


The Epidemiology of Necrotizing Fasciitis at a Rural Level I Trauma Center During the COVID-19 Pandemic

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Abstract

Introduction: The impact of the COVID-19 pandemic on non-COVID-19 pathologies has been experienced worldwide. While people appropriately avoided social interactions, many also avoided essential medical care for acute and chronic conditions. This delay in seeking care has been associated with increased morbidity and mortality in several conditions, including life-threatening infections such as necrotizing fasciitis.

Methods: We retrospectively reviewed the records of patients that presented to the University of Vermont Medical Center for necrotizing fasciitis during the 1-year period following the declaration of a global pandemic on March 11, 2020. We subsequently compared this data with that of the previous 4 years.

Results: During the period of March 12, 2020 to March 12, 2021, there were 17 cases of newly diagnosed necrotizing fasciitis. Compared with an average per year of 8 cases over the previous 4 years, this represents a 113% percent increase in cases of necrotizing fasciitis during the study period ($P = .071861$). Out of the 17 cases, 4 patients died during their admission, producing a case-fatality rate of 23.5%. This represents a statistically significant increase from previous years ($P = .003248$), where the average case-fatality rate was 6.3%.

Conclusion: Our study demonstrates a substantial increase in cases of necrotizing fasciitis following the onset of the coronavirus pandemic. A significant increase in the case-fatality rate was also observed. Given the growing body of literature describing the negative impact of the pandemic on non-COVID-19 morbidity and mortality, our study posits necrotizing fasciitis as one of many affected pathologies.

Level of Evidence: Level IV. Epidemiological

Keywords

COVID-19, soft-tissue infection, pandemic

Key Takeaways

- Following the onset of the pandemic, UVMMC observed a 113% increase in cases of necrotizing fasciitis.
- There was also a statistically significant increase in the case-fatality rate compared with previous years.
- Our study illustrates the importance of continued screening and patient outreach amidst pandemic-related lockdowns.

Introduction

To date, the novel coronavirus (SARS-CoV-2) has plagued societies across the globe for more than 18 months. In addition to the tragedy of lives lost due to COVID-19, the pandemic has also had large-scale psychosocial and

economic impact. At the onset, citizens began to self-isolate, businesses were shut down, and political discourse grew increasingly polarized. As a result, many individuals were left to fend for themselves amidst the chaos, fear, and confusion. Moreover, hospitals were crippled by the rapid increases in COVID-19 admissions, which quickly outpaced their capacity to provide adequate

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care. Many institutions were forced to reallocate staff and resources. As a result, procedures deemed as “elective” were canceled or postponed. In fact, during the first 12 weeks of the pandemic, an estimated 28 million surgeries were canceled worldwide.^{1,2} At the same time, the infrastructure and protocols for telemedicine visits were slow to develop, causing many patients to miss appointments with their primary care providers, foregoing vital health surveillance, lifestyle counseling, and medication adjustments.

In March of 2020, approximately 2 months after the first infection was reported in the United States, strict lockdown measures were initiated to mitigate viral spread. This was accompanied by a robust media narrative encouraging social distancing and isolation. However, while such messaging was critical to promoting awareness regarding the novel coronavirus, it may have done so at the expense of a continued emphasis on general health maintenance practices such as diet, exercise, glycemic control, etc. This is particularly important for patients with more chronic and indolent co-morbidities. Additionally, in the setting of such widespread fear and confusion, individuals lacking adequate health literacy may have been further deterred from seeing a doctor, leading to delayed presentations and resultant increases in non-COVID-19 morbidity and mortality.³

Evidence of delayed care, particularly in the early months of the pandemic is well described in the literature. There were notable reductions in emergency room visits, even for severe conditions such as appendicitis, stroke, and myocardial infarction.^{4,5} Such delays are not without significant ramifications, evidenced by a plethora of case-reports detailing the ensuing impact on severity of presentation and outcomes after treatment.⁶⁻⁸ In one report, Lazzarini et al describes 12 instances of delayed pediatric presentations which resulted in 6 admissions to the intensive care unit, and 4 deaths. The parents of all 12 patients acknowledged they avoided the hospital due to fear of COVID-19.⁹

Unfortunately, the effect of delayed care on acute illness was likely compounded by widespread neglect for general health maintenance. Management of chronic illnesses faced significant setbacks, as patients fearful of acquiring COVID-19 avoided critical health maintenance visits with primary care providers.¹⁰ Drastic increases in outpatient cancellations and postponements were observed worldwide.¹¹ For such conditions such as obesity, hypertension, atherosclerotic cardiovascular disease, and diabetes, delayed presentation for acute conditions, preceded by months of insufficient health maintenance likely intensified the pandemic’s effect on non-COVID-19 morbidity and mortality.

