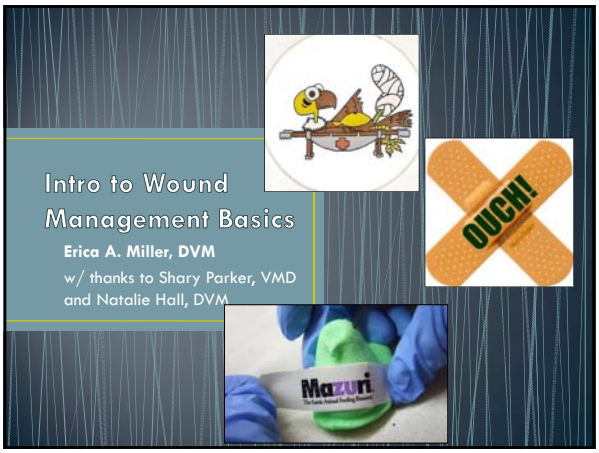


Plan--basics

- Patient assessment
- Wound healing
- Wound assessment
- Wound cleaning
- Topical treatments
- Bandaging
- More in-depth info
- Hands On Practice
- Case Studies

But be flexible!

Address Emergencies First

- Seizures
- Shock/Comatose
- Overt hemorrhage
- Fresh open fracture
  - Esp. with potential of limb twisting

Fresh Open Fracture

- Stop hemorrhage
- Clean (remove feathers, dirt, etc.)
- Cover with KY Jelly or Surgilube
- Wrap*
- NSAIDs and Abx

*immobilizing prevents further damage and decreases pain!

Pain Meds--Basics

- If it looks like it hurts…
  - Assess injury, not animal
- Hydrate first
- Bone or deep pain
  - Mix NSAIDs & Opioids
  - Consider locals/topicals
- Neurogenic Pain
  - Gabapentin
- NSAIDs (anti-inflam.)
  - Oxicams
  - Profens
  - Salicylates
  - Coxibs
- Opioids (analgesic)
  - Tramadol
  - Butorphanol
  - Fentanyl
- Topical Gel/Spray
  - Amount/Timing!

Euthanasia

Pre-set parameters

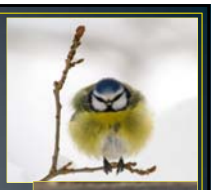
- Releasable?
- Quality of life?
- Time/resources?
- Risk to others?

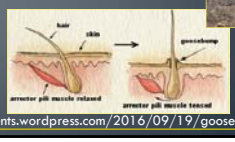
Determine method

- Humane/acceptable?
- Legal?
- Training?
- Aesthetic?
- Use/disposal of carcass?

Skin

- Largest organ of the body
- Main function is protection
  - from bacteria, chemicals, and temperature
  - secretions kill bacteria
  - melanin provides a defense against UV light
  - fur and feathers are barrier against trauma
- Body temperature regulation
  - cold temperatures → dermal blood vessels constrict
  - feathers and fur "piloerect"





Images: https://spatialexperiments.wordpress.com/2016/09/19/goosebumps/

Stages of Healing

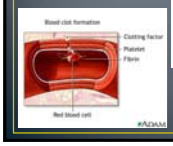
Healing actually starts immediately after initial insult or injury

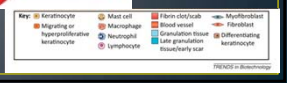
1. Hemostasis
2. Inflammation-debridement
3. Proliferation-repair
4. Maturation-contraction

Slide courtesy of J.L. Swanson Wildlife Health Center at Cornell

WOUND HEALING
1. Hemostasis & Inflammatory Stage

- Vasoconstriction, then vasodilation to bring new cells to the wound; Platelets aggregate; WBCs remove debris and fight infection
- Bandage to clean, protect, keep moist



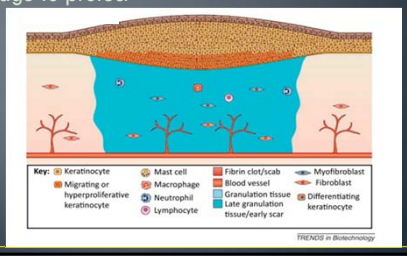


WOUND HEALING
2. Proliferation (Granulation) Stage (Fibroplasia stage)

- Fibroblasts migrate in to lay down collagen matrix
- New capillaries are formed
- Resident bacterial flora—don't use antiseptics!
- Bandage to keep moist and protect

