

CERVICAL NECROTIZING FASCIITIS: AN UNCOMMON SEQUELA TO DENTAL INFECTION

RICHARD M. MOSS, MD

SUMET KUNPITTAYA, MD

ACHAREE SORASUCHART, MD

CHIANG MAI, THAILAND

Necrotizing fasciitis is a soft-tissue infection, usually polymicrobial, that causes necrosis of fascia and subcutaneous tissue while sparing skin and muscle. Although it more commonly involves the groin, abdomen, and extremities, it may also occur in the head and neck, usually secondary to dental infection. We report a case of cervical necrotizing fasciitis arising from a dental infection and review the cause, pathophysiology, diagnosis, and treatment of this potentially lethal entity. Early detection and intervention is emphasized. Extensive surgical debridement remains the mainstay of treatment. In addition, a clarification of the various eponyms it has gone under in the past is offered.

KEY WORDS — deep neck infection, dental infection, necrotizing fasciitis.

Necrotizing fasciitis (NF) has been reported extensively in the general surgery literature.¹⁻³ In recent years, it has also received attention in the otolaryngology literature as more cases of NF occurring in the head and neck region are documented.⁴⁻⁶ It is defined as a soft-tissue infection that causes necrosis of fascia and subcutaneous tissue while sparing skin and muscle. It has a propensity for rapid and diffuse spread, may invade vascular structures, and usually arises from a polymicrobial anaerobic or mixed aerobic-anaerobic infection. It is most commonly seen in adults, involving the groin, abdomen, and extremities, although no region of the body is exempt. It is, in these cases, usually secondary to bowel injury, trauma, or inadequate care of mundane infections such as perirectal abscesses or cutaneous ulcers. It is often seen in conjunction with a perforated viscus in postpartum patients after a traumatic delivery or in intravenous drug abusers. The highest incidence of infection occurs in patients with impaired immune systems and those with small-vessel disease, such as diabetes mellitus. Mortality rates have been reported as high as 52% and 73% in the general surgery literature.^{1,2}

Necrotizing fasciitis occurs rarely in the head and neck in comparison with other regions of the body. It most commonly arises secondary to dental infections such as dental caries, gingivitis, or pulpitis, although it has been reported to occur following peritonsillar abscess as well.⁶ Any infections, however, that may precipitate a deep neck infection can potentially lead to NF. These include tonsillar infections, salivary gland infections, cervical adenitis, and otologic, dermatologic, and traumatic sources. Because of the rapid and fulminant course of NF, prompt recognition is essential. The mainstays of treatment are broad-spectrum intravenous antibiotic therapy, radical surgical debridement, nutritional support, and early detection and treatment of complications.

CASE REPORT

A 30-year-old Thai man presented to the outpatient otolaryngology department with dysphagia, odynophagia, marked swelling of the left submandibular area and upper neck without fluctuance, trismus, bulging of the left lateral neck, and malaise. Two days prior to presentation, he had extractions of the lower left first and second molars by a local dentist. On admission his blood pressure was 130/90, pulse 100, temperature 38°C, hemoglobin 16, hematocrit 48, and white blood cell count 14,500 with a shift to the left. Electrolytes, urine analysis results, and findings on chest radiography were within normal limits. Blood cultures were performed, and he was subsequently prescribed 2 million units of intravenous penicillin every 4 hours.

By the second day, the patient's temperature had risen to 40°C. The swelling of the left submandibular and upper neck area had increased to involve the entire left side of his neck. An incision and drainage procedure of the left submandibular region was performed with general anesthesia. Twenty milliliters of purulent material was evacuated from the submandibular space. None was found in the parapharyngeal space. Large Penrose drains were placed in the incision. Intravenous cloxacillin, 1 g every 6 hours, was added to the antibiotic regimen.

The next day, there was no resolution of the fever, and an increased swelling of the entire neck, including the right side, was observed. It was also noted that the swelling had spread below the right clavicle to involve the anterior chest wall down to the nipple. Crepitus was found on palpation. A computed tomographic scan of the neck and chest revealed subcutaneous gas formation in the neck and right anterior chest wall. The patient was taken to the operating room for a more extensive incision and drainage procedure. Multiple parallel incisions were made in the neck and right side of the chest.

From the Department of Otolaryngology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand.

Abundant, foul-smelling purulent material was evacuated from the neck and right anterior chest wall. In addition, the fascia overlying the muscles of the neck and chest (including the strap, sternocleidomastoid, deltoid, and pectoralis major muscles) was found to be necrotic, although the underlying muscle and overlying subcutaneous tissue and skin were uninvolved. The involved fascia was extensively debrided. A diagnosis of NF was made.

Specimens taken previously (blood, and pus from submandibular space) grew β -hemolytic group A *Streptococcus* and α -hemolytic *Streptococcus* sensitive to penicillin and chloramphenicol. *Bacteroides melaninogenicus* was also found, but no sensitivity was recorded. The cloxacillin was discontinued, and intravenous chloramphenicol 1 g every 6 hours and gentamicin 80 mg every 8 hours were added.

