Wound Care

Functions of the Skin

► Protection against the environment
► Controls body temperature
► Functions as an excretory organ
► Functions as a sensory organ
► Provides immunity
► Calcium metabolism
► Provides identity

Functional Components of Skin

► Epidermis
  - The tough, leathery outer surface of the skin
  - Cell types: keratinocytes, melanocytes, Merkel cells, Langerhans' cells
  - Functions: protection, regulates body’s fluid content, production of vit D, cosmesis
Functional Components of Skin

► Dermis
  ▪ Highly vascular, superficial lymphatics
  ▪ Cell types: fibroblasts, macrophages, WBC, mast cells
  ▪ Functions: nutrition, thermoregulation, sensation

Wound Management, Myers. Pg 5

Functional Components of Skin

► Subcutaneous Tissue
  ▪ Supports the skin
  ▪ Consists of adipose tissue & fascia
  ▪ Adipose:
  ▪ Fascia:

Sequence for Tissue Healing

► 1. Inflammatory Phase
► 2. Proliferation Phase
► 3. Maturation/Remodeling Phase
1. **Inflammatory Phase**

- Begins at the time of injury and lasts a few days
- Control of blood loss occurs first
  - Edema
  - Vasoconstriction of blood vessels
  - Platelets form a plug
- Within 30 minutes of vasoconstriction, vasodilation occurs resulting in localized redness, warmth, swelling, and pain

1. **Inflammatory Phase continued**

<table>
<thead>
<tr>
<th>Cell</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMN</td>
<td>Kills bacteria and cleans the wound</td>
</tr>
<tr>
<td>Macrophage</td>
<td>Kills bacteria and cleans the wound</td>
</tr>
<tr>
<td></td>
<td>Directs repair process</td>
</tr>
<tr>
<td>Mast cell</td>
<td>Secretes enzymes</td>
</tr>
<tr>
<td></td>
<td>Accelerates demise of damaged cells</td>
</tr>
</tbody>
</table>

**Signs & Symptoms of Inflammation**

- Redness
- Swelling
- Heat
- Pain
Signs & Symptoms of Infection
► Elevated body temp / fever
► Flu-like symptoms
► Tachycardia
► Lab values consistent with infection
  • WBC
► Purulent drainage / pus
► Persistence of malodorous wound drainage
► Induration

2. Proliferative Phase
► As the inflammatory phase progresses & the cells needed for repair & regeneration reach the injury site, the proliferative phase begins

2. Proliferative Phase continued
► 4 crucial events during proliferative phase:
  • Angiogenesis
  • Granulation tissue formation
  • Wound contraction
  • Epithelialization
2. Proliferative Phase continued

The proliferative phase is complete when the wound is completely resurfaced with epithelial tissue & the functional barrier of the skin has been restored

<table>
<thead>
<tr>
<th>CELL</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angioblast</td>
<td>Forms new blood vessels</td>
</tr>
<tr>
<td>Fibroblast</td>
<td>Builds granulation tissue</td>
</tr>
<tr>
<td>Myofibroblast</td>
<td>Causes wound contraction</td>
</tr>
<tr>
<td>Keratinocyte</td>
<td>Reepithelializes wound surface</td>
</tr>
</tbody>
</table>

3. Maturation/Remodeling

The granulation tissue laid down during the proliferation phase must be strengthened and reorganized to fit the surrounding tissue

- Collagen synthesis continues and the fibers reorient along the lines of stress

  - Internal influence:
  - External influence:

3. Maturation/Remodeling continued

Remodeling continues up to 2 years following wound closure

- Even once fully remodeled, scar tissue is AT MOST only 80% of the original tissue's strength
Factors Influencing Wound Healing

- The wound itself
- Local Factors
- Systemic Factors

THE WOUND ITSELF

- Mechanism of onset:
- Size and Location of wound:

THE WOUND ITSELF (continued)

- Wound Hydration:
- Necrotic Tissue:
- Infection:
Factors Influencing Wound Healing

► LOCAL FACTORS:
  ▪ Circulation:
  ▪ Sensation:
  ▪ Mechanical Stress:

Systemic Factors

► Age of patient
► Medication
  ▪ steroids, immunosuppressive therapy
► Lifestyle
  ▪ Nutrition, obesity, smoker, exercise, stress
► Diseases
  ▪ diabetes, anemia, PVD, COPD

Types of Wound Closure

► Primary Intention
► Secondary Intention
► Tertiary Intention (aka delayed primary closure)
Wound Closure

► **Primary Intention:** When a wound is cleanly incised and has minimal tissue loss, the wound margins can be closely approximated and the defect sutured or otherwise promptly closed.