Glycemic control in patients with diabetes mellitus exemplifies the importance of regular patient counseling and surveillance. Diabetics are predisposed to a host of

complications including heart attack, stroke, renal failure, and life threatening infections such as necrotizing fasciitis. Necrotizing fasciitis is characterized by rapidly progressive infection of subcutaneous tissue and fascial planes which leads to widespread necrosis and systemic toxicity.¹² Early signs of necrotizing fasciitis include cellulitis, and fever; however, it can also follow a more indolent progression, and subsequently escalate at a frightening rate. Case reports of delayed presentations of necrotizing fasciitis due to the COVID-19 pandemic have been reported,¹³⁻¹⁵ however rates of necrotizing fasciitis on a larger scale have yet to be described. The nature of this specific pathology and its associated risk factors provides a unique opportunity to reveal both a direct (ie, delayed presentation) and indirect (ie, worsening glycemic control and obesity) impact on acute care and surgical disease burden. This study examines the incidence, patient characteristics, and outcomes of necrotizing fasciitis at the University of Vermont Medical Center (UVMCC) during the 1-year period following the onset of the coronavirus pandemic.

Methods

The WHO declared the pandemic on March 11, 2020. Over a year later, local governments began to relax precautionary measures, as businesses began to reopen, and masking policies were lifted. In order to capture an annual incidence of necrotizing fasciitis coinciding with the coronavirus lockdown, the records of all patients admitted for necrotizing fasciitis, gas gangrene, and Fournier’s gangrene during the period of March 12, 2020 to March 12, 2021, were retrospectively reviewed. A similar review was conducted for the same time period beginning in 2016, 2017, 2018, and 2019.

ICD-10 codes were utilized for the aforementioned inclusion criteria. Patients under 18 years old were excluded from our study. Readmissions for recently diagnosed necrotizing soft-tissue infection (ie, due to recurrent infection, post-operative complications, etc.) were not counted as additional cases.

A chi-squared goodness of fit test was used to compare rates of necrotizing fasciitis and associated case-fatality rates during the study period with averages taken over the previous 4 years prior to the onset of the pandemic. A two-sample t-test was used to analyze the age distribution and average A1c values of our study population. A chi-square test was used for sex. All calculations were done using Microsoft Excel.

Results

During the period of March 12, 2020 to March 12, 2021, there were 17 cases of newly diagnosed necrotizing fasciitis admitted to UVMCC. Compared with an average per year of 8 cases over the previous 4 years, this represents

Table 1. Total Cases of Necrotizing Fasciitis and Corresponding Descriptive Data.

| Category | 2016-2017 | 2017-2018 | 2018-2019 | 2019-2020 | 2020-2021 |
|--|-----------------|-----------------|------------------|------------------|-----------------|
| Mean age (<i>and range</i>) | 57.9 (38-86) | 55.6 (38-86) | 60 (28-83) | 57.4 (42-74) | 59.1 (33-82) |
| Gender distribution | M (82%) F (18%) | M (90%) F (10%) | M (83%) F (27%) | M (56%) F (44%) | M (53%) F (47%) |
| Mean BMI (<i>and range</i>) | 37 (30.2-44.2) | 30 (20.2-36.4) | 32.3 (21.3-41.6) | 31.6 (20.6-42.8) | 39* (21.3-66.4) |
| Proportion with a history of diabetes mellitus | 90 | 50 | 71 | 56 | 59 |
| Mean A1c (%) (<i>and range</i>) | 9.2 (7.2-13.6) | 10.1 (8.8-11) | 8.4 (6.8-9.2) | 7.6 (5.7-11.2) | 10.3 (7.4-14.1) |
| Clinical syndrome | | | | | |
| Necrotizing fasciitis type I | 10 (100%) | 4 (66%) | 3 (43%) | 8 (89%) | 11 (65%) |
| Necrotizing fasciitis type II | 0 | 1 (17%) | 4 (57%) | 1 (11%) | 6 (35%) |
| Gas gangrene (clostridial myonecrosis) | 0 | 1 (17%) | 0 | 0 | 0 |
| Total cases | 10 | 6 | 7 | 9 | 17 |

*2 out of 17 patients did not have recorded height or weight for BMI calculation.

