Addressing the Dressing: Goal Based Wound Management

Dot Weir, RN, CWON, CWS
ORLANDO, FLORIDA

Decision Making

- Wound assessment must be the basis
- Wounds are dynamic and changing - topical treatments must be also
- Evidence based (to the extent possible)
- If our decisions are based on goals with an outcome in sight, they are probably the right ones

Dressing Outcomes

- Obliteration of dead space
- Absorption of exudate
- Protection of peri-wound skin
- Maintenance of moist environment
- Autolytic support
- Reduction of pain
- Protection and insulation
- Bacterial barrier/bacterial management

Epithelial Healing of Skin Wounds


The Moist Wound

The Painful Wound
Epithelial Migration Beneath a Blister

Moist Wound Environment

- Insufficient moisture in exposed wound tissues causes desiccation and cell death, and prevents epithelial migration and matrix deposition
- Excessive moisture due to exudate inhibits cell proliferation and breaks down matrix components
- Moisture balance in the wound bed is maintained by appropriate choice of dressings

Wound Bed Preparation: Removal of Barriers to Healing

Types of Debridement

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical</td>
<td>Removal of necrotic tissue by mechanical means</td>
<td>Wet-to-dry dressings, hydrotherapy, ultrasound, abrasion</td>
</tr>
<tr>
<td>Surgical</td>
<td>Removal by surgical instrument</td>
<td>Scalpel, scissors, hydrosurgery, lasers, curettes</td>
</tr>
<tr>
<td>Biosurgical</td>
<td>Sterile larvae selectively digest necrotic tissue and bacteria</td>
<td>Sterile blowfly or horsefly larvae</td>
</tr>
<tr>
<td>Autolytic</td>
<td>Uses the body’s own enzymes to dissolve necrotic tissue; assisted with moisture-retentive dressings</td>
<td>Films, hydrogels, hydrocolloids, honey</td>
</tr>
<tr>
<td>Enzymatic</td>
<td>Topical application of enzymes to liquefy necrotic tissue</td>
<td>Collagenase</td>
</tr>
</tbody>
</table>

Wound Cleansing

- Use of fluids to remove loosely adherent contaminants and devitalized material from the wound surface
- All wounds should be cleansed between dressing changes
- Process of cleansing can create tissue trauma

Wound Cleansing - Solutions

- Selection of wound cleanser needs to weigh cleaning capacity against potential toxicity to cells in the wound
- Grossly contaminated wounds may be better cleansed with commercial agent or antimicrobial (antiseptics or antibiotics) agent
- Skin cleansers (those for incontinence) should not be used to cleanse an open wound
**Wound Cleansing - Solutions**

- Commercial Cleansers
  - Enhanced wound cleansing due to surface active agents
    - Help break the bonds of the foreign bodies to the wound surface
    - Strength of their chemical reactivity directly proportional to their cleansing capacity and toxicity to cells

**Wound Cleansing – Antiseptics**

- Agents that destroy or inhibit the growth and development of microorganisms, in or on living tissue
- Routine use discouraged
  - Goal of wound cleansing vs. wound disinfection
  - Dilution decreases toxicity but decreases activity as well
  - Elimination of necrotic and foreign material prepares the wound for routine cleansing with safer agents

---

**Washing Legs**

- Soap and water is suitable alternative as long as water not contaminated
  - Fluid has only brief contact with wound surface
  - Hygienic cleanse of feet and legs may override concern with wound depending on patient
  - No baths

---

**Addressing the Wound Environment**

**Dressing Categories:**

**Form vs. Function**

- What it is MADE OF:
  - Water
  - Polymers
  - Collagen
  - Cellulose
  - Hydropolymer
  - Top secret ingredient

- What it is DOES:
  - Absorbs Drainage
  - Hydrates Dry Tissue
  - Maintains Moisture
  - Conforms to Depth
  - Conforms to Contours
  - Provides bacterial control
  - Provides odor control
  - Stays in place well via its own adhesive

**The Ideal Dressing**

- Manages exudate appropriately: does not desiccate or macerate
- Provides environment for healing
- Thermally insulating
- Impermeable to bacteria, minimizes contamination
- Use in infected wounds
- Non-traumatic, non- or minimally painful on removal
The Ideal Dressing

- User friendly; ease of application
- Cost effective
- Compatible with support needs (i.e. compression wraps)
- Minimize need for secondary dressing when able
- Free from particulate or toxic contamination
- Remain in place for expected time frame

How To Decide?