By the fourth postoperative day (admission day 8) the patient's fever had resolved. The chloramphenicol was discontinued. On the 10th postoperative day (admission day 14), despite overall clinical improvement, the patient was returned to the operating room for further debridement of necrotic skin seen at the edges of the incisions made previously. After this procedure, the gentamicin was discontinued, and the patient continued to receive intravenous penicillin. On day 23 of the patient's admission, an attempt was made to close the operative wound with skin grafting to avoid scar contracture. After the operation, the patient developed multiple wound infections that were successfully controlled by local wound care. The wounds subsequently healed by secondary intention without further event. The patient was discharged on admission day 32 to be followed in the outpatient department. He was prescribed oral penicillin for 2 weeks after discharge.

DISCUSSION

Necrotizing fasciitis is a clinical entity that has received various eponyms in the past.¹ This has led to some confusion over the cause and nature of the disease. It was initially described as "hospital gangrene" during the Civil War.^{10,11} Meleney¹² in 1924 referred to "streptococcal gangrene" and described a synergistic interaction between *Streptococcus* and an aerobic *Staphylococcus*. Meleney felt that an arthus-type reaction was responsible for the changes seen in NF. This was based on the observed focal necrosis induced in rabbits upon subcutaneous injection of viable *Streptococcus*. McCafferty and Lyons¹³ postulated that collagen necrosis was secondary to the proteolytic effect of streptokinase and staphylokinase. Schwab and Cromartie¹⁴ and Cromartie et al¹⁵ showed that the toxic effect of *Streptococcus* is related to the cell wall. After injecting cell wall extracts from group A *Streptococcus* into rabbits, inflammation, necrosis, and separation of dermal collagen was demonstrated. Schwab^{16,17}

later showed that the streptococcal toxicity resides specifically in the mucopeptide fraction of the cell wall, which was found to bind easily with connective tissue in vitro. The reaction was enhanced by streptococcal hyaluronidase.

Other terms used to describe the clinical entity of NF include "Meleney's synergistic gangrene," "bacterial synergistic gangrene," and "synergistic necrotizing fasciitis." Clostridial gangrene is a necrotizing cellulitis produced specifically by the clostridial organism but often accompanied by other organisms.⁵ Although NF was originally felt to be caused primarily by aerobic agents such as β -hemolytic *Streptococcus* and *Staphylococcus aureus*, with the advent of more sophisticated anaerobic culture techniques, recent studies have shown that anaerobic bacteria play a significant role.^{1,2,6,8} Most reported cases of NF suggest polymicrobial mixed aerobic-anaerobic infection. The more common anaerobic organisms seen in NF of the head and neck include *Peptostreptococcus*, *B. melaninogenicus*, *Fusobacterium*, and *Clostridium*, all reflecting oral flora. Many strains of *Bacteroides* are found to be penicillin-resistant secondary to the elaboration of β -lactamase.

Gas-producing wound infections are generally produced by bacteria of the *Clostridium* group. However, nonclostridial infections have been reported to produce gas in the neck.¹⁸ They are usually associated with less tissue necrosis than clostridial infections. The division of the clinical entity of NF into the various categories or eponyms ascribed to it in the past does not appear to be useful clinically, nor does it influence treatment. It may in fact impede or delay appropriate management. All presentations with fever and necrotizing soft-tissue infections, regardless of classification, are surgical emergencies requiring radical surgical intervention. The more general term "NF" aptly describes this disease entity and permits comparisons with results of treatment in other regions of the body.

In the initial presentation of NF, physical findings may be indistinguishable from the original infection or wound that caused it. It may occur in any part of the body, most commonly the leg, although not infrequently it will occur in the arms, genitalia, and trunk. In the head and neck, the eyelids appear to be the most common area of involvement.⁶ Necrotizing fasciitis is characterized by the presence of fascial necrosis with widespread undermining of the skin and clinical manifestations of severe infection. The skin may be spared at first, but with the continued progression of the infection, thrombosis of the subcutaneous blood supply can occur, with eventual cutaneous necrosis. This is in contrast with Ludwig's angina, a more superficial infection characterized by a rapidly spreading cellulitis that may be gangrenous, involving primarily the subcutaneous tissue and soft tissue of the submental, sublingual

gual, and submandibular spaces. Like NF, Ludwig's angina is most commonly secondary to dental infections and is often associated with chronic systemic diseases. It can also conceivably precipitate NF. It is uncommon in NF to see muscle necrosis, possibly because of the better blood supply of striated muscle. In addition, the origin of the blood supply to skeletal muscle is usually proximal to the site of infection.

