

Necrotizing fasciitis

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Necrotizing fasciitis (NF) is a rare but potentially fatal infection involving the subcutaneous tissue and fascia. It is commonly known as *flesh-eating disease*. Deaths from NF can be sudden and sensational and often make headline news. Necrotizing fasciitis is prevalent enough that most primary care physicians will be involved with managing at least 1 case during their time in practice, but infrequent enough for most to be unfamiliar with the disease.

At onset, NF can be difficult to differentiate from cellulitis and other superficial infections of the skin. In fact, studies have shown that only 15% to 34% of patients with NF have an accurate admitting diagnosis.^{1,2} Only early diagnosis and aggressive surgical treatment can reduce mortality and morbidity.³ Family physicians are often the first point of contact for these patients, and a high index of suspicion is needed, as there is a paucity of initial signs. This article aims to review NF, especially with regard to early diagnostic clues. We also describe a case that illustrates the difficulty of diagnosing the disease in its early stages. We chose a case of subacute NF to illustrate how its signs can be subtle—we feel that family physicians should be aware of this entity.

Case description

A 62-year-old woman of Chinese descent was admitted to hospital with a 3-day history of fever, shortness of breath, and biochemical evidence of septicemia (raised total white blood cell count and C-reactive protein levels). No obvious source of sepsis could be identified at the time of admission, except for complaints of left lower leg pain. There was no evidence of inflammation of the leg at that time.

She had a history of left knee osteoarthritis, for which she had been undergoing a course of acupuncture for the past 6 weeks. Otherwise, her medical history was unremarkable.

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Abstract

OBJECTIVE To describe the defining characteristics and treatment of necrotizing fasciitis (NF), emphasizing early diagnostic indications.

QUALITY OF EVIDENCE PubMed was searched using the terms *necrotizing fasciitis* and *necrotizing soft tissue infections*, paired with *early diagnosis*. Results were limited to human studies in English. Additional articles were obtained from references within articles. Evidence is levels II and III.

MAIN MESSAGE Necrotizing fasciitis is classified according to its microbiology (polymicrobial or monomicrobial), anatomy, and depth of infection. Polymicrobial NF mostly occurs in immunocompromised individuals. Monomicrobial NF is less common and affects healthy individuals who often have a history of trauma (usually minor). Patients with NF can present with symptoms of sepsis, systemic toxicity, or evidence of skin inflammation, with pain that is disproportional to the degree of inflammation. However, these are also present in less serious conditions. Hyperacute cases present with sepsis and quickly progress to multiorgan failure, while subacute cases remain indolent, with festering soft-tissue infection. Because the condition is rare with minimal specific signs, it is often misdiagnosed. If NF is suspected, histology of tissue specimens is necessary. Laboratory and radiologic tests can be useful in deciding which patients require surgical consultation. Once NF is diagnosed, next steps include early wound debridement, excision of nonviable tissue, and wide spectrum cover with intravenous antibiotics.

CONCLUSION Necrotizing fasciitis is an uncommon disease that results in gross morbidity and mortality if not treated in its early stages. At onset, however, it is difficult to differentiate from other superficial skin conditions such as cellulitis. Family physicians must have a high level of suspicion and low threshold for surgical referral when confronted with cases of pain, fever, and erythema.

Résumé

OBJECTIF Décrire les caractéristiques et le traitement de la fasciite nécrosante (FN), en insistant sur l'importance du diagnostic précoce.

QUALITÉ DES PREUVES On a consulté PubMed à l'aide des rubriques *necrotizing fasciitis* et *necrotizing soft tissue infections*, en combinaison avec *early diagnosis*. Les résultats se limitaient aux études humaines de langue anglaise. D'autres articles provenaient de la bibliographie des articles retenus. Les preuves sont de niveaux II et III.

