Age-related comorbidities that impact on wound healing

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Objectives

- Function of skin
- Phases of wound healing
- Wound healing in older adults
- Local & systemic factors affecting wound healing
- Biofilms
- Chronic diseases & drug Rx affecting healing
Connective tissue that consists of cells, fibres and an extracellular matrix

- Largest organ of the body
- Weights of 2.5 kg (approximately)
- Receives 1/3 of body’s blood volume
- Thickness from 0.5 to 0.6 mm
Function of the skin

- Body’s first line of defence against infection
- Regulates body temperature & body fluids
- Site of metabolism of important nutrients
- Barrier against microorganisms (acidic pH 4-5)
- Provides protection from mechanical damage caused by heat, cold, radiation, chemicals and sun rays

(Wright, 2004)
Skin structure

**DIAGRAM OF SKIN STRUCTURE**

1. Hair
2. Basal cell layer
3. Sebaceous gland
4. Sweat duct
5. Erector pili muscle
6. Sweat gland
7. Collagen and elastin fibres
8. Hair follicle
9. Blood vessel
10. Nerves

Age-related comorbidities that impact on wound healing: Wound management workshop
Definition of a wound

A loss of continuity of skin

Any damage to the basic three layers (subcutaneous, dermis and epidermis) of the skin would result in a wound

(Alexander et al, 1994)
Phases of wound healing

Normal healing of acute skin wounds proceeds through a sequence of 4 distinct phases (that overlap temporarily):

1. Hemostasis (1-3 days)
2. Inflammation (2-5 days)
3. Repair/ Proliferation (5-24 days)
4. Remodeling/ Maturation (24 days - 1 year)
Hemostasis

What happens?
Epinephrine is released in an attempt to minimize bleeding into the soft tissues.

When does it happen?
From initial injury to approximately 3 hours post injury.

What cells are involved?
Platelet cells are responsible for clot formation and releasing cytokines.

Click the "Learn More" button to see how hemostasis works.
Wound healing in older adults

- **Aging** causes slower wound healing (> 60 years old)
- Not an actual impediment in terms of quality of healing
- **Homeostasis** easily affected by illness
- **Temperature** regulation impacted over time
- **Gait changes** (esp > 80 yrs= increased double stance time; decreased gait speed)
- **Cellular changes** (diminished cell mediated immunity)
- **Skin** = epidermis thins, becomes dryer and less elastic; decreased S/C fat; sweat glands, blood vessels and nerve cells decrease in number
Wound healing in older adults

- **Cardiac**: decreased cardiac output affects blood flow to all organs
- **Respiratory**: vital capacity decreases,
- **Gastrointestinal**: decreased absorption of nutrients, decreased hepatic blood flow
- **Genitourinary**: decreased blood flow and decline in renal function
- **Musculoskeletal**: decreased muscle mass & strength; increased bone loss
- **Neurological**: brain atrophy, increased fragility of blood vessels, decreased cerebral blood flow, decreased proprioception (spatial awareness)
## Factors affecting wound healing

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Local factors affecting wound healing

Type of wound, its depth and following local factors:

• **Site:** facial wounds heal faster than those of foot

• **Tissue:** skin heals faster than muscle, which heals more quickly than fascia

• **Oxygenation:** vital for all stages of wound healing

• **Contamination:** the persistence of microorganisms leads to prolongation of the inflammatory phase

• **Blood supply: ischaemia:** impaired blood supply will lead to lack of oxygen & other nutrients at the wound site

• **Desiccation; temperature:** temperature of wounds decreases faster than that of the surrounding skin, and low temp (even a decrease of 2 degrees C) can temporarily arrest cell growth
Systemic factors affecting wound healing

- **Age/ Gender/ Sex hormones:** protein synthesis is lower; monocytes migrate later, inflammation persists longer. Estrogen can improve age-related impairment in healing in both men & women.
- **Stress:** diminishes inflammatory response and reduces the production of cytokines.
- **Disease:** presence of chronic disease tends to lead to slower healing (e.g. people with RA frequency of leg ulcers is 3 times higher; in diabetes the risk of infection is 5 times higher than non-diabetics).
- **Drug therapy:** adverse effects on ability of the body to heal.
- **Alcoholism & smoking:** have negative effect and exercise has a positive effect.
- **Nutrition:** all the components of the diet are important to enable optimal wound healing.
Local factors- oxygenation

Critical for all wound healing!

