Pediatric Wounds: Basic to Complex
Addressing Wound Management, Pressure Injury & NPWT

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Disclosure Information

• I have nothing to disclose
• Any mention of Trade names of certain products are for familiarity & example and are not intended to be an advertisement or a recommendation
• Any examples given are not an all inclusive list

Objectives

1. Describe the optimal wound healing environment
2. Choose the appropriate wound dressing based on the understanding of general wound dressing categories coupled with knowledge of wound characteristics
3. Identify most common causes of pressure injury in the neonatal/pediatric populations
4. Explain ways in which pressure injury in the neonatal/pediatric populations can be prevented
5. Describe the use of negative wound pressure therapy in the pediatric population
Our Skin

Quick Facts: Our largest organ system

Functions

• Protection
• Barrier to infection, chemicals, UV radiation
• Metabolism
• Vitamin D
• Thermoregulation
• Sweating, excretion of waste, fluid regulation
• Receives sensory input

Receives 1/3 of the body’s circulating blood

Layers of the Skin

• Epidermis
• Avascular
• Five layers
  • Stratum basale
  • Stratum spinosum
  • Stratum granulosum
  • Stratum lucidum
  • Stratum corneum

Inner layer

Outer layer
Layer of the Skin

- Dermis
  - Thickest layer
  - Highly vascularized
  - Primarily collagen and elastin
  - Houses nerve & sensory organs
  - Houses sweat & sebaceous glands
  - Made up of two layers
    - Papillary Dermis-supplies O₂ to epidermis
    - Reticular Dermis-structural support

Layers of the Skin

- Subcutaneous Tissue
  - Functions to support skin
  - Two Layers:
    - Adipose tissue-large blood vessels, nerves, insulation, protection, stores energy
    - Fascia-fibrous connective tissue, separates and surrounds almost all structures

Types of Wounds

- Acute-traumatic
- Surgical
- Pressure
- Chronic
  - Venous ulcers
  - Arterial ulcers
  - Diabetic ulcers
Types of Wound Healing

- Superficial
- Primary intention
- Delayed primary intention
- Partial-Thickness
- Secondary intention

Superficial Wound Healing

- 1st degree burns
- Scrapes
- Contusions
- Shear/friction injury
- Heal themselves with proper intervention (keeping clean and dry)

Primary Intention

- Surgical wounds
- Wound edges approximated w/ sutures or staples
- Usually close in 7 days
- Usually minimal to no scarring
Delayed Primary Intention

- Traumatic wounds
- Wound is left open and sutured later (4-7 days) when risk for infection is decreased
- Common when
  - Wound is contaminated/high risk for infection
  - Large amount of tissue loss
  - Large amount of tissue tension

Partial Thickness Wound Healing

- When there is loss of the dermal layer
- Refers to:
  - Abrasions, skin tears, 2nd degree burns, Stage II pressure injury
- Goal is to keep moist and clean and to eliminate the source of trauma

Secondary Intention

- a.k.a. Contraction
- Full thickness wounds only
- Edges cannot be approximated due to massive tissue loss or nonviable wound edges
- Usually have high microbial content, slough, and necrosis
Stages of Wound Healing

Regardless of the type of wound, all wounds must heal in the following pattern:

- Hemostasis/Coagulation
- Inflammation (1-10 days)
- Proliferation (3-28 days)
- Maturation/Epithelialization
- Remodeling (9 days - years)

Neonatal / Pediatric Wounds

- Surgical
- Extravasation Injury
- Thermal
- Pressure injury
- Chemical injury
- Mechanical
- Heel Sticks

- Ostomy
- Tracheostomy
- G-tubes
- Incontinence-associated dermatitis
- Moisture associated dermatitis

Factors Affecting Wound Healing in Pediatrics

- Protein-calorie malnutrition
- Impaired perfusion
- Decreased oxygenation
- Edema
- Infection
- Decreased epidermal:dermal cohesion
- Deficient stratum corneum
- Impaired thermoregulation

- Immature immune system
- Immature renal & hepatic systems
- Age / Gestational age
- Use of steroids
- Comorbidities
- Bioburden
- Malnutrition-Vitamins A, C & Zinc
- Immobility
## Optimal Wound Healing Environment

