VANDERBILT UNIVERSITY MEDICAL CENTER

Guideline: Frostbite Management Guidelines

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I. Definitions

A. **Frostnip** is associated with pallor, numbness, and pain on rewarming. It is completely reversible with warming and leads to no resulting tissue loss.

B. **Frostbite** is defined by the actual freezing of the tissues. This leads to intracellular ice crystal formation and cell destruction, associated microvascular occlusion, tissue anoxia and reperfusion injury.

C. **Frostbite severity**
   a. **First degree:** hyperemia with significant edema, non-blistered.
   b. **Second degree:** partial skin thickness necrosis, forms large tense serous blisters.
   c. **Third degree:** full thickness and possible subcutaneous tissue loss, forms hemorrhagic blisters and/or dark eschar.
   d. **Fourth degree:** full thickness skin necrosis involving bone, tendon, or muscle.

II. Pre- Hospital Guidelines for Management of Severe Frostbite

1. Primary assessment/treatment for ABCs and traumatic injury
2. Vital signs, including temperature if possible
3. Anticipate/treat/prevent hypothermia
4. Protect frostbitten tissue from further cold injury and trauma:
   a. Protect and cover exposed limbs from wind and cold
   b. If possible, remove wet or tight-fitting garments (e.g., rings, jewelry, boots) and replace with dry, loose-fitting, bulky, insulating dressings or garments
   c. Mechanically protect any frozen tissue to prevent further damage with bulky dressings
5. Immediate (<1-2 hours) evacuation possible:
   a. Consider helicopter if anticipate prolonged ground extrication >1-2 hours
   b. Do not attempt to rewarm frostbitten tissue
      i. Do NOT rub affected part or apply heat (direct or indirect)
   c. Motrin (Ibuprofen) 800mg PO (if available and not contraindicated)
   d. Prevent trauma and direct pressure (blankets, litter straps, etc.) to frostbitten tissues
      i. Build frame and padded splint around frostbitten limbs during transport
      ii. Do NOT have patient walk on frostbitten feet or use frostbitten hands unless patient or rescuer in danger
   e. Elevate frostbitten limbs above level of the heart if possible
6. Immediate evacuation (> 1-2 hours) NOT possible:
   a. Seek nearest warm shelter
   b. Remove wet clothing, tight fitting garments, rings, jewelry, and boots. Replace with dry, insulating, loose-fitting garments or padded dressings.
   c. Call the burn center to discuss possible re-warming
   d. Consider rewarming ONLY if able to prevent refreezing:
      i. Rapid rewarming with water immersion 104 F (40 C) is preferred method
         1. Avoid tissue touching sides or bottom of container
         2. Warm for 10-30 minutes (until tips of frostbitten limbs become flushed red or purple, and tissue soft and pliable to gentle touch)
         3. Caregiver should test and circulate warm water with hand
      ii. Slow rewarming (warm tent/hut, adjacent body heat) if only option
      iii. Avoid using any direct heat: fire, space heaters, oven because risk of thermal injury to non-perfusing tissue (frostbite)
      iv. Anticipate pain with re-warming
      v. Do not break or drain blisters that may appear after re-warming

vi. Apply loose, bulky sterile dressings and avoid pressure points
vii. Elevate affected areas above level of the heart to help with swelling

e. Motrin (Ibuprofen) 800mg by mouth (if available and not contraindicated)
f. When evacuation possible:
    i. Avoid refreezing of thawed tissue
    ii. Prevent trauma and direct pressure (blankets, litter straps, etc.) to frostbitten tissues with frame and padded splint around frostbitten limbs during transport

7. Hydration with warm oral fluids (if alert and no nausea/vomiting) or IV hydration
8. Supplemental oxygen if available
9. Maintain non weight bearing status whenever possible to affected tissue
10. Rewarming should not be started if refreezing is expected before definitive care; repeated freeze/thaw cycles are contraindicated for thrombolytics and tend to have worse outcomes