PRINCIPAL MESSAGE On classe la fasciite nécrosante selon sa microbiologie (polymicrobienne ou monomicrobienne), son anatomie et la profondeur de l'infection. La FN polymicrobienne touche surtout des sujets immunodéprimés. La FN monomicrobienne est plus rare et touche des sujets sains qui ont souvent une histoire de traumatisme (généralement mineur). La FN peut se manifester par des symptômes de septicité, de toxicité systémique ou des signes d'inflammation de la peau, avec une douleur disproportionnée par rapport au degré d'inflammation. Ces signes se rencontrent aussi dans les affections moins graves. Les cas hyper-aigus sont d'emblée en septicité et évoluent rapidement vers une insuffisance touchant plusieurs organes, alors que les cas subaigus demeurent indolores, avec une suppuration des tissus mous. Puisqu'il s'agit d'une affection rare ayant peu de signes spécifiques, le diagnostic est souvent erroné. Si on soupçonne une FN, il faut faire l'histologie d'un échantillon de tissu. Des examens de laboratoire et de radiologie peuvent aider à décider si un patient requiert une consultation en chirurgie. Une fois le diagnostic de FN établi, les étapes suivantes comprennent le débridement précoce de la plaie, l'excision du tissu non viable et un traitement avec un antibiotique à large spectre par voie intraveineuse.

CONCLUSION La fasciite nécrosante est une maladie rare qui entraîne des taux élevés de morbidité et de mortalité si elle n'est pas traitée précocement. Au début, toutefois, elle est difficile à distinguer des autres affections cutanées superficielles comme les cellulites. Le médecin de famille devrait avoir un haut niveau de suspicion et recourir rapidement à une consultation en chirurgie devant un cas de douleur, de fièvre et d'érythème.

Table 1 presents some of the investigations performed at time of admission. Blood cultures grew group A β -hemolytic streptococci (*Streptococcus pyogenes*) susceptible to penicillin, ampicillin, and clindamycin. The patient was treated with intravenous clindamycin and crystalline penicillin. She developed an area of erythema over her left shin, which progressed over the next few days and started to blister. She complained of leg pain, which was relieved with acetaminophen. Initially attributed to the underlying osteoarthritis of her left knee, the pain progressed to involve her shin. By the fourth day of admission she had become apprehensive when examined and fearful of moving her leg.

Table 1. Laboratory results of a woman presenting with a 3-day history of fever, shortness of breath, and left lower leg pain: Later histologic tests were consistent with necrotizing fasciitis.

INVESTIGATION	RESULTS	NORMAL VALUES
Hemoglobin	12.4 g/dL	12.0–16.0 g/dL
Total white blood cell count	10.2 × 10 ⁹ /L	4.0–10.0 × 10 ⁹ /L
Platelets	200 × 10 ⁹ /L	140–400 × 10 ⁹ /L
C-reactive protein	333 mg/L	0.2–8.8 mg/L
Sodium	131 mmol/L	130–145 mmol/L
Potassium	3.2 mmol/L	3.5–4.9 mmol/L
Urea	6.2 mmol/L	2.2–7.7 mmol/L
Creatinine	102 μ mol/L	40–85 μ mol/L
Glucose	11.2 mmol/L	3.9–11.0 mmol/L
Blood cultures	Positive for group A streptococcus	NA
Urine cultures	No bacterial growth	NA

NA—not applicable.

An orthopedic consultation was obtained and an initial diagnosis of cellulitis was made. However, her fever did not subside, despite the administration of appropriate intravenous antibiotics. Her erythema and bullae worsened; on day 8 of admission, a decision for surgical exploration was made to exclude NF. Intraoperative visual inspection did not reveal any obvious necrotic tissue. A sample of tissue was sent for histologic assessment. She continued to be febrile.

Histology results were reported as consistent with NF. On day 11 of admission, she underwent further surgical exploration, which this time suggested macroscopic evidence of early NF. An extensive wound debridement was performed, and her temperature and laboratory parameters subsequently normalized. She was discharged soon after with minimal morbidity.