Wound Closure continued

► **Secondary Intention:** An open wound missing tissue is allowed to close naturally as granulation tissue fills the defect.

Wound Closure continued

► **Tertiary Intention:** Highly contaminated wounds are kept open for several days to observe for infection. Thereafter, they are closed as in primary intention closure
► (Aka delayed primary closure)
Abnormal Wound Healing

- Abnormal results
  - Hypertrophic scar formation
  - Keloid scar formation

PAUSE

- Pause to compare notes with your desk partner
- Ask your desk partner any questions you have
- Share a “light bulb” moment or help to clarify something for your desk partner

Partial Thickness vs. Full Thickness Wounds

- **Partial Thickness Wounds** = loss of the epidermis and/or a portion of the dermis
- **Full Thickness Wounds** = total destruction of the epidermis and dermis
Types of Wounds

- Types of Ulcers (wounds)
  - Pressure Ulcers
  - Vascular Ulcers
    - Arterial Insufficiency Ulcers
    - Venous Insufficiency Ulcers
  - Neuropathic Ulcers

Pressure Ulcers

- Wound caused by unrelieved external pressure against the skin over a bony prominence, resulting in localized ischemia and/or necrosis of the tissue beneath the area.

Pressure Ulcers

- Contributory Factors
  - Shear – force applied parallel to the skin
  - Moisture – maceration & erosion
  - Friction – may cause blister or abrasion
  - Extrinsic factors – proper bed, W/C cushion
  - Intrinsic factors – muscle atrophy, medications, malnutrition
Pressure Ulcer Classification

- Stage I
- Stage II
- Stage III
- Stage IV

Stage I

- Non-blanchable erythema of intact skin. An observable pressure related alteration of intact skin who compared to the opposite area may include the following changes:
  - Tissue consistency or sensation
  - Skin Temp
  - Redness/purple hues
  - Induration

Stage II

- Partial thickness loss of skin involving epidermis and/or dermis. The ulcer is superficial and presents clinically as an abrasion, blister or shallow crater.
Stage III
 ► Full thickness tissue loss involving damage to or necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia. The ulcer presents clinically as a deep crater with or without undermining of the adjacent tissue.

Stage IV
 ► Full thickness tissue loss with extensive destruction, tissue necrosis, or damage to muscle, bone, tendon, or joint capsule.

Vascular Ulcers
 ► Vascular Dysfunction
 ► Wound location
Arterial Ulcers

- Wounds resulting from arterial insufficiency occur secondary to ischemia from inadequate circulation of oxygenated blood often due to complicating factors such as atherosclerosis.

Risk Factors Contributing to Arterial Ulceration

- Hyperlipidemia and Elevated LDL
- Smoking
- Diabetes
- Hypertension
- Trauma
- Advanced Age

Myers, p206

How can you test Arterial Insufficiency?

Myers, p208-212
Venous Ulcers

- Wounds resulting from **venous insufficiency** occur secondary to inadequate functioning of the venous system, resulting in inadequate circulation and eventual tissue damage and ulceration

Risk Factors Contributing to Venous Ulceration

- Vein Dysfunction
- Calf Muscle Pump Failure
- Trauma
- Previous Venous Insufficiency Ulcer
- Advanced Age
- Diabetes

Myers, p 235-236

What tests can you do to test for Venous Insufficiency?

