

Update in Wound Care

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Objectives

- Understand the physiologic differences that exist in *acute* versus *chronic* wounds
- Review factors contributing to the chronic, non-healing wound
- Understand how diabetes and other immunosuppressive diseases affect wound healing
- Review the myriad of wound care products available to the care giver



Basic Wound Physiology

- There are important and stark differences between the acute and chronic wound.
- A chronic wound is defined, loosely, as wound that has not healed in 30 days since the time or occurrence
- An acute wound is one that has occurred recently and is often caused by accidental trauma (lacerations, etc) but may be iatrogenic (incisions, biopsy sites, etc)



The Acute Wound: Normal Wound Healing

- Normal wound healing occurs in three distinct phases, however they overlap:
 - **Inflammatory phase**: removal of devitalized tissue and prevention of invasive infection
 - **Proliferative phase**: Beginning of regeneration and scar formation
 - **Remodeling phase**: Maximization of wound strength and building of structural integrity

Phases of Wound Healing

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WOUND HEALING: ALTERNATIVES IN MANAGEMENT

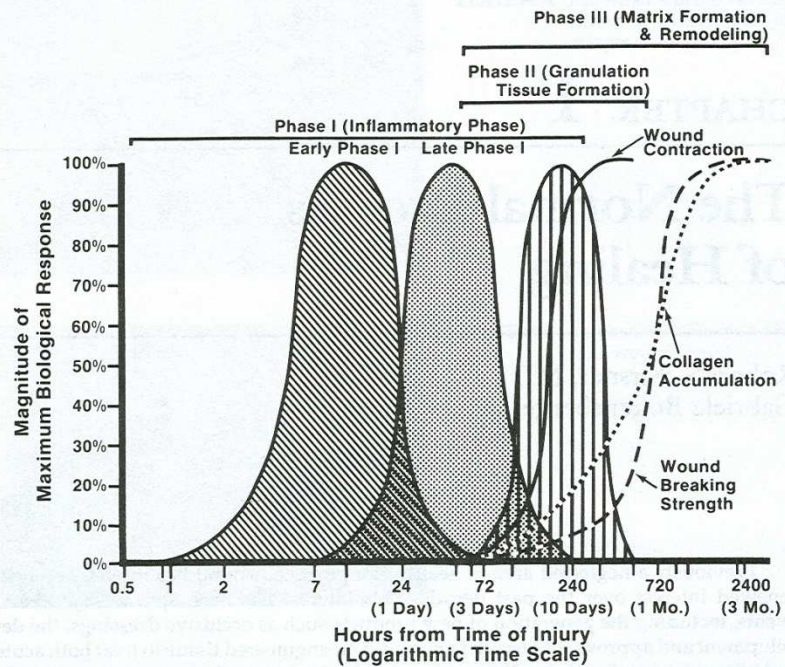
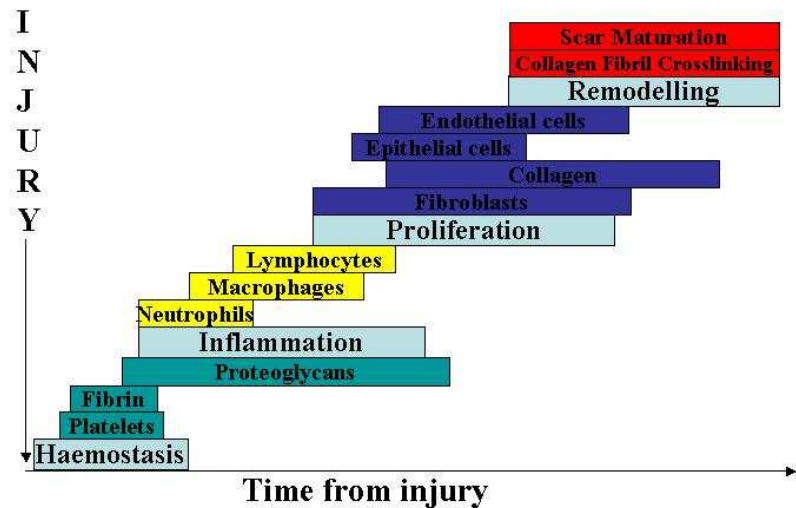


FIGURE 1-1. The three overlapping phases of healing.

