Wound Care 101 - Fundamentals of Wound Healing
Anatomy and Physiology

Everything you always needed to know but didn’t want to ask …

Speakers

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Objectives for Fundamentals of Wound Healing

- Will be able to discuss:
  - Anatomy and Physiology of Skin
  - Effects of Normal and Aging Skin
  - Basic Skin Care
  - Principles of Effective Wound Management
  - Acute & Chronic Wound
  - Process of Wound Healing – 3 Phases Wound Healing
  - Types of Wound Healing
  - Wound Healing vs Factors Delaying Wound Healing
Anatomy and Physiology of the Skin

Functions of human skin

1. Identify the 2 major layers of human skin and briefly discuss their functions

   - Normal Skin
   - Aging Skin
Normal Skin

- Elastic
- Lubricated
- Acid mantle: pH 4.5-5.5
- Largest organ of the body
- Weighs 6-8 pounds
- Varied thickness
Skin Functions

Protection

Sensation: transmits sensations, touch, pressure, pain

Thermoregulation: regulates body temperature and prevents excessive loss of body fluids

Excretion: excretes wastes, sweat

Metabolism: Synthesizes vitamin D

Communication: facial expressions
Anatomy: Layers of the skin
Epidermis – Epithelial Layer

- Thickness: 1mm
- 5 layers
  - Outermost Layer – Stratum Corneum
    - Dry, dead cells, rich in keratin
  - Other Layers –
    - Stratum Lucidum, Stratum basale,
    - Stratum Granulosum, and
    - Stratum Germinativum contain living cells.
- Regenerates on average every 28-30 days

Functions of the Skin
- Protection from epidermal water loss - dehydration
- Maintaining skin integrity against physical barriers, such as shear, friction and toxic/chemical irritants
- Melanocytes: Produce melanin (pigment/color)
Dermis

Provide the tensile strength, support we need.

Major Proteins are Collagen, elastin, and reticular fibers which give support and elasticity. Connective tissue.

Fibroblast: form collagen, synthesize and secrete proteins

Function:
- Produces hair, regulates body temperature,
- Houses sensory receptors
- Supplies nutrients and oxygen

Contains:
- Hair Follicles and Sweat Glands
- Sebaceous glands which secrete oil to lubricate the skin
- Lymphatic's, blood vessels, and cutaneous (skin) nerve endings.
Subcutaneous Tissue – Fatty Tissue

- Is a loose connective tissue (Fatty)
- Function:
  - Mechanical insulation
  - Thermal insulation
  - Attaches to underlying structures
  - Cells are adipose tissue which provides cushion between the skin, muscles & bones
- Gives each person their body Shape.
Effects of Normal Aging Skin

Decrease In:
- Dermal thickness
- Fatty layer – bones decreased protection
- Collagen and Elastin - less recoil
- Retext Ridges – saggy skin
- Epidermal -Junction separates epidermis from dermis
- Sensation – can not sense pressure or hot and cold temperature
- Vitamin D – fragile bones, fractures
- Sweat Glands – dry skin

Increase In:
- Epidermal cells regenerate every 60 days – Skin Tear
- Sun damage
Principles of Effective Wound Management

Wounds do not occur in isolation.

There are a number of reasons why a patient develops a wound.

A thorough patient assessment must be completed before a realistic plan and goals/outcomes can be established.

There are 3 Principles in wound care management

- Control, reduce or eliminate causative factors
- Provide systemic support to reduce existing and potential co-factors
  - co-morbidities
- Maintain a physiologic Local wound environment
Principle 1: Control, reduce or eliminate causative factors:
- Pressure, shear, friction, moisture, Circulatory impairment (Venous Arterial), Neuropathy (Diabetic) or Surgical.
- What was the original cause of the wound?
- Once you have identified the cause then a plan needs to be put in place to reduce or eliminate these factors. Such as:
  - Selection of a support surface
  - Implementation of a turning schedule, measures to reduce shear and friction
  - Management of incontinence
  - Use of compression therapy.
  - Monitor blood sugar.
Principle 2

- Principle 2: Provide systemic support to reduce existing and potential co-factors – co-morbidities.
- Need to assess and manage patient cardiovascular and pulmonary status.
- Nutrition and fluid support.
- Other systemic conditions that affect wound healing: diabetes, medications such as steroids, and immunosuppression.

Once you have identified these systemic cofactors then a plan needs to be put in place to intervene and correct any deficiencies. Such as:

- Measures to improve oxygenation. May need oxygen.
- Correct nutritional deficiencies. May need oral supplements, vitamins, and mineral supplements.
- Measures to control blood sugars, medication side effects.
Principal 3

- Principal 3: Maintain a physiologic Local wound environment –
- Need to apply an appropriate topical therapy that provides a wound environment that is optimal for healing.
- Removal of necrotic tissue
- Identify and eliminate infection - control of microorganisms
- Obliterate the dead space
- Absorb excess exudates
- Adequate perfusion of blood, oxygen and nutrients
- Maintain moist wound surface – hydration and ph of the wound bed
- Provide thermal insulation – control the temperature of the wound bed
- Protect the wound bed from injury or trauma
Acute wounds are defined as a disruption in the integrity of the skin and underlying tissues that progress through the healing process in a timely and uncomplicated manner.

Acute wound is 2 weeks or less.

