

# Diagnosis of Necrotizing Fasciitis with Bedside Ultrasound: the STAFF Exam

Erik Castleberg, MD\*  
Natasa Jenson, MD\*  
Vi Am Dinh, MD\*†

\* Department of Emergency Medicine, Loma Linda University, Loma Linda, California  
† Department of Medicine, Division of Pulmonary and Critical Care, Loma Linda University, Loma Linda, California

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The early diagnosis of necrotizing fasciitis is often ambiguous. Computed tomography and magnetic resonance imaging, while sensitive and specific modalities, are often time consuming or unavailable. We present a case of necrotizing fasciitis that was rapidly diagnosed using bedside ultrasound evaluating for subcutaneous thickening, air, and fascial fluid (STAFF). We propose the STAFF ultrasound exam may be beneficial in the rapid evaluation of unstable patients with consideration of necrotizing fasciitis, in a similar fashion to the current use of a focused assessment with sonography for trauma exam in the setting of trauma. [West J Emerg Med. 2014;15(1):111–113.]

## INTRODUCTION

Necrotizing fasciitis is a severe soft-tissue infection with significant morbidity and mortality, reported between 25% and 75%.<sup>1</sup> In the United States, the annual age-adjusted incidence is approximately 4.3 infections per 100,000 of the population. This produces a heavy financial toll, with a mean hospital length of stay of 36 days, resulting in an average cost per patient of \$62,846.<sup>2</sup>

Although necrotizing fasciitis is primarily a clinical diagnosis, patient presentations can be ambiguous. While a computed tomography (CT) is traditionally used to confirm the diagnosis prior to surgery in uncertain cases, newer research shows ultrasound may be a specific modality in confirming the diagnosis and preventing delays in definitive surgical treatment.<sup>3</sup>

## CASE REPORT

A 44-year-old female presented to the emergency department (ED) with a 3-day history of left groin and inner thigh redness, pain, and swelling; associated with fever, chills, and vomiting. The patient was seen the prior day in a local urgent care at which time she was treated with intravenous vancomycin for cellulitis and discharged on oral antibiotics. The patient presented to the ED within 24 hours of discharge from the urgent care. The initial ED vitals revealed an afebrile (36.9°C), normotensive (126/63) patient with tachycardia (124) and mild tachypnea (22). On physical exam, the patient had left inner thigh and groin induration

measuring 12 cm x 12 cm. The patient was morbidly obese with a BMI >45 kg/m<sup>2</sup>, making crepitus difficult to appreciate on physical exam. Her initial labs were as follows: lactate 3.5 mmol/L, WBC 18.2 x 10<sup>3</sup> per mm<sup>3</sup>, hemoglobin 12.3 g/dL, sodium 136 mmol/dL, glucose 225 mg/dL (12.5 mmol/L), and creatinine 1.8 mg/dL (159 μmol/L). This gave her a laboratory risk indicator for necrotizing fasciitis (LRINEC) score of 6, C-reactive protein (CRP) excluded. (CRP was not ordered in the ED). A bedside ultrasound was performed, which showed positive subcutaneous thickening, air, and fascial fluid (STAFF) concerning for necrotizing fasciitis (Video 1). The patient's soft tissue ultrasound findings are significantly different when compared to normal soft tissue ultrasound (Video 2). The patient was started on intravenous vancomycin and piperacillin/tazobactam empirically, and surgery was consulted.

Based on the LRINEC score, ultrasound findings, and physical exam, the patient was taken immediately to the operating room for presumed necrotizing fasciitis and forwent either CT or magnetic resonance imaging (MRI). In the operating room she underwent operative debridement of the left groin and perineum, resulting in excision of 15 cm x 23 cm of tissue with extensive washout. At the close of the surgery the patient was admitted to the surgical intensive care unit post-operatively for septic shock requiring vasopressors and ventilator dependence. The patient underwent repeat washouts with minor debridements daily for 3 days, with lactate normalization and a down-trending WBC to 13.5 x

$10^3$  per  $\text{mm}^3$  on post-operative day 3. She was extubated and transferred to a step-down unit on post-operative day 5, after which plastic surgery was consulted to evaluate for possible skin graft. Over the course of 9 days and 4 additional operative washouts, the patient was deemed to be a poor graft candidate. A wound vacuum-assisted closure (V.A.C.) device was placed, and the patient was transferred to the plastic surgery service on day 9. The decision was made to forgo skin graft during her immediate hospital stay. The patient was fully ambulatory and discharged home with a wound V.A.C. on post-operative day 28. The patient subsequently received a skin graft, and has been recovering well since.