- Location
- Size
- Exudate
- Tissue Type
- Bacterial Burden
- Support needs

Location

- 

Size

- 

Exudate

- 

Accurate Assessment!!
Exudate: Protecting Periwound Skin

Tissue Type

Support Needs

Bacterial Burden
- Silver
- Cadexomer Iodine
- Pigmented Foam
- PHMB
- Honey
- DACC

Dressing Function

Wound Fluid Management

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Films</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocolloids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogels</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table:

- Cover/protect
- Hydrate
- Maintains Moisture/ Autolytic Support
- Adds moisture
- Absorption
- Fills Space

- Gauze
- Hydrofibers
- Calcium Alginate
- Hydrocolloid
- Hydrogel
Addressing the Dressing

- Is the wound bed dry?
  - Hydrate it.
- Is the wound draining?
  - Absorb it.
- Is there space?
  - Fill it.
- Is it filled in?
  - Cover it.

Addressing the Dressing

- Is the wound bed dry?
  - Hydrate it.
- Is the wound draining?
  - Absorb it.
- Is there space?
  - Fill it.
- Is it filled in?
  - Cover it.

Part B Reimbursement

- 1994 Surgical Dressing Policy
  - Extended coverage to chronic wounds that had been debrided by any means
- Private insurance coverage also available
- Documentation
  - Debridement
  - Size and location
  - Exudate amount

Transparent Films

- Description:
  - Polyurethane or co-polymer with porous adhesive layer.
  - Allows transmission of oxygen and moisture vapor.
  - Now available with silicone adhesion
Transparent Films

- **Indications:**
  - Primary or secondary dressing
  - Partial-thickness wounds
  - Stage I or II pressure ulcers
  - Low exuding wounds
  - Superficial burns
  - Donor sites

- **Advantages:**
  - Wound visualization
  - Impermeable to fluids and bacteria
  - Conformable
  - Autolytic debridement
  - Reduces friction
  - Change daily or longer up to 7 days
  - Multiple sizes
  - Available with silver

- **Disadvantages:**
  - No absorption
  - Difficult adherence to dry, flaky skin
  - May cause maceration

Hydrocolloids

- **Description:** Hydrophilic colloid particles bound to polyurethane foam or film
- **Indications:**
  - Primary or secondary dressing
  - Partial and superficial full thickness wounds
  - Pressure ulcers (Stage I or II, shallow Stage III or IV)
  - Superficial burns
  - Donor site

- **Advantages:**
  - Maintain moist wound environment, autolysis
  - Impermeable to bacteria and moisture
  - Thermal insulation
  - Longer wearing (up to 7 days)
  - Self-adhering; Conforming; various shapes, sizes and thickness
  - Available with silver, honey

- **Disadvantages:**
  - Opaque
  - Will not handle heavy exudate
  - Contraindicated for infection
  - May be difficult to remove from fragile skin
  - May leak; sticky residue
  - Doesn’t fill space or undermining

Hydrogels - Amorphous

- **Description:** Non-cross-linked polymers plus water and/or glycerin
  - Some have added ingredients:
    - Alginate for viscosity
    - Collagen, hyaluronic acid for performance
    - Hypertonic Sodium for fluid shift, autolysis
    - Silver, PHMB for bacterial control
Hydrogels - Amorphous

• Indications:
  • Stage II to IV pressure ulcers
  • Line wound bed, not fill it
  • Partial and Full thickness wounds
  • Abrasions, Skin tears
  • Minor burns, Radiation burns
  • Wounds with necrosis

Advantages
• Hydration of the wound bed
• Autolytic debridement
• Easily rinses from wound
• Available in saturated gauze pads; can fill space
• May reduce pain
• Available with silver

Disadvantages
• Potential for maceration
• Minimal absorption
• Requires secondary dressing
• Daily dressing changes usually required

Hydrogels: Sheets

• Description: Cross-linked polymers with central mesh to hold them together.
• Made from combinations of water and glycerin.
• Most are slightly absorbent – trap moisture