Table 2. Annual Comparison of Specific Interventions, ICU Admissions, and Case-Fatality Rates.

| | 2016-2017 n = 10 | | 2017-2018 n = 6 | | 2018-2019 n = 7 | | 2019-2020 n = 9 | | 2020-2021 n = 17 | |
|----------------------|---------------------|-----|--------------------|------|--------------------|------|--------------------|------|---------------------|------|
| | No | % | No | % | No | % | No | % | No | % |
| Surgical debridement | 10 | 100 | 6 | 100 | 7 | 100 | 9 | 100 | 14 | 82.4 |
| Skin grafting | 2 | 20 | 0 | 0 | 0 | 0 | 1 | 1.1 | 1 | 5.9 |
| ICU admission | 4 | 40 | 3 | 50 | 2 | 28.6 | 5 | 55.6 | 8 | 47.1 |
| Death | 0 | 0 | 1 | 16.7 | 1 | 14.3 | 0 | 0 | 4 | 23.5 |

a 113% percent increase in cases of necrotizing fasciitis during this time period ($P = .071861$). As represented in [Table 1](#), there was a slight increase in the average BMI of patients presenting with necrotizing fasciitis ($P = .1532$). Consistent with the previous 4 years, the majority of cases were polymicrobial (necrotizing fasciitis type I), and diabetes mellitus was the most common predisposing risk factor.

The mean age of patients who presented during our study period was 59.1, compared to 57.9 in previous years ($P = .780425$). There was also a higher proportion of females compared with previous years; 47% during the pandemic vs an average of 28% in previous years ($P = .0782055$).

In addition to an increase in total volume, there was also an increase in fatalities associated with cases of necrotizing fasciitis during the study period (March 12, 2020 to March 12, 2021). Of the 17 cases, 4 patients died during their admission, producing a case-fatality rate of 23.5%. This represents a statistically significant increase from previous years ($P = .003248$), where the average case-fatality rate was 6.3%. [Table 2](#) shows the number of fatalities, the proportion of patients receiving surgical intervention, and the proportion of patients admitted to the ICU during their hospital course. ICU admissions during the study period were relatively consistent with previous

years, while the overall debridement rate decreased from 100% to 82%. Of the 3 patients who received no surgical debridement, one left against medical advice (AMA), 1 died on the day of their admission, and a third chose to pursue hospice care.

The majority of cases during the pandemic occurred between July and December of 2020. [Table 3](#) lists all 17 cases occurring during the study period in chronological order. Only one patient presented within 24 hours of symptom onset (i.e. swelling, erythema, presence of a boil). In this particular case, the infection was noted by a home health aid. Patient risk factors for necrotizing soft tissue infection are also listed in [Table 3](#), along with serum glucose and A1c values for those that had them recorded during their admission. Eleven of the 17 patients had a previous diagnosis of diabetes mellitus. Of these patients, 9 had an A1c ordered at admission. These patients had an average A1c of 10.3% (range 7.4-14.1). This compares to an average A1c of 8.6% in the pre-pandemic group, representing a 20% increase ($P = .403938$) during the pandemic. Only one patient with previously diagnosed diabetes had an A1c below 7.5%, and only one of these patients had an A1c checked within 6 months of their admission for necrotizing fasciitis.

[Table 3](#) also lists the number of surgical debridements performed per case. The study group had an average of

Table 3. Subset of Patients Admitted during the 2020–2021 Coronavirus Pandemic.

