Frostbite

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Objectives

- Overview of frostbite
- Challenges of Care
- Recommendations for optimal healing
Physiology of Thermal Injury

### Pre-freezing
- Superficial skin reaches less than 50°F (10°C)
- “Hunting Reaction”
- Constriction of microvasculature System
- Increased viscosity of vascular contents

### Direct Cell Damage
- Skin tissue less than 28°F (-2°C)
- Extracellular ice crystals form
- Intracellular dehydration
- \( \uparrow \) intracellular electrolyte concentrations
- Cellular collapse
- Membrane ruptures
- Cellular death
Physiology of Thermal Injury cont.

Indirect Cell Damage (during re-warming)

- Microvascular collapse at vein/arteriole levels
- Microthrombi
- ↑ blood viscosity
- Endothelial damage
- Edema formation
- Ischemia
- Tissue death
- Nerve and muscle may be affected

Note: Edema expected to resolve approximately 72 hours from onset. Gangrenous tissue may be present within 9 days.
Prognostic Indicators of cold injury

**Favorable—Dermal Viability**
- Sensation to pin prick
- Normal skin color
- Bullae with clear fluid
- Malleable skin

**Unfavorable**
- Hemorrhagic vesicles / Bullae
- Non-blanching cyanosis
  - “Dipped in grape juice look”
- Hard, non-malleable skin
Factors Contributing to Cold Injury

- Alcohol a factor in >60% of all reported cases nationwide
- YK Delta probably >90% involve alcohol
- Equipment Failure
- Sudden weather changes
- Inadequate clothing & gear
- Contributing Medical conditions
Cold Thermal Injury

- Superficial skin less than 50°F (10°C)
- Tissue injury occurs

Contributing factors:
- Wind chill factor
- Duration of Exposure
- Wet Clothing
- Warm/re-freeze/re-warm cycle

Increased damage
Examination & Staging

**Superficial injury**
- 1° - insensate central white plaque surrounded by ring of hyperemia
- 2° - Clear/milky within 24 hours surrounded with erythema and edema

**Deep Injury**
- 3° - Hemorrhagic blisters usually followed by eschar formation around 2 weeks post injury
- 4° - Complete necrosis with visible tissue loss
Three phases of Treatment

1. Pre-thaw phase--field care
2. Re-warming phase—hospital care
3. Post Thaw phase—post injury care
Pre-thaw phase--Field Care

- Protect, Pad and splint
- DO NOT RUB
- Slow re-warming (not supported by literature)
- Do not attempt to thaw if refreezing is possible
Re-warming phase: hospital care

- **Rapid re-warming 100° – 104° F**
- **Surgical antimicrobial agent in water bath**
- 15-45 min until thaw complete
  - Red color, pliable skin
- **Active movement of joint(s) helpful**
- **NO MASSAGE/ No PROM**
- **See Protocol (Still in development?)**
Re-warming Phase Goals

- Thaw tissue and halt direct cell damage
- Suppress local & systemic thromboxane production by the injured tissue
- Provide adequate analgesia
- Prevent infection
- Maximize tissue retention
Post-thaw Phase: Wound Care

- Does not prevent post-thaw progressive dermal ischemia

- To Debride or not to Debride
  - White or clear blisters = debride (supported by literature)
  - Hemorrhagic blisters = don’t debride

- Debride/Aspirate? (debated)
Frostbite Wound Care Goals

- Promote optimal tissue circulation
- Control odor
- Skilled wound care
- Prevent Infection
- Psychological Support
- Waiting game for amputation in severe cases
  - 22-45 days until clear demarcation
Standard Frostbite Wound Care

- Sharp debridement
  - Leave hemorrhagic blisters
  - Frequency
    - Daily if non-viable tissue present and if patient tolerates
  - Ortho Opinion

- Whirlpool

- Topical Medications: Silvadene vs. Aloe

- Typical Dressings
  - Adaptic
  - Topical medication
  - Gauze & gauze rolls

- Patient Education
  - NO Nicotine!
  - Protect injured area!
References

Available upon Request