

Necrotizing Fasciitis: Early Sonographic Diagnosis

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ABSTRACT: Necrotizing fasciitis is a rare, but potentially fatal bacterial infection of the soft tissues. Establishing the diagnosis at the early stages of the disease remains the greatest challenge. We report a case of necrotizing fasciitis involving the upper extremity. Sonography revealed subcutaneous emphysema spreading along the deep fascia, swelling, and increased echogenicity of the overlying fatty tissue with interlacing fluid collections. The patient responded well to early surgical debridement and parenteral antibiotics. © 2010 Wiley Periodicals, Inc. *J Clin Ultrasound* 39:236–239, 2011; Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/jcu.20766

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Necrotizing fasciitis (NF) is a life-threatening infection of the soft tissues. It is an uncommon and often rapidly progressive infection of the deep soft structures. NF may involve any part of the body, but the extremities and perineum are most frequently affected.¹ At its early stages, NF is difficult to differentiate from common skin infections such as cellulitis and a high index of clinical suspicion is required. Delay in establishing the correct diagnosis and surgical exploration results in high morbidity and even mortality.² Clinical recognition is difficult and imaging studies can prove helpful in suggesting early diagnosis. CT and MRI are most frequently used diagnostic tools in patients with suspected

NF.^{3,4} Sonography (US) has rarely been used in the diagnosis of NF.^{5–8}

We report a case of NF affecting the right upper extremity after a venipuncture, which was diagnosed early based on US findings.

CASE REPORT

A 62-year-old male was admitted to our surgical department because of gastrointestinal bleeding. His medical history was significant for recently diagnosed diabetes mellitus. On admission, he was in poor general condition with severe anemia and hypovolemia. Flexible endoscopy revealed a peptic ulcer located in the duodenum. The patient was treated medically with intravenous fluids and omeprazole. He received 4 units of packed red blood cells. A few days later, the patient complained of a small patchy discoloration on the right forearm approximately 5 cm above the venipuncture site. Within the next 24 hours, the skin induration and erythema progressed to involve the whole medial aspect of the right forearm and arm and it became extremely painful. The patient was running a fever. There was no crepitus on palpation.

US examination was performed using a 8- to 12-MHz linear-array probe connected to a Famiio 8 scanner (Toshiba, Tokyo, Japan). It showed increased echogenicity of the subcutaneous fatty tissue with interconnected thin anechoic spaces corresponding to perifascial fluid resulting in a cobblestone appearance. There was a gas layer just above the deep fascia with posterior “dirty” acoustic shadowing (Figure 1). The subcutaneous emphysema extended a few centimeters beyond

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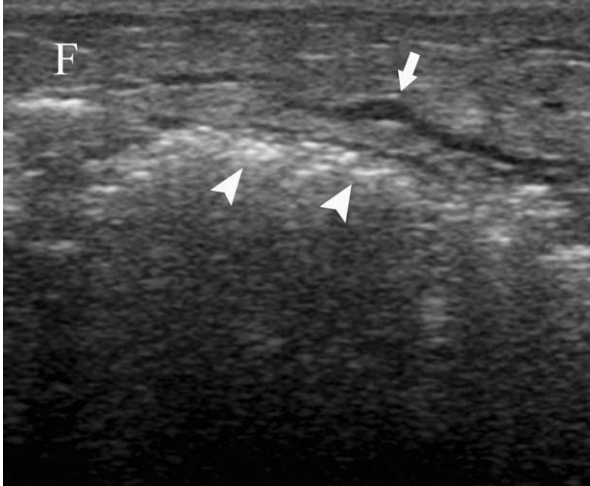


FIGURE 1. Transverse sonogram of the forearm shows the hyperechoic soft-tissue emphysema (arrowheads) with acoustic shadowing. The overlying subcutaneous fat (F) shows increased echogenicity with interlacing anechoic spaces (arrow) representing perifascial fluid spreading along the fascial planes (cobblestone appearance).

the area of skin discoloration, but the subcutaneous fat still appeared normal at that level (Figure 2). Scans of the upper extremity showed normal musculature without any detectable gas bubbles or fluid collections within the muscles. The US examination suggested the diagnosis of NF and therefore the patient underwent urgent surgical exploration. A long longitudinal incision was made over the affected area. On inspection, the subcutaneous tissue was edematous and turbid fluid was discharged from the wound edges. The perifascial planes had a foamy appearance with crepitations due to gas bubbles. Only a few small necrotic patches were found within the skin and subcutaneous fat and the deep fascia still appeared normal. The tissues were debrided and copiously irrigated. Gram stain of the excised necrotic tissues revealed multiple cocci. However, the cultures taken at the operation were negative, probably due to transportation error. The patient responded well to surgical debridement and parenteral antibiotics. The infection was controlled and there was no need for further explorations. Subsequently, the skin defects were covered by means of flap plasty.

