Maine Medical Center Trauma Clinical Practice Guideline (MMCT-CPG)

Frostbite Management Guideline

(MMC-CPG ID: 2022-02)

Guidelines and recommendations for the management of patients with frostbite injury.

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First Publication Date	Publication Date	Supersedes CPG
January 2019	December 2022	dated September 2019

Guidelines translate best evidence into best practice. A well-crafted guideline promotes quality by reducing healthcare variations, improving diagnostic accuracy, promoting effective therapy, and discouraging ineffective – or potentially harmful – interventions.

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PURPOSE

These guidelines are not intended to supplement physician/APP judgement. Rather, these guidelines are intended to provide a basic framework for the assessment and determination of frostbite, guide the initial interventions and treatments, as well as to educate and provide insight to others regarding the management of frostbite.

BACKGROUND

Due to our location, Maine Medical Center treats several patients with frostbite each year. The purpose of this guideline is to guide the diagnosis and grading of frostbite and to provide an algorithm for treatment with either conservative management, intra-arterial thrombolytic therapy (IATT), or intravenous thrombolytic therapy (IVTT).

Frostbite is a cold thermal injury caused by prolonged exposure to cold temperatures. It has the potential to cause significant morbidity and disability. Traditionally, the treatment of frostbite has been conservative with expectant management utilizing amputation and reconstruction when necessary [1]. Recently, more aggressive treatment with thrombolytic therapy has gained widespread use with impressive clinical outcomes [2]. With both conservative and aggressive initial treatment, frostbite injuries may take months to demarcate. At this time, a surgical evaluation is made to determine if amputation or reconstruction is indicated.

Pathophysiology: In the first stage of injury, direct cellular damage caused by intracellular freezing results in direct cell death and extracellular freezing leads to cellular membrane damage. This results in intracellular dehydration, electrolyte imbalances and subsequent cellular death. In the second stage of injury, the coagulation pathway is activated by cellular death [3]. A cycle of vasoconstriction and vasodilation occurs which leads to thrombosis and ischemia. The accumulation of inflammatory mediators, subsequent localized edema and additional platelet aggregation exacerbates this ischemic cycle [3].

INITIAL MANAGEMENT

1. Trauma/Burn Surgery Consultation
    a. Complete history and physical examination to evaluate for traumatic injuries
    b. Collect baseline laboratory data:
        i. CBC, CMP, Coagulation Panel, Toxicology Screen, ETOH level
2. Rapid Rewarming: core body temperature and affected extremity
    a. Warmed IV fluids, warm blankets, Bair hugger, increase room temperature
    b. Water bath: submerge and swirl affected extremity in water bath
        i. Temperature should be 42 degrees Celsius, use a thermometer and add more water to maintain temperature
        ii. Continue for 30 minutes or until tissue warm, soft and pliable
3. Classification – Grade when affected area is **RE-WARMED**. Injury may demarcate within the first 72 hours.
    a. Grade 1 – partial thickness skin freezing with numbness, erythema, hyperemia and the absence of blisters.
    b. Grade 2 – full thickness dermal freezing with erythema, hyperemia, and serous or milky blistering.
    c. Grade 3 – Dermal and subcutaneous freezing with hemorrhagic blisters on presentation. Skin necrosis and eschar formation after two weeks.
    d. Grade 4 – full thickness dermal, subcutaneous tissue, muscle, tendon and bone freezing with mottled deep red or cyanotic coloring with mummification of tissues after several weeks.
4. Evaluate eligibility for thrombolysis based on clinical grading and imaging results.
    a. Grade 1 or 2 AND adequate perfusion on ICG microangiography
        i. Proceed with conservative management
    b. Grade 3 or 4 OR impaired perfusions on ICG microangiography
        i. Consider IATT for isolated upper extremity frostbite (see appendix A)
        ii. Consider IVTT for isolated lower extremity frostbite or concomitant upper and lower extremity frostbite (see appendix B)

IMAGING MODALITIES

1. Imaging: All imaging should be performed after extremity is **RE-WARMED**.
    ICG Microangiography (SPY) – see 'IcG Microangiography for Frostbite Guide'
        i. IcG contrast is used to assess microvascular perfusion with ultraviolet light
        ii. Performed at bedside by Trauma/Burn team
        iii. Performed on all frostbite patients on initial evaluation
        iv. For who undergo IVTT, repeat approximately 24 hrs after Tenecteplase administration
    b. Angiography
        i. Catheter directed contrasted fluoroscopy to assess microvascular perfusion
        ii. Used in patients who undergo IATT per Interventional Radiology for diagnosis and for evaluation of response to treatment
    c. Nuclear Bone Scan
        i. 3 phase scan with delayed imaging and technetium contrast tracer to assess macrovascular, microvascular, soft tissue and bone perfusion
        ii. Perform at least 2 days after injury for surgical planning