Myers, p 237-238
Characteristics of Arterial & Venous Insufficiency Ulcers

<table>
<thead>
<tr>
<th>Location</th>
<th>Arterial Ulcers</th>
<th>Venous Ulcers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of Ulcers</td>
<td>Lower third of leg, toes, web spaces (distal toes, dorsal foot, lateral malleolus)</td>
<td>Proximal to the medial malleolus</td>
</tr>
<tr>
<td>Appearance</td>
<td>Smooth edges well defined; lack granulation tissue; tend to be deep</td>
<td>Irregular shape; shallow</td>
</tr>
<tr>
<td>Pain</td>
<td>Severe</td>
<td>Mild to moderate</td>
</tr>
<tr>
<td>Pedal Pulse</td>
<td>Diminished or absent</td>
<td>Normal</td>
</tr>
<tr>
<td>Edema</td>
<td>Normal</td>
<td>Increased</td>
</tr>
<tr>
<td>Skin Temperature</td>
<td>Decreased</td>
<td>Normal</td>
</tr>
<tr>
<td>Tissue Changes</td>
<td>Thin and shiny; hair loss; yellow nails</td>
<td>Flaking; dry skin; brownish discoloration</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Leg elevation increases pain</td>
<td>Leg elevation lessens pain</td>
</tr>
</tbody>
</table>

Neuropathic Ulcers

► Wounds caused by mechanical stress that people can't feel because of sensory loss
► The #1 cause of neuropathic ulcers =

Fruth, p151

Neuropathic Ulcers continued

► Plantar surface of foot in areas of greatest pressure
► Round punched-out appearance
► Calloused rim, with dry/cracked periwound
► Minimal drainage
► Patient’s don’t report pain

Fruth, p154
Assessing, Measuring & DOCUMENTING Wounds

- Location & Shape
- Size
- Wound Bed (Tissue type)
- Exudate (drainage)
- Tunneling and/or Undermining
- Stage
- Pain or sensation
- Periwound Skin integrity
- Edema
- Peripheral pulses (with an extremity wound)
- Treatment

Location & Shape

- Be specific, using anatomically correct terminology
- Draw pictures to clarify, if necessary.
- Photography

Size

- Be sure to include length, width, and depth measurements in centimeters.
- Use a measuring device!! (small clear goni)
Size continued

[The greatest length and greatest width are measured.] “The orientation of these dimensions needs to be documented for consistent future measurements. For example, length is typically measured in cephalad-caudal direction, and width is perpendicular to length. Clinicians may also use the clock face method superimposed over the wound: that is, 12 o'clock is toward the patient’s head and 6 o’clock is toward the feet. If the clock is not used in the cephalad-caudal direction, then 12 o’clock must be defined in terms of anatomic orientation. Dimensions are measured with reference to the numbers on the face of the clock: for example, 12-6 measures 1.0 cm and 3-9 measures 2.3 cm.”

Kloth, 2002

Wound Bed
Types of Tissue in Healing Wounds

- **Granulation tissue** – the pink to Red, moist fragile connective tissue – containing new collagen, blood vessels, fibroblasts, and inflammatory cells – that fills in an open wound bed during the proliferative phase of healing
- **Eschar** – dry, leathery necrotic tissue adhering to a wound bed. Black, necrotic tissue.
- **Slough** – Loose, stringy necrotic tissue. Yellow = infected, fibrinous slough.
- **Bone** or any other tissue (ligament, tendon, muscle)

Wound Exudate (Drainage)

- **Types of Exudate**
  - Serous (clear)
  - Sanguinous (bloody)
  - Serosanguinous
  - Purulent discharge (pus)
- **When documenting, describe:**
  - **AMOUNT** – none, minimal, moderate, copious
  - **COLOR** – see types above
  - **ODOR** – present, absent
**Tunneling**
- Tunneling is a narrow passageway created by the separation of fascial planes.
- Measured (in cm) by inserting a probe into the passageway until resistance is felt (depth is the distance from the probe tip to the point at which the probe is level with the wound bed).
- Use clock terms to identify the tunnel’s position within the wound bed.
- Common in surgical wounds.
- May not be readily visible, so you need to thoroughly probe to identify the full extent of tissue destruction.

**Undermining**
- When the tissue under the wound edges erodes, resulting in a large wound with a small opening.
- Measured (in cm) by inserting probe under the wound edge directed almost parallel to the wound surface until resistance is felt (depth is the distance from the probe tip to the point at which the probe is level with the wound bed).
- Use clock terms to identify the undermining.
- Common in pressure ulcers.
- May not be readily visible, so you need to thoroughly probe to identify the full extent of tissue destruction.