Necrotizing fasciitis

Necrotizing skin infections were first described by Jones in 1871, although at the time the term *hospital gangrene* was used.⁴ The term *necrotizing fasciitis* was coined by Wilson in the 1950s to describe necrosis of the fascia and subcutaneous tissue with relative sparing of the underlying muscle.⁵ Necrotizing fasciitis is characterized by rapid destruction of tissue, systemic toxicity, and, if not treated aggressively, gross morbidity and mortality. Early diagnosis and aggressive surgical treatment reduces risk; however, it is often difficult to diagnose NF, and sometimes patients are treated for simple cellulitis until they rapidly deteriorate.⁶ Antibiotic therapy is mandatory, and early surgical exploration and debridement is critical to ensuring a good outcome.

Quality of evidence

A PubMed search was conducted using the key words *necrotizing fasciitis* and *necrotizing soft tissue infections*, both also paired with *early diagnosis*. We limited our search to articles in English and human studies. Additional articles were identified from key references within articles. Google Scholar was used to search for historic texts by Wilson and Jones.^{4,5}

Necrotizing fasciitis is uncommon and no randomized controlled trials or meta-analyses were available. As such, the evidence presented here is level II and III.

Main message

Classification. Different terms and classifications have been used to describe necrotizing infections of the skin and subcutaneous tissue. These include *necrotizing fasciitis*, *synergistic necrotizing cellulitis*, *streptococcal myonecrosis*, and *gas gangrene*. This variety of classifications and terminology has been based on affected anatomy, microbial cause, and depth of infection. Awareness of this helps to reduce confusion.

Terms like *necrotizing fasciitis*, *myonecrosis*, and *necrotizing adipositis* refer to classification by depth of infection. *Type 1* and *type 2* infections refer to classification based on microbial cause. Historically, necrotizing infections were classified according to anatomical sites. *Fournier gangrene* (involving the perineum) and *Ludwig angina* (involving submandibular and sublingual spaces) are examples. These infections were named after the physicians who first described them.^{7,8}

Although these descriptive terms are useful, they cause much confusion. One recently proposed recommendation suggested that the term *necrotizing soft tissue infections* should be used to describe them all, as treatment is the same: early surgery and broad spectrum antibiotics.⁹ For the purposes of this article, however, the more familiar term *necrotizing fasciitis* will be used.

Microbiology. Microbiologically, NF has been classified as either type 1 (polymicrobial) or type 2 (monomicrobial).¹⁰

Polymicrobial infections are more common, with cultures yielding a mixture of aerobic and anaerobic organisms.¹¹ These infections typically occur in the perineum and trunk. The isolates reflect normal skin commensalism found adjacent to the site of infection. For example, in NF of the perineum, anaerobic bacteria are isolated. The etiologic isolates consist of Gram-positive organisms, such as *Staphylococcus aureus*, *S pyogenes*, and enterococci; Gram-negative aerobes, such as *Escherichia coli* and *Pseudomonas* species; and anaerobic organisms, such as *Bacteroides* or *Clostridium* species.^{12,13} Type 1 NF occurs in immunocompromised individuals, such as patients with diabetes mellitus or chronic renal failure.

Monomicrobial infections are less common than the polymicrobial variety. These typically occur in the limbs and afflict healthy patients with no implicative comorbidities. There is often a history of trauma, frequently trivial. As *S pyogenes* and *S aureus* are the usual pathogens, type 2 NF might be associated with toxic shock syndrome.⁹ Community-acquired methicillin-resistant *S aureus* (MRSA) has increasingly been described in NF. A recent retrospective review of cases from 2000 to 2006 in Los Angeles, Calif, showed MRSA isolated in one-third of cases.¹³

Pathology. Most cases commence with trauma to the skin surface (eg, from a penetrative injury or even acupuncture needles, as was the case with our patient), with seeding of bacteria. Infection starts in the deep tissue planes, and the epidermis might not be initially affected. The clinical disease is expressed when infective organisms spread through the tissue along the deep fascia. Bacteria rapidly multiply within viable tissue, although fibrous attachments between subcutaneous tissues and fasciae limit spread to areas like the hands, feet, and scalp. Lack of fibrous attachments in the trunk and limbs, however, can lead to widespread infection and tissue destruction. Infection also spreads to venous and lymphatic channels, leading to edema. The spread of bacteria results in thrombosis of blood vessels in dermal papilla, resulting in ischemia and gangrene of subcutaneous fat and dermis.¹⁴ If the fascia is breached, infection of the muscle leading to myositis occurs. Gas-producing organisms such as *Clostridium* species can give rise to subcutaneous gas, from which stems the descriptive term *gas gangrene*.