- Reduce or eliminate causative factors
- Systemic support - blood, $O_2$, fluid, nutrition, +/or antibiotics
- Remove necrotic tissue or foreign body
- Eliminate infection
- Obliterate dead space
- Absorb exudate
- Maintain moist environment
- Protect from further trauma
- Protect from bacterial invasion
- Provide thermal insulation

## Wound Dressings - Facts

- Matching wound characteristics w/ dressing features is paramount to healing
- Moist wounds heal faster than dry wounds
- Dry wounds should be kept moist by dressing
- Wounds with heavy exudate should be dried by the dressing
- Change dressings when soiled - in just 5 min. Staph epidermidis can migrate through 5 layers of moist gauze. (Cochrane Collaboration, 2008)
- Once a day cleansing as a minimum
- Foreign body left in wound bed by dressing will impede healing
- Wound treatment that has not shown improvement in 10-14 days MUST be changed

## Wound Dressing - Categories

- **Primary** - contacts wound directly
- **Secondary** - covers the primary dressing
- **Occlusive** - completely covers wound environment and keeps all moisture at wound
- **Semi-occlusive** - allows some $O_2$ and moisture vapor through dressing
## Dressing Selection Criteria

- Protect the wound
- Facilitate atraumatic removal
- Minimal changes required
- Remain in place in a humidified environment
- Correct size
- Meets wound's needs
- Protects peri-wound skin
- Price & cost

***A dressing is only as good as the clinician who selects it*** (Dargent, 2001)

## Wound Dressing-Types

<table>
<thead>
<tr>
<th>Gauze</th>
<th>Hydrofiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-adherent contact layers</td>
<td>Foam</td>
</tr>
<tr>
<td>Hydrogel</td>
<td>Skin Sealant</td>
</tr>
<tr>
<td>Hydrocolloid</td>
<td>Enzymes</td>
</tr>
<tr>
<td>Transparent Film</td>
<td>Negative Pressure Wound Therapy (Kim)</td>
</tr>
<tr>
<td>Calcium alginate</td>
<td></td>
</tr>
</tbody>
</table>

## Gauze

**Examples:** 2x2, 4x4, packing NuGauze

**Uses:**
- Wet-to-damp for debridement
- Dry for draining wounds

**Contraindications:**
- Healthy granulating wounds
- Dry wound bed
## Non-Adherent Contact Layers

### Examples:
- Telfa™ (not latex free)
- Adaptic®
- White petrolatum impregnated gauze
- Xeroform gauze

### Uses:
- Superficial wounds
- Draining wounds
- Non-stick occlusion
- Intact incisions

### Contraindications:
- Known sensitivity to product

## Hydrogel/Gels

### Examples:
- Amorphous (Carrasyn gel)
- Sheet gels (Vigilon)

### Uses:
- Partial-thickness wounds
- Necrotic or granulating wounds
- Dry wound beds
- Burns
- Keep bladder plates moist (Bladder extrophy patients)

### Contraindications:
- Grossly infected wounds
- Stage IV pressure injury

## Hydrocolloid

### Examples:
- DuoDerm®
- DuoDerm thin®
- DuoDerm paste®

### Uses:
- Prevention
- Partial thickness
- Full thickness
- Autolysis
- Ulcers with cavity (paste only)

### Contraindications:
- Infected wounds
- Stage IV pressure injury
- Wounds with significant depth
# Transparent Films

**Examples:** Tegaderm Op-site

**Uses:** Partial thickness wounds
Debride eschar
Autolysis
Prevention
Allows exchange of O$_2$
Prevents penetration by bacterial or fluid

**Contraindications:** Skin tears
Moist wounds
Infected wounds

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# Calcium Alginate

**Examples:** Kaltostat®
Sorbsan

**Uses:** Draining wounds
Hemostatic properties

**Contraindications:** Dry wound bed

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# Hydrofiber

**Examples:** Aquacel®
Aquacel Ag®

**Uses:** Exudate absorption
absorbent material that turns into a gel when in contact with exudate
Silver ion products have antimicrobial properties

**Contraindications:** Dry wound beds
Foams

<table>
<thead>
<tr>
<th>Examples: Hydrosorb®</th>
<th>Lyofoam®</th>
<th>Mepilex®</th>
<th>Mepilex Lite®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses:</td>
<td>Partial thickness wounds</td>
<td>Skin tears</td>
<td>Full thickness wounds</td>
</tr>
<tr>
<td>Contraindications:</td>
<td>Heavily exuding wounds</td>
<td></td>
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</tr>
</tbody>
</table>