WOUND HEALING
3. Maturation Stage (& Epithelialization) Stage

- Epithelial cells migrate
- Tissue contracture occurs
- Bandage to protect



PATIENT ASSESSMENT

The traumatized patient experiences

- Pain
- Fear
- Probability of other system involvement

PATIENT ASSESSMENT

All wound management starts with

- Stabilization
  - Quiet, warmth, fluids
- Thorough exam
- Pain meds
- Antibiotics

Fresh Open Fracture

- Stop hemorrhage
- Clean (remove feathers, dirt, etc.)
- Cover with KY Jelly
- Wrap
- NSAIDs and Abx

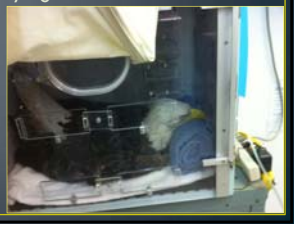
Take home message…

Pain Meds--Basics

- If it looks like it hurts…
  - Assess injury, not animal
- Hydrate first
- Bone or deep pain
  - Mix NSAIDs & Opioids
  - Consider locals/topicals
- NSAIDs (anti-inflam.)
  - Oxicams
  - Profens
  - Salicylates
  - Coxibs
- Opioids (analgesic)
  - Tramadol
  - Butorphanol
  - Fentanyl

Initial Assessment

- Assess & manage the patient
  - i.e., stabilize the patient
- Assess & manage the wound itself
- Assess & manage the underlying cause of the wound



Wound Assessment

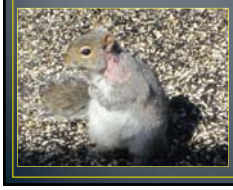
- Size and Location
- Depth of Tissue Involvement
- Age
- Color
- Underlying Cause

Size and Location

- Larger, deeper = more likely to:
  - Be infected, necrotic
  - Involve vessels & nerve damage
  - Become desiccated
- Over joints
  → pressure points, tension, low vasculature
  = more difficult to heal

Depth of Tissue Involvement

- Superficial
  - Abrasions
  - Some road rash



Depth of Tissue Involvement

- Partial thickness
  - Deep abrasions
  - Minor/superficial lacerations
  - Not common in birds

Depth of Tissue Involvement

- Full thickness
  - Many lacerations; +/- skin lifted; e.g., degloving or avulsion injury
  - Muscle exposed but not involved

Depth of Tissue Involvement

- Deep
  - Extends through skin into fascia, muscle, etc.
  - Penetrating or Perforating punctures

Age/Presence of Infection

- Acute
  - Recent, fresh edges, live tissue
  - Not infected
  - *Potential* to be infected

Age/Presence of Infection

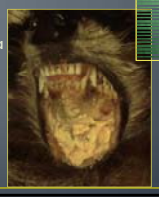
- Chronic
  - Older, refuse/cannot heal
  - Inadequate blood flow
    - Pressure, infection

Color

- Black
  - Necrotic tissue
  - non-viable
- Need to
  - Slowly remove dead tissue

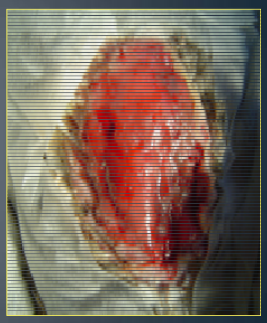
Color

- Yellow(ish)
  - Moist necrotic tissue (slough)
  - Purulent material
- Need to:
  - Remove debris and bacteria
  - Absorb exudate
  - Decrease edema



Color

- Red
  - Fresh bleeding or
  - Granulation tissue
    - Fragile
    - Innate antimicrobial properties
- Need to:
  - PROTECT
  - Keep MOIST



Green

- Normal for birds due to biliverdin

Underlying Causes

- ***Gunshot*:** deep, penetrating, contamination
- ***Hit By Car*:** abrasion to degloving, underlying damage, contamination
- ***Bite*:** bacteria "injected"
- ***Electrocution*:** gradual progression, edema

Other Factors

- Disease
- Cagemates
- Lack of mobility
- Poor nutritional status
- Pressure, friction, etc.
- Above must be eliminated or minimized for healing to occur

When to consider euthanasia

- Open, comminuted fractures
- Extensive muscle trauma
- Significant infection
- Very sick and debilitated animals
- Presence of other significant problems
- Joint involvement
- Significant tendon involvement
- Large skin deficits (>30%)
- Damage to follicles of remiges or retrices
- Likely to result in significant debilitation/loss of function