The infection can spread rapidly, with involvement of an entire extremity occurring in 24 hours. If unchecked, dusky devascularized bullae may be seen on the skin, filled with dark brown fluid. Necrosis of the skin and subcutaneous tissue will follow these changes. Severe systemic effects may also be seen, including prostration, tachycardia, and fever. Marked leukocytosis will be noted. In the patient with NF of the head and neck, initial findings will relate to the portal of entry of infection, usually dental in origin. There may be crepitus in the soft tissue, although the absence of this does not rule out gas formation. Gas formation can occur in areas inaccessible to accurate palpation. Soft-tissue radiography or computed tomography (CT) scan can be useful in detecting this. Fisher et al¹⁰ detected soft-tissue gas formation with CT in 19 of 28 patients with NF below the clavicle. Detection of this may aid in early diagnosis. Identification of specific areas in which infection has spread can be accomplished more readily preoperatively, allowing for complete and thorough drainage during the operation. If the infection has spread within the carotid sheath or into the mediastinum, earlier detection is possible. The presence of vascular thrombosis, erosion of vessels, or mediastinitis can be detected prior to operation. In our case, CT detection of gas formation in the subcutaneous tissues of the anterior chest wall allowed for a more precise assessment of areas requiring drainage.

Previously described complications for deep neck infection may also arise in NF, including airway obstruction, arterial erosion, jugular vein thrombophlebitis, mediastinitis, aspiration pneumonia, septic shock, and lung abscess.^{7-9,11} A case of carotid artery thrombosis leading to acute hemiplegia in an infant has been reported.¹⁰

In the general surgery literature, Rouse et al² reported a mortality rate of 73% (20/27). Death was due to persistent wound sepsis, systemic septic complications despite local infection control, and myocardial infarction. The high incidence of chronic debilitating disease in patients with NF places these patients at risk for developing nosocomial infections and consequent multiple-organ system failure. In patients succumbing to systemic septic conditions, death was usually preceded by renal failure. Autopsies revealed multiple abscesses in the renal parenchyma. Emphasis on early surgical intervention was placed in light of the fact that 11 of 12 patients died

when a delay in treatment of more than 12 hours after diagnosis occurred.²

Freischlag et al⁴ reported a mortality rate of 52% (11/21). Again, time elapsed before the operation proved to be a factor. When it was delayed more than 24 hours after diagnosis, an overall mortality of 70% was noted. If the operation was undertaken in less than 24 hours, a 36% mortality rate was seen.⁴ In a small group of patients with NF arising in the head and neck, a mortality rate of 27.5% was documented.⁶

The presence of underlying systemic disease appears to be a factor in the genesis and survival rates of NF. The presence of diabetes mellitus or arteriosclerosis was associated with a mortality rate above 80%.² Chronic renal failure, obesity, immunosuppression, and malnutrition were all found to influence survival rates adversely.¹¹⁻¹³

TREATMENT

Effective treatment of NF is based on early recognition and surgical intervention. If a portal of entry can be identified (usually dental for infections involving the head and neck), prompt management of this focus of infection should be accomplished. A complete bacteriologic evaluation is required, including Gram's stain and aerobic and anaerobic cultures of purulent material. Appropriate transport of culture specimens and the use of proper culture media for aerobic and anaerobic culture is essential. Special efforts should be made to ensure anaerobic technique. Intravenous antibiotics effective against the common infecting organisms should be instituted. High doses of penicillin and clindamycin or chloramphenicol for penicillin-resistant *Bacteroides* are good first choices pending results of culture and sensitivity tests. If there is any reason to consider gram-negative bacterial infection, instituting a triple antibiotic regimen with the addition of an aminoglycoside is indicated.

Early radical debridement and drainage of all involved tissue remains the most important aspect of treatment. Multiple incisions are often required. In our case, serial parallel incisions were made in the neck, extending to the anterior chest wall. Subcutaneous tissue is usually edematous and may ooze a serosanguineous material upon incision. Fascial necrosis usually extends further than cutaneous involvement. Repeated debridements may be necessary. Excision to the point of bleeding tissue is a useful guide for debridement. Management of electrolyte abnormalities, in particular hypocalcemia, and control of underlying systemic illnesses are crucial. Hypocalcemia has been noted secondary to loss of calcium through saponification by necrotic fat. Attention should be paid to the overall nutritional status of the patient. Skin grafting or primary closure of open wounds may be needed after the condition resolves to avoid scar contractures.

SUMMARY

Necrotizing fasciitis is a potentially serious complication of routine infections in the head and neck. It usually arises from a dental focus of infection, although other infected areas of the head and neck can lead to NF; particularly in patients with chronic systemic debilitating illnesses such as diabetes mellitus. For those patients suspected of having NF, a CT scan is an important adjunct to clinical impression and will aid in assessing the full extent of the infection. It will also assist in the earlier detec-

tion of complications such as involvement of the carotid sheath or mediastinitis. Appropriate cultures and Gram's stains should be performed. As NF is polymicrobial in nature, with mixed aerobic and anaerobic organisms present, initial intravenous antibiotics should be broad-spectrum and include high doses of penicillin and clindamycin or chloramphenicol for penicillin-resistant organisms. The mainstay of treatment is early radical debridement and drainage of all infected tissue. Only with prompt surgical intervention can complications and mortality be reduced.

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