DOI: 10.33470/2379-9536.1413

ORIGINAL ARTICLE Volume 10 Issue 2

The Case for Using Composition Tomography to Evaluate Perirectal Necrotizing Fasciitis: Is It Really Necessary?

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ABSTRACT

Clinical reviews of Fournier's Gangrene state that diagnostic protocol includes interpreting CT, MRI, or Ultrasound imaging along with clinical symptoms and lab findings. We think that the use of imaging techniques as a diagnostic tool is no longer needed as Fournier's Gangrene is specific enough of a disease that clinicians can diagnose using labs and physical examination alone.

Cases of perirectal necrotizing soft tissue infection recorded at St. Marys Medical Center were reviewed. Results of physical exams and imaging were compared along with measurements of severity upon admittance and length of stay. Due to the COVID-19 pandemic, we investigated if patients were delaying seeking treatment for their condition that those presenting pre-pandemic.

It was found that no additional, clinically significant, information was gained using imaging techniques, particularly CT scans, that wasn't gathered using a physical exam. The only instances where imaging provided useful were when the patient presented to the clinical setting very early in the disease process. It was also found that a higher number of patients delayed seeking treatment due to the Sars-CoV-2 pandemic. Our sample size was too small to determine whether the number of delayed patients was statistically significant.

We conclude that CT scans are not needed in diagnosing Fournier's Gangrene unless the disease is in its early stages. This should result in more rapid diagnosis and treatment in the operating room. This is especially important when hospital resources are short and the patient presents in an advanced disease state; relevant to the ongoing Sars-CoV-2 pandemic.

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KEYWORDS
CT Scan, Composition Tomography, Fourniers Gangrene, Necrotizing Fasciitis, Necrotizing Soft Tissue Infection, General Surgery

BACKGROUND

Peri-rectal necrotizing fasciitis, also known as Fournier's Gangrene (FG), is a serious and rapidly life-threatening condition where rapid inhiation of treatment protocol is imperative to ensure optimal patient outcomes. Rapid diagnosis is the first step in initiating treatment for this necrotizing soft tissue infection (NSTI). A physician must have proper expertise on the subject to ensure accurate diagnosis and proper medical management during the patient's stay in the hospital.

There are 4 types of NSTIs. Type 1 NSTIs are the most common, occurring in 55-90% of cases.[1] They are characterized by polymicrobial, including gram-positive and negative organisms, notably clostridioides, typically affecting the trunk or perineum and unrelated to trauma. These infections are typically complicated by comorbidities resulting

in immunodeficiencies like Diabetes Mellitus.[2] Subsequent tissue breakdown occurs from antecedent abscesses, perforations, or bacterial translocation.[3] The majority of the damage done is due to α-toxin and θ-toxins. These infections typically present with out-of-proportion pain with rapid onset. The wound is often foul-smelling and drains a thin serosanguinous fluid. Crepitus and woody induration may also be found upon physical exam. Disease progression to bacteremia and sepsis typically occurs late and depicts poor outcomes with a significant increase in mortality. Additionally, clostridial species are notoriously difficult to grow and isolate in culture. Thus, negative blood cultures should not be relied upon to rule out systemic infection. Hence, one should not wait for pathology reports to aid their diagnosis, as it ultimately delays important time-dependent treatment.

Type 2 NSTIs typically involve Lancefield group A-streptococcus (Streptococcus pyogenes) that often occurs in combination with S. Aureus,[2] may spread aggressively to local tissues, and include Toxic shock syndrome. Patients with type 2 NSTIs are typically younger, (previously) healthier, and more commonly present with a history of trauma, recent surgery, or IV drug use. Type II NSTIs are not linked to any specific comorbidities, puncture wounds, other skin lesions, or injections.[2,4] Group A-Strep M proteins' ability to manifest as a superantigen makes this type of NSTI significantly more difficult to manage. The resultant activation of the inflammatory cascade is orders of magnitude larger than what is normally seen due to the massive release of cytokines IL-1, IL-6, and tumor necrosis factor-α leading to severe systemic toxicity, catastrophic septic shock, and multi-organ failure often seen with GAS NSTIs. Additionally, GAS species utilize several exotoxins to evade the innate immune system and break down hyaluronic acid in connective tissues.[2]

Type 3 NSTIs are typically caused by clostridium species and/or gram-negative marine organisms, notably V. vulnificus. This class is less widely accepted than type I and IIs. It is only seen in warm water coastal regions such as the southeastern United States, Central and South America, and Asia. This class is extremely dangerous due to high mortality (around 35–44%) and early evidence of significant systemic toxicity.[2,5] Multisystem organ failure and cardiovascular collapse are described to occur very early (within 24 hours) and can even be observed without any localized cutaneous evidence of infection.[2,3,5,6] Lastly, Type IV NSTIs are fungal, often via Candida or zygomycetes.[2]

Most commonly, FG infections are poly-microbial 54% of the time, E. coli 46.6%, Streptococcus 36.8%, and more rarely, Bacteroides, Enterobacter, Staphylococcus, Enterococcus, Pseudomonas, Corynebacterium, and Klebsiella.[7]

Typically, cases of Fournier's Gangrene occur in patients presenting with multiple comorbidities and risk factors such as a long history of smoking, diabetes mellitus type 2, and obesity.[8] Additionally, there is some overlap in these factors contributing to an increased mortality risk in patients with pre-existing conditions such as diabetes, heart disease, renal failure, and kidney disease.[9] These comorbidities make for more difficult case management and accelerate the disease process, thus only driving the importance promptly performing medical intervention.