Halsted's Surgical Principles

- Gentle handling of tissues
- Aseptic technique
- Maintain blood supply to tissues
- Hemostasis
- Close without tension

Wound Cleaning

- Pain Meds before beginning…
- Foreign Material or Necrotic Material
  - Feathers, soil, gravel, wood
  - Dead tissue
  - Irritating (→enzyme release)
  - Sources of bacteria
  - Extra surface area for bacterial proliferation
  - Mechanically separate wound edges

Local Pain Meds—take time

- Topical "Caines"
  - 1 or 2% Lidocaine gel
  - Lidocaine + Prilocaine
  - Cetacaine
  - Ophthalmic tetracaine
- Other topicals
  - Arnica, Traumeel
  - Surpass (Diclofenac)
  - DMSO
- Injectables
  - Bupivacaine
  - Lidocaine

Wound Cleaning

- Pain Meds before beginning…
- Foreign Material or Necrotic Material
  - Feathers, soil, gravel, wood
  - Dead tissue
  - Irritating (→enzyme release)
  - Sources of bacteria
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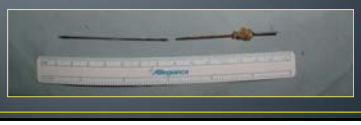
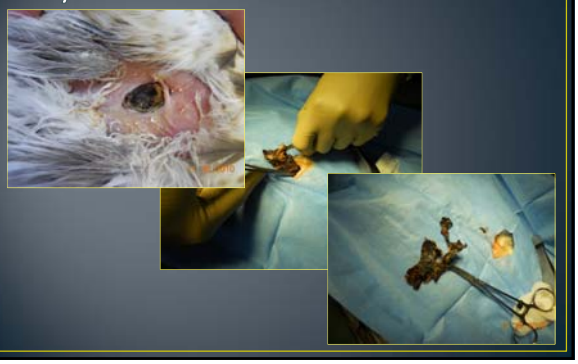


Why remove the scab?



Wound Cleaning

- Clean to the extent the patient will tolerate
- May need to do in stages
- May need to repeat

First Clean AROUND the Wound

- Protect wound bed
  - WET gauze or water based lubricant
- Prep around wound
  - Pluck feathers (carefully) or shave
  - Feather free HEALTHY skin around wound
- Clean around wound
  - Dilute povidone iodine scrub or chlorhexidine, cleaning preparations (CVMD® wound cleanser, wound cleanser sprays), saline
  - Do NOT use hydrogen peroxide: tissue necrosis

Clean the Wound

- Irrigate (flush) wound
  - Remove gross contaminants
  - Gentle stream warmed saline
  - Lift skin edges (forceps)
- Take bacterial culture
- Apply topical pain meds & wait!
- Clean wound itself
  - Dilute chlorhexidine (25ml Nolvasan in 1L water = .05%)
  - Dilute povidone iodine (1ml Betadine in 1L 0.9% NaCl = 1%)
  - 35cc syringe and 19g needle or 60cc syringe and 18g needle (8psi)
  - FLUSH!!!---THE SOLUTION TO POLLUTION IS DILUTION!

Wound Cleaning

- Debridement
  - GENTLY tug at necrotic tissue
  - If not EASY, must be surgically removed
  - Remove all foreign material
- As thorough as possible
- Last flush with sterile saline

Antibiotics

- Use initially if infected or contaminated
  - Or if in doubt!
- Use AFTER cleaning
  - Triple Antibiotic Ointments (TAO)
  - Silver Sulfadiazine (SSD)
  - Honey [Sugar, 50% Dextrose]
    - Hyperosmolar & Hygroscopic
    - Provides cellular energy
    - Enzyme produces H_2O_2 & Gluconic acid
    - = Antibiotic

- DON'T use on exposed bone

Antibiotics—Systemic

- Many wounds will be old and contaminated
  - Dirt, pus, maggots, necrotic tissue, exposed bone?
- Cat (and dog) bites are notoriously infected
  - Wild animals susceptible to *P. multocida* and sepsis from other gram – bacteria
- Broad-spectrum antibiotics are indicated

Closing the Wound

- Decision: primary vs. secondary enclosure
  - primary: suture/glue
    - delayed primary enclosure
      - treat open until considered not contaminated and then close
  - secondary: allow for tissue granulation
- Time period
  - primary closure should only be done in wounds < 6-8 hours old

Wound Closure

- Fresh, uncomplicated lacerations
- "Clean" wounds
  - Before significant bacterial proliferation and penetration
- Glue
  - If wound is small
  - If there is little to no tension
  - If skin is thin (rabbits)
- Suture
  - Larger, irregular wounds
  - When tension or motion is present