ANTICOAGULATION

1. All grade 2-4 injuries:
    a. Enoxaparin 1mg/kg BID for 7 days, followed by
    b. Aspirin 81 mg daily for 30 days
2. IVTT: Heparin drip for 24 hrs after Tenecteplase infusion, then transition to enoxaparin as above to complete 7 days
3. IATT: Heparin drip for entirety of IATT treatment, then transition to enoxaparin as above to complete 7 days
4. See Appendix A and B for details

CONSERVATIVE MANAGEMENT

1. Local Wound Care
    a. Protective dressings with several layers of gauze to avoid trauma to the affected tissues
    b. Topical antimicrobials depending on depth of injury
    c. Bedside debridement of bullae which impede range of motion or have decompressed
2. Edema Management
    a. Elevate affected extremities
    b. Light compression
3. Pain control – see Burn Pain and Sedation Guideline
4. Physical and Occupational Therapy Consultation
    a. No range of motion restrictions
    b. Weightbearing for ADLs
5. Patient Education
    a. Avoid re-freezing and trauma to affected areas

SURGICAL MANAGEMENT

- Early Debridement: if there is concern for infection
- Amputation: mummified or clearly demarcated digits/extremities
- Reconstruction: skin grafts or flaps for full thickness tissue loss

PERFORMANCE IMPROVEMENT MONITORING

Intent / Expected Outcomes

Performance / Adherence Measures

1. Will assess adherence to this CPG at morning report
    a. Notation within the registry timeline will be considered the review data source.
2. PIPS as needed

Data Source

Rounds and review of patient record

SYSTEM REPORTING & FREQUENCY

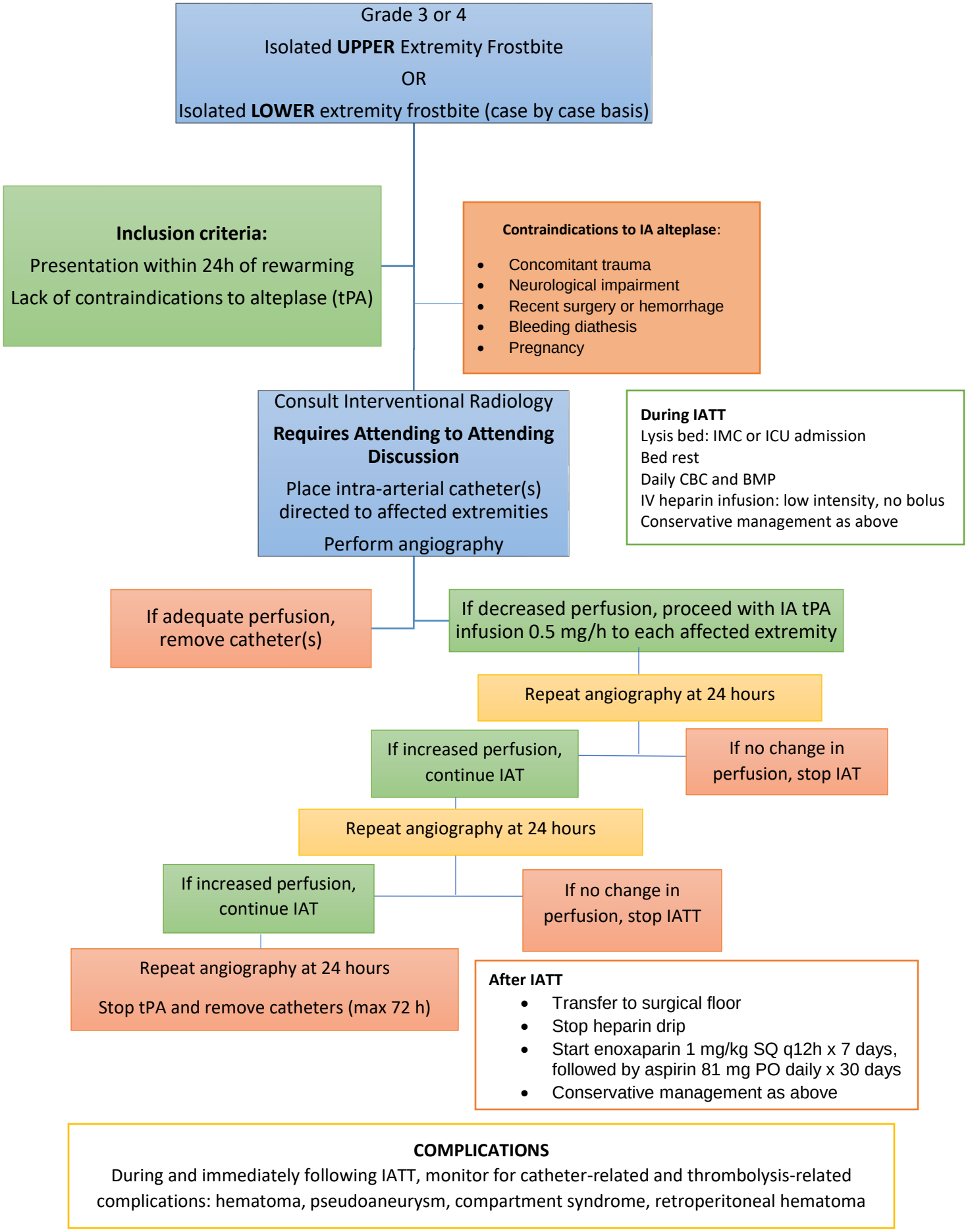
The above constitutes the minimum criteria for PI monitoring of the MMCT-CPG. System reporting will be performed annually; additional PI monitoring and system reporting may be performed as needed.