In addition, infections with toxin-producing bacteria (*S aureus* and *S pyogenes*) can lead to a toxic shock-like syndrome. Therefore, seemingly limited infection can result in septic shock and multiorgan failure.

Risk factors. Often, patients presenting with NF have some predisposition to infection. Immunocompromise, advanced age, peripheral vascular disease, and obesity are some predisposing factors. **Box 1** lists known risk factors. In a Singapore study, 70.3% of patients with NF had diabetes mellitus.¹ Most patients have a history of

trauma, or there might be a history of surgery or penetrating injury. However, the injury can be quite trivial; eg, insect bites or scratches. As in the case we described, NF has even been reported after acupuncture.¹⁵ This type of specific history (further examples of which are summarized in **Table 2**) is often only obtained if the physician directly questions the patient; otherwise, patients are likely to neglect or forget to mention it.

Nonsteroidal anti-inflammatory drug use has been implicated in severe necrotizing streptococcal infections. It is postulated that nonsteroidal anti-inflammatory drugs impair lymphocyte function.¹⁶ However, it could also be that suppression of symptoms and signs of inflammation leads to later diagnosis, especially in patients presenting early with nonspecific symptoms.¹⁷

Risk factors for NF in the pediatric population include malnutrition and skin infections such as varicella.^{18,19}

It is important to emphasize that physicians should not rule out NF in normal healthy patients with minor dermatologic trauma. These are the cases that get missed, and which are often sensationalized.

Clinical features. Patients with NF can present with constitutional symptoms of sepsis (eg, fever, tachycardia, altered mental state, diabetic ketoacidosis) alone or with evidence of skin inflammation, which makes diagnosis a little more straightforward.

Limbs are among the most common sites of infection. According to a retrospective review of patients treated for NF in 3 tertiary hospitals in Canada, common sites of infection included the lower extremities (28%), upper extremities (27%), perineum (21%), trunk (18%), and the

Box 1. Risk factors for necrotizing fasciitis

- Diabetes
- Chronic disease
- Immunosuppressive drugs (eg, prednisolone)
- Malnutrition
- Age > 60 years
- Intravenous drug misuse
- Peripheral vascular disease
- Renal failure
- Underlying malignancy
- Obesity

Table 2. Precipitating events causing necrotizing fasciitis

TRAUMATIC	NONTRAUMATIC
Surgery	Soft tissue infection
Minor invasive procedures (eg, joint aspirations, acupuncture)	Burns
Intravenous drug use	Childbirth
Penetrating injuries (eg, insect and animal bites)	

head and neck (5%).²⁰ As NF first starts in the deep tissue planes, at initial presentation there might be minimal epidermal involvement. This can make it difficult to differentiate from non-necrotizing skin infections and cellulitis.

Patients with NF are usually systemically toxic, initially presenting with fever (temperature greater than 38°C), tachycardia, diaphoresis, and possibly even an altered mental state or diabetic ketoacidosis. The physical examination should include all parts of the body to search for skin inflammation. This is especially necessary for patients who present with sepsis of which the source is not obvious. The perineum and oral cavity are areas that can be easily missed.²¹

Most patients present with signs of skin inflammation (ie, pain, skin edema, and erythema). However, as these are also present in less serious conditions such as erysipelas and cellulitis, the degree of pain relative to the skin condition might provide the physician with clues—NF typically presents with pain out of proportion to the degree of skin inflammation.

Erysipelas, being an infection of the superficial dermis, has well-defined borders and might blister profoundly. With cellulitis, one can expect erythema with lymphangitis and minimal blistering.

