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# Frostbite

# 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
- ↑ 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 24hours 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 debribe
    - 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