III. Emergency Department Guidelines for Management of Severe Frostbite

1. Primary assessment/treatment for ABCs and traumatic injury
2. Document vital signs, including core temperature (esophageal or rectal)
3. Assess and treat for hypothermia
4. Provide supplemental oxygen
5. Tetanus prophylaxis as indicated
6. Motrin 800 mg PO (if not contraindicated or previously provided)
7. Establish IV access for hydration and analgesia
8. Circulating water bath:
    a. Temp 104 F (40 C)
    b. 10-30 minutes until distal tip of frostbitten limb becomes flushed red or purple, and tissue soft and pliable to gentle touch
    c. If outerwear (gloves, socks, etc) are adherent and also frozen, do not forcibly remove. Immerse the entire area in the warm water – may take longer than 30-45 minutes to fully rewarm. Once the outerwear can be safely removed, remove and continue rewarming
9. Anticipate pain with re-warming
10. Air dry – do NOT towel dry.
11. Defer aspiration or debridement of clear, cloudy, or tense blisters to burn center consultant. Can occur at referral center.
12. Wrap frostbitten areas in warm dry linens. Defer to application of topical aloe vera and padding between affect digits to burn center consultant. Can occur at referral center.
13. Dry bulky padded dressing to avoid pressure points
14. Avoid tapping, bumping or ambulation on frostbitten tissue
15. Elevate above level of the heart to reduce edema
16. Consult Burn Center for further management and Alteplase (t-PA) eligibility:
    a. Initiate IV Alteplase (t-PA) prior to transfer if advised by Burn Center consultant and meets Inclusion Criteria:
        ☐ Severe frostbite with clear evidence of frozen tissue and/or decreased perfusion upon rewarming
        ☐ < 24 hours from time of completion of rewarming (warm ischemia time)
        ☐ No contraindications to Alteplase (t-PA)
    b. Confirm IV Alteplase (t-PA) treatment protocol (see part V. Guidelines for Management)

IV. Inpatient Guidelines for Management of Severe Frostbite

1. Primary and secondary assessments, including a history and physical
    a. Document time spent outdoors, pictures of the affected areas prior to and following rewarming, and time rewarming was completed,
2. Document vital signs, including temperature, and obtain an accurate weight
3. If patient is hypothermic, continue to treat until normothermic
4. Provide supplementation oxygen
5. Ensure patient has IV access and initiate hydration with warm IV fluids
6. Remove wet or tight-fitting garments (e.g., rings, jewelry, boots) and replace with dry, loose-fitting, bulky, insulating dressings or garments
7. Warm the environment
8. Medications
    a. Scheduled Ibuprofen
    b. Consider starting scheduled Gabapentin and/or Tylenol for additional pain management
9. If t-PA eligibility assessment has not been completed, perform assessment
10. If the patient is a candidate, initiate IV Alteplase (t-PA)
11. Prepare and initiate rapid rewarming if not completed prior to admission
12. Daily Wound Care
    a. Take down all dressings and wash wounds at least once a day
    b. Allow to air dry
    c. Blisters may continue to form for 2-7 days following rewarming
        i. clear/cloudy tense blisters should be unroofed/debrided daily
        ii. hemorrhagic blisters should be left intact
13. PT/OT consults
    a. Therapists can assist with off-loading shoes to prevent walking on the injured areas
    b. Maintain full non-weight bearing status to prevent rupturing of the hemorrhagic blisters for the first 72 hours
    c. Early ambulation after 72 hours with wound protection

V. Guidelines for Management of Severe Frostbite (3rd or 4th degree)

Vanderbilt Burn Center Absolute Contraindications:

If YES to any, do NOT give Alteplase (t-PA)

NO	YES
☐	☐ Repeated freeze-thaw cycles
☐	☐ > 24 hours warm ischemia time (defined as passive or active rewarming)
☐	☐ Concurrent or recent (within 1 month) intracranial hemorrhage, subarachnoid hemorrhage or trauma with active bleeding
☐	☐ Inability to follow a neurologic exam (intubated and sedated for example, altered mental status)
☐	☐ Severe uncontrolled hypertension (SBP > 180 mmHg) and/or DBP > 105 mmHg): Hydralazine and/or labetalol may be used to lower BP to acceptable limits per burn center consultant. Do not begin Alteplase (t-PA) until BP within acceptable limits.

Relative Contraindications to Alteplase (t-PA):

If yes to any of the following: discuss with the patient and the Burn Surgeon specialist

NO	YES	
☐	☐	Recent intracranial or intraspinal surgery, serious head trauma (within 3 months)
☐	☐	History of an active gastrointestinal bleeding
☐	☐	Pregnancy

Use Caution and discuss with Burn Surgeon specialist if YES to any of the following:

NO	YES	
☐	☐	Age >75
☐	☐	Prior ICH, known structural intracranial process, intracranial neoplasm
☐	☐	Non-compressible vascular punctures
☐	☐	Recent internal bleeding (within 2-4 weeks)
☐	☐	Dementia
☐	☐	Remote history of ischemic stroke (> 3 months)
☐	☐	Recent major surgery (within 3 weeks)