Necrotizing fasciitis typically presents with patchy discoloration of the skin with pain and swelling, but without a defined margin or lymphangitis.^{14,22} Progression of NF is marked with the development of tense edema, a grayish-brown discharge, vesicles, bullae, necrosis, and crepitus.²³ Hemorrhagic bullae and crepitus are sinister signs, with the likelihood of underlying fascia and muscle being compromised.²⁴ Crepitus is a later sign, however, and is found in only about 18% of cases of NF.¹²

Although crepitus and blistering are the most specific signs of necrotizing soft tissue infection, they are not sensitive. Two retrospective case series, by Wang et al⁶ and Elliot et al,²⁵ reported an absence of crepitus in 62% to 63% of cases and an absence of blistering in 76% to 95% of cases upon initial presentation. As mentioned earlier, lymphangitis and lymphadenopathy are absent in necrotizing infections, but they remain features of cellulitis.^{14,22}

Localized pain is another clue to NF. As the disease is a deep-seated infection, the epidermis is minimally involved at initial presentation. The patient might complain of pain out of proportion to the degree of dermal involvement or pain that extends past the apparent margin of infection.²³ The pain patients experience with cellulitis can be assuaged with acetaminophen with codeine or a similar analgesic, along with careful positioning of the affected area. The pain experienced with NF, on the other hand, is often severe, and patients can be exceedingly apprehensive and fearful when examined. However, certain patients, notably those with diabetic neuropathy with loss of sensation, can experience minimal pain, resulting in a missed diagnosis. This is especially likely in concealed sites of infection, such as the perineum or oral cavity. **Table 3**^{14,22-26} lists clinical features indicative of NF.

A patch of anesthesia over the site of erythema is also sometimes described in NF. This is thought to be due to infarction of cutaneous nerves in necrotic subcutaneous fascia and soft tissue.²⁶

Table 3. Clinical features suggestive of necrotizing soft tissue infections

SKIN	PAIN	GENERAL
Erythema with ill-defined margins	Pain that extends past margin of apparent infection	Fever with toxic appearance
Tense edema with grayish or brown discharge	Severe pain that appears disproportionate to physical findings	Altered mental state
Lack of lymphangitis or lymphadenopathy	Decreased pain or anesthesia at apparent site of infection	Tachycardia
Vesicles or bullae, hemorrhagic bullae		Tachypnea due to acidosis
Necrosis		Presentation with DKA or HHNK
Crepitus		

DKA—diabetic ketoacidosis, HHNK—hyperosmolar hyperglycemic non-ketotic acidosis.

Data from Seal,¹⁴ Green et al,²² Headley,²³ Hsiao et al,²⁴ Elliot et al,²⁵ and Dufel and Martino.²⁶

Disease progression. Necrotizing fasciitis can follow a hyperacute or a subacute course of progression. The patient with a hyperacute course presents with sepsis and rapidly progresses to multiorgan failure. Diagnosis of sepsis is obvious, and these patients are hospitalized.

Several authors have described a subacute variation of NF.²⁷⁻²⁹ These patients have an indolent disease course, with festering soft tissue infection. After the infection reaches a certain threshold, sudden deterioration is an important clinical feature. Aggressive surgical debridement is the cornerstone of treatment in these cases. Progression of disease is invariable in this group, and a delay in diagnosis can lead to greater soft tissue loss and mortality.²⁷⁻²⁹ In summary, Wong et al describe this entity of subacute NF as having a slow indolent course with an absence of systemic disturbance, gradual tissue necrosis with progressive cutaneous changes over the affected site, and progression of disease despite use of antimicrobial medications, followed by a sudden deterioration with rapid progression of NF or systemic features of sepsis. At the time of surgery, histologic features are consistent with NF.²⁸

Subacute NF can present a diagnostic dilemma, and the primary care physician, as the likely first point of contact, should be aware of this.

