HOW TO FIX A DITCH, A GUIDE TO HEALING CHRONIC WOUNDS

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CHRONIC WOUNDS

Common problem for Physicians and healthcare providers

5.7 million Americans are affected

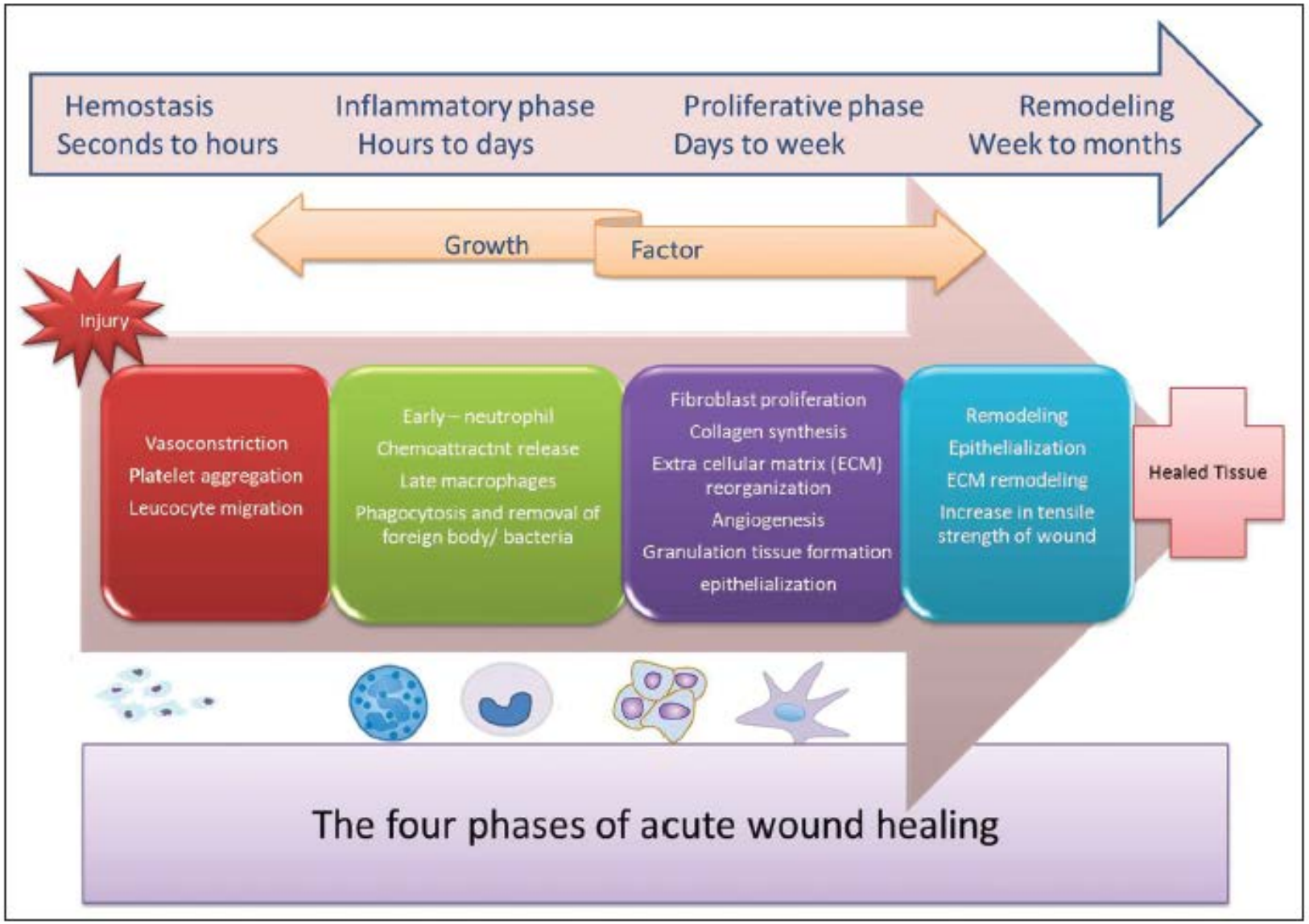
Costing $20 Billion annually

OVERVIEW

- Discuss Phases of Wound Healing
- Causes of Delayed Wound Healing
- When to Biopsy and Why
- Treatment of Chronic Wounds
- Holsey's Hot Topic