**Stage**
- See previous slides.
- When eschar is present, accurate staging of the pressure ulcer is not possible until the eschar has sloughed or the wound has been debrided.
Pain or Sensation

► Can document patient's report of pain during the procedure.
► Inability to perceive pain in a wound may lead to noncompliance with prevention & management.
► Assess sensation in patients with DM, peripheral neuropathy, or burns.
► Semmes-Weinstein monofilaments

Periwound Skin Integrity

► Is it macerated?
► Thin, frail, transparent?
► Scaley, cracked, callused?

Edema

► Assess for edema and induration (firm edema) because they impact function and are associated with wound infection.
► Edema is either pitting or nonpitting.
► Take circumferential measurements of both sides (right and left).
► Would you take volumetric measurements (volumeter)? Why or why not?
Peripheral Pulses

Peripheral pulses should be assessed for all extremity wounds

Treatment

- Debridement
- Dressings
- Modalities

Treatment - Debridement

- **Purposes for Debridement**
  - Decrease bacteria in wound
  - Increase effectiveness of topical antimicrobials
  - Shorten inflammatory phase of healing
  - Decrease energy needed by body
  - Eliminate physical barrier to wound healing
  - Decrease wound odor
- **Debridement is indicated** when there is necrotic tissue, foreign material, or debris within a wound bed
Treatment - Debridement

- Types
  - Sharp Debridement
  - Autolytic Debridement
  - Enzymatic Debridement
  - Mechanical Debridement
    - Wet-to-Dry Dressings
    - Whirlpool
  - Surgical Debridement

Treatment - Dressings

- Reasons for a dressing:
  - Protection
  - Absorption
  - Compression
  - Immobilization

- Common Dressings
  - Gauze:
    - Widely used
    - May become enmeshed in wound and slow healing
  - Impregnated Gauze

Treatment - Modalities

- Whirlpool
- Pulsed lavage
- Electrical stimulation
- Hyperbaric oxygen therapy
Whirlpool

- One of the oldest forms of wound care
- Rarely used today
- Indications:
  - Infected, heavily draining wounds
  - Foreign matter embedded in wound bed
  - Wounds that require rehydration or have thick necrotic tissue
- When not indicated, whirlpool can prolong wound healing

Puliti, 2012

Pulse Lavage with concurrent suction

- The standard of care for wound irrigation
- Using a gun-shaped device, saline flows through, delivering a constant irrigation to the wound bed as a negative pressure removes the irrigant into an external canister.
- Simple, effective, promotes circulation
- Can be done at bedside

Puliti, 2012
Negative Pressure Wound Therapy (NPWT)

A wound vacuum is negative pressure wound therapy (NPWT). In many deep wounds, edema and accumulation of drainage in the wound occurs. A constant, negative pressure device applied to the wound with a drainage system can help with the removal of excess fluid. The device consists of a pump, tubing, reservoir, and special foam type of dressing (which is cut to fit the wound). Constant NPWT is applied for 48 hours, then the dressing is removed, the wound is cleansed and reevaluated. A new, smaller foam dressing may be cut and placed in the wound for another 48 hours.

Ultrasound

- **High Frequency**
  - Contact
  - Reduces inflammation
  - Stimulates granulation tissue formation & collagen remodeling
  - Either submerged in water or directly over a wound with a barrier

- **Low Frequency**
  - Noncontact
  - The probe does not actively touch the wound
  - Saline is used as the medium

Puliti, 2012
Electrical Stimulation

► High-volt, pulsed current
► Improves blood flow

Pulib, 2012

Easing the Pressure

► “Wound healing often includes prolonged periods of bed rest. Frequently, the individual will have to maintain a specific body position while in bed to offload sensitive areas.”

Kubec, 2012

Easing the Pressure

► The National Pressure Ulcer Advisory Panel defines a support surface as:
  ▪ “a specialized device for pressure redistribution designed for management of tissue loads, micro-climate, and/or other therapeutic functions.”
  ▪ “No single type of support surface has been shown to consistently perform better than all others under all circumstances.”

Kubec, 2012
Easing the Pressure

- At risk for pressure ulcers:
  - Use a static mattress or overlay
  - Made of foam, static air, or fluid filled (water &/or gel)

- Has an existing pressure ulcer:
  - Dynamic surfaces use alternating pressure to provide pressure redistribution

Kubec, 2012

Excellent Documentation Tips


References

References