Hospitalization. Primary care physicians have to use clinical judgment to decide which patients who present with evidence of skin inflammation should be

hospitalized or receive further evaluation. As mentioned earlier, only 15% to 34% of patients with a discharge diagnosis of necrotizing skin and subcutaneous infection had an admitting diagnosis of NF.^{1,2}

Further, some patients with non-necrotizing soft tissue infections will require admission. Studies of patients with soft tissue infection showed that a history of diabetes mellitus, pyrexia, hand infections, and an area of inflammation greater than 70 cm² are independent predictors of hospitalization.³⁰

Hospitalization is indicated for patients with soft tissue infections accompanied by signs and symptoms of systemic toxicity (fever, hypothermia, tachycardia [heart rate more than 100 beats/min]), hypotension (systolic blood pressure less than 90 mm Hg or more than 20 mm Hg below baseline), an altered mental state, severe infection (including those requiring formal operative intervention), intractable nausea and vomiting, immunocompromise, failure of outpatient therapy, and poor social support. The latest Infectious Diseases Society of America skin and soft tissue infection guidelines indicate that hospitalization should be considered in patients with "hypotension and/or an elevated creatinine level, low serum bicarbonate level, elevated creatine phosphokinase level (2-3 times the upper limit of normal), marked left shift, or a C-reactive protein level more than 13 mg/L."³¹

In the early stages of NF, cutaneous manifestations are a continuum, but signs and symptoms evolve over time.⁶ Even if, at first encounter, the physician might diagnose uncomplicated cellulitis, it is prudent to advise early review if symptoms or signs progress.

Diagnosis and decision for surgical exploration. The criterion standard for diagnosis of NF is histology of tissue specimens obtained during surgical exploration, which was demonstrated in our case description. During surgical exploration, tissue integrity and depth of invasion can be assessed. Fascial necrosis and loss of fascial integrity indicate a necrotizing infection. Muscle involvement and necrosis are indicative of an advanced stage.

To help decide which patients require surgical exploration, particularly in those with equivocal clinical signs, laboratory and radiologic tests might sometimes be useful.

Leukocytosis with neutrophilia, acidosis, altered coagulation profile, impaired renal function, raised creatinine kinase levels, and raised inflammatory markers, such as C-reactive protein levels, are all helpful if viewed within the whole of the clinical context.

Clinical scores like the laboratory risk indicator for NF (LRINEC) score are available to help diagnose NF and differentiate it from other skin and soft tissue infections (Tables 3^{14,22-26} and 4^{9,32}). A score of 6 and above (intermediate or high risk) suggests NF. The patient in our case scored 7. In a study by Brogan et al,¹⁹ an intermediate to high risk of NF had a positive predictive value of 92% and a negative predictive value of 96%. However, the LRINEC

score was based on retrospective studies of patients with diagnosed or highly suspected NF. It has not been validated in patients for whom the diagnosis of NF is not apparent in the initial assessment. Further, certain tests, such as the C-reactive protein test, are not readily available in the primary care setting, where patients present with infection in the early stages and where laboratory support is limited; therefore, this score is not easily ascertained. Blood cultures are usually part of the workup in hospital and might yield up to 27.3% positive cultures in necrotizing infections,¹¹ compared with the mere 2% positive blood culture yield in patients with cellulitis.³³

Plain x-ray films can demonstrate subcutaneous gas, but this is a specific not a sensitive finding (positive in fewer than 25% of cases) and absence of gas does not exclude NF.¹⁵ Computed tomography and magnetic resonance imaging (MRI) might be useful in cases where signs are equivocal or diagnosis is in doubt. Asymmetrical fascial thickening, fat stranding, and gas tracking along fascial planes are important imaging findings. Computed tomography scans are estimated to have a sensitivity of 80% for detecting necrotizing soft tissue infections.³⁴ In cases of cellulitis, MRI will demonstrate subcutaneous thickening with fluid collection. However, when there is deep fascia involvement with fluid collection, thickening, and enhancement after contrast administration, necrotizing infections must be considered.³³ According to Schmid et al,³⁵ the sensitivity of MRI is 100% with a specificity of 86%. This has been disputed, and other authors have argued that in early cases of NF, MRI might not show fascial involvement.³⁶ In summary, if clinical suspicion is high, surgeons can opt to explore and perform tissue biopsies rather than delay treatment for imaging studies.