PHASE OF WOUND HEALING

- Hemostasis
- Inflammation
- Proliferation/Repair
- Maturation/Remodeling


Hemostasis
Seconds to hours
Inflammatory phase
Hours to days
Proliferative phase
Days to week
Remodeling
Week to months
Growth
Factor
Injury
Vasoconstriction
Platelet aggregation
Leucocyte migration
Early – neutrophil
Chemoattractnt release
Late macrophages
Phagocytosis and removal of foreign body/ bacteria
Fibroblast proliferation
Collagen synthesis
Extra cellular matrix (ECM) reorganization
Angiogenesis
Granulation tissue formation
epithelialization
Remodeling
Epithelialization
ECM remodeling
Increase in tensile strength of wound
Healed Tissue
The four phases of acute wound healing

NORMAL AND ABNORMAL SIGNS OF INFLAMMATORY PROCESS

- Normal Symptoms
- Redness
- Swelling
- Heat
- Pain

- Abnormal Symptoms
- Wound breakdown
- Over-active bleeding
- Increased pain
- Pus or unusual drainage
- Spreading redness around the wound
- Flu-like symptoms

CAUSES OF DELAYED WOUND HEALING

DIDN'T HEAL

DIDN'T HEAL

- Diabetes
- Infection
- Drugs: Steroids and antimetabolites impede proliferation of fibroblasts and collagen synthesis
- Nutrition
- Tissue Necrosis caused by pressure

- Hypoxia: Inadequate tissue oxygenation
- Excess Tension on the wound -> necrosis
- Another wound: multiple wounds fighting for substrates for healing
- Low Temperature

DIABETES

- According to the CDC as of 2018
  - 10.5% of the US has Type II diabetes
  - 21.4% of the population is undiagnosed
  - 34.5% of the population is prediabetic

DIABETES AND ITS AFFECT ON WOUND HEALING

Hyperglycemia decreases the body's immune system and increases the risk of infection

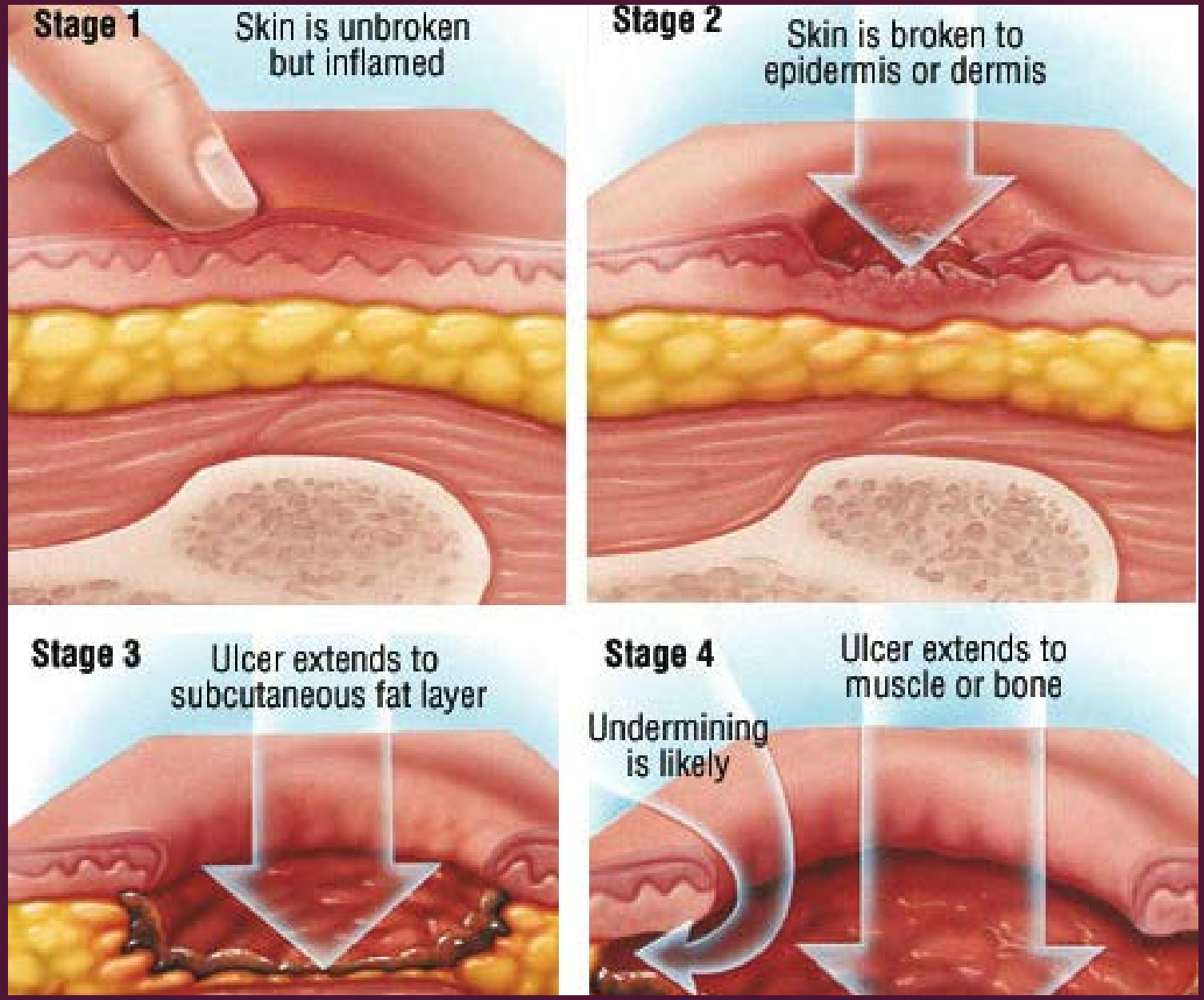
Hyperglycemia increases the inflammatory phase. This leads to the formation of chronic wounds.