DISCUSSION

NF is a progressive, rapidly spreading infection of the soft tissues. This type of infection was originally reported to affect the genital region and was described as Fournier's gangrene.⁹ Subsequently, Meleney found NF to involve also other

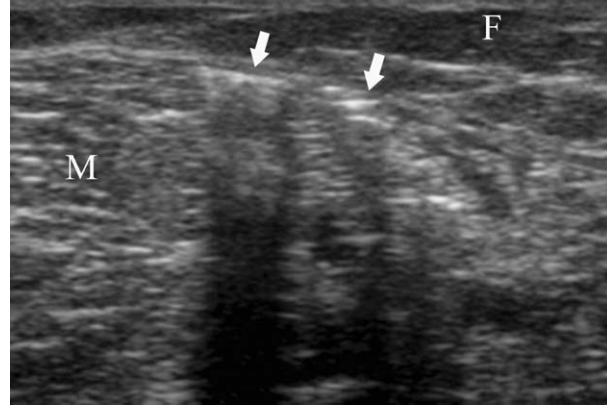


FIGURE 2. Transverse sonogram of the arm obtained just above the proximal margin of the skin induration and erythema demonstrates a hyperechoic focus (arrows) with posterior acoustic shadowing above the deep fascia corresponding to gas bubbles. At that level the subcutaneous fat (F) still appears normal. M, muscles.

body regions.¹⁰ The term of “necrotizing fasciitis” was introduced by Wilson in 1952.¹¹ Recently, the term of necrotizing soft-tissue infections was proposed to highlight the same treatment strategy in this group of infections.¹²

NF is an infection that spreads along the superficial and deep fascial planes of the soft tissues. The skin and muscles are usually spared at the early stages of the disease. The speed with which the infection progresses depends on the virulence of the causative pathogen and the degree of immune suppression of the host. NF is a synergistic bacterial infection usually due to a mixed flora. Most frequently cultured pathogens are streptococci. Clostridial infections, although commonly suspected, are rarely responsible.¹ NF often occurs in patients predisposed to infection because of the underlying chronic disease, especially diabetes mellitus, that is a risk factor found in 21–64% of cases.¹ Patients present with severe pain that is often disproportionate to physical findings.

Initially, NF has an insidious course and its clinical picture may be similar to cellulitis. A hallmark of NF is liquefying necrosis of the subcutaneous tissues, fascia, skin, and also muscles in severe cases. Purpuric or necrotic areas in the skin, which are indicative of NF, appear late in the course of the disease. The diagnosis of NF is a clinical one, but it is often delayed, because the infection begins and progresses in the deep layers of the subcutaneous tissues, giving initially a false impression of a typical cellulitis. The provisional diagnosis based solely on clinical findings is incorrect in 64% cases.¹³ Early recognition is essential because any delay in the surgical management results in worse prognosis.^{2,14}

Imaging studies can be helpful in suggesting an early diagnosis of NF. Radiographic studies are often used in cases without the typical clinical signs of NF such as overt skin necrosis or tissue crepitus. Radiographic findings in NF are similar to those found in cellulitis. Cellulitis begins and spreads in the superficial layers of the subcutaneous tissues. In contrast, NF involves deeper structures and the inflammatory changes are more severe.¹⁵ The subcutaneous emphysema is a distinguishing sign of NF, but crepitus is not always present on palpation. Plain films show subcutaneous emphysema when there is a moderate to large amount of gas within the tissues. Although crepitus is found on physical examination in only 12–36% of patients with NF, soft-tissue gas is seen on plain x-ray in 17–57% of patients.¹ Tissue emphysema has been generally regarded a late finding in NF. Our case illustrates, however, that in some cases tissue gas appears early in the course of the disease.