Hydrogels: Sheets

• Indications:
  • Stage II to IV pressure ulcers
  • Partial and Full thickness wounds
  • Abrasions
  • Donor sites
  • Skin tears
  • Minor burns
  • Radiation burns
  • Wounds with minimal necrosis

Calcium Alginates

• Description: Composite of fibers derived from seaweed; calcium salt of alginic acid, calcium alginate fibers.
• Exchange of sodium and calcium ions
  • Forms sodium alginate – gel
• Differences in manufacturing will determine degree and direction of wicking of wound exudate

CMC Fiber Dressing

• Alternative to calcium alginates
• 30% more absorptive
Calcium Alginate Rope

Calcium Alginates

- Indications:
  - Stage II to IV pressure ulcers
  - Partial and full thickness wounds
  - Dehisced surgical wounds
  - Moderate to heavy exudate
  - Sinus tracts, undermined areas
  - Mild hemostasis
  - Infected wounds

Calcium Alginates

- Advantages
  - Highly absorptive, non-occlusive
  - Can be used in infection
  - Hemostatic properties for minor bleeding
  - Useful in tunneling, undermining
  - Atraumatic removal if fully hydrated
  - Facilitates autolysis
  - Available in sheets, ropes, and composites
  - Available with silver

- Disadvantages
  - Requires secondary dressing
  - Can dry out, adhere to wound bed and leave fibers if not fully hydrated
  - May macerate if hydrated product on intact skin

Superabsorbent Dressings

Foams

- Description:
  Polyurethane open cell sheets, single or multilayered.
  - Multiple varieties
    - Thickness, absorption, bordered, film surface, cavity “filler”
    - Incorporated charcoal, surface active agent, silver

- Indications:
  - Stage II to IV pressure ulcers
  - Partial and full thickness wounds
  - Infected or non-infected wounds
  - Tunnels and cavities (specific dressings)
  - Donor sites
  - Minor burns
  - Minimal to heavy exudate
**Foams**

**Advantages**
- Highly absorptive, non-occlusive
- Can be used in infection
- Available with or without border
- May be useful in tunneling, undermining (specific dressings)
- May be used under compression wipes
- Atraumatic removal if not self-adhering, if self-adhering, atraumatic if hydrated
- Available in sheets, ropes, and composites
- Available with silver

**Disadvantages**
- May require additional tape
- May macerate if hydration extends beyond border of wound
- Not recommended for dry eschar

**What About Cover (secondary) Dressings?**
- Most dressings need to be covered
- Exceptions:
  - Bordered products
  - Self adhering (hydrocolloids, films, some foams)
  - The frequency of change will be based on the primary dressing and/or exudate levels

**Advanced Secondary Dressings**
- More than a convenience
- Absolutely can reduce skilled nursing needs
- Showering
- Incontinence
- Contamination

**Composite/Combination Dressings**
- Two or more “forms” of dressings to serve multiple purposes
- Either stand-alone or combined with another dressing

**Collagen Wound Dressings**
- Collagen is a biologically derived material
  - Source can vary
  - It is the basic structural material of the body
  - It is biodegradable/bioresorbable
  - Collagen’s primary function is NOT related to exudate management or moisture retention

**Role of Exogenous Collagen**
- Hemostasis
- Attracts macrophages and fibroblasts
  - Fibroblasts demonstrate increased proliferation and synthesis when attached to a collagen matrix
- Modulates effects of excess matrix metalloproteases; acts as sacrificial substrate
### Function of Collagen Dressings
- To provide a structural support and scaffolding to the wound
- To guide tissue in-growth
- To attract cells to the wound site
- To increase cellular proliferation in the wound site

### Bacterial Burden
- Silver
- Cadexomer Iodine
- Pigmented Foam
- PHMB
- Honey
- DACC

### Polyhexamethylene Biguanide (PHMB)
- Chlorhexidine most commonly used biguanide
  - Possibly cytotoxic for use in wounds
- PHMB more biocompatible
- 0.2 – 0.3% bound in dressings, Effective barrier to bacterial contamination
  - Effective against common wound pathogens

### Cadexomer Iodine
- Cadexomer starch as a carrier of 0.9% iodine
- 1 gram absorbs up to 6 ml of fluid
- Slow release of iodine during uptake of fluid
- No evidence of resistance
- Effective against common wound pathogens
- Changed every 1-3 days