VASCULAR SUPPLY

- Physical Examination
- Arterial Doppler
- Venous Doppler
- Vascular Consult if needed

ARTERIAL VERSUS VENOUS WOUND

UNDER PRESSURE



IMPLICATIONS OF PRESSURE

Decreases blood flow to the wound

Leads to necrosis which increases your risk of infection

WHAT IS BIOFILM?

Wound bacteria that grow in clumps embedded in a thick, self-made, protective slimy barrier of sugars and proteins

Causes a chronic inflammatory response leading to an increase of neutrophils and macrophages. This results in reactive oxygen species and proteases that damage the normal surrounding tissue, proteins, immune cells and tissue cells.

Only visible with microscopy. However, slough may indicate that biofilm is present. Biofilm is a gel-like and shiny layer.

PREDISPOSING FACTORS THAT CAUSE BIOFILM

- Ischemia or necrosis of tissue
- Poor patient nutrition
- Co-morbidities that impair immune function
- Treatment with immune suppressing drugs

MANAGEMENT OF BIOFILM

- High Resistance
  - Antibodies
  - Antibiotics
  - Disinfectants
  - Phagocytic inflammatory cells
- Treatment
  - Debridement
  - Cleansing the wound
  - Preventing new bacteria from reaching the wound

NUTRITIONAL SCREENING

- Significant weight loss
- Co-morbidities predisposing to decreased nutrition
- Immobility and Inactivity
- Appetite Decline
- Adverse Effects of Medications

IMMUNONUTRITION

Vitamin C 500mg by mouth twice daily

Zinc 220 mg by mouth for 14 days

Protein supplementation

IMPORTANCE OF ZINC ON WOUND HEALING

- Cofactor for collagen formation, metabolizes protein, liberates Vitamin A from storage in the liver, interacts with platelets in clotting, assists in immune function
- Zinc can be lost rapidly through wound drainage
- Albumin is needed for the transportation of Zinc

VITAMIN C

cofactor in the hydroxylation of proline and lysine residues in procollagen

vital for the strength and stability of collagen fibers

enhances neutrophil function and acts as an antioxidant.

PROTEIN SUPPLEMENTATION

- Normal Albumin levels (3.4-5.4 g/dl)
- Normal Prealbumin (22-45 mg/dl)
- Who needs protein?