- Important for **cell metabolism**- especially energy production
- Prevents wounds from **infection**, induces angiogenesis
- **Increases re-epithelialisation** and proliferative phase
- Promotes wound **contraction**
- In early healing- the wound is depleted of oxygen and is hypoxic due to metabolically active cells= **growth factors** are released
- **Oxygen** levels are later restored which sustains the wound healing
Local factors - infection

- Once skin is injured, micro-organisms that are normally at the skin surface obtain access to the underlying tissues.
- State of infection and replication of the micro-organisms determines how the wound is classified:
  - Contaminated (presence of non-replicating organisms on a wound)
  - Colonised (presence of replicating organisms without tissue damage)
  - Local infection/ critical colonisation (micro-organism replication and beginning of local tissue responses)
  - Spreading invasive infection (presence of replicating organisms within a wound with subsequent host injury)
Local factors - infection

- **Inflammation** is a normal part of the wound healing process and it is important to the removal of contaminating micro-organisms.
- In the absence of effective decontamination, the inflammation may be **prolonged**.
- Bacteria in infected wounds occur in the form of **biofilms**, which are complex communities of aggregated bacteria embedded in a self-secreted extracellular polysaccharide matrix (EPS).
- Biofilms develop **protected microenvironments** and are more resistant to conventional antibiotic treatment.
- **Staphylococcus aureus, Pseudomonas aeruginosa, streptococci** are common bacteria in infected and clinically non-infected wounds.
Biofilm video
Removal of biofilm video
Best practice recommendations:

- **Providone**- iodine in solution or impregnated wound dressings can be used to manage bacterial biofilms in chronic wounds (Level B recommendation)
- **Cadexomer iodine** dressing could be used to manage biofilms in chronic wounds (Level B)

(The Joanna Briggs Institute, Nov 2012)

(Grades of recommendations:
A - Strong support that merits application
B- Moderate support that warrants consideration of application
C - Not supported)
Treatment of biofilms- iodine

Adverse effects of iodine:

- 27 RCTs found no substantial difference in adverse reactions between iodine and other methods of local wound care.
- However, *iodine should not be used* with people who have the following conditions:
  - Known or suspected *sensitivity* to iodine
  - Impaired *renal* function
  - Hx of *thyroid* disorders
  - Extensive *burns* to the body
  - Before and after *Rx with radio-iodine* until permanent healing has been achieved

(The Joanna Briggs Institute, Nov 2012)
Treatment of biofilms- Ag

**Best practice recommendations:**
(Not as effective as iodine, but consideration should be given to the environment, patient, wound and local resources when selecting wound management products)

**Topical silver- impregnated dressings** could be used to manage biofilms in chronic wounds (Level B)
Denaturing of biofilms is more likely to be maintained through use of **elemental silver dressings and sustained release silver products** (Level B)

AE: not to be used for patients with silver sensitivities and silver sulphadiazine products for patients with sulphur sensitivities

(The Joanna Briggs Institute, Nov 2012)
Chronic disease - Diabetes

- **Blood sugar levels** - elevation in BSL stiffens the arteries and cause narrowing of the blood vessels.
- **Poor circulation** - narrowed blood vessels = decreased blood flow and oxygen to the wound. Elevated BSL decreases the function of RBCs that carry nutrients to the tissue. This lowers the efficiency of WBCs that fight infection. Without sufficient nutrients and oxygen = wound heals slowly.
- **Neuropathy** - nerves are damaged by high BSLs, therefore there is a loss of sensation. Person can’t feel a developing blister, infection or wound = severity can progress and complicate healing.
Chronic disease - Diabetes

- **Immune system deficiency** - efficiency of immune system is lowered, therefore raises the risk of infection. Certain enzymes and hormones are produced in response to high BSLs which reduce immunity.

- **Infection** - poor immune response = higher risk of infection = slows the overall healing process. If left untreated can increase the risk of developing gangrene, sepsis or osteomyelitis. This can lead to amputation of a limb.
Chronic ulcer - Case study

(written consent obtained from resident & family to utilise photos for education)
Chronic ulcer - Case study

(written consent obtained from resident & family to utilise photos for education)
“It wasn’t really insulin. You don’t have diabetes yet. It was just a warning shot.”
Peripheral Venous Insufficiency

Arteries carry blood from your heart out to the rest of the body. Veins carry blood back to the heart, and valves in the veins stop the blood from flowing back. When the veins have trouble sending blood from the limbs back to the heart, it is called venous insufficiency (VI). In this condition, blood does not flow back properly to the heart, causing blood to pool in the legs.

