

# ANESTHETIC IMPLICATIONS OF NECROTIZING FASCIITIS

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*Necrotizing fasciitis, also known as necrotizing acute soft tissue injury (NASTI), commonly occurs as a consequence of group A streptococcal disease. An estimated 9,400 cases of invasive group A streptococcal disease occur annually in the United States, with 600 cases classified as NASTI. Mortality associated with NASTI is estimated at 20% to 50%. Research indicates that early diagnosis and surgical excision of necrotic tissue is the key to minimalization of mor-*

*bidity and mortality associated with NASTI. Repeated surgeries typically are required in patients with NASTI, posing unusual anesthetic challenges. This article provides an overview of NASTI and includes preoperative, intraoperative, and postoperative anesthetic considerations.*

**Key words:** Anesthesia, group A streptococcal disease, necrotizing fasciitis.

**N**ecrotizing fasciitis, also known as necrotizing acute soft tissue injury (NASTI), Fournier gangrene, or flesh-eating bacteria, is a progressive, often polymicrobial bacterial infection of the fascia and surrounding soft tissue.<sup>1</sup> This infection rapidly spreads along fascial planes and, if left untreated, is nearly uniformly fatal.<sup>2</sup> In 1999, The Centers for Disease Control and Prevention estimated there were approximately 9,400 annual cases of invasive group A streptococcal disease in the United States.<sup>3</sup> Three hundred of these cases were classified as streptococcal toxic shock syndrome, and 600 were diagnosed as NASTI. Mortality associated with NASTI was approximately 20% and about 50% in cases of streptococcal toxic shock syndrome.<sup>3</sup>

Risk factors that predispose patients to the disease include diabetes, vascular disease, alcoholism, intravenous drug abuse, immunosuppression, malnourishment, and obesity.<sup>4</sup> Less frequently, people without known risk factors may experience NASTI as a consequence of exposure to a virulent organism (group A *Streptococcus*) or after an insect or animal bite. Local tissue trauma in the form of a contusion, small burn, or ingrown nail also have been implicated on rare occasions.<sup>5</sup>

Typical portals of entry in cases of necrotizing fasciitis include the perirectal area, the genitourinary tract, surgical incision sites, cutaneous ulcers, and areas of soft tissue trauma.<sup>5</sup> Key factors that minimize morbidity and mortality include early diagnosis, aggressive fluid resuscitation, early emergency surgical debridement, appropriate antibiotic therapy, and supportive care.<sup>2,6</sup>

The most common single infectious organism responsible for necrotizing fasciitis is group A *Streptococcus*. Group A streptococcal disease can be expressed

with wide variation, ranging from minimal illnesses, such as strep throat or a skin infection such as impetigo, to severe illnesses such as necrotizing fasciitis and streptococcal toxic shock syndrome.<sup>5</sup> However, a polymicrobial infection with gram-positive and gram-negative anaerobic and aerobic bacteria is most often responsible for the wound infection.<sup>5</sup>

• *Clinical manifestations.* Symptoms with NASTI tend to be somewhat variable, but within 24 hours following minor trauma or skin opening (eg, boil, pimple), pain and redness progress rapidly. These symptoms are accompanied by severe pain in the general area of the injury. Viral symptoms may be present in the form of chills, fever, myalgia, and diarrhea.<sup>7</sup> Typically, the skin exhibits an area of redness (erythema) that progressively spreads, often far from the initial area of infection. As the infection progresses, it can produce a dusky or purplish discoloration to the affected area. Cellulitis, edema, blisters, and subcutaneous crepitus also may be present. The wound may appear necrotic, with extension of pain and swelling to untreated areas far removed from the original external wound. Often, within 72 to 96 hours, measurable signs of dehydration, altered mental status, and cardiovascular instability are evident in the absence of treatment. As septicemia intensifies, additional signs of multisystem organ failure may appear.<sup>7</sup>

• *Management.* Research strongly suggests that early diagnosis and surgical excision of necrotic tissue are key to minimalization of morbidity and mortality.<sup>8</sup> A retrospective review of medical records found that of 60 patients examined between 1980 and 1996 with a diagnosis of NASTI, the average age was 52 years. Of the 60 patients, 56% were women, 64% were African American, and 73% had a concomitant disease process such as diabetes or cardiovascular disease. Patients who were treated conservatively with antibiotics and

minimal surgical procedures had a mortality rate of 38%. Conversely, patients who were treated more aggressively with wide excision and debridement, appropriate antibiotic therapy, and general supportive care had only a 4.2% mortality rate ( $P = .0007$ ).<sup>4</sup>