### Pigmented Foams
- Polyvinyl alcohol (PVA) sponge with organic pigments
  - Methylene blue (≤ 0.00025 gr/gr)
  - Crystal (Gentian) violet (≤ 0.00025 gr/gr)
- Bacteriostatic against common wound pathogens
- Changed every 1 – 3 days
Silver

Antimicrobial Action of Ag+

- Broad spectrum of antimicrobial action
  - Gram Positives
  - Gram Negatives
  - Aerobes / Anerobes
- Ag+ can kill antibiotic-resistant bacteria
  - MRSA, VRE
- Effective against fungi
- Anti-inflammatory

Mechanism of Action

- Antibacterial
  - Provides barrier on wound surface to prevent bacterial colonization and penetration
  - Antibacterial activity has been shown to vary with the plant source
- Anti-inflammatory
  - Noted reduction in edema and pain
- Wound Healing
  - Moist wound environment created by the osmotic effect of the honey
  - Autolytic debridement

dialkyl carbamoyl chloride: DACC

Bacteria and fungi binding
What happens to the bound bacteria?

- They get inactivated = their metabolism is slowed down
- They no longer replicate (Ljungh et al)
  - The formation of bacterial toxins is also slowed down or stopped
  - Supports the wound healing process

Considerations for Antimicrobial Dressings

- Is it a barrier or does it deposit the antimicrobial agent onto the wound bed?
- Does it need to be hydrated?
  - Is it hydroactive?
- Does it need to contact the wound surface?
- How long is the antimicrobial action?
- Can the patient get it?
- How long should you use it?

Active Agents

- Devices or pharmaceutical agents; have FDA approval to market for active wound healing
- Because of FDA approval, usually carries CMS and Medicaid (in some states) reimbursement

Regulatory Approval

- Premarket approval (PMA)
  - Class III Devices
    - Support or sustain life
    - Pose some level of risk
    - Must prove safety and efficacy
- HCT/Ps (Human cells, tissues, and cellular and tissue-based products)
  - Made from human tissue
  - Serves same role in recipient (homologous use)
  - Minimally manipulated
  - Registration establishes good practices
- 510K
  - Equivalent to a marketed device

Active Agents/Drugs

- Topicals:
  - Becaplermin
  - Collagenase
- HCT/Ps
  - Cellular
  - Acellular
  - Amniotic
  - Cellular
  - Acellular

Biologics: What Are They?

- Devices or products that enable manipulation of the healing process through wound supplementation with agents that are natural contributors to the healing process
- Must be demonstrated to be safe and efficacious before they can receive approval for human use by the FDA
- Extremely expensive to carry out the experimental studies required for FDA approval
Role of PDGF

<table>
<thead>
<tr>
<th>Cells That Produce PDGF</th>
<th>Cells that PDGF Acts On</th>
<th>Cellular Response to PDGF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelets</td>
<td>Neutrophils</td>
<td>Stimulates chemotaxis</td>
</tr>
<tr>
<td>Keratinocytes</td>
<td>Macrophages</td>
<td>Stimulates chemotaxis, induces release of other GFs</td>
</tr>
<tr>
<td>Fibroblasts</td>
<td>Fibroblasts</td>
<td>Stimulates proliferation &amp; chemotaxis, stimulates production of matrix molecules (collagen, fibronectin, proteoglycans, etc.)</td>
</tr>
<tr>
<td>Smooth muscle cells</td>
<td>Endothelial cells</td>
<td>Stimulates proliferation and new blood vessel formation</td>
</tr>
<tr>
<td></td>
<td>Smooth muscle cells</td>
<td>Stimulates proliferation &amp; chemotaxis, recruits smooth muscle cells to site of new blood vessel formation</td>
</tr>
</tbody>
</table>

Autologous Platelet Gels

- Patients own blood drawn and used to make gel
- Blood transferred to centrifuge type device that spins blood down, separating platelets
- Through various processes, platelets are stimulated to release contents of alpha granules

Becaplermin

- Recombinant platelet derived growth factor
- Indicated for treatment of lower extremity diabetic neuropathic ulcers that extend into the subcutaneous tissue or beyond and have an adequate blood supply
- Indicated as an adjunct to, and not a substitute for, good ulcer care practices.