CT and MRI are frequently used diagnostic tools in patients with suspected NF. The CT findings suggesting NF include asymmetric fascial thickening, fluid collections along the deep fascia, and soft tissue gas.⁴ Although MRI has a high resolution for soft tissues, its value is limited in NF, because the patients are often too ill to undergo a timely study. MRI findings such as fluid collections along the deep fascial sheath and thickening of the deep fascia with contrast enhancement suggest NF.³ Nevertheless, both CT and MRI have high sensitivity and low specificity for NF.^{3,4,16}

The US appearance of NF has rarely been reported in the literature.^{6–8,17} The findings suggesting NF include thickening of the deep fascia, diffuse thickening of the overlying fatty tissue, and a fluid layer of at least 4 mm in thickness along the deep fascia. Yen et al⁸ reported a sensitivity of 88.2% and specificity of 93.3% for US in the diagnosis of NF using the aforementioned criteria. The diagnosis of NF is further aided by the detection of gas within the soft tissues, which is pathognomonic of NF.

The US appearance of NF is similar to that of cellulitis. In both conditions, there is swelling and increased echogenicity of the subcutaneous tissue. However, fluid spaces tracking along the deep fascia strongly suggest the diagnosis of NF and are usually not observed in cellulitis.⁶

In NF, the inflammatory changes are usually more severe and located in deeper layers than in cellulitis. In our patient, the US diagnosis of NF was based on the recognition of gas in the soft tissues and fluid collections dissecting along the deep fascia. Gas in the soft tissues is indicative of

NF and warrants an urgent surgical exploration and debridement. In our case, the debridement was performed before the development of overt necrosis of the deep fascia. The infection was controlled early and there was no need for any subsequent debridement procedures.

Our case highlights two essential features of NF. First, the subcutaneous emphysema may appear early in the course of the disease due to gas-forming bacteria. Second, the inflammation spreads along the deep fascia and extends beyond the margins of apparent skin infection.

In conclusion, US is a useful tool for early recognition of NF, especially due to gas-forming bacteria. The subcutaneous emphysema and fluid collections spreading along the deep fascia are hallmarks of NF. The use of US evaluation is strongly recommended in patients with atypical or rapidly progressive cellulitis to detect NF at its early stage.

REFERENCES

1. Cunningham JD, Silver L, Rudikoff D. Necrotizing fasciitis: a plea for early diagnosis and treatment. *Mt Sinai J Med* 2001;68:253.
2. McHenry CR, Piotrowski JJ, Petrinic D, et al. Determinants of mortality for necrotizing soft-tissue infections. *Ann Surg* 1995;221:558.
3. Schmid MR, Kossman T, Duewell S. Differentiation of necrotizing fasciitis and cellulitis using MR imaging. *AJR Am J Roentgenol* 1998;170:615.
4. Wysoki MG, Santora TA, Shah RM, et al. Necrotizing fasciitis: CT characteristics. *Radiology* 1997;203:859.
5. Hosek WT, Laeger TC. Early diagnosis of necrotizing fasciitis with soft tissue ultrasound. *Acad Emerg Med* 2009;16:1033.
6. Tsai CC, Lai CS, Yu ML, et al. Early diagnosis of necrotizing fasciitis by utilization of ultrasonography. *Kaohsiung J Med Sci* 1996;12:235.
7. Chao HC, Kong MS, Lin TY. Diagnosis of necrotizing fasciitis in children. *J Ultrasound Med* 1999;18:277.
8. Yen ZS, Wang HP, Ma HM, et al. Ultrasonographic screening of clinically-suspected necrotizing fasciitis. *Acad Emerg Med* 2002;9:1448.
9. Fournier J. Gangrene foudroyante de la verge. *Sem Med* 1883;3:345.
10. Meleney F. Hemolytic *Streptococcus gangrene*. *Arch Surg* 1924;9:317.
11. Wilson B. Necrotizing fasciitis. *Am Surg* 1952;18:416.
12. Anaya DA, Dellinger EP. Necrotizing soft-tissue infection: diagnosis and management. *Clin Infect Dis* 2007;44:705.
13. Hefny AF, Eid HO, Al-Hussona M, et al. Necrotizing fasciitis: a challenging diagnosis. *Eur J Emerg Med* 2007;14:50.

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14. Majeski J, Majeski E. Necrotizing fasciitis: improved survival with early recognition by tissue biopsy and aggressive surgical treatment. *South Med J* 1997;90:1065.
15. Fayad LM, Carrino JA, Fishman EK. Musculoskeletal infection: role of CT in the emergency department. *Radiographics* 2007;27:1723.
16. Arslan A, Pierre-Jerome C, Borthne A. Necrotizing fasciitis: unreliable MRI findings in the preoperative diagnosis. *Eur J Radiol* 2000;36:139.
17. Hanif MA, Bradley MJ. Sonographic findings of necrotizing fasciitis in the breast. *J Clin Ultrasound* 2008;36:517.