Additional bedside tests include needle aspiration and incision biopsy. Negative results, however, cannot exclude NF. Surgical exploration is preferable.

Table 4. Laboratory risk indicator for NF: A score of ≤5 points indicates a low risk (<50% probability) of NF; 6-7 points indicate an intermediate risk (50%-75% probability) of NF; 8 points or more indicate a high risk (>75% probability) of NF.

INVESTIGATION	SCORE
Serum C-reactive protein ≥ 150 mg/L	4 points
White blood cell count	
• 15 000/μL-25 000/μL	1 point
• > 25 000/μL	2 points
Hemoglobin	
• 11.0-13.5 g/dL	1 point
• < 11 g/dL	2 points
Serum sodium < 135 mEq/L	2 points
Serum creatinine > 1.6 mg/dL (141 mmol/L)	2 points
Serum glucose > 180 mg/dL (10 mmol/L)	1 point

NF—necrotizing fasciitis.

Data from Anaya and Dellinger⁹ and Wong et al.³²

It must be emphasized that diagnosis of NF is clinical, and the clinician should draw information from both the patient's condition and the aggregate of tests. Physicians should have a high index of suspicion and low threshold for surgical referral.

Macroscopic findings during surgical exploration include gray necrotic tissue, lack of bleeding, thrombosed vessels, "dishwater" pus, noncontracting muscle, and a positive "finger test" result, which is characterized by lack of resistance to finger dissection in normally adherent tissues.⁹

Treatment. Once the diagnosis is made, treatment must begin on multiple fronts. First, surgical consultations should be urgently requested with the intention of early wound debridement for collection of tissue cultures, excision of all nonviable tissue, and delineation of the extent of the disease. (This is also important as tissue hypoxia limits the efficacy of intravenous antibiotics, which was demonstrated in our patient—her fever did not break despite intravenous antibiotics until the wound debridement and fasciotomy were complete.) Patients are often incredulous at the preoperative briefing when told they need an extensive operation for their skin infection; it is important to educate them about the gravity of their condition and the risk of increased mortality if surgical debridement is not performed.

Until blood culture results are available, wide spectrum coverage with intravenous antibiotics (with an awareness of resistance in the patient population being treated) is started. These antibiotics cover *S pyogenes*, *S aureus* (including community-acquired MRSA if indicated, according to local resistance patterns), and Gram-negative aerobes and anaerobes as clinically indicated. In particular, Gram-negative organisms would be suspected in perineal and abdominal wall wounds, necrotic diabetic foot ulcers, and in heavily contaminated wounds associated with devitalizing major trauma.

Hyperbaric oxygen has also been used as an adjunct to surgery and antibiotics. Its role is still ill-defined. Some authors have reported a reduction in mortality, morbidity, and need for repeated debridement in up to two-thirds of cases.^{37,38} Well-controlled randomized controlled trials are still lacking. Moreover, a retrospective review by Golger et al showed that morbidity associated with NF was higher in patients who underwent hyperbaric oxygen therapy.²⁰

In type 2 NF caused by streptococci resulting in streptococcal toxic shock syndrome, intravenous immunoglobulins might play a therapeutic role. Recently, a multicentre, randomized, double-blind, placebo-controlled trial evaluated the safety and efficacy of intravenous immunoglobulins in streptococcal toxic shock syndrome. The trial was prematurely stopped because of poor recruitment, but it showed 3.6-fold higher mortality in the placebo group compared with the treatment group.³⁹