WORK UP

Laboratory Studies- CBC, BMP, Serum Protein, Albumin, Prealbumin, Coagulation studies, Wound Cultures

Imaging Studies- x-ray, MRI, Bone Scan

Wound Biopsy

OSTEOMYELITIS

- *Common Bacterial Causes*
  - *Staphylococcus aureus*
  - Coagulase-negative streptococci
  - Aerobic gram-negative bacteria
  - Anaerobes including *Finegoldia*

TREATMENT OF OSTEOMYELITIS

- Piperacillin-tazobactam 3.375 g IV q6h or
- Ampicillin-sulbactam 3 g IV q6h or
- Ticarcillin-clavulanate 3.1 g IV q6h or
- Cefepime 2 g IV q8-12h (consider adding metronidazole 500 mg q8h for empiric anaerobic coverage)
- Penicillian Allergy
  - Clindamycin 600 mg IV/PO q6h or metronidazole 500 mg IV/PO q8h plus ciprofloxacin 750 mg PO or 400 mg IV q12h or levofloxacin 750 mg PO daily, or moxifloxacin 400 mg PO daily

TREATMENT OF OSTEOMYELITIS

- If MRSA is suspected
  - Add vancomycin 15 mg/kg IV q12h
  - If a contraindication exists to the use of vancomycin, an alternative anti-MRSA agent such as linezolid, daptomycin, or ceftaroline may be used

TREATMENT OF OSTEOMYELITIS

- Oral therapy after IV therapy from contiginous spread of infection
  - Amoxicillin-clavulanate 875 mg/125 mg PO q12h or
  - Ciprofloxacin 750 mg PO q12h
    plus clindamycin 300-450 mg PO q6h or
  - Levofloxacin 750 mg PO daily
    plus clindamycin 300-450 mg PO q6h or
  - Moxifloxacin 400 mg PO daily

ROLE OF WOUND BIOPSY

Assess for atypical wounds

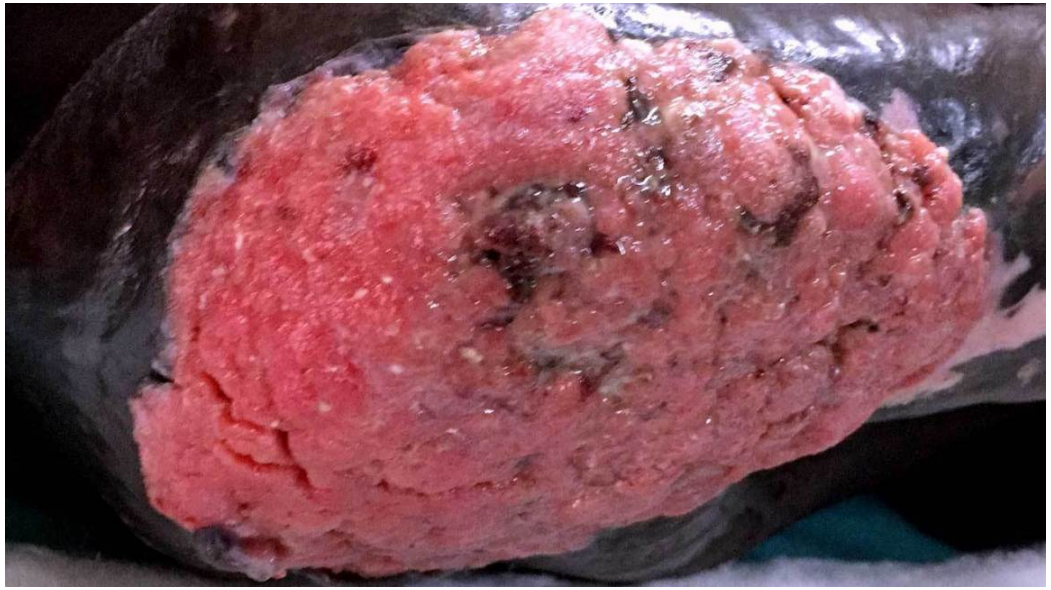
- basal cell carcinoma
- squamous cell carcinoma
- Melanoma
- cutaneous T-cell lymphoma
- Pyoderma Gangrenosum
- Calciphylaxis

Evaluate for Osteomyelitis

Recommended when wound has been present for greater than 3 months

MARJOLIN'S ULCER

- Rare and Aggressive
- Originating from a chronic wound
- Type of Squamous Cell
- Can heal and reoccur multiple times
- More common in men