Towards healing

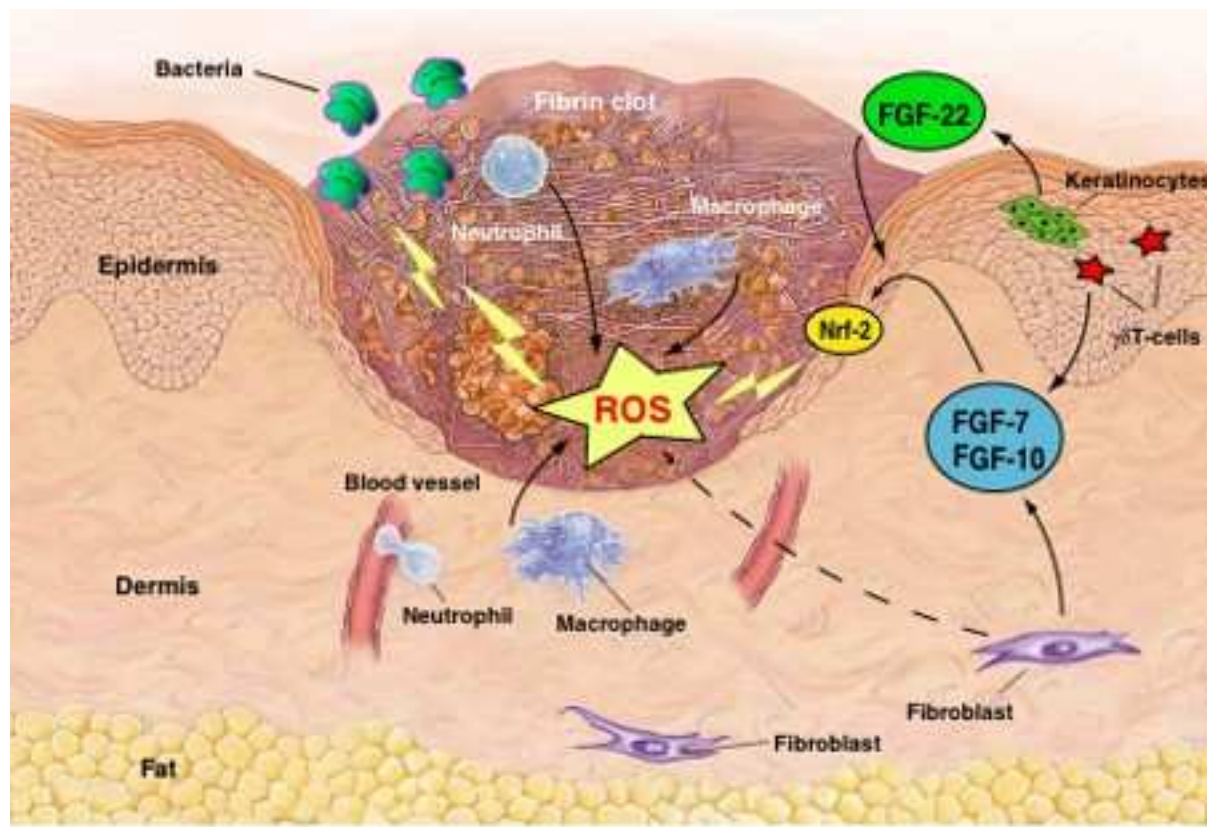




The Acute Wound: Inflammatory Phase

- Begins immediately following injury to the tissue
- Key processes are:
 - Hemostasis
 - Removal of dead/devitalized tissue
 - Prevention of colonization and invasive infection
- Blood elements enter the wound via disrupted vessels
 - Elements of hemostasis then act to prevent further hemorrhage

Many players in wound healing



Inflammatory Phase

- Platelets degranulate
 - Releasing growth factors PDGF, TGF-beta
 - A provisional fibrin matrix is formed
 - This is a scaffold for cell migration required for the later phases of wound healing
- Inflammatory cells are recruited to the wound site
 - Neutrophils infiltrate the wound for 48 hrs
 - Purpose: remove dead tissue and prevent infection
 - Prolonged WBC persistence in a wound may be a factor that causes a wound to become chronic