EDITOR'S KEY POINTS

- Necrotizing fasciitis is a rare but potentially fatal disease; it can occur in all parts of the body, including the oral cavity and the perineum.
- Typically, patients who develop type 1 (polymicrobial) necrotizing fasciitis are immunocompromised in some way. However, with the type 2 (monomicrobial) variety, patients are usually immunocompetent with a history of trauma (sometimes minor).
- Diagnosis is often delayed because of a paucity of signs and a low index of suspicion.
- Necrotizing fasciitis is a clinical diagnosis. Blood tests and imaging, especially magnetic resonance imaging and computed tomography scans, can be helpful but are not diagnostic. Surgical exploration is advised if clinical suspicion is high.
- Management includes fluid resuscitation, if indicated, intravenous broad spectrum antibiotics, and early surgical debridement. Increasingly, community-acquired methicillin-resistant *Staphylococcus aureus* is being identified as the infective agent.

POINTS DE REPÈRE DU RÉDACTEUR

- La fasciite nécrosante est une maladie rare mais potentiellement mortelle; elle peut survenir dans n'importe quelle partie du corps, incluant la cavité buccale et le périnée.
- Typiquement, les patients qui développent une fasciite nécrosante de type 1 (polymicrobienne) sont plus ou moins immunodéprimés. Toutefois, ceux qui souffrent du type 2 (variété monomicrobienne) sont habituellement immunocompétents avec une histoire de trauma (parfois mineur).
- On tarde souvent à poser le diagnostic vu le peu de signes et un faible indice de suspicion.
- Le diagnostic de la fasciite nécrosante est clinique. Les examens sanguins et l'imagerie, notamment la résonance magnétique et la tomодensitométrie, peuvent être utiles mais ne permettent pas de poser le diagnostic. Une exploration chirurgicale est indiquée en présence d'un fort degré de suspicion.
- Le traitement inclut un rééquilibrage liquidien, si indiqué, des antibiotiques à large spectre par voie intra-veineuse et un débridement chirurgical précoce. De plus en plus fréquemment l'agent infectieux identifié est le staphylocoque doré résistant à la méthicilline d'origine extrahospitalière.

Prognosis. Mortality due to NF is considerable. Without surgical intervention, mortality approaches 100%. When necrotizing infections were first described by Jones, mortality was reported as 46%.⁴ More recent data indicate a mortality of 16.4% for community-acquired necrotizing soft tissue infections⁴⁰ and 36.3% for postprocedural necrotizing infections.⁴¹ All of these patients were managed in hospital with intravenous antibiotics and surgical interventions; considering medical progress in the last 135 years, mortality is still substantial. Mortality is higher in patients with streptococcal toxic shock syndrome. Diabetic patients, especially those presenting with diabetic ketoacidosis or hyperosmolar hyperglycemic nonketotic acidosis have

higher rates of death and longer lengths of hospital stay.⁴² A delay in surgery of more than 24 hours was an independent risk factor for mortality.¹

There is also considerable postoperative morbidity, sometimes from extensive debridement resulting in muscle loss. Patients might have to undergo a period of rehabilitation to regain function of the affected areas. Scarring and disfigurement can also be substantial.

Prophylaxis. As NF is a potentially lethal disease, the primary care physician might be asked whether those in close contact with the patient should be given chemoprophylaxis. Particular mention is made of type 2 infections caused by *S pyogenes* (group A streptococcus) as this organism is highly contagious and has been responsible for epidemics of scarlet fever, pharyngitis, and surgical wound infections. Recommendations are available: United Kingdom and Centers for Disease Control and Prevention recommendations for the management of close community contacts of those with invasive group A streptococcal disease both affirm that antibiotic prophylaxis is not warranted given currently available evidence.⁴³⁻⁴⁵ It is, however, recommended that health care workers routinely inform and educate household contacts of patients with invasive group A streptococcal infections, advising them to seek medical attention immediately if they develop symptoms.

Conclusion

Necrotizing fasciitis is an uncommon condition in general practice but one that risks serious morbidity. Clinicians must practise increased vigilance when treating patients with erythema, pain, and fever in order not to miss this rare but life-threatening condition. 🌿

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All the authors contributed to the literature review and preparing the manuscript for submission.

Competing interests

None declared

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