This research and other studies have indicated that many surgical debridement procedures may be required to adequately remove all areas of necrotic tissue. In extreme cases, surgical amputation of the affected limb and extensive disfiguring surgeries may be necessary.<sup>9</sup> In addition to surgery, the primary treatment modalities for NASTI include antibiotic coverage based on culture and sensitivities and symptomatic support of cardiovascular, respiratory, and metabolic nutritional status. Hyperbaric oxygen therapy has been advocated, particularly in anaerobic organism-based soft tissue infection.<sup>10</sup> Hyperbaric treatment also may be beneficial for aerobic-based NASTI, although outcome studies with significant findings are not available.<sup>11</sup> The Table provides a handy reference for providing anesthetic care to patients with NASTI.

### Preoperative considerations

Typically, patients in whom infection progresses without aggressive treatment and workup have acute septic

shock at admission. As tempting as it may be to delay surgery, such patients warrant the highest level of surgical priority. Surgery should be postponed only briefly for the time required to establish appropriate intravenous access, to begin intravascular volume resuscitation, and to place specific invasive monitors.<sup>12</sup> Often the patient will need vigorous volume resuscitation and correction of any hemoglobin or clotting deficiencies in the initial phases of wound and sepsis management. Selection of monitors usually is related to the degree of tissue involvement, perfusion indications, and comorbid conditions. Above all, perfusion to end organs must be optimized as soon as possible to minimize multisystem organ dysfunction.<sup>13</sup>

Laboratory testing should include standard specimens for complete blood cell count, electrolyte levels, coagulation status, and type and crossmatch. Many providers include arterial blood gases to assess acid-base status and pulmonary function. Serum albumin and total protein testing should be included to determine underlying nutritional status. Serum lactate levels can be helpful to assess tissue perfusion. Additional laboratory studies to ascertain end-organ involvement and comorbid conditions include liver function tests and creatinine clearance.<sup>14</sup>

**Table. Anesthetic considerations in the management of necrotizing fasciitis**

Several general anesthetic rules of thumb should be considered in cases of necrotizing acute soft tissue injury (NASTI). These include the following:

1. Do not cancel the case; cases should be postponed occasionally only to resuscitate, obtain intravenous (IV) or central access, or obtain blood or blood products.
2. Achieve IV access promptly using a large bore IV catheter.
3. Hydrate aggressively and monitor volume status and adequacy of end-organ perfusion.
4. Monitor for physiologic instability, which is common after surgery.
5. Administer blood products as soon as indicated, rather than using watchful waiting.
6. Be prepared for repeated surgical exploration within 24 to 48 hours.
7. Consider postoperative intubation and critical care unit management.
8. Be alert that massive fluid requirements, coupled with septic pathophysiologic effects, can lead to progressive airway edema.
9. Prepare for a tracheostomy for severe cases of NASTI.
10. Be prepared for repeated debridement, because 1 procedure is rarely sufficient. Five to 10 repeated debridement procedures, typically performed every other day, are not unusual.
11. Be prepared to transfer a patient for hyperbaric oxygen therapy, given as frequently as twice daily (a probable cotherapy) if a hyperbaric chamber is not present at the initial treatment facility.
12. Obtain pain management consultation.
13. Consider the effects of the disease and its treatment on body image and obtain appropriate psychosocial consultation.
14. Make sure that blood products are available and have not reached their expiration dates.

NASTI case management often involves fluid resuscitation in the form of crystalloid, colloid, and blood product administration. Early restoration of adequate end-organ tissue perfusion will greatly improve the overall outcome for the patient.<sup>13</sup> Typically, the degree of successful tissue debridement can be gauged by the location of viable tissue and removal of NASTI-compromised tissue beds. One measure of external tissue viability visible to the surgeon is the presence of bleeding vascular beds. Large amounts of blood loss and significant fluid shifts can be experienced during the early stages of surgical debridement.