| Admission date | Age | Gender | Symptoms and duration (prior to admission) | Predisposing risk factor | A1c at admission (%) | Serum glucose | Number of surgical debridements |
|----------------|-----|--------|---|--------------------------|----------------------|---------------|--|
| 02/24/21 | 82 | M | 1 week; scrotal pain/swelling | Diabetic | | 110 | 1 (deceased) |
| 01/27/21 | 63 | F | 2 days; right forearm pain after needle stick injury | Alcohol use disorder | | 99 | 1 |
| 01/09/21 | 46 | F | 4 days; boil on right buttock | Diabetic | 8.9 | 104 | 1 |
| 01/06/21 | 71 | M | 3 weeks; scrotal boil | Diabetic | 7.4 | 346 | 3 |
| 12/17/20 | 42 | M | 4 days; scrotal swelling | Diabetic | 9.7 | 254 | 1 |
| 11/28/20 | 71 | F | 1 day; sacral ulcer (identified by home health aid) | Diabetic | | 172 | 1 (deceased) |
| 11/25/20 | 74 | F | Unknown; labial boil | Diabetic | 10.2 | 358 | 2 (deceased) |
| 09/29/20 | 73 | F | Unknown; left leg severe pain, erythema, and swelling | Diabetic | 10.8 | 65 | 1 (followed by BKA) |
| 09/14/20 | 77 | M | 1 week; left buttock swelling | Stage III CKD | 5.6 | 142 | 4 |
| 09/02/20 | 34 | M | 4 days; scrotal swelling and boil | Diabetic | 9.2 | 316 | 3 |
| 08/20/20 | 33 | F | 5 days; pain, erythema, and swelling of right leg | Diabetic | | 78 | 0 (patient left AMA) |
| 08/15/20 | 74 | F | 1 week; pain, erythema, and swelling of right leg | Opioid use disorder | | 100 | 0 (denied surgery; sent home for hospice care) |
| 08/03/20 | 36 | M | 2 days; multiple boils on buttocks | Diabetic | 12.3 | 151 | 7 |
| 07/18/20 | 69 | F | 4 days; perineal boil | Obesity (BMI 40) | 5.8 | 112 | 5 |
| 05/29/20 | 76 | M | Unknown; perineal boil | Obesity (BMI 34) | 5.8 | 135 | 2 |
| 05/21/20 | 38 | M | 1 month; abdominal pain with multiple ulcers | Obesity (BMI 55) | | 228 | 0 (deceased on day of admission) |
| 03/26/20 | 46 | M | >1 month; scrotal swelling | Diabetic | 14.1 | 367 | 5 |

2.2 debridements, which was slightly less than the average for the pre-pandemic group (2.3 per patient). 3 patients in the study group died early during their admission, resulting in the cancellation of further debridement procedures. One patient received a BKA after their first debridement due to the severity of their infection. One patient left AMA, and another elected to pursue palliative care.

Discussion

Necrotizing fasciitis is a severe form of soft tissue infection which necessitates urgent surgical intervention. Delays in care may have severe consequences.^{16,17} It is strongly associated with predisposing risk factors such as diabetes, obesity, and alcohol use, all of which are modifiable with lifestyle modification, regular surveillance, and medication. Due to fear of contracting COVID-19, the pandemic caused many patients to cancel or delay care for both acute conditions and regular health maintenance appointments. For example, European nations collectively saw an 87% reduction in outpatient activity after lockdown measures were implemented.¹⁸ Without regular surveillance, guidance, and support, patients with co-morbidities, such as diabetes, atherosclerotic cardiovascular disease, obesity, and substance use disorders are more likely to

suffer a decline in their overall health status. After the onset of the pandemic, disturbing trends in weight gain, glycemic control, blood pressure, cardiovascular fitness, and mental health were observed.^{19,20} Poorly controlled chronic illness then predisposes to more severe, acute-on-chronic presentations. Outcomes for these patients are likely to be further complicated by delayed presentation to the emergency department.

The University of Vermont Medical Center is a tertiary care hospital serving a large, rural catchment area covering Vermont and upstate New York. It is the only level 1 trauma center in the region. Our study brings into focus the impact of the pandemic on rural trauma hospitals. We observed twice the number of cases of necrotizing fasciitis compared with the previous 4 years and a statistically significant increase in the case-fatality rate. This suggests that the pandemic, as described for many other acute pathologies, had a substantial effect on both the number of patients diagnosed with necrotizing fasciitis and subsequent outcomes after admission.

Compared with prior years, there was a slight decrease in the average number of debridements per patient during the study period. This was contrary to our expectations, as the number of debridements per patient might be considered a marker of disease severity. However, this data

point was likely confounded by the increased case-fatality rate; 2 patients died after their first operative debridement, 1 patient died after only 2 debridements, and another died on the day of their admission before any surgical intervention could be performed. Additionally, one patient had a below-the-knee amputation after their first debridement.

There was also a decrease in the overall debridement rate; 82.4% of patients (14 out of the 17) underwent at least one surgical debridement procedure compared with a rate of 100% in the pre-pandemic group. However, of the patients that received zero surgical intervention, one left against medical advice (AMA), another died before making it to the operating room, and the third elected not to have surgery (severe infection requiring above-the-knee amputation) and was sent home for hospice care. Collectively, it appears as though the observed decrease in average number of debridements per patient, as well as the decreased overall debridement rate may be indicative of increased disease severity at the time of presentation.

The majority of cases reported during the pandemic occurred between July and December of 2020. This period aligns more closely with the “second wave” of coronavirus infections, months after universal lockdown measures were initiated. This may be the result of delayed or neglected primary health surveillance during the early months of the pandemic, predisposing patients to worsening glycemic control, weight gain, etc. In fact, the majority of patients were diabetics and obese, with an average BMI of 39, and an