Inflammatory Phase

- Monocytes/macrophages follow neutrophils into the wound 48-72 hrs after injury
- These are key regulatory cells for this and later stages of wound healing
- By day 3 after injury, these are the most predominant cell type in the healing wound
- The absence of monocytes/macrophages has severe consequences for healing wounds



Proliferative Phase

- Occurs roughly on days 4-21 of wound healing (following injury)
- Re-epithelialization begins early after injury, but is a key process during this phase
- Proangiogenic factors are released by macrophages
- Formation of new blood vessels and survival of granulation tissue is important for wound healing during this phase



Remodeling Phase

- This is the longest phase of acute wound healing
- It lasts from 21 days up to a year
- This overlaps some with re-epithelialization but really gets going after programmed regression of blood vessels and granulation tissue
- Remodeling is the least understood phase of wound healing



The Chronic Wound

- We typically speak of wound being “chronic” when it hasn’t closed in 30 days
- Generally, the wound will “arrest” in the granulation phase, resulting in a chronic, open and often times painful, draining wound
- The causes of a wound becoming chronic are numerous: the understanding of how to get the wound to progress to closure is woefully lacking.

The Chronic Wound: Barriers to Healing

- Poor vascular inflow and outflow
- Poorly controlled diabetes
- Obesity (Fat is poorly vascularized)
- Malnutrition
- Immunosuppression (chronic, steroid induced and acute)
- Wound infection or chronic colonization
- Foreign bodies
- Cancer
- Genetics (Ehlers-Danlos, Werner syndromes)
- Hx of radiation exposure
- Tobacco use
- Alcohol use
- Pressure
- Uremia and Jaundice
- Age



The Chronic Wound

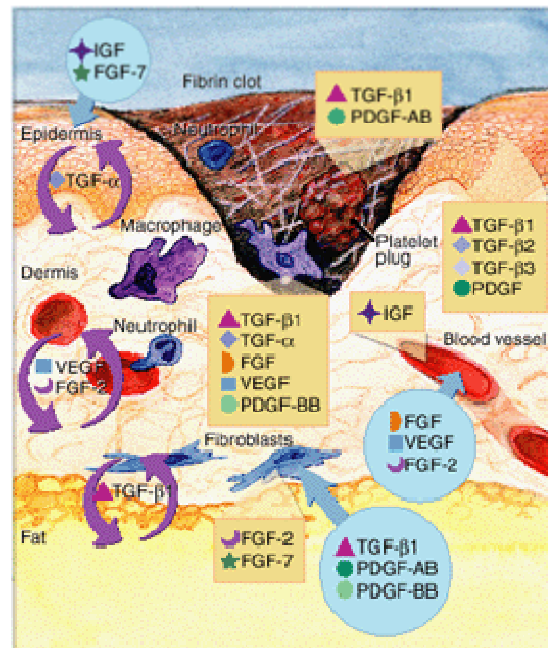
- Less well understood factors:
 - Metalloproteases: have both a positive and negative effect, but don't know how to use them and aren't very good at blocking them
 - Abnormal response to injury: Such as in neural tissue injury
 - Inadequate scar formation: such as in pressure sores, diabetic foot ulcers and venous stasis ulcers



Let's look at the acute wound again

- There are at least 15 growth factors, cytokines and other biologically active molecules involved in the normal wound healing process
- Neutrophils, macrophages and monocytes, platelets, RBCs, fibroblasts, endothelial cells and keratinocytes are all crucial for normal wound healing (acute and chronic)

Cytokines, Growth Factors and Cells



How we (mis)treat wounds

- Knowing what we know about what is needed to heal a wound, why would we use:
 - Betadine
 - Hydrogen peroxide
 - Bleach
 - Wet-to-dry dressings
 - Rubbing alcohol

.....to “treat” a wound????

Betadine and Hydrogen Peroxide

- These are indiscriminate cell killers
- They are the nuclear weapon (WMD) of all cells
- Yes, they destroy bacteria...and every other cell type in the wound



To properly clean a wound...