PYODERMA GANGRENOSUM

- Starts as a small painful nodule
- Becomes ulcerated with violaceous borders
- Usually associated with systemic diseases such as Hepatitis, Inflammatory Bowel Disease, Cirrhosis, Lupus, Sjogren's Disease

CALCIPHYLAXIS

- Chronic Renal Failure Patients
- Usually within 3 years of dialysis
- More common in women
- Histology=calcifications
- Most common site is the thigh
- Will most likely need surgical debridement

WOUND BED PREPARATION (TIME)

Clinical Observation	Clinical Action
Tissue Nonviable or deficient	Debridement
Infection or Inflammation	Remove infected foci
Moisture Imbalance	Apply moisturing –balancing dressings, compression, negative pressure, and other methods of removing excess fluid
Edge margin non-advancing or undermined	Reassess cause, refer, or consider corrective advanced therapies such as bioengineered skin, debridement, skin grafts

SPECIAL THERAPIES

- Negative Pressure Wound Vac
- Hyperbaric Oxygen Therapy
- Becaplermin gel 0.01%
- Collagenase
- Compression Therapy

USES FOR NEGATIVE PRESSURE WOUND VAC

- diabetic ulcers
- venous ulcers
- arterial ulcers
- pressure ulcers
- first and second degree burns
- chronic wounds
- wounds with large amounts of drainage
- surgical and acute wounds at high risk for infection

CONTRAINDICATIONS FOR WOUND VAC

Necrotic tissue with eschar present or a viable eschar present
Untreated osteomyelitis
Fistulas present
Soft tissue malignancy
Exposed blood vessels
Exposed nerves

Exposed anastomotic site
Exposed organs

HYPERBARIC OXYGEN THERAPY

BREATHING 100% OXYGEN WHILE UNDER INCREASED ATMOSPHERIC PRESSURE

ROLE OF HYPERBARIC OXYGEN ON NON-HEALING WOUNDS

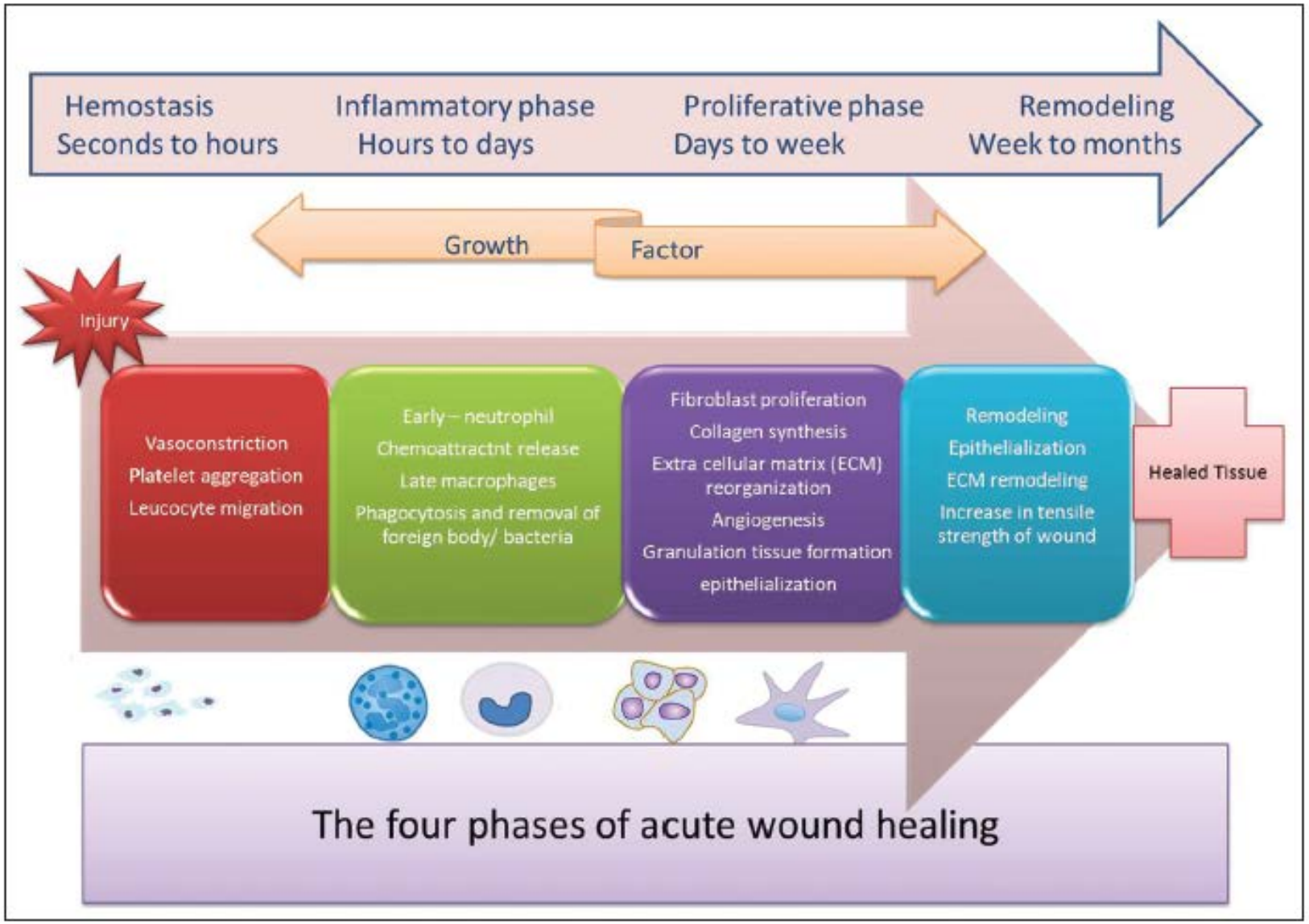
- Refractory Osteomyelitis-failed antibiotic treatment
- Promote osteoclast formation
- Facilitates the penetration of antibiotics