Document the risks and benefits discussion with the patient in their chart

Alteplase (t-PA) Treatment Protocol

☐ Actual patient weight
☐ 2-3 large-bore peripheral IVs. One line dedicated to Alteplase (t-PA)
☐ Baseline labs (CBC, BMP, Mg, P, ionized-Ca, PT/TT, CK, and HCG if indicated)
☐ Invasive tubes before Alteplase (t-PA). Avoid NT suction if possible.
☐ Limit arterial, venous, muscular, and subcutaneous punctures during infusion. Avoid puncture of non-compressible sites. Provide Tdap before initiating therapy.
☐ Alteplase (t-PA) bolus 0.15mg/kg over 2 min, then
☐ Alteplase (t-PA) drip 0.15 mg/kg/hr over 6 hours
☐Total dose Alteplase (t-PA) not to exceed 100mg
☐ Flush tubing with NS to ensure that entire does of Alteplase (tPA) administered
☐ Lovenox therapeutic dose of 1 mg/kg SQ immediately following (within 10 minutes) the completion of Alteplase (tPA) infusion. Continued Lovenox Q12 hours for 1 week.
☐ Patient to remain on bedrest during infusion

Quick Reference for *Approximate* Expected Dose Based on Weight

Administration of Activase (Alteplase) when thrombolytic therapy (t-PA) is initiated at the Burn Center				
Weight (kg)	Bolus dose (mg) (over 2 min)	Infusion Dose (mg) (over 6 hours)	Rate (mL/hr)	Total Dose (mg)
40	6	36	6	42
42	6.3	37.8	6.3	44.1
44	6.6	39.6	6.6	46.2
46	6.9	41.4	6.9	48.3
48	7.2	43.2	7.2	50.4
50	7.5	45	7.5	52.5
52	7.8	46.8	7.8	54.6
54	8.1	48.6	8.1	56.7
56	8.4	50.4	8.4	58.8
58	8.7	52.2	8.7	60.9
60	9	54	9	63
62	9.3	55.8	9.3	65.1
64	9.6	57.6	9.6	67.2
66	9.9	59.4	9.9	69.3
68	10.2	61.2	10.2	71.4
70	10.5	63	10.5	73.5
72	10.8	64.8	10.8	75.6
74	11.1	66.6	11.1	77.7
76	11.4	68.4	11.4	79.8
78	11.7	70.2	11.7	81.9
80	12	72	12	84
82	12.3	73.8	12.3	86.1
84	12.6	75.6	12.6	88.2
86	12.9	77.4	12.9	90.3
88	13.2	79.2	13.2	92.4
90	13.5	81	13.5	94.5
92	13.8	82.8	13.8	96.6
94	14.1	84.6	14.1	98.7
95	14.25	85.5	14.25	99.75

VI. Frostbite Injury Practice Management Pathway

Vanderbilt Regional Burn Center

Frostbite Injury Practice Management Pathway

PAGE:
- **On-Call Burn Attending**
- On-Call Burn Resident

Rewarming should take place in the **Burn Unit** to shorten rewarming time and to decrease hypothermia

Any possible **associated trauma** or **chemically impaired**?

YES ---> Immediate traumagram to r/o any source of trauma or bleeding that would be a contraindication for thrombolytics

Hypothermia? Must treat with frostbite

Management:
- ABCDE's
- Place an IV for fluid rehydration and pain management
- Update Tetanus
- Obtain an accurate (not estimated) weight
- **If Hypothermic**:
  - Remove all cold/wet clothing
  - Consider a Bear Hugger/increasing room
  - Warmed IV fluids/oxygen
  - Document cord body temp
- **Document**
  - Time of arrival
  - Time of rewarming
  - Obtain photographs
- Obtain dopplerable pulses in the affected digits
- **Labs**: CMP, CBC, Coags, Utox
- Keep involved extremities elevated and protected
- **Analgesia**:
  - Start Ibuprofen 800mg on arrival, continue every 8 hours
  - Consider starting Gabapentin 300mg
- **Rapid rewarming**
  - Water immersion 104 F (40 C) is preferred method
  - Avoid tissue touching sides or bottom of container
  - Warm for 10-30 minutes (until tips of frostbitten limbs become flushed red or purple, and tissue soft and pliable to gentle touch)

Next Step:
Call **On-Call Burn Attending for management guidelines**

When photographing affected extremities take pictures of the front and back. If only one extremity is affected take a picture of unaffected extremity for comparison.

If concerned for 3rd or 4th degree Frostbite, CALL IMMEDIATELY! Time is tissue, they may be a candidate for thrombolytic therapy. These patients require an ICU bed secondary to getting thrombolytics.

****Starting thrombolytics early is vital, for every hour of delay there is a 28% decrease in salvage rate.****