Ideally, intravenous access and invasive monitoring should be matched to the degree of tissue involvement and the anticipated level of surgical debridement. In addition, access and monitors should be adjusted to the patient's comorbid conditions and level of septicemia. An arterial line and a pulmonary artery catheter, or at least a central venous catheter, are reasonable choices for most significant cases of NASTI.<sup>13</sup>

### **Positioning and operating room transport**

Typical sites of NASTI involvement include the perineum, genitalia, sacrum, buttocks, and groin.<sup>8</sup> Consequently, positions of choice to facilitate surgical access include lithotomy, lateral, and prone. Occasionally a case may require movement of the patient through more than one position. Unfortunately, obesity tends to be a relatively prevalent comorbid condition with NASTI.<sup>4</sup> As a result, the operative team needs to make sure that adequate help is available to assist in positioning and movement of the patient during the perioperative period.

Patients with minimal reserve or significant soft tissue involvement may receive care in intensive care units. Often such patients are intubated and ventilated and are given a variety of vasoactive pharmacologic agents. And, when pulmonary function is extremely compromised, a portable ventilator may be needed to transport the patient to the operative theater safely. Patients with little physiological reserve must be assessed carefully before transport to the operating room.

### **Intraoperative considerations**

Typically, wide and repeated surgical debridement is the cornerstone of NASTI therapy.<sup>1</sup> For significant tissue involvement, surgery is performed every other day for up to several weeks. Additional surgical procedures must be considered in the management of these cases; a diverting colostomy and urinary diversion are particularly useful to minimize wound contamination in a perianal-perirectal-perineal site of infection.

A surgical airway, in the form of a tracheotomy, may be indicated for severe protracted cases of NASTI or in cases accompanied by underlying pulmonary system failure or other manifestations of sepsis. Anesthesia support may be used for the placement of central lines, Hickman catheters, dialysis catheters, and gastrostomy feeding tubes for patients requiring dialysis or nutritional support or for whom long-term nothing-by-mouth status is anticipated.

NASTI cases usually are considered to be infected. Consequently, isolation and infection control guidelines are of utmost importance.

The type of anesthesia used often depends on the degree of sepsis present and the body area involved. Early stages of coagulopathy tend to make regional anesthesia more problematic. And positioning requirements, such as lateral, lithotomy, and prone make anything other than general anesthesia more of an anesthetic challenge.

Selection of induction agents depends on the degree of sepsis and the adequacy of the patient's intravascular status. As noted, comorbid conditions often found in this patient population make delayed gastric motility a significant possibility. Careful attention must be given to reducing the risk of aspiration. In addition, it is critical that any attempt to secure the airway be preceded by thorough preoxygenation. This need becomes readily apparent when confronted with an obese patient with diminished functional residual lung capacity and increased oxygen consumption due to early signs of sepsis.

### **Postoperative issues**

Overall goals during the postoperative period are directed at obtaining adequate end-organ perfusion pressures. During the early stages of wound and systemic infection management, it may be advisable to continue tracheal intubation following initial surgical debridement to provide optimal ventilation, stabilization of the patient's condition, and safety. Other considerations include the provision of an intensive care monitored bed, critical care management, and nutritional management consultation, if necessary. The literature supports the implementation of hyperbaric oxygen therapy to promote increased wound healing.<sup>11</sup> Thus, the anesthetist should anticipate that the patient with NASTI may be transferred if the institution does not offer hyperbaric oxygen therapy. Transfer may influence the decision about whether the patient should remain intubated or be extubated postoperatively.

Anesthesia department pain management services should be mobilized, and scheduling of additional

operative debridement procedures at 24- to 48-hour intervals should be anticipated. Referral to physical therapy, occupational therapy, and social work services should be made. Psychological counseling to help minimize the significant lifestyle and body image alterations that often accompany this disease process is of utmost importance.

Anesthetic considerations for the patient with NASTI can be viewed largely in terms of the ABCs: airway, breathing, and circulation. For airway and breathing, adequate oxygenation and anticipation of airway edema are prime considerations. Consequently, a tracheostomy may be a prudent consideration for patients who are likely to require extensive debridement procedures over a long period. Mechanical ventilation and critical care unit management may be necessary for patients who have comorbid conditions or extensive disease. Some patients may require a ventilator during transport to the operating room or continued postoperative endotracheal intubation and ventilation, particularly patients who are likely to have ongoing extensive surgical procedures within a relatively short time. Circulatory considerations include administration of adequate levels of volume support, including blood and blood products, that are assessed via appropriate laboratory testing. Utilization of vasopressors may be helpful to combat septic shock and optimize overall organ perfusion.

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