Ex. Surgical wound, or abrasion or laceration.
Chronic wounds are defined as those wounds that fail to progress through the normal, orderly and timely sequence of wound healing.

The chronic wound gets stuck in the Inflammatory or the Proliferation phase.

A chronic wound is 2 weeks or older.

Types of Wound Healing

Primary Closure
- The wound edges are approximated and sutured together.
- Healing takes place by re-epithelialization
- If no complications heals and knits together quicker. Usually Acute Wounds
  - Surgical Incision, graft or a flap

Secondary Closure
- Wound is left open to fill in
- Involves
  - Wound bed fills in with Collagen deposited - Granulation tissue
  - Wound Contraction
  - Re-Epithelialization
- Longer process and time to close. Usually occurs in Chronic Wounds
  - Pressure, Venous, Arterial, Diabetic, Infection or severely contaminated, Trauma
The process of wound healing is a complex sequence of events. It starts when the injury occurs and it continues with the wound closed over and ends with scar tissue formation. The Goal of wound healing is to develop **Scar Tissue** in the wound bed and restore an intact epidermis.

There are 2 mechanisms by which the body is capable of healing.

**Regeneration** – is the replacement of damaged cells by identical/same type of cells. The types of cells that regenerate or replace themselves for wound healing are the epithelial cells or Epidermis.

**Repair** – is the main way healing occurs. During repair (wound healing process) damaged tissue is replaced by connective tissue which then forms **scar tissue**
Phases of Wound Healing

- Hemostasis (clotting)
- Inflammatory Phase (reaction)
- Proliferation Phase (regenerative)
- Maturation Phase (remodeling)

Silvery white scar
Intact epidermis
Hemostasis - The Vascular Response:
At the time of injury bleeding occurs.
The main cells are the platelets and macrophages.
Hemostasis is the arrest of the hemorrhage at the site of blood vessel damage. *Bleeding is stopped.*
The result is a fibrin clot is formed.
The **fibrin clot** starts to breakdown and initiates the next phase.
This phase (Hemostasis) last about 6-12 hours
Inflammatory Phase

- The main inflammatory cells are the neutrophils, macrophages, cytokines, and growth factors.
- Macrophages play a key role in regulating events in wound healing and induce the cells to start the next phase.
- This phase is characterized by inflammation:
  - localized swelling/edema,
  - erythema,
  - heat and pain.
  - Increased wound drainage
- The main job of this phase is to get and keep the wound bed clean so new tissue can be laid down.
- In an Acute wound, this phase lasts 4-6 days.
Proliferation Phase

- The main cells are fibroblast, proteins (collagen and elastin), macrophages, and growth factors.
- This phase is characterized by
  - The formation of granulation tissue,
  - Angiogenesis (new blood vessels)
  - Wound contraction
  - Epithelialization.
- In an Acute wound this phase usually last 4 - 24 days.
Maturation Phase

The main cells are collagen and macrophages.

This phase is characterized by

- Reorganize
- Remodeling
- The formation of scar tissue.

This gives the wound its tensile strength.

The *tensile strength* of scar tissue is 80% compared to normal skin.

In Acute wounds this phase begins about 20 days post injury and last for months.

In more complex Acute wounds can last up to 2 years.
The Ideal Wound Environment

- Moist
- Free from excess exudate
- Free from necrotic tissue
- Free from trauma
- Warm
- Protected from bacterial infection
- Acidic
- Oxygen sensitive
Non-healing Wounds

- Inadequate circulation/perfusion
- Unrelieved mechanical stresses (pressure)
- Systemic diseases
- Non-compliance
- Edema
- Infection/Osteomyelitis
- Cytotoxicity
- Malnutrition
Factors Delaying Wound Healing

- Systemic
- Local
- Psychological
- Lifestyle
Factors Delaying Wound Healing

Systemic

- Metabolic Disorders:
  - Diabetes
  - Renal failure
- Respiratory Disorders:
  - COPD
  - airway disease
- Circulatory Disorders:
  - Anemia,
  - CHF
- Immune deficiency:
  - HIV,
  - Rh Arthritis,
  - Cancer

- Immunosuppressive therapy:
  - Chemo
- Nutritional State:
  - Dehydration
  - Vitamin deficiency
  - Protein
  - Calories
- Medication:
  - Steroids,
  - Anticoagulants
- Age
Factors Delaying Wound Healing

Local

- Necrosis:
  - Eschar
  - Slough
- Bacterial burden
- Infection vs Contamination
- Prolonged inflammation
- Exudate:
  - Desiccation
  - Excess
- Cellular dysfunction
- Edema
- Local Medications — in wound bed

- Biochemical imbalance — ph
- Perfusion — blood supply
- Hypoxia
- Temperature
- Debris/Foreign Material
  - Gauze Fibers
  - Sutures
  - Dressing Material — get it ALL out
- Chemical stress — Cytotoxic agents
- Mechanical — pressure, shear, friction
Factors Delaying Wound Healing
Psychological Factors

- Stress & anxiety
- Depression
- Motivation and concordance
- Factitious Injury (intentional/unintentional)
- Sleep deprivation
Factors Delaying Wound Healing
Lifestyle Factors

- Age
- Employment
- Environment:
  - where they live
  - how clean is the environment
- Hobbies/interests
- Cultural/religious beliefs
- Financial status
- Do they have medical insurance
Questions?
References