Overview

Frostbite involves freezing of tissues. Ice crystals form leading to tissue damage. Skin and muscle are considerably more susceptible to freezing damage than tendons and bones, which explains why the patient may still be able to move severely frostbitten digits.

Frostbite is caused by cold exposure, whose effects can be magnified by moisture or wind. For example, the chilling effects on skin are the same with an air temperature of 20°F and a 30 mile per hour wind as with an air temperature of 0°F and only a 2 mile per hour wind.

Skin contact with metal or any solvent like gasoline in very cold weather can cause virtually instantaneous freezing; skin will often stick to metal and be lost. The risk of frostbite is increased by generalized hypothermia, which decreases skin blood flow as part of the mechanism for preservation of core body temperature.

Two related injuries, trench foot and immersion foot, involve prolonged exposure to wet cold above freezing. The resulting tissue damage is produced by ischemia. Children are at greater risk for frostbite than adults because their skin is thinner and less weathered. Also, children lose heat from the skin more rapidly.

Risk Factors

- Extremes of age
- Homelessness
- Immobilization
- Exposed skin in harsh conditions
- Exposure to water or dampness
- Working outdoors in the cold
- Outdoor winter activities
- Inadequate or tight fitting clothes
- Fatigue
- Altered mental status
- Use of nicotine or vasoconstriction drugs
- Mountain climbing
- High altitude
- Previous cold injury

Diagnosis: Frostbite and related injury

Frostbite of varying degrees looks quite similar when first seen. The magnitude of damage becomes evident with re-warming and time to demarcation of the damaged tissues.

Signs and Symptoms

- reddened, blue or pale cold skin
- puckering and painful with superficial frostbite
- blistering
- painless, numb with white waxy appearance, with deep frostbite
- gangrene with prolonged exposure

Common Locations

•Hands	•Nose
•Feet	•Cheeks
•Skin	•Corneas
•Ears	

Initial Classification; The First Encounter

Superficial Frostbite

- only the skin and fat below the skin are frozen
- tissues beneath are still compressible with pressure

Deep Frostbite

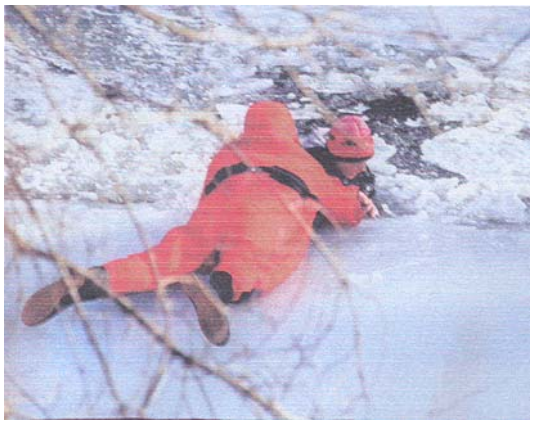
- skin, fat and underlying tissue like muscle are all frozen
- the extremity or body part has a hard “wood like” feeling
  likely a third or fourth degree injury

Hands, feet, noses, and ears are most likely to be affected by frostbite

Cold immersion foot (or hand)

Describes a non freezing injury of the hands or feet, resulting from chronic exposure to wet conditions and temperatures just above freezing, i.e. 35-50°F

Although the entire hand or foot may appear black, deep tissue destruction may not be present. The damage may turn out to be skin alone after re-warming.



Final Classification after Re-warming

First degree: redness and swelling without skin breakdown
Second degree: large, clear blister formation accompanies the edema with partial thickness skin loss
Third degree: full thickness skin and fatty tissue destruction occurs commonly with hemorrhagic vesicle formation
Fourth degree: full thickness skin destruction including muscle and bone with gangrene

Second degree frostbite

While the affected body part is initially nearly always hard, cold, white and anesthetic, the appearance of the lesion changes frequently during the course of treatment. Additionally, the initial treatment regimen is applicable for all degrees of insult and the initial classification is often not prognostically accurate. The degrees of damage are comparable to the degrees of burn injury, as opposed to a burn. However, the final degrees of tissue destruction is usually less with cold injuries then initial findings indicate. Some of the initially damaged tissue recovers whereas with a burn , what you might see initially usually gets worse over time.

INITIAL ASSESSMENT AND MANAGEMENT

- Remove from cold environment
- Manage the ABC's
- Look for other injuries or illness
- Begin to treat any hypothermia
- Remove damp or constricting clothing and replace with loose garments
- NO ATTEMPT SHOULD BE MADE TO RE-WARM THE FROSTBITTEN AREA IN A COLD ENVIRONMENT
- Do not attempt any re-warming if there is a danger of re-freezing
- Avoid rubbing the affected area with warm hands or snow, as this can cause further injury
- Avoid applying pressure to the frostbitten area
- Cover blisters and injured area with a soft dressing
- If the affected body part is an extremity, wrap it in a blanket for mechanical protection during transport
- Avoid any medication which can enhance heat loss and impair shivering
- In the absence of a life threatening problem like severe hypothermia, it is better to walk with frozen feet to a safe environment than attempting to re-warm in a cold environment.
- Once removed from the cold: elevate the injured area to reduce any developing swelling
- During long transport in warm air environment (60 minutes)
  - can begin to re-warm by immersion of the frostbitten area in water 100-105°F
  - do not use dry heat as the risk of compounding the injury is great with any method of thawing other than immersion in warm water
  - process of re-warming may take 30-45 minutes
  - return of color and sensation indicates thawing
  - once thawed patient cannot walk on cold injured feet elevate the injured area

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Complications

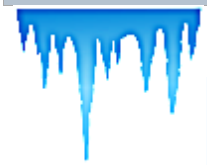
- Short Term: infection, soft tissue loss, gangrene, loss of nails
- Long Term: painful tingling sensations in the area, excessive sweating in the area, extreme cold sensitivity, abnormal skin color, muscle atrophy, joint stiffness, tremors

Prognosis

Prognosis for a superficial frostbite is excellent, if appropriate treatment is provided. Some tissue loss is likely with deep frostbite.

- Favorable prognostic signs - Early sensation to pinprick - Healthy appearing skin color - Clear rather than blood filled blebs
- Poor prognostic signs - Cyanosis (blue-gray color) - Bloody blebs or blisters that do not extend to tips of digits - Frozen appearance

Prevention



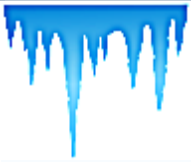
Be aware of factors that can contribute to frostbite, such as extreme cold, wet clothes, wind chill, and poor circulation. This can be caused by tight clothing or boots, cramped positions, fatigue, certain medications, smoking, alcohol use, or diseases that affect the blood vessels, such as diabetes.

Wear suitable clothing in cold temperatures and protect susceptible areas. In cold weather, wear mittens (not gloves); wind-proof, water-resistant, many-layered clothing; two pairs of socks (cotton next to skin, then wool); and a scarf and a hat that cover the ears (to avoid substantial heat loss through the scalp).

Before anticipated prolonged exposure to cold, don't drink alcohol or smoke, and get adequate food and rest.

If caught in a severe snowstorm, find shelter early or increase physical activity to maintain body warmth.

References:



Eric Perez, MD. National Institute of Health. Retrieved May 18, 2006.

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