - Hospitalization with IV antibiotics for spreading cellulites

Abscess
- Involves the fascia tissue
- Treatment
  - Incise and drain
  - Debridement
  - Tissue graft may be necessary
  - Antibiotics therapy is variable

Osteomyelitis
- Affects and/or small bones of the foot
- Associated with a non-healing or a recurring ulcer
- Severity of infection
  - Visible or palpable bone implies an 85% chance of osteomyelitis
- Treatment
  - Bone Biopsy
  - Bacterial culture
  - Debridement
  - Hospitalization with IV antibiotics
**BIOBURDEN/INFECTION**

- Oral
  - Severe periodontal disease (60 – 90%)
  - Tooth loss (80%)
  - Ill fitting dentures (50%)
  - Mouth ulcers (30%)
  - Gum recession
  - Oral pain
  - Chewing abnormalities
  - Dry mouth
  - Gingivitis
  - Periodontal disease
  - Swallowing Abnormalities (Dysphagia)
  - Disease of the oropharynx and esophagus
  - Dementia
  - Stroke

**ANTIMICROBIAL THERAPY**

**Common Antiseptic/Antimicrobial Agents**

- Povidone - Iodine Agents
  - 1% solution (10% polyvinylpyrrolidone iodine)
  - 10% ointment/3% cream
  - Fibroblast and keratinocyte toxicity (1%)

- Sodium Hypochlorite Solution
  - Dakin’s solution – 0.5% solution (0.125% - 0.25%)
  - Collagen degradation (granulation)
  - Fibroblast and endothelial cell toxicity

- Acetic Acid
  - 0.125% - 0.025%
  - Fibroblast and keratinocyte toxicity

- Hydrogen Peroxide (H₂O₂)
  - 3% solution – cytotoxic
  - 0.003% - non cytotoxic
  - Poor antimicrobial affect

- Silver Sulfadiazine
  - Antimicrobial affect
  - Sulf allergy
  - Transient leukopenia (neutropenia with white cell depression)

- Petrolatum
  - Slows epithelialization

**MOISTURE ASSOCIATED SKIN DAMAGE**

- MASD
  - Incontinence-associated dermatitis
  - Intertriginous dermatitis
  - Periwound moisture-associated dermatitis
  - Peristomal moisture-associated dermatitis
**MOISTURE ASSOCIATED SKIN DAMAGE**

- Peristomal Skin
  - Mechanical stress
  - Moisture
  - Increased bioburden and fungi
- **End Result**
  - MASD
  - Dermatitis
  - Folliculitis
  - Infection

**Maintain Skin Integrity**

- Daily skin inspections
  - Compromised peripheral circulation
- Promote skin hygiene
  - Cleanse skin with saline and skin cleanser
  - Avoid alkaline agents which increase skin irritation
  - Maintain skin pH 4 - 6.8 to avoid bioburden build up and/or risk of infection
  - Use skin protectant or barrier
  - Do not massage or rub over bony prominences

**PAIN**

- Dressings
  - Dried out/adherent
    - Irritate local nerve endings
    - Wet-to-dry (gauze)
    - Tissue in-growth into product matrix
    - Premature release - skin tears, damage tissue, cause pain
    - Gauze/Hydrocolloids
    - Frequency of dressing changes
      - Uncomfortable
      - Biologically undesirable
      - Wound tissues - hypothermic
      - Nerve endings are irritated
  - Dressing of choice
    - Non traumatic to tissues when removed
    - Low "peel" force
  - Non adherent dressings
    - Moisture retentive dressings
      - Hydrogels, hydrofibers, alginates and soft silicones
      - Enzymatic debriding agent
      - Medicate before, during and after as appropriate
PAIN

**Observation**
- Vocalization of pain
  - Constant muttering
  - Moaning or groaning
  - Screaming/crying out

**Breathing**
- Strenuous
- Labored
- Negative noise on inhalation or expiration

**Pained facial expression**
- Clenched jaw
- Troubled or distorted face
- Crying

**Body language**
- Clenched fist
- Wringing of the hands
- Strained and inflexible position
- Fetal position
- Rocking

**Movement**
- Restless
- Altered gait
- Forceful touching
- Rubbing of body parts
- Afraid to move

---

WOUND BED PREPARATION

**Cleansing**
- Dressing change
- Non cytotoxic, non irritating cleanser
  - Skin cleansers/wound cleansers
- Irrigation pressure between 4 - 15 psi
  - 35 cc syringe with 19 gauge soft tipped catheter
  - 8 psi
  - >15 psi may drive ulcer fluid & debris into the ulcer

---

WOUND BED PREPARATION

**Debridement**
- Removal of dead or devitalized tissue
- Debridement not considered surgical wound
  - Surgical or sharp
  - Mechanical (wet-to-dry, whirlpool, pulsed lavage)
  - Enzymatic (collagenase)
  - Autolytic (ulcer fluid)
  - Biodebridement (maggot therapy)
- Excessive debridement can result in a reinstitution of the inflammatory process with an influx of inflammatory cytokines
WOUND BED PREPARATION

