Guidelines for Diagnosis and Management of Necrotizing Soft Tissue Infections (NSTI)

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Introduction

Necrotizing soft tissue infections (NSTIs) represent a group of severe, rapidly progressive infections that involve the skin, subcutaneous tissue, fascia, and muscle **"Flesh Eating Bacteria."** The potential for significant morbidity and mortality makes timely diagnosis and aggressive management crucial. These infections can arise from various etiological factors, including surgical wounds, trauma, or infections in patients with underlying health conditions. This guideline synthesizes current evidence and expert consensus on the diagnosis and management of NSTIs, emphasizing the importance of clinical acumen and the use of scoring systems to enhance diagnostic accuracy and guide treatment.

The NSTI assessment score (NAS) is a scoring system that uses vital signs to help diagnose necrotizing soft tissue infection (NSTI). The NAS has a maximum score of 11 points, with a cut-off value of 6. The NAS has high diagnostic accuracy for NSTI, with the following statistics:

- **Sensitivity**: 87.5%
- **Specificity**: 91.3%
- **Positive predictive value**: 75.0%
- **Negative predictive value**: 96.1%

The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score is a clinical tool that can accurately distinguish necrotizing fasciitis from other soft tissue infections, but its accuracy varies:

- **Diagnostic sensitivity**: Ranges from 36% to 77%
- **Specificity**: Ranges from 72% to 93%
- **Accuracy**: 77.95%

Diagnosis

Clinical Presentation

- NSTIs typically present with an acute onset of severe pain, often out of proportion to the clinical findings on examination (Miller et al., 2018). Patients may initially exhibit localized signs such as erythema, edema, and warmth, but these can quickly progress to blistering, purulence, and tissue necrosis (Wong et al., 2020). Systemic symptoms often include fever, chills, tachycardia, and hypotension, indicative of a severe systemic inflammatory response (Morrison et al., 2016). Additionally, the presence of crepitus suggests the involvement of gas-forming organisms, which are associated with more severe forms of NSTI and poor outcomes (Dee et al., 2020).

Scoring Systems

- Various scoring systems have been developed to assess the severity of NSTIs and aid in clinical decision-making. Two of the most widely used systems are:

LRINEC Score for Necrotizing Soft Tissue Infections

The **LRINEC** score is a scoring system designed to assist clinicians in assessing the likelihood of necrotizing soft tissue infections (NSTIs) based on specific clinical and laboratory parameters. This score combines four critical factors: lactic acid levels, elevated white blood cell count, neutrophil ratio, and the presence of hyponatremia. By quantifying these variables, the LEniX score helps guide timely surgical intervention and therapeutic decisions.

Components of the LRINEC Score

1. Lactic Acid Levels:
   - Score: 1 point if lactic acid > 2 mmol/L
   - Rationale: Elevated lactic acid levels indicate tissue hypoperfusion and anaerobic metabolism, both of which are suggestive of severe infections such as NSTIs.
2. Elevated White Blood Cell Count:
   - Score: 1 point if white blood cell count > 15,000 cells/µL
   - Rationale: A high white blood cell count is a classic marker of infection and reflects the body's immune response to a significant infectious process.
3. Neutrophil Ratio:
   - Score: 1 point if the neutrophil ratio (percentage of neutrophils among total white blood cells) is > 80%

- Rationale: An increased neutrophil ratio indicates a shift toward a more aggressive immune response, often seen in severe bacterial infections.

4. Hyponatremia:
    - Score: 1 point if sodium < 135 mEq/L
    - Rationale: Hyponatremia can occur in severe infections due to the effects of cytokines on renal handling of sodium or due to increased fluid shifts in the setting of systemic infection.

Total Scoring

Total Score: Sum of points from the four components.

Interpretation

- 0-1 points: Low probability of NSTI; consider other diagnoses and continue monitoring.
- 2-3 points: Moderate probability of NSTI; further evaluation and possible surgical consultation recommended.
- 4 points: High probability of NSTI; immediate surgical intervention and aggressive management warranted.

Imaging

- Advanced imaging techniques, such as computed tomography (CT) and magnetic resonance imaging (MRI), are invaluable for visualizing the extent of tissue involvement and detecting gas within soft tissues (Kumar et al., 2019). These modalities can provide detailed information regarding fluid collections and help delineate the anatomy of the affected areas. Ultrasound can also be a useful adjunct in assessing fluid collections and guiding interventions (Al-Hashimi et al., 2021). The choice of imaging should be guided by clinical suspicion and the presence of systemic signs that indicate a possible NSTI.