Skin Sealant

<table>
<thead>
<tr>
<th>Examples: Skin prep (contains alcohol)</th>
<th>3M™ Cavilon™ NoSting (no alcohol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses:</td>
<td>Healthy, intact skin-protectant</td>
</tr>
<tr>
<td>Contraindications:</td>
<td>Open skin</td>
</tr>
</tbody>
</table>

Enzymes

<table>
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<th>Example: Collagenase</th>
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<tr>
<td>Uses: Necrotic slough</td>
</tr>
<tr>
<td>Contraindications: Eschar, unless scored</td>
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</table>
Common Causes of Pressure Injury

- Conventional Pressure Injury
  - Immature skin
  - Compromised perfusion
  - Sub-optimal nutrition
  - Impaired mobility / paralysis
  - Fluid retention / edema
  - Moisture
  - Long OR cases

- Medical Device-Related
  - Catheter hubs
  - Pulse ox probes
  - CPAP masks
  - Nasal cannulas
  - Tracheostomies
  - Occiput injury
  - Casts / splints
  - Endotracheal tubes
  - Collars

Pressure Injury Prevention

- Positioning aides:
  - Gel pillows
  - Fluidized positioners
  - Pressure distribution mattresses
  - Moisture management
  - Floating the heels

- Foam product:
  - Under hubs for IV catheters and PAL catheters
  - Under central lines
  - Under tracheostomy and gastrostomy tubes
  - Under CPAP masks and cannulas
  - At pressure points of collars, cast, splints

Thank you for your attention!
Negative Pressure Wound Therapy

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Disclosure Information

I am the Editor-in-Chief of the Journal of Pediatric Surgery

Outcomes

The learner will:
- Discuss three indications and contraindications of Negative Pressure Wound Therapy (NPWT)
“Healing is a matter of time, but also a matter of opportunity”
~Hippocrates

Negative Pressure Wound Therapy (NPWT)
An active wound management system that utilizes controlled negative pressure which is applied uniformly to the wound through an open cell foam or other interface dressing in a constant or intermittent fashion

- Maintain a moist wound environment
- Control exudate and odor
- Reduce pain, infection and pain
- Promote perfusion and granulation
- Provide wound contraction
- Reduce dressing changes and cost

NPWT Indications
- Chronic wounds
- Surgical wounds
- Acute wounds
- Traumatic wounds
- Dehisced incisions
- Diabetic wounds
- Pressure injury
- Meshed grafts
- Partial thickness burns
## NPWT Considerations

- Will symptoms be managed more effectively?
- What are wound dimensions and can NPWT be easily applied?
- Any contraindications?
- Will placement of tubing be a problem?
- If discharged home can they manage therapy at home?
- Can wound bed be prepared effectively?
- Is patient and family willing and able to consent?


## NPWT Contraindications/Precautions

- Patient non-compliance
- Dressing retention
- Foam adherence
- Bleeding
- Pain
- Malignant wounds
- Mobility hazard
- Untreated osteomyelitis
- Non-enteric and unexplored fistulas
- Necrotic tissue and eschar present
- Therapies such as MRI, defib etc.
- Don't place on organs, nerves, blood vessels, anastomotic sites

## Therapy Guidelines

- Start and stop therapy at appropriate times
- 24 Hour continuous therapy
- Dressing changes 48-72 hours
- Wound measurements at initiation of NPWT and at least weekly
- Progress to closure products and therapies
### Application Steps

- Perform wound bed preparation
- Possible dressing interface application
- Perform application of the NPWT dressing
- Initiate Therapy Unit
- Dressing removal

### Bridging and “Y” Connecting Wounds

Bridging connects multiple wounds in close proximity to each other by a foam strip.

Bridging may be used to position the pad/tubing away from an undesirable area (e.g. Sacral area).

“Y” connecting connects 2 separate systems to one Therapy Unit.

Image of bridging Retrieved from: https://www.youtube.com/watch?v=ErG8Vy49jQ0

### Troubleshooting

- Leak detected
- Blockage
- Low Battery
- Canister/tubing problems
- Difficult areas to apply NPWT
- What if NPWT doesn’t work

Image of troubleshooting Retrieved from: ostomyoutdoors.com
Thank You!

Questions?

References