Moisture Balance
- Reduce pain
- Softens eschar
- Promote perfusion
- Barrier against environmental contamination
- Promote rapid migration of epidermal cells
- Reduce nosocomial infection

WOUND BED PREPARATION

Bacterial Barrier
- Control the hydration and oxygen tension of a wound
- Barrier
  - Bacteria
  - Moisture
  - MVTR
- Preserve phagocytic function

WOUND BED PREPARATION

Thermoregulation
- Circulation/sweating
- Limits the effects of tissue cooling
  - 6°C cooler due to fluid evaporation
  - Rewarming the wound base
  - Vasoconstriction (decreased tissue oxygen tension)
- Hypothermia
- Decreased neutrophil function
- Decreased collagen deposition
- Increased wound infection
WOUND DRESSING CHANGE GUIDELINES

Verify
- Policies and procedures
- Orders
- Treatment plan

Set up
- PPE/Field
- Necessary equipment
- Assistant(s)
- Positioning/draping

Wash & Glove
- Dressing removal
- Cleanse
- Assess and treat
- Redress
- Repositioning

Clean up
- Field
- Dispose of contaminates

Documentation
- Treatment procedure
- Resident concerns
- Discuss with legal proxy

STEROILE TECHNIQUE

Sterile Technique
- Meticulous hand washing
- Use of a sterile field
- Sterile instruments
- Sterile supplies
- Sterile gloves for the application
  - Immunocompromised individuals
  - Severe burns
  - Surgical wounds
  - Extensive wounds debridement

CLEAN TECHNIQUE

Non-Sterile
- Hand washing
  - Reduce the overall number of microorganisms
- Maintaining a clean environment with a clean field
- Clean field & gloves
- Sterile instruments
- Prevent direct contamination of materials & supplies
Technique for the Management of Chronic Wounds

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Handwashing</th>
<th>Gloves</th>
<th>Supplies</th>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound cleansing</td>
<td>Yes</td>
<td>Clean</td>
<td>Normal saline or commercial wound cleaner-sterile; maintain as clean per care setting policy</td>
<td>Irrigation with sterile device; maintain as clean per care setting policy</td>
</tr>
<tr>
<td>Routine dressing change without debridement</td>
<td>Yes</td>
<td>Clean</td>
<td>Sterile; maintain as clean per care setting policy</td>
<td>Sterile; maintain as clean per care setting policy</td>
</tr>
<tr>
<td>Dressing change with mechanical, chemical or enzymatic debridement</td>
<td>Yes</td>
<td>Clean</td>
<td>Sterile; maintain as clean per care setting policy</td>
<td>Sterile; maintain as clean per care setting policy</td>
</tr>
<tr>
<td>Dressing change with sharp, conservative bedside debridement</td>
<td>Yes</td>
<td>Sterile</td>
<td>Sterile</td>
<td>Sterile</td>
</tr>
</tbody>
</table>

* "Maintain clean as per care setting policy." (Address the parameters for maintenance, such as expiration dates for supplies, consideration of cost and correct interpretation of the manufacturer's recommendations. WOCN Position Statement, Revised January 2005)

FORMULARY

Final product inclusion

Literature review

Literature review best evidence

Evaluate on clinical basis

Make a short list of 2-3 products class

FORMULARY

Decision Tree (MEASURES)

- Based on the resident, the ulcer characteristics, and the efficacy of the dressing
- Minimize trauma to wound bed
- Eliminate dead space
- Assess and manage exudate
- Support the body's tissue defense system
- Use non-toxic wound cleansers
- Remove bacteria, debris, necrotic tissue
- Environment maintenance - thermal insulation and moist wound bed
- Surrounding tissue - protect from injury and bacteria
- Education for all staff involved

Types

- Gauze
- Transparent films
- Hydrocolloid
- Hydrogel
- Alginites
- Foam
- Composite
- Collagen
- Debriders
- Hydrofibres
- Ionic Silver
- Biologicals
FORMULARY

Chronic Exudate
- Biochemically different than acute wound fluid
- Increased levels of MMPs - break down matrix proteins
- Increased macromolecules bind growth factors inhibiting cell proliferation
- Slows down or blockage of keratinocytes, fibroblasts and endothelial cells
- Loss of protein to the host, can damage the surrounding healthy skin
- Excellent culture medium for bacterial growth

FORMULARY

Exudate Type
- Inflammatory
  - Serous - watery plasma, thin, clear or light color
  - Serosanguineous - plasma and red blood cells or thin, light red to pink
  - Sanguineous - thin, red, bloody
- Infection
  - Seropurulent - contains some white blood cells and living or dead organisms, cloudy, yellow, tan
  - Purulent - contains white blood cells and living or dead organisms, thick, creamy yellow, green, or brown
  - Bloody purulent
- Amount
  - Scant, Moderate, Heavy or Copious

STONE KNIVES, BEAR CLAWS AND GAUZE

- Cost
- Labor Intensive
- Higher Infection Rate
- Non Selective Debridement
- Painful
- Moisture Evaporation
- Decreased Tissue Temp
- Aerosolization of Bacteria
**WOUND DRESSINGS**

