Wound healing and repair

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Objectives

• acute versus chronic wounds
• phases of wound healing
• basic principles of wound management
• wound management
• summary
Acute versus chronic wounds

Acute wounds

orderly physiologic sequence of inflammation, proliferation and maturation

Chronic wounds

inadequate angiogenesis, impaired innervation, or impaired cellular migration (*ischemic ulcers, venous ulcers, neuropathic foot ulcers and infected wounds including surgical site infections*)

Risk factors for non-healing

- Peripheral artery disease
- Diabetes
- Chronic venous insufficiency
- Aging
- Immunosuppressive therapy
- Chemotherapy and Radiation therapy
- Spinal cord disease and immobilization
- Malnutrition
- Infection
- Smoking and nicotine replacement therapy

Phases of wound healing

1. **hemostasis**
   platelets aggregation, activation of clotting cascade, release of growth factors and cytokines (PDGF, TGF-β,…)

2. **inflammation**
   increased vascular permeability, cellular recruitment:
   - Accumulation of mononuclear leukocytes and transformation into macrophages
   - Mast cells degranulate, releasing histamine and other mediators of vasodilation and cellular migration
   - Release of vasoactive substances from stromal mast cells
   - Migration and concentration of polymorphonuclear leukocytes that digest bacteria, foreign debris, and necrotic tissue with lysosomal enzymes
3. **epithelialization**
basal cell proliferation and epithelial migration occurring in the fibrin bridgework inside a clot

4. **fibroplasia**
fibroblast proliferation, accumulation of ground substance, and collagen production

5. **maturation**
collagen cross-linking, collagen remodeling, wound contraction and repigmentation

Basic principles of wound management

To ensure proper healing, the wound needs to be well vascularized, free of devitalized tissue, clear of infection and moist!

Wound dressings should eliminate dead space, control exudate, prevent bacterial overgrowth, ensure proper fluid balance, be cost-efficient, and be manageable for the patient.


Wound management

Antibiotics

no evidence for antibiotic therapy as prophylaxis in non-infected chronic wounds reserved for wounds that appear clinically infected (local or systemic symptoms)

Wound debridement

irrigation – decrease of bacterial load, remove of loose material
surgical
enzymatic – Collagenase, Papain, Bromolain
biologic – maggot therapy with Australian sheep blow fly or green bottle fly

Wound management

Topical therapy

- **Growth factors** –
  - **PDGF Becaplermin** (approved for use in the United States as an adjuvant therapy for the treatment of diabetic foot ulcers)
  - **GM-CSF** (significantly higher rates of healing in 60 patients with venous ulcers)
  - **EGF** (not significantly associated with a greater reduction in ulcer size and higher ulcer healing rate compared with placebo)

Wound management

Antiseptics and antimicrobials

- Cadexomer iodine (reduces bacterial load and provides a moist wound environment)
- Silver sulfadiazine (antiseptic)

Wound management

Wound dressings

general principles for chronic wound management

• Hydrogels for the debridement stage

• Foam and low-adherence dressings for the granulation stage

• Hydrocolloid and low-adherence dressings for the epithelialization stage

Films, alginates, hydroactives

Wound management

Wound closure

- primary closure and delayed primary closure

- negative pressure wound therapy

Wound management

Wound coverage

- Full-thickness skin grafts
- Split-thickness skin grafts
- Cell-based dressings (epidermal or dermal elements, collagen and fibroblasts)
Discussion

• To ensure proper healing, the wound needs to be well vascularized, free of devitalized tissue, clear of infection and moist!

• Wound dressings should eliminate dead space, control exudate, prevent bacterial overgrowth, ensure proper fluid balance, be cost-efficient, and be manageable for the patient.

• Topical agents such as antiseptics and antimicrobial agents can be used to control contamination.

• Negative pressure wound therapy is frequently used to manage complex wounds prior to definitive closure.

• Acute wounds can often be closed primarily. Chronic wounds can undergo delayed closure or coverage with skin grafts or bioengineered tissues.