- You're better off with a sniper...a specific antimicrobial for the job...



Bleach

- Diluted bleach is commonly known as “Dakin’s solution”
- Actually, at very low concentrations (very dilute), Dakin’s will kill bacteria and allow the eukaryotic cells to survive.
- The main problems?
 - Getting the concentration correct
 - Not “over wetting” the wound
 - Using it in the “correct” phase of healing

Why not “Wet to Dry”???

- For many decades this was the standard in the open, non-healing wound
- It keeps the wound “moist” (a must)
- It protects from bacterial invasion (physical barrier)
- It is a modality still in use today
- Why not use it?

Wet-to-dry

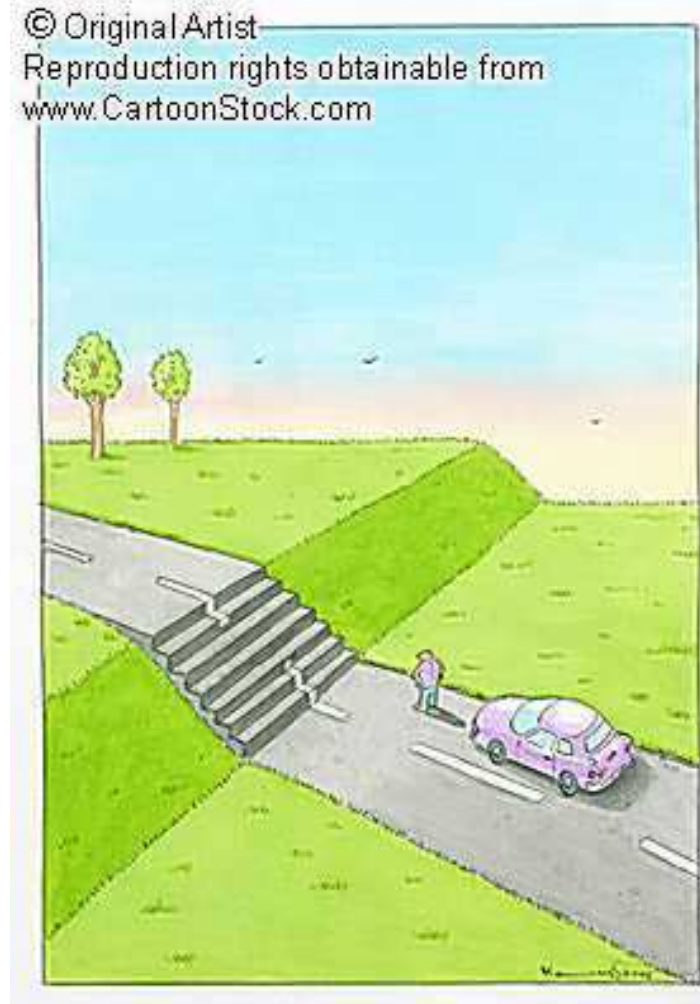
- The wet gets dry very quickly...gauze sponges are SPONGES...they are made to wick fluid from a wound
 - This prevents the wound from being maintained in a state of physiologic moisture balance
- These sponges are perfect culture media for bacteria that are wicked away
 - Dark, moist and bloody
- Over a period of 24 hours, there will be in-growth of neo-tissue into the sponge
 - Then, someone comes along and RIPS it off, essentially causing the injury pattern to have to start over

Why won't it heal?

- This should be the first question posed in the presence of a chronic wound
- Sometimes it's very predictable at the time of an injury (accidental or planned trauma)
- Factors which contribute directly to non-healing wounds:
 - Inadequate arterial supply
 - Inadequate venous drainage
 - Inadequate lymphatic drainage
 - Diabetes (esp poorly controlled)
 - Obesity
 - Tobacco use
 - Collagen disease

Barriers to healing

- Obesity – Venous HTN
- Diabetes – Obesity
- PVD – Diabetes
- Malnutrition – Diabetes
- Poor patient compliance with tx plan





Diabetics

- First and foremost need very tight glucose control
- Require a detailed assessment of their peripheral neurologic and vascular status
- Be liberal with arterial Doppler and/or angiography
- Assess for significant neuropathy
 - Neuropathy is a more significant contributor to diabetic foot wounds than is arterial insufficiency

Venous Hypertension

- Venous HTN (note: varicose veins, leg swelling, etc) goes hand-in-hand with lymphatic congestion
- The venous system and lymphatics must be able to rid the wound bed of unwanted debris in order to facilitate wound healing
- Absent these 2 routes of egress, the wound will become stagnant

Diabetes, diabetes, diabetes...