## DISCUSSION

The diagnosis of necrotizing fasciitis is initially suspected by clinical findings classically characterized by erythema with ill-defined borders, rapid progression in size, and association with severe pain and tenderness beyond the apparent area of involvement.<sup>4,5</sup> While blisters, hemorrhagic bullae, drainage, skin discoloration, and crepitus are important diagnostic clues in more advanced cases, they are unfortunately associated with poor sensitivity, late onset, and severe disease.<sup>4,5</sup> While the literature has stressed high fever, hypotension, and multi-organ failure as indicators of possible necrotizing fasciitis<sup>6-8</sup>, a review found that only 53% were febrile and 18% were hypotensive at presentation.<sup>5</sup>

Often, the early stage of necrotizing fasciitis is clinically indistinguishable from soft tissue infections such as cellulitis and erysipelas, making the early diagnosis difficult.<sup>4,5</sup> While more subtle, this presentation is associated with a similar mortality if not treated by early aggressive surgical debridement.<sup>1</sup> In the case discussed, the patient presented a day earlier to an urgent care with only redness and pain, lacking crepitus, discharge, fever, or other classic findings on physical exam. The speed at which her symptoms progressed attests to the virulence of the disease and importance of early recognition.

Diagnostic criteria have been developed due to frequent ambiguity of the clinical diagnosis. These include the use of decision rules (LRINEC score),<sup>9</sup> CT, MRI, and ultrasound; with CT and MRI being the mainstays of diagnosis in ambiguous cases. While studies have shown that CT and MRI provide a higher sensitivity and superior evaluation of disease extent compared to ultrasound,<sup>10</sup> these imaging modalities can be time consuming, thus delaying definitive treatment.<sup>1,7</sup>

The diagnostic ultrasound findings consistent with necrotizing fasciitis include fascial and subcutaneous tissue thickening, abnormal fluid accumulation in the deep fascia layer, and, in advanced cases, subcutaneous air.<sup>6,8</sup> These criteria can be recalled using a proposed “STAFF” mnemonic. A retrospective review of 32 pathologically confirmed necrotizing fasciitis showed that ultrasound revealed changes in subcutaneous fat (87.5%), underlying fascia (56%), and muscle (46.8%), but did not reveal histologically

apparent inflammation in the subcutaneous tissues (9.3%) or muscle (25%) in several cases.<sup>11</sup> However, while it is not recommended to exclude necrotizing fasciitis on the basis of ultrasound,<sup>3</sup> it has been shown to be specific for soft tissue infections, with one study reporting sensitivity of 88% and specificity of 93% using ultrasound.<sup>8</sup> The sensitivity of ultrasound varies depending on the location and extent of necrotizing fasciitis; current ultrasound technology is thus unable to safely rule out the diagnosis. Here, a case is presented where bedside ultrasound allowed providers to forgo time intensive tests such as CT or MRI, which would have delayed definitive operative management in an unstable patient with necrotizing fasciitis.

## CONCLUSION

The early diagnosis of necrotizing fasciitis is often ambiguous and carries a high rate of morbidity and mortality if the diagnosis is missed. Although more sensitive, CT and MRI are time consuming and might not be readily available. Since a delay in treatment results in significantly increased morbidity and mortality; prompt diagnosis is crucial. The diagnostic ultrasound findings consistent with necrotizing fasciitis can be easily recalled by remembering to do an exam for STAFF. It warrants a special reminder, however, that ultrasound is not sensitive enough to exclude the diagnosis. Given clinical suspicion, and a negative ultrasound study, a more sensitive study such as CT, MRI or in advanced cases surgical exploration, is warranted.

While further study is required, this case supports that the early use of ultrasound in the form of a STAFF exam is an appropriate adjunct in those patients in whom there is a clinical suspicion of necrotizing fasciitis, with the goal of expediting operative debridement in much the same way as a focused assessment with sonography for trauma (FAST) exam is used to expedite laparotomy in unstable patients with abdominal trauma.

**Video 1.** Ultrasound video demonstrating Subcutaneous Thickening, Air, and Fascial Fluid (STAFF).

**Video 2.** Soft tissue ultrasound findings are significantly different when compared to normal soft tissue ultrasound

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*Address for Correspondence:* Vi Am Dinh, MD. Loma Linda University, 11234 Anderson Street, A108, Loma Linda, CA 92354. Email: vadinh@llu.edu.

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