

Case Letter

Frostbite on the Hand of a Homeless Man

To the Editor:

A 58-year-old homeless man presented to the emergency department after being found wandering in the middle of winter in Detroit, Michigan, with altered mental status. A workup for his mental incapacitation uncovered severe electrolyte disturbances, hyperglycemia, and acute renal failure, as well as both alcohol and drug intoxication. After 1 day of admission the patient reported progressive swelling, blistering, and pain in the right hand. The pain was stabbing in nature, worse with movement, and graded 10 of 10 (1=minimal; 10=severe). His medical history was notable for diabetes mellitus with peripheral neuropathy, hypertension, hyperlipidemia, and alcohol and drug abuse. The patient was not taking any medications for these conditions.

Physical examination revealed 2+ moderate pitting edema in all distal extremities, with increased edema of the dorsal aspect of the right hand. The right hand also demonstrated patchy erythema and was warm to touch. The dorsal aspect of the right ring finger had a dusky tip and was studded with several tense blisters (Figure). Vital signs were stable. Based on the patient's history and physical examination findings, a diagnosis of frostbite was made. Our treatment process involved several modalities including immersion of the affected site in a warm water bath, surgical debridement of blistered sites, tetanus toxoid, penicillin to prevent infection, and oral ibuprofen for pain management. At 3-day follow-up, the patient's condition substantially improved with a decreased amount of erythema, edema, and pain. All affected sites were successfully preserved with no evidence of focal, motor, or sensory impairment.

Frostbite is a form of localized tissue injury due to extreme cold that most commonly affects the hands and feet, with the greatest incidence occurring in adults aged 30 to 49 years.^{1,2} Other sites commonly affected include the ears, nose, cheeks, and penis. Frostbite injuries can be categorized into 4 degrees of severity that correlate with the clinical presentation.^{1,3} Rewarming the affected site is necessary to properly classify the injury, as the initial appearance

may be similar among the different degrees of injury. A first-degree injury classically shows a central white plaque with peripheral erythema and is extremely cold to touch. Second-degree injuries display tense blisters filled with clear or milky fluid surrounded by erythema and edema within the first 24 hours. Third-degree injuries are associated with hemorrhagic blisters. Fourth-degree injuries involve complete tissue loss and necrosis.¹ Frostbite injuries also may be classified as superficial or deep; the former affects skin and subcutaneous tissue, while the latter affects bones, joints, and tendons.^{3,4} The superficial form exhibits clear blisters, whereas hemorrhagic blisters demonstrate deep frostbite.

Factors such as the surrounding temperature, length of exposure, and alcohol consumption may exacerbate frostbite injuries.¹ Conditions such as atherosclerosis and diabetes mellitus, which can cause neuropathy and peripheral vascular disease, also are potential risks. Psychiatric patients also are at risk for frostbite given the propensity for eccentric behavior as well as the homeless due to inadequate clothing or shelter. Diagnosis often can be made based on medical history and physical examination, though techniques such as radiography, angiography, digital



Right hand of a homeless man demonstrated patchy erythema. The dorsal aspect of the right ring finger had a dusky tip and was studded with several tense blisters.

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Selected Differential Diagnoses of Frostbite

Condition	Characteristics
Frostbite	Severe cold injury; superficial form displays clear blisters, whereas deep frostbite displays hemorrhagic blisters
Frostnip	Mild cold injury; localized pain and pallor with possible numbness; reversible with warming the cold tissue
Chilblain (pernio)	Repeated exposure to cold, not freezing, temperatures; typically presents as pruritic red-purple papules, macules, plaques, or nodules on face, tibia, and hands/feet
Trench foot or cold immersion foot (or hand)	Nonfreezing injury to hands/feet due to chronic exposure to wet or cold conditions; commonly presents with painful burning and dysesthesia, edema, blistering, redness, ecchymosis, and ulceration at site
Cellulitis	Bacterial infection of skin and underlying tissues; commonly presents with erythema, warmth, swelling, and pain in affected area

plethysmography, Doppler ultrasonography, and bone scintigraphy (technetium-99) also have been utilized to determine severity and prognosis.² Differential diagnoses of frostbite are listed in the Table.

Frostbite treatment begins with removal of wet clothing and region protection. Rewarming the site should not begin until refreezing is unlikely to occur

and involves placing the injured area in water (temperature, 40°C–42°C) for 15 to 30 minutes to minimize tissue loss.^{1,2} Analgesics, tetanus toxoid, oral ibuprofen, and benzylpenicillin also are indicated, along with daily hydrotherapy.^{1,2} White blisters should be debrided, while hemorrhagic blisters should be left intact. Amputation and aggressive debridement typically are delayed until complete ischemia occurs and final demarcation is determined, usually over 1 to 3 months.¹ Combination therapy allowed for a positive outcome in our patient.

Frostnip is a mild form of cold injury characterized by localized pain, pallor, and possible numbness.³ Warming the cold area restores the function and sensation with no loss of tissue. Chilblain or pernio refers to a localized cold injury that typically presents as pruritic red-purple papules, macules, plaques, or nodules on the face, anterior tibial surface, or dorsum and tips of the hands and feet.³ The primary cause is repeated exposure to cold, not freezing, temperatures.

Trench foot or cold immersion foot (or hand) is a nonfreezing injury to the hands or feet caused by chronic exposure to wet conditions and temperatures above freezing.³ Painful burning and dysesthesia as well as tissue damage involving edema, blistering, redness, ecchymosis, and ulceration are common. Cellulitis is a bacterial infection of the skin and underlying tissues that can occur anywhere on the body, but the legs are most commonly affected. Typical presentation involves erythema, warmth, swelling, and pain in the infected area.

Although the conditions described above may be considered in the differential diagnosis, physical examination and the patient's clinical history typically will allow for the distinction of frostbite from these other disease processes.

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