- Little more need be said...
 - Consistently elevated glucose leads to neutrophil dysfunction
 - Consistently elevated glucose in the tissue gives bacteria a wonderful source of nutrition
 - Neuropathy leads to:
 - Non-functioning sweat and oil glands → dry skin
 - Dry skin → breaks down
 - Breakdown → lets bacteria in...

More on diabetes...

- Microvascular disease in the setting of DM is a result of malfunctioning nerves...diabetic neuropathy
- The vessels will not dilate and constrict as appropriate for proper acute and chronic wound healing (see “Physiology of wounds”)
- Additionally, larger vessel disease leads to poor arterial flow

Diabetic Foot Ulcer



Some thoughts on your DM patients...

- They need a bi-annual (minimum) foot exam to assess for neuropathy:
 - Pinwheel
 - Filament test
 - Vibratory testing
- They should be taught to LOOK into their shoes every time before putting them on and,
- To look at their feet daily for early wounds
- Each year, 50,000 diabetics get something amputated: toe, foot or leg
 - 70% will die within the next 5 years after BKA

DM gone bad



How I look at a wound:

- I begin by asking myself:
 - How did this wound happen?
 - How old is the wound?
 - What has been done thus far and, did it work?
 - Why is it NOT healing?
- Then I,
 - Measure wound
 - Take photos
 - Develop a treatment plan



Is it infected?

- Superficial wound cultures will do little to tell you whether or not a wound is infected
- If you are not capable, send to a surgeon who is willing to get tissue for a *quantitative* tissue culture
- If there are $> 10^5$ organisms per gram of tissue, you have an infection
- I like to hit these from 2 directions:
 - Systemic antibiotics
 - Topical therapies

Antibiotics

- An oral agent with good tissue penetration and good bioavailability is imperative
 - Fluroquinolones
- If resistant organisms, such as MRSA, grow out place a PICC and start on Vancomycin.
- Topically, I use a variety of agents:
 - For eschar penetration (dry gangrene): mafanide acetate (Sulfamylon) (\$25/2 oz)
 - For cheap, broad coverage: Silver sulfadiazine (Silvadene)...must be applied BID (400 gm/\$55)
 - Silvasorb (OTC, \$35/1.5 oz)
 - Silver dressings (will cover later)

The “whys” and cautions:

- Sulfamylon: penetrates tissue (like for dry gangrene). However, may cause a transient metabolic acidosis
- Silver sulfadiazene: very inexpensive. However, it's messy and has to be put on BID
- Silvasorb: not as messy. It is a hydrogel, so it absorbs some of the wound exudate. However, it's expensive and not covered by insurance

Why Silver?

- Ionic silver is a well known broad spectrum antimicrobial
- It's activity lasts up to 7 days
- It is effective against *Pseudomonas*, MRSA and VRE
- In a dressing with hydrofiber properties, it will provide the wound with a more physiologic environment



Chemical wound debridement

- Panafil and Accuzyme were wonderful treatments...that our government is going to take away from us
- The government sites “lack of rigorous studies” even though safety is not an issue
- Of interest: they came off the market at the same time that CMS was going to stop covering them...hmmmm...coincidence???

What's the buzz about honey?

- High osmolality -Honey is a saturated or supersaturated solution of sugars that has strong interaction with water molecules. The lack of 'free' water inhibits the growth of microorganisms.
- Hydrogen peroxide -When honey is diluted by wound exudates, hydrogen peroxide is produced via a glucose oxidase enzyme reaction. This is released slowly to provide antibacterial activity but does not damage tissue.
- Antibacterial phytochemicals Some honeys still have antimicrobial activity even when hydrogen peroxide activity has been removed..