The system review and data analysis will be performed by the MMC Trauma Service under the direction and responsibility of the MMC Trauma Medical Directory and MMC Trauma Medical Program Manager.

RESPONSIBILITIES

It is the Burn Medical Director's responsibility to ensure familiarity, appropriate compliance, and PI monitoring with this MMCT-CPG.

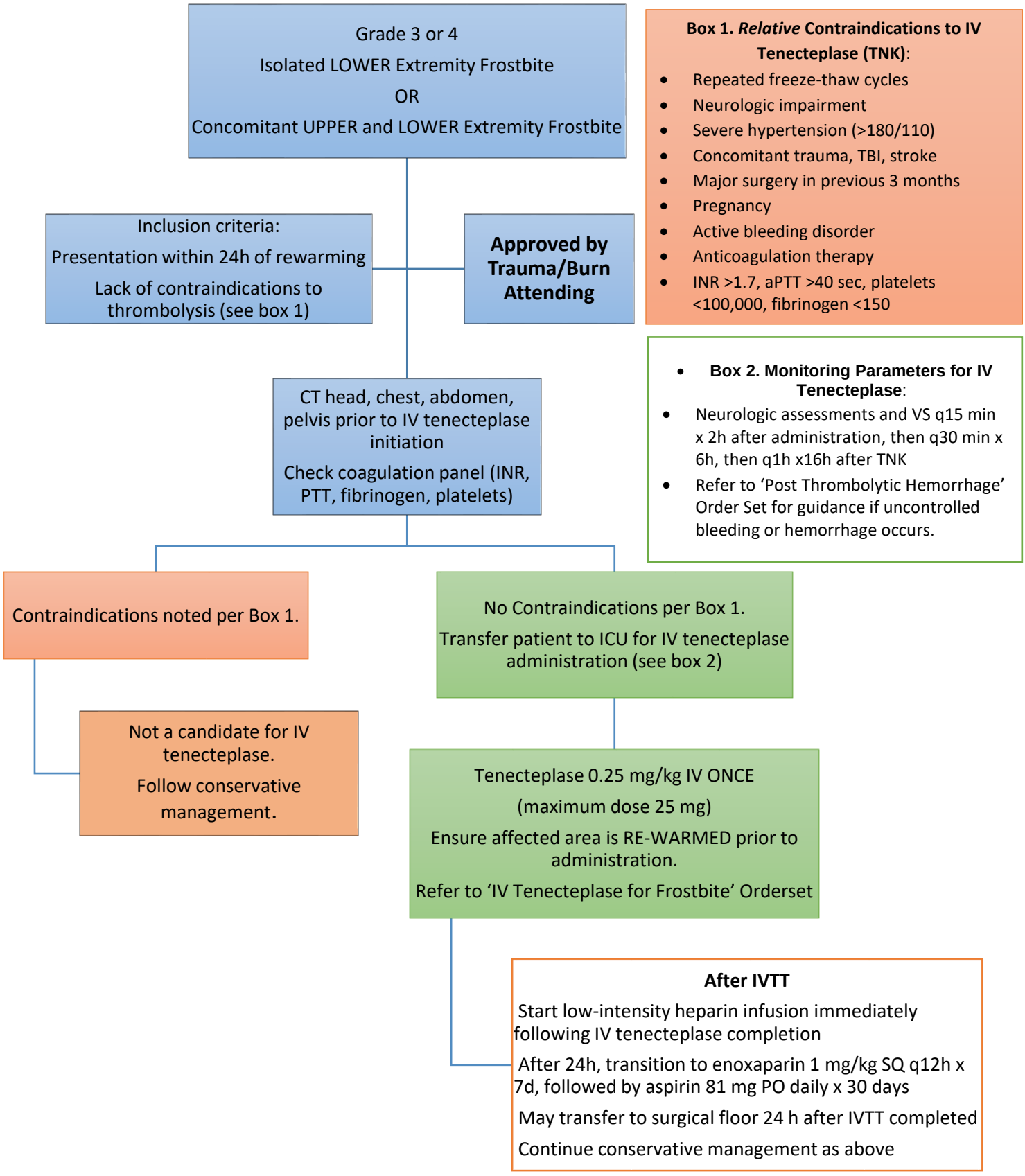
APPENDIX A: Intra-Arterial Thrombolytic Therapy (IATT)



COMPLICATIONS

During and immediately following IATT, monitor for catheter-related and thrombolysis-related complications: hematoma, pseudoaneurysm, compartment syndrome, retroperitoneal hematoma

APPENDIX B: Intravenous Thrombolytic Therapy (IVTT)



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