Important Safety Information

Boxed Warning

WARNING: INCREASED RATE OF MORTALITY SECONDARY TO MALIGNANCY
An increased rate of mortality secondary to malignancy was observed in patients treated with 3 or more tubes of Becaplermin gel in a postmarketing retrospective cohort study. Becaplermin gel should only be used when the benefits can be expected to outweigh the risks. Becaplermin gel should be used with caution in patients with known malignancy.

Application

- Apply in a thin continuous layer approximately 1/16 of an inch (size of a dime)
- Cover with saline moistened dressing and left in place for approximately 12 hours
- Dressing should then be removed and ulcer rinsed with saline or water and covered again with a second moist dressing
- Must be refrigerated!

Cellular and Tissue Products

- Can be classified as acellular (biologically inert) or cellular (containing living cells)
- May be sourced from
  - Biological tissue
  - Animal (eg, equine/bovine/porcine/ovine)
  - Human (eg, cadaveric skin, placenta, neonatal foreskin [keratinocytes and fibroblasts])
  - Plant (containing cellulose)
  - Synthetic materials (naturally not present)
  - Composite (biological and synthetic)
Csilla: Block out trade name
Amanda Wright, 2/9/2015
Acellular Matrices

- Human and animal derived products are processed to remove cells leaving the collagen matrix and destroying pathogens
- Collagen may be cross-linked
  - Stabilize
  - Inhibit degradation and prolong presence in the wound
- May function as a biological modulator
  - A material or substance derived from biological or synthetic sources that influences biological processes such as wound healing


Acellular Mode of Action

- Provides scaffold
  - For MMPs to bind to and break down collagen in the product
  - To support cell ingrowth and granulation tissue formation
  - For epithelial cells, fibroblasts and endothelial cells to migrate into and proliferate
  - To contain/protect growth factors
- Optimal response will be achieved using a matrix that is closest to the tissue it is replacing


Function of Cellular Skin Substitutes

- Goal of use is to restore skin barrier
- Secrete extracellular matrix (collagen)
- Produce growth factors needed by the wound at the needed time and needed amounts


Cellular Therapy

Keratinocytes

<table>
<thead>
<tr>
<th>TGF-α</th>
<th>PDGF-A, PDGF-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL-4, IL-12</td>
<td>FGF-2</td>
</tr>
<tr>
<td>IL-8</td>
<td>FGF-1, FGF-2,</td>
</tr>
<tr>
<td>IGF-2</td>
<td></td>
</tr>
</tbody>
</table>

Fibroblasts

- First described as a treatment for wounds in 1910 in a large case series
- Contain a combination of growth factors, collagen-rich extracellular matrix, and viable cells
  - Neonatal fibroblasts, and epithelial cells
  - Mesenchymal stem cells (MSCs)

Amnion
Chorion
Epithelial Layer
Basement membrane
Sponge Layer
Stromal Layer in Amnion
Stromal Layer in Chorion
Trophoblast Layer
Compact Layer
Epithelial Cell
Fibroblast
Mesenchymal Stem Cell
Trophoblast Cell
Collagen
Other ECM

Amniotic Acellular Products
• Conceptually similar to other acellular products
• Contains soluble mediators that recruit adult MSCs
• Provides biologically active extracellular matrix for cell ingrowth

Amniotic Cellular Products
• Manufactured to preserve cells, extracellular matrix and growth factors
  – Neonatal mesenchymal stem cells
  – Epithelial cells and fibroblasts
• Extracellular matrix provides three dimensional support
  – Promotes cellular adhesion and migration

Cellular Devices Do Not “Take”
• They are not skin grafts\textsuperscript{1,2}
  – There is no vascularization\textsuperscript{2}
  – There is no integration\textsuperscript{2}
  – There is no persistence per se

Patient Selection: Thought Processes
• Type, history, and duration of wound
  – Consider atypicals, trauma
• Wound bed preparation: Is it ready?
  – Debridement
  – Bioburden management
• Ability to offload/compress
• Insurance coverage

Mesenchymal Stem Cells
• Provide matrix proteins, cytokines, and growth factors
• Coordinate tissue repair process
  – Down regulation of inflammation
  – Stimulation of blood vessel formation
  – Recruitment and support of fibroblasts and epithelial cells


References

- Hess CT. Skin & Wound Care, Seventh Edition. Lippincott Williams & Wilkins: 2013

References