Community Acquired MRSA (CA-MRSA)

- This is an epidemic
- Pustules form in the dermis and rapidly progress to subcutaneous abscess
- This is not the same bug as nosocomial MRSA
- Treatment:
 - I & D
 - Lavage
 - 14 days of Bactrim
- Everyone they come into contact with is at risk
- Most will have at least one more episode



Wound Care Products to remember

- Silver products
 - Acticoat
 - Aquacel Ag
 - Silverlon
- Hydrogels
- Graded compression stockings (NOT! Unna's Boots)
- Apligraf (and other dermal replacements)



New Surgical Devices and Therapies

- Versajet
- Pulse Lavage
- Negative Pressure Wound Therapy (most commonly used is KCI's Wound V.A.C.)
- Alloderm (ultrathin cadavaric skin devoid of cells)
- Hyperbaric Oxygen Therapy: limited use, but saves the diabetic foot on occasion

Anodyne

- Monochromatic Infrared photo-thermal energy (MIRE)
- 890 nanometers (wavelength)
- Applied via light emitting diodes (LEDs)
- Can penetrate up to 5 cm
- It increases circulation (up to 400%)
- www.Anodynetherapy.com



Things I recommend you not do:

- Biopsy the leg of a vasculopath or poorly controlled diabetic
- Biopsy the skin/SC of someone on steroids
- Biopsy the skin/SC of someone with rheumatoid disease
- Biopsy the skin/SC of someone with chronic venous hypertension

Other recommendations...

- Wound packing...DON'T!
 - You just opened an abscess...why would you pack it and block the egress of any pus you didn't get out?
 - In actuality, I do it: but only for overnight to “stent” the wound edges open...then remove it
 - Pack it just long enough to keep it open...
 - Antibiotics are usually not necessary once the abscess is drained

Things that drive me crazy (er)

- Antibiotic lavage:
 - No study on earth has proved this prevents infection, but many have proved it incites a riotous antibiotic resistance problem
 - One very well done ER study proved that TAP water is as good as sterile water to lavage/irrigate acute wounds
- Not allowing wounds to get wet
 - Wash 'em! Depending on the dressing, at least every 3 days
 - I like Ivory soap, but if you must use something medicated, use Chlorhexadine (4%)
- Whirlpool therapy: YUCK! It should be called “Cesspool” therapy

More crazy things...

- Indiscriminate HBO therapy: if it was all that great, we wouldn't have chronic wounds
- Calling every wound that you don't know the cause of "A spider bite"
- Revascularization of the leg with multiple stents
 - Stents are for short segment disease
 - Find a vascular surgeon who will jump the bad spot
- Giving antibiotics to an uncomplicated laceration
 - They won't prevent infection
 - Use presumptively for extremely dirty wounds and those that involve bone

Osteomyelitis

- Worry about it: it's expensive and causes limb loss in lots of patients
 - Get a plain x-ray first (this is called CYA...some insurance won't cover the MRI if you didn't get a plain film first)
 - Get an MRI...it's the standard to diagnose osteo
 - If they have it, get ID involved, put in a PICC and treat them for a long time
 - Think amputation early in a diabetic...you might save their life

Things I recommend you DO:

- Find a surgeon willing to take your patient to the O.R. and debride the non-healing wound
 - Sometimes taking a chronic wound back to acute wound status will get the healing started
- Avoid wound care facilities that are “flavor of the month factories”, HBO addicts (“it cures everything” or those who slap a VAC on every wound that walks in...
 - They’ll use whatever the rep brings and change the plan every week...these things take TIME

Don't forget...

- A nutritional analysis...preferably by an RD
 - Not just for diabetics any more!
- Vitamins!
- Protein supplements (Ensure, Glucerna...take your pick)
- Compression therapy
- Hgb A1C and Urine microalbumin in DM pts...gives you insight into their overall control



Summary

- A thorough history will generally lead you to a reason for a non-healing wound
- Aggressive initial debridement in a chronic wound will often set the stage for successful recovery
- Many new and novel products are available for wound care, obviating the need for outdated therapies such as wet-to-dry dressings and betadine lavage





Questions???