Wound Closure

- Delayed Suturing
  - (No vet; animal not in condition for anesthesia; wound infected)
  - Clean wound, cover & change bandage q12-24h
  - Assess wound and animal for suturing at each bandage change
- Second Intention
  - (allow to scab/heal on its own)
  - Allow wound to granulate and epithelialize from edges
  - Longer healing time & often more intensive management
  - Necessary for some older wounds (infected, lots of damage)
  - Necessary for some larger wounds with tissue loss
  - Necessary for some wing wounds to avoid stricture

BANDAGE GOALS

- Protect wound from environment
- Manage wound exudate
- Provide support and comfort
- Create wound environment that actively promotes healing

Bandages should be....

- Comfortable
- Applied evenly and snugly – but NOT too tight
- Positioned so as to avoid damage to tissue and healing process

□ Major Goal

To provide protection and support for an injured area

What else do bandages do?

- Immobilize the affected area (prevents movement) and therefore minimize pain and provide comfort
- Protect wounds following surgery (avoids contamination and keeps site clean)
- Prevent tissue desiccation (drying out)
- Provide thermal insulation
- Prevent self-inflicted trauma
- Hold dressings in place
- Provide localized pressure to avert hemorrhage and swelling

Building a Bandage

- Primary or Dressing layer
- Secondary layer
- Tertiary Layer

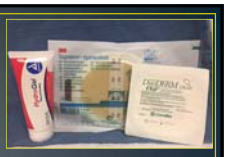
BANDAGING
Primary/Contact Layer

- Sterile
- Occlusive (keeps clean)
- Moisture retentive
- Deliver topical meds
- Choice depends on type of wound → purpose of bandage

Primary/Contact Layer

- Dirty or Infected Wounds
  - = want to clean
  - = Adherent
  - Fine mesh or open weave gauze
  - AgMesh™
  - Wet-to-dry
  - Acts to wick stuff from wound
  - Change q12-24h

Primary/Contact Layer



- Clean but still oozing (may be infected)
  - = Non-adherent
    - Polyurethane Foam (Allevyn™ or Tegaderm™ foam)
      - Keep surface moist, but absorb excess exudates
      - Increase rate of epithelialization
  - = Autolytic (debride)
    - Hydrocolloids (Duoderm™, Replicare™)
    - Hydrogels (Aquasorb™, Solosite™)
  - = Absorbants (conform, absorb, moist)
    - Alginates (Kaltostat™, Mesalt™) & Hydrogels (above)
    - Hydrofibers (Aquacel™)
      - Slow healing, granulating lesions: ulcers, pressure sores, pododermatitis

Primary/contact layer

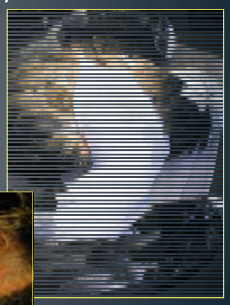
- Clean, granulation bed present
  = Non-adherent, adhesive
  - Semi-occlusive Dressings
    - Tegaderm™, Bioclusive™
    - Thin, flexible, transparent polyurethane membrane
    - Adhesive to dry skin
    - Oxygen permeable
    - Impermeable to bacteria and water
    - Accumulates fluid and exudate
    - Prevents desiccation & scab formation
    - Reduces pain, speeds epithelialization

Primary/contact layer

- Clean, non-infected; granulation present
  = Non-adherent, adhesive
  - Hydrogels
    - Aquasorb™, BioDres™, Silvasorb™, Vigilon™, Solosite™,
    - Thin gel adhered to mesh
    - Absorb fluid
  - Collasate™/Collamend™
    - Can now be used as 1°layer
    - Forms "scab"

Secondary/Absorbent Layer

- Absorb fluid/exudate
- Cushion wound
- Immobilize wound and surrounding tissue
- Roll cotton, gauze, Telfa™, cast padding



Tertiary Layer

- Hold 1st two layers in place
- Vetrap™, tapes, gauze tape, Elasticon™
- May need additional tape to hold tertiary layer in place

All-Day Workshop

- More on Patient Stabilization
- Types of topical dressings
- Types of bandage materials
- Hands on practice with cleaning/treating wounds and stabilizing fractures
- Bandage changing
- Managing types of wounds
  - Bites, electrocutions, lacerations, bumblefoot, punctures, gunshot, etc.

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