When evaluating a patient for possible Fournier gangrene, protocol calls for performing a physical exam, obtaining labs, and utilizing imaging techniques such as magnetic resonance imaging (MRI), computed tomography (CT), or Ultrasound (US).[10,11] If the case is confirmed as FG, surgical intervention is typically warranted because the affected region is highly vascular. Standard treatment combines antibiotics based on wound cultures and surgical debridement, as needed.[12] The case for imaging when evaluating a case of FG is to determine the extent of the case and plan for surgical debridement. Diagnosis and evaluation can be performed with CT and US. CT is the preferred method for higher specificity in diagnosing Fournier gangrene and for superior evaluation of disease extent.[13] Subsequent utilization of broad-spectrum antibiotics and aggressive surgical debridement of the gangrenous tissue are essential for successful treatment.

Clinical signs and symptoms

NSTIs present similarly to cellulitis or abscesses, thus complicating the route to diagnosis. Presentation

varies slightly based on the pathogen responsible and the anatomical location of the infection. Generally, erythema, swelling, fever, and pain extending beyond the visual margins of the infection are commonly found during physical exams. Additional signs of NSTIs include pain disproportionate to exam findings and other "hard" clinical signs occurring later in the disease progression, such as the presence of bullae, skin ecchymosis that precedes skin necrosis, presence of gas in the tissues upon examination, and cutaneous anesthesia. While these signs are present in only 7%-44% of cases, they should prompt immediate surgical exploration of the wound. Clinicians may also see antibiotic treatment resistance via infection progression despite their use.

Most importantly, a chronology of disease gathered through a thorough history can aid in diagnosis. Symptoms and signs of NSTIs typically progress rapidly. This rapid progression of the disease stresses that timing is of the utmost importance to treat the disease properly. Patients presenting with signs and symptoms of systemic toxicity or shock are already in an advanced disease state, and appropriate surgical evaluation must happen quickly.[3]

We chose to evaluate the necessity of imaging techniques as part of the protocol for assessing cases of necrotizing fasciitis. Unfortunately, timely imaging studies are not always possible. For the sake of speed, ordering imaging techniques can eat up valuable time to treatment, depending on hospital resources and staff availability. If the use of imaging techniques were optional, the care provider would be able to evaluate and treat the patient much more quickly, thus increasing the likelihood of optimal outcomes.

METHODS

Study Population

Data for this study was collected using the St. Mary's Medical Center Electronic Health Record in Huntington, WV. Potential cases were gathered by searching for those who were diagnosed with necrotizing fasciitis, admitted to the hospital, and underwent surgical wound debridement. A total of 19 individuals met the requirements for this study: 12 males and 7 females. The average patient age was 51.3 years, with ages ranging from 35-68.

Clinical Data

Each patient who met criteria for this study's medical record was reviewed to assess physical exam results and imaging interpretation (if imaging was performed). The results of the physical exam and imaging studies were then summarized. Additional data was recorded, such as the number of instances the patient's wound was surgically debrided, the size of the debrided area, the size of tissue infection on CT, length of stay, readmission, and comorbidities such as diabetes, smoking, alcohol use, and steroid use. The results of the imaging and physical exams were compared for any additional findings from imaging not gathered by the physical exam.

Each patient's relative condition upon admission to the hospital was also determined. Any externally motivated or patient-driven delays in seeking treatment were noted. Additional surgical and wound-care interventions during the patient's hospital stay were also recorded. These included Pannectomy, Colostomy placement, Penectomy, Suprapubic Tube Placement, and skin grafts.

RESULTS

The results of the imaging techniques were compared to the physical exam findings. It was found that no additional data was gathered from the imaging technique, which was not gathered from the physical exam. Additionally, the area of the necrotic tissue found on physical exam was typically much larger than seen on CT. In the cases where the patient presented to the clinical setting early in the disease process, imaging such as CT scans revealed more than the physical exam.

As expected, it was found that the majority of patients in the study were chronic tobacco users, obese, and/or had a diagnosis of Type 2 diabetes. Most of the patients with diabetes were poorly controlled or previously undiagnosed at the time of clinical presentation.

Patient delay in seeking treatment was evaluated since the Sars-CoV-2 (Covid-19) Pandemic began. It

was found that there was a higher incidence of delay in treatment seeking. Four of the 8 patients admitted during the pandemic's onset were determined to have some delay seeking treatment, with 1 directly citing the pandemic, whereas only 1 patient out of 11 was determined to delay seeking treatment pre-Sars-CoV-2.

