

Aggressive Soft Tissue Infections

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KEYWORDS

• Necrotizing fasciitis • Soft tissue infection • Sepsis • Gas gangrene

KEY POINTS

- Necrotizing soft tissue infections (NSTIs) are rapidly progressive and lead to sepsis, multi-system organ failure, and sometimes death.
- The diagnosis of NSTI is based on clinical findings with the aid of certain laboratory values and imaging.
- Prompt diagnosis and immediate surgical debridement are necessary for the management of NSTIs.
- Surgical debridement should involve complete excision of all tissues that were involved in the disease. Multiple operations may be required.
- Broad-spectrum empiric antibiotics should be given once the diagnosis is suspected, but should not be a substitute for surgical management. Antibiotics can then be tailored to cultures obtained from debridement.

BACKGROUND

Necrotizing soft tissue infections (NSTI) are relatively rare but potentially fatal diseases that are caused by virulent, toxin-producing bacteria. Necrotizing fasciitis has been originally used to describe these infections, but now the term necrotizing soft tissue infection is used to include infections wherein the necrosis extends beyond the fascia. Incidence is varied, about 3800 to 5800 cases yearly, but this is likely underreported because of different reporting practices.¹ Mortality has been reported to range from 21% to 43%,^{2,3} but recently, there has been decline in mortality to 10% to 12%.⁴ Proposed explanations include increased awareness and early diagnosis, improvements in intensive care and resuscitation, better wound care options, and improved antibiotic coverage.

PATHOPHYSIOLOGY

The hallmark of NSTI is the progressive infection, toxin production, activation of cytokines, thrombosis, ischemia, tissue destruction, and death, which all differentiate it

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from uncomplicated skin and soft tissue infections. Any infection that is left untreated can progress to local necrosis. The pathophysiology depends on the specific bacterium involved in the infection. Necrosis can be secondary to toxins that cause vascular occlusion and necrosis. Bacteria can also produce toxins that lead to progressive systemic inflammation, sepsis, and death. NSTI has been originally described by 2 distinct microbiological profiles, but the classification has evolved over time with additional pathogen classes.

TYPE I INFECTIONS

Type I infections are the most common type of NSTI (55%–80%). These type I infections involve mixed infections, including aerobic and anaerobic bacteria. *Streptococcus* is the most common aerobic bacteria (and overall), and *bacteroides* is the most common anaerobe.⁵ Diabetes mellitus, obesity, immunosuppression, chronic kidney disease, cirrhosis, malignancy, and alcohol abuse are common risk factors and contribute to the underlying failure of host immune system that leads to these infections.⁶

Some NSTIs are named based on their anatomic location. Fournier gangrene involves the perineum or genital areas.⁷ Ludwig angina involves the submandibular space that can spread into the neck and mediastinum, causing a cervical necrotizing fasciitis.⁸

TYPE II INFECTIONS

Type II infections involve either beta-hemolytic *Streptococcus* or *Staphylococcus aureus* (10%–15%).⁹ Typically there is a history of trauma to the area, including surgery and intravenous drug use, which supplies the initial inoculation.¹⁰ The bacteria involved in these infections produce exotoxins, and their specific features contribute to their virulence. M proteins on the surface bind directly to T-cell receptors, causing rapid proliferation and a resultant immense proinflammatory cytokine release that produces the septic shock associated with NSTI.^{11,12} The inflammatory response then causes widespread thrombosis of blood vessels, preventing host's immune system from attacking the infection as well as necrosis of the tissues.¹³ Varied exotoxins produced by the bacteria cause neutrophil damage, break down connective tissue structural components, and decrease viscosity of the purulent fluid so that it transmits along fascial planes.^{14,15}

TYPE III INFECTIONS

Infections caused by *Clostridium* spp and *Vibrio vulnificus* (from warm coastal seawater or consumption of raw oysters) are classified as type III infections. These infections are more common in Asia. Water that is contaminated can penetrate the smallest of wounds and spread rapidly. The mortality is high, ranging around 30% to 40%.^{16,17}

TYPE IV INFECTIONS

Aeromonas hydrophila and fungi are found in these infections. *Candida* spp are typically found in immunocompromised patients and zygomycetes in immunocompetent patients. Frequently these fungal infections are a result of penetrating traumatic injury. Type IV infections are rare, but aggressive, with rapid extension, and the associated mortality is high, especially when immunocompromised.¹⁸

PRESENTATION

The initial symptom of NSTI is pain. Typically this pain is out of proportion to examination findings, and it is the most consistent clinical finding.^{19,20} The initial appearance of

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