**Transparent Film**
- Polyurethane or copolymer
- Waterproof
- Vapor transmission
- Bacterial barrier
- Autolytic debridement
- Light exudate
- Difficult to apply
- Cause skin tears

**Hydrocolloid**
- Self-adherent
- Bacterial barrier
- Autolytic debridement
- Decrease pain
- Cost effective
- Not for use with infected wounds, tracts or over exposed tendon or bone

**Hydrogel**
- Cross-linked or non-cross-linked polymers plus water and glycerin
- Amorphous or cast
- Hydrates ulcer bed
- Dehydrates if open to air
- Facilitates autolytic debridement
- Atraumatic
- May reduce pain
- Dry to light exudate
- Maceration possible
WOUND DRESSINGS

Calcium Alginate
- Absorbent
- Biocompatible
- Atraumatic removal
- Autolytic debridement

Hydrofiber
- Alternative to calcium alginates
- Non-woven pad or ribbon
- Sodium carboxymethylcellulose
- 30% more absorptive

Polyacrylate Dressings
- Polyacrylate core
- Affinity for protein molecules found in wound debris, necrotic tissue and microorganisms
- Ringer’s solution
- Protein molecules move toward the polyacrylate core
- Ringer’s solution is pushed into the wound bed
- “Rinsing effect” for 24 hours
- Debrides, rinses, absorbs, cleans
**WOUND DRESSINGS**

- Collagen
  - Absorbent and non-adherent
  - Promotes granulation tissue formation
  - Facilitates autolytic debridement
  - Not for 3rd degree burns or dry-black necrotic ulcers
  - Scarring

- Foam
  - Primary or secondary coverage
  - Absorptive
  - Oxygen permeable
  - Partial and full thickness wound
  - Infected or non-infected wounds
  - Minimal trauma
  - Facilitate autolytic debridement
  - Not for use on dry eschar

**ANTIMICROBIALS**

- Cadexomer Iodine
  - Cadexomer - moisture balance
  - Polysaccharide starch lattice (beads)
  - 0.9% elemental iodine
  - Sustained iodine released in lower levels over time
  - Absorb 7-10 x wt. in fluid
  - Autolytic debridement
  - MRSA, VRE, Staphylococcus aureus
ANTIMICROBIALS

Methylene Blue and Gentian Violet
- Polyvinyl alcohol sponge
- Bacteriostatic
- Open cell structure
- Trap and inhibit exudate and debris
- Absorb 12 x wt. in exudate
- Alter redox/oxidation potential of bacterial cell wall
- Not for use on 3rd degree burns

ANTIMICROBIALS

Silver Misconceptions
- Silver dressings do not improve healing rates
- Silver reduces wound bioburden, treat localized infection and prevent systemic spread
- Silver dressings are toxic to wounds and delay healing
  - Inconclusive
- Bacteria become resistant to silver
  - Unknown
- Silver dressings could make bacteria resistant to antibiotics
  - No evidence of a cross-resistance between silver and antibiotic
- Silver dressings are too expensive
  - Many direct and indirect costs may be difficult to measure

ANTIMICROBIALS

Silver Sulfadiazine (SSD)
- Burns
  - 1% in a carrier cream
  - Two antibiotics agents
  - Higher release of metallic silver
  - A lower relative concentration of ionized silver
  - Sulf allergy
  - Short half life
  - May increase healing times
**ANTIMICROBIALS**

**Ionic Silver**
- **Broad spectrum**
  - Effective against aerobic, anaerobic, gram + & gram - bacteria, yeast, fungi, virus
- **Rare resistance**
  - E Coi & Pseudomonas
- **Saline**
  - Reacts with the Ag+ cation
  - Forms silver chloride crystals
  - Decreases the amount of silver released
- **Enzymatic debriders**
  - Ag+ ion denatures

**ANTIMICROBIALS**

1. **Ionic silver**
2. **3 pronged approach makes resistance less common**

**ANTIMICROBIALS**

- **Honey**
  - Leptospermum scoparium tree
  - Echium vulgare plant
  - Osmotic effect
  - Antioxidant affect
  - Acidic mantel (low pH)
  - May assist with microbial control
  - MRSA
  - VREs
  - Gram negatives
WOUND DEVICE

Negative Pressure Wound Therapy
- Sub-atmospheric pressure
- Contains effluent
- Increasing blood flow through reduction of interstitial edema
- Removal of inflammatory cytokines and management of exudate
- Pressure ulcers
- Diabetic foot ulcers
- Arterial/venous insufficiency ulcers
- Grafts and flaps

IN SUMMARY

Wound Infection, Houston We Have a Problem
- Determining whether wounds are infected is often difficult
- Determine the accuracy of clinical symptoms and signs to diagnose infection
- Wound Bed Prep
- Advanced Wound Dressings

REFERENCES
REFERENCES


Contemporary Concepts in Wound Health, number 1. Sterile versus Nonsterile Wound Care...An interactive monograph for healthcare professionals, ©1998 Dumex Medical Surgical Products LTD.


REFERENCES


REFERENCES