BECAPLERMIN

- Indication: Treatment of diabetic wounds with adequate blood supply
- Mechanism of action: Recombinant human platelet-derived growth factor; promotes chemotactic recruitment and proliferation of cells involved in wound repair and enhances granulation tissue formation
- Results: Within 8 weeks (15% completely healed); within 10 weeks (25% completely healed)

COLLAGENASE

- FDA approved for Chronic Wounds
- Provides enzymatic debridement of wounds
- Encourages Migration and Proliferation of fibroblasts, keratinocytes, and endothelial cells
- New Compatibility
- Covered by insurance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COMPRESSION THERAPY

Gold Standard for Venous Ulcers

Purpose

- Reduces the diameter of the vessels
- Returns blood to the central circulation
- Reduces edema
- May improve arterial circulation
- May reduce levels of inflammatory cytokines and proteases

VENOUS ULCERS

- Multicenter study of 1000 patients with Chronic Lower Extremity Ulcers
  - arterial hypertension (70.5%)
  - obesity (45.2%),
  - non-insulin dependent diabetes (27.2%)
  - dyslipidemia (24.4%)
  - metabolic syndrome (18.4%).[15]

NEW RESEARCH

Therapies targeting autologous cytokines and enzymes

- Adam 12, membrane-anchored metalloprotease, is increased in Chronic Wounds and inhibits growth factors
- Epidermal Growth Factor found to cause keratinocyte migration, fibroblast function and the formation of granulation tissue

Stem Cell Therapy

- autologous marrow mesenchymal stem cells implanted in a collagen dermal substitute
- pluripotential cells that develop into durable tissue and elaborate growth factors and cytokines

HOLSEY'S HOT TOPIC

- Skin Manifestations and Coronavirus
  - Due to small vessel occlusion
  - nonpruritic blanching livedoid vascular eruption
  - Easily confused with other disease processes

PATIENT PRESENTATION

- Patient 1 (Bangkok)
  - skin rash, petechiae, and a low platelet count
  - Diagnosed with Dengue Fever
  - Correct diagnosis was made later when patient developed respiratory symptoms

- Patient 2 (United States)
  - low fever, nasal congestion, postnasal drip, and a wet cough
  - 1 week later developed a nonpruritic blanching livedoid vascular eruption and blood in urine
  - Within 24 hours the rash and hematuria resolved but patient developed Covid like symptoms

ITALIAN STUDY

- 148 patients
  - 60 excluded as they had started a new medication in the last 15 days
  - 88 patients included
    - 20.5% developed skin manifestations
    - 44% at the onset of symptoms
    - Most commonly on the trunk with mild to no pruritis

RESOURCES

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