It was also found that the average length of hospital stay pre-pandemic (9.18 days) was shorter than that of those currently during the pandemic (11.25 days) by, on average, 2.07 days. This was likely due to 2 significant outliers in the sample but should not be ignored entirely (Figure 1).

CONCLUSION

The data gathered from this study shows that CT scans do not typically gather additional information in diagnosing Fournier gangrene. Most patients presenting with peri-rectal necrotizing fasciitis were accurately evaluated by the physical exam alone. Imaging techniques appeared to be useful only when the patient presented early in the disease progression, reflecting findings described in other similar studies where the necrotic lesion was masked by superficial tissue or had not fully ripened into obvious necrotic status.[14]

The presence of air in the fascial planes is rare in the early stages of NSTIs, and fascial fluid collections are not always seen. Imaging modalities such as CT might provide information about underlying conditions in NSTI cases that contribute to or result from the infection, such as diverticulitis or abscesses. In certain cases, CT helps to evaluate the extent of disease progression via tissue swelling, inflammation, and gas formation. Other studies have determined that MRI scanning has the highest sensitivity and specificity;[15] however, this method is time-consuming and expensive. Additional data that can aid in diagnosing necrotizing fasciitis are admission white blood cell (WBC) counts greater than 15.4 x 10(9)/L and serum Na less than 135mmol/L.[16]

In more advanced cases, treatment should not be delayed for imaging or laboratory assessment, as it delays time to treatment.[14,15] We agree with this idea.

In this study, several patients delayed treatment for fear of the ongoing SARS-CoV-2 pandemic.

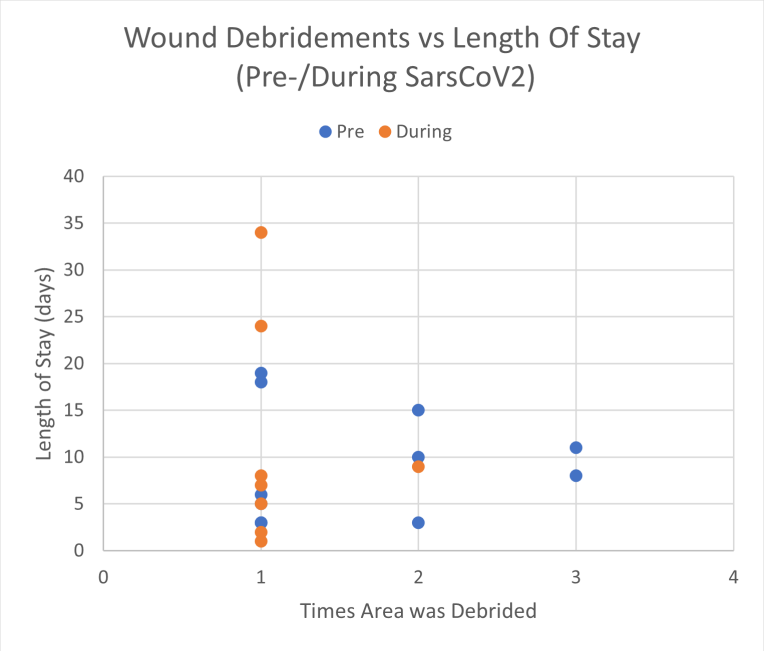

FIGURE 1: The number of days patients stayed in the hospital were compared to the number of times their wounds were debrided. This was performed for patients admitted before and after the onset of the Sars-CoV-2 pandemic.

While it was found that there were more instances of delayed presentation to the clinic in the SARS-CoV-2 era, we cannot determine if this was a widespread phenomenon from our data. It is noted that other studies describe COVID-19 delaying case presentation, and cases are more extreme as a result.[17] This only makes it more important that patients get debridement and treatment more quickly. One could reasonably assume that the delay in seeking treatment is a valid concern; it must be ensured that patients presenting to the clinic can be sent to the operating room quickly for any necessary surgical intervention.

Using the information gathered from our study, we believe that imaging, specifically CT, is not always necessary to diagnose peri-rectal necrotizing fasciitis. The detailed history, physical exam, and clinical suspicion should outweigh laboratory and imaging aids for diagnosing necrotizing fasciitis, especially if the patient presents in the early stages of the disease when the therapeutic yield of debridement is the greatest.[18] If need be, clinical suspicion can be supported by fresh frozen sections alongside gram staining done during incisional biopsy. It might result in more timely identification of this life-threatening condition.[14] Furthermore, the exact contribution of imaging modalities in the early stages of necrotizing fasciitis is still under debate. It should be correlated with the clinical presentation if good clinical judgment cannot be relied upon.[14,18]

In the future, it is necessary to investigate relevant laboratory findings such as C-reactive protein, white cell count, hemoglobin, sodium, glucose, creatinine, and additional medical interventions in relation to time spent in the hospital. Understanding how the patient's condition corresponds to surgical interventions throughout time could provide a more accurate prediction of how and when to utilize hospital resources in a race against time.

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