Symptoms:

- swelling of the legs or ankles (oedema)
- pain that gets worse when standing and subsides when legs are raised
- leg cramps
- aching, throbbing, or a feeling of heaviness in the legs
- itchy legs
- weak legs
Age-related comorbidities that impact on wound healing: Wound management workshop
Chronic disease - COPD

- Alters the delivery of oxygen and nutrients to tissues to promote wound healing.
- Added complications of reduced mobility and exercise intolerance due to SOB
Chronic disease - cardiac

- The heart pumps oxygenated blood through the circulatory system to all body tissues.
- People with heart disease have poor pump function, therefore all body tissues suffer.
- Cardiac disease can involve the dysfunction of the coronary arteries, valves or the electrical conduction system.
- Any dysfunction of the cardiac system creates significant difficulties with wound healing.
- Specific diseases that affect wound healing are Coronary Artery Disease and Congestive Heart Failure.
Chronic diseases - cardiac

- Coronary artery disease - blood vessels become clogged producing signs and symptoms of angina and MI. Blood flow is diverted from the periphery of the body, affecting circulation to the tissues = reduces oxygen and nutrients.

- CHF - heart’s inability to pump enough blood for body functioning. Can be left or right sided heart failure, but symptoms of both relate to fluid overload. Common are ulcers in lower extremities and oedema.
Drug therapy impacting on healing

Drugs interfere with specific phases of wound healing and may affect:

- Cells
- Pathways
- Growth factors
- Cytokines

Drug side-effects can:

- Reduce blood flow
- Affect blood cells and organ functions critical to wound healing
Corticosteroids inhibit fibroplasia and formulation of granulation tissue

Low dose = causing mild anorexia
High dose = interference with fibroplasia, vascular proliferation and delaying epithelialisation. Delays wound contraction and increase potential for infection
Topically applied = cause vasoconstriction at the edge of wound. Must separate wound edge from the product used to treat skin rash
Antineoplastic drugs (anti-cancer)
Cytotoxic but not cancer cell-specific. Reduces numbers of red and white blood cells.
Known to be responsible for ulcers with long term use or on high doses.

Anti-platelet drugs (includes aspirin & NSAIDs)
Inhibit prostacyclin synthesis, inflammatory mediators and platelet aggregation - disrupts all stages of healing.
Increases local ischaemia and hypoxia associated with chronic VLU.
Drug Rx (con’t)

Antibiotics
Overused in treatment of chronic or acute wounds. Kill bacteria and don’t improve wound healing in non-infected wounds.
Topical Doxycycline was evaluated in controlled trial and was found to be effective in treatment in chronic diabetic lower extremity foot ulcers.

Colchicine
Used in treatment of gout, has a number of negative effects on wounds - reduces fibroblast synthesis and inhibits wound contraction.
Anti-coagulants
Inhibit coagulation and can adversely affect wound by increasing the risk of haematomas. Can cause tissue necrosis “purple toe syndrome”
Drug Rx (con’t)

Diuretics
Dehydration effects and can increase glucose concentration which impacts on wound healing

Vitamin A
Studies shown that it can reverse the effects of oral corticosteroids. (risk of hypervitaminosis A)

Vitamin C
Most important in wound healing and tensile strength of a wound. Influences resistance to infection, strengthens and promotes new blood vessel formation.

Zinc
Important mineral in wound healing due to structural integrity of protein. Used topically in Rx of VLU.
Nutrition

Recognised for over 100 years that nutrition is an important factor in wound healing. The nutritional needs of the wound are complex, requiring the following:

- **Energy**
- **Carbohydrates**
- **Protein**
- **Amino Acids** (arginine and glutamine)
- **Fat** (polyunsaturated fatty acids)
- **Vitamins** (A, C, E)
- **Mineral metabolism** (Mg, Cu, Zn, Fe)

(Cherry & Hughes, 2010)
In summary...

Aging causes slower wound healing (> 60 years old)
It is not an actual impediment in terms of quality of healing

Nurses need to understand wound healing process, as well as risk factors and diseases that impact on the wound healing for an older adult.

Most importantly being able to comprehensively assess and address the individual needs of every person
References


References


References

- You Tube videos- “Wound healing process”; “Biofilm”; “Removing biofilm”