Frostbite

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Frostbite is a cold injury in which an area of the body is frozen.

The damage caused by frostbite results from a combination of factors. Freezing kills some cells: others survive. Because cold causes blood vessels to narrow, tissue that is near the frozen area but not itself frozen may be damaged as a result of the decreased blood flow. Sometimes cold also causes clots to form in small blood vessels in this tissue. These clots may limit blood flow so much that the tissue dies. When blood flow returns to the affected area, the damaged tissues release a number of chemical substances that promote inflammation; inflammation worsens the damage caused by the cold. In addition, toxic substances are released into the bloodstream as frozen tissue is warmed. These toxins may cause irregular heart rhythms (arrhythmias). Therefore, doctors monitor heart function and blood levels of these toxins.

Exposure to below-freezing temperatures puts any part of the body at risk of frostbite. The risk of frostbite damage depends on how cold it is and how long the part was exposed. People at greatest risk of developing frostbite are those who have poor circulation because of diabetes or arteriosclerosis, blood vessel spasm (which may be caused by smoking, some neurologic disorders, or certain drugs), or constriction of blood flow by gloves or boots that are too tight. Exposed hands and feet and an exposed face are most vulnerable. Contact with wetness or metal accelerates freezing and is particularly dangerous.

Symptoms

Symptoms vary with the depth and amount of tissue frozen. Shallow frostbite results in a numb white patch of skin that peels after warming. Slightly deeper frostbite causes blisters and swelling of the affected area. Deeper freezing causes the extremity to feel numb, cold, and hard. The area is pale and cold. Blisters often appear. Blisters filled with clear fluid indicate milder damage than do blisters filled with bloodstained fluid.

The extremity may become gray and soft (wet gangrene). If wet gangrene develops, in many cases the extremity must be amputated. More frequently, the area becomes black and leathery (dry gangrene).

Diagnosis and Treatment

Frostbite is diagnosed by its typical appearance and occurrence after significant exposure to cold.

A person who has frostbite should be covered with a warm blanket and given a

hot beverage, because people with frostbite may also have hypothermia. The frostbitten area should be warmed as quickly as possible by immersing it in warm water that is no hotter than can be comfortably tolerated by the caregiver (100 to 104° F). Rubbing the area (particularly with snow) leads to further tissue damage. Because the area has no sensation, it should not be warmed in front of a fire or with a heating pad or electric blanket. The frostbitten area becomes extremely painful on warming; thus an injection of an opioid analgesic may be necessary. Blisters should not be broken. If blisters break, they should be covered with antibiotic ointment.

It is more damaging to thaw and refreeze tissue than to allow it to remain frozen. Thus, if a person with frostbite must be reexposed to freezing conditions, particularly if he must walk on frostbitten feet, the tissue should not be thawed. Thawed feet are more vulnerable to damage from walking. If the person must walk on thawed feet to reach help, every effort should be made to protect the damaged tissue from rubbing, constriction, or further damage.

Once the tissue is warmed, the frostbitten area should be gently washed, dried, wrapped in sterile bandages, and kept meticulously clean and dry to prevent infection. Anti-inflammatory drugs, such as ibuprofenSome Trade Names
ADVIL
MOTRIN
NUPRIN
by mouth, or aloe vera gel applied topically helps relieve the inflammation. Infection requires use of antibiotics, although some doctors give antibiotics to all people with deep frostbite. Some doctors also use drugs given intravenously, such as low-molecular-weight dextransSome Trade Names
PROMIT
MACRODEX
GENTRAN
, heparin, or phenoxybenzamineSome Trade Names
DIBENZYLINE
, to improve circulation to the affected area, although these forms of treatment are beneficial only in the first few days after injury.

Most people slowly improve over several months, although amputation is sometimes necessary to remove the dead tissue. Because frostbite may appear to affect a larger area and to be more severe than it will weeks or months later, the decision to amputate is usually postponed for several months until the area has had time to heal.