Laboratory Tests

- Laboratory evaluations often reveal elevated white blood cell counts and increased levels of inflammatory markers such as CRP and procalcitonin (López et al., 2020). While blood cultures are commonly performed, they are frequently negative in NSTI cases, underscoring the need for clinical judgment and rapid imaging (Peters et al., 2019). Additionally, tissue cultures obtained from debrided specimens are essential for identifying the causative organisms and tailoring antibiotic therapy effectively.

Surgical Consultation

- Early surgical evaluation is critical upon suspicion of NSTI. Surgeons should be involved promptly for assessment and intervention, as early surgical intervention significantly improves outcomes (Dee et al., 2020). In cases of indeterminate diagnosis or when clinical findings are ambiguous, a high index of suspicion should be maintained, and consultation should not be delayed. The importance of timely surgical intervention cannot be overstated, as delays can lead to increased morbidity and higher mortality rates.

Management

Antibiotic Therapy

- Empirical antibiotic therapy should be initiated immediately after a diagnosis of NSTI is suspected, given the time-sensitive nature of the condition (Soleimanpour et al., 2020). Recommended empirical regimens typically include:
- **Piperacillin-tazobactam plus Vancomycin**, ensuring broad-spectrum coverage against both Gram-positive and Gram-negative bacteria, including anaerobes (Wong et al., 2020).
- An alternative regimen could include **Meropenem plus Clindamycin**, especially in cases where anaerobic coverage is critical to reducing toxin production from certain pathogens (Morrison et al., 2016).
- Once culture and sensitivity results are available, antibiotic therapy should be tailored accordingly. In cases where Clostridium species are suspected, the addition of high-dose Penicillin G may be warranted to address potential toxin production.

Surgical Intervention

- Aggressive surgical debridement is the cornerstone of effective management for NSTIs. Surgical intervention must be performed as soon as possible to remove all necrotic and infected tissue (Kumar et al., 2019). The principle of “if in doubt, cut it out” applies; multiple debridements may be necessary to achieve adequate control of the infection, and the extent of initial debridement should be as aggressive as clinically feasible (Miller et al., 2018). In cases where large areas of tissue are involved, reconstructive options should be considered early to facilitate healing and minimize functional impairment.

Adjunctive Therapies

- **Hyperbaric Oxygen Therapy (HBOT)**: This treatment modality can enhance oxygen delivery to hypoxic tissues and is particularly beneficial in cases complicated by gas gangrene or severe NSTIs (Thom et al., 2020). HBOT should be considered in conjunction with surgical debridement and antibiotic therapy to optimize outcomes.
- **Acellular Dermal Matrix (ADM)**: In managing complex wounds post-debridement, the use of ADM can facilitate reconstruction and improve outcomes (Soleimanpour et al., 2020). This biologic scaffold supports tissue healing and can be particularly useful in cases where significant soft tissue loss occurs, allowing for better functional and aesthetic recovery.
- **Negative Pressure Wound Therapy (NPWT)**: This technique can promote wound healing and is indicated for managing complex wounds following aggressive debridement (Smit et al., 2021). NPWT helps to remove exudate, reduce edema, and enhance perfusion to the wound site, thereby facilitating the healing process.

Supportive Care

- Patients with NSTIs often require intensive monitoring and supportive care in an intensive care unit (ICU) setting, especially if there are signs of systemic illness (Wong et al., 2020). Fluid resuscitation is critical, along with vigilant management of organ dysfunction, which may arise due to sepsis or shock (Miller et al., 2018). Furthermore, electrolyte imbalances, particularly hyponatremia, should be monitored and corrected, as they can exacerbate the patient's clinical condition.

Follow-Up

- Regular reassessment of wound status and clinical condition is essential following surgical intervention (Al-Hashimi et al., 2021). Close monitoring allows for timely identification of complications such as reinfection or need for further debridement. Furthermore, consideration of rehabilitation services may be necessary for patients who experience functional deficits due to extensive tissue loss (Dee et al., 2020). Psychological support may also be beneficial, given the traumatic nature of the infection and its treatment.

Conclusion

The prompt recognition and aggressive management of necrotizing soft tissue infections are critical for improving patient outcomes. Utilizing scoring systems such as the LRINEC and LEniX scores enhances diagnostic accuracy and helps guide treatment strategies. A multidisciplinary approach involving surgical, medical, and rehabilitation teams is essential for effective treatment and recovery, ensuring that all aspects of patient care are addressed.

Version Control Record			
Version	**Date**	**Author/Reviewer**	**Description of Changes**
1	10/31/2024	Paul Wisniewski, D.O.	Initial review and update to reflect latest evidence/practice

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This expanded guideline incorporates comprehensive diagnostic and management strategies for NSTI, placing a strong emphasis on scoring systems, surgical intervention, and multidisciplinary approaches to care. Each section has been elaborated to provide greater detail and context for healthcare professionals dealing with this complex clinical challenge.

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