AAST Acute Care Surgery Didactic Curriculum

Necrotizing Soft Tissue Infections (NSTI)

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Overview

- Formerly known as necrotizing fasciitis, necrotizing soft tissue infections (NSTI) are relatively rare but life-threatening skin and soft tissue diagnoses characterized by widespread tissue necrosis.
- Incidence has increased over the past several decades, and mortality is estimated to be between 20 and 30%.
- Often severe, rapidly progressive, and associated with sepsis and multisystem organ failure.
- Rapid recognition, antibiotic initiation, and surgical debridement are crucial.
- Risk factors:
    - Intravenous drug use
    - Immunosuppression
    - Diabetes mellitus
    - Traumatic injuries
    - Varicella infections
    - Obstetrical/gynecologic procedures
    - Can occur in postsurgical and immunocompromised patients

Types of NSTI

- Type I- Polymicrobial (most common- 70-80% of cases), often including both aerobic and anaerobic organisms
- Type II- Monomicrobial
    - Group A streptococcus is the most common pathogen, followed by Methicillin-resistant staphylococcus aureus (MRSA)
- Type III → Some experts have proposed NSTI caused by *Vibrio vulnificus*, *Aeromonas hydrophilia*, or clostridial species should be classified as type III
- In rare cases, can be caused monomicrobial gram-negative pathogens
- Fournier's gangrene- NSTI of the perineum (generally polymicrobial)

Pathophysiology

- Pyrogenic toxins bind to antigen-presenting cells, resulting in rapid T-cell proliferation and subsequent production of cytokines that perpetuate shock and multiorgan failure.

Diagnosis

- Classical physical exam findings:
  - Erythema
  - Soft-tissue edema
  - Severe pain
  - Fever
  - Hemorrhagic bullae or skin necrosis
- Hypotension and shock are a later symptom associated with higher mortality.
- Imaging and laboratory values are not predictably reliable in assisting with diagnosing NSTI, and can be helpful tools in equivocal cases, but should not delay operative treatment in cases where there is a high index of suspicion for NSTI.
- Imaging:
  - Plain radiographs can demonstrate gas in soft tissues.
  - CT can demonstrate fascial air or gas, soft tissue edema, or fascial enhancement.
- Laboratory values are often utilized to aid in the diagnosis of NSTI.

LRINEC score

- The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, developed in 2004 by Wong and colleagues, is a diagnostic clinical decision instrument validated for differentiating NSTI from other soft tissue infections.
  - Utilizes 6 serum parameters:
    - White blood cell count
    - Hemoglobin
    - Sodium
    - Glucose
    - Creatinine
    - C-reactive protein
  - On a scale of 0-13, a score ≥6 is the traditional "threshold" for diagnosis of NSTI, indicates a moderate risk of NSTI (50-75% probability), whereas a score ≥8 indicates a high risk (>75% probability).
  - Studies seeking to validate this tool have variable results on its reliability, and LRINEC scores can be artificially elevated in other musculoskeletal infections. The LRINEC score should not replace clinical judgement in evaluating possible NSTI.

Treatment of NSTI

- Resuscitation
    - NSTI patients may have extremely high intravenous fluid requirements (as high as 10 to 12L of crystalloid per day) due to toxin-mediated capillary leak syndrome and diffuse endothelial damage.
- Antibiotic treatment
    - Empiric antibiotic therapy should begin as soon as NSTI is suspected.
        - Infectious Diseases Society of America (IDSA) guidelines recommend vancomycin or linezolid plus one of the following therapies: piperacillin-tazobactam, a carbapenem, or ceftriaxone-metronidazole
        - If concern for Group A Streptococcal infection, treatment with clindamycin in combination with penicillin for 10-14 days is recommended
        - MRSA infections should be treated with vancomycin, linezolid, daptomycin, or ceftaroline
        - *A. hydrophilia* infections should be treated with doxycycline plus either ceftriaxone or ciprofloxacin
        - *V. vulnificus* infections should be treated with doxycycline in combination with either ceftriaxone or cefotaxime
    - Definitive treatment should be based on intraoperative cultures and sensitivity information.
- Surgery
    - The mainstay of diagnosis and treatment is prompt and aggressive surgical debridement.
    - Earlier surgery has been demonstrated as an independent predictor of survival in NSTI.
    - Surgery can determine the extent of infection, assess the need for debridement/amputation, and obtain intraoperative fluid and tissue cultures.
    - Debridement should begin centrally and remove all necrotic tissue.
    - Wounds should be left open with wet-to-dry dressings soaked in solutions with antimicrobial properties, such as betadine or Dakins solution.
    - Wounds should be frequently re-evaluated, typically with a planned re-exploration within 24-48 hours of the initial debridement.
    - Multiple operative explorations and debridements are typically necessary. When no further necrotic tissue is encountered during operative evaluation, it is appropriate to transition to bedside dressing changes.
    - Negative-pressure devices may facilitate closure/healing of wounds.
    - Multidisciplinary surgery teams may be required due to structures involved and/or for eventual reconstruction.
- Proposed adjuvant therapies, including plasmapheresis and hyperbaric oxygen therapy, are currently controversial and require more research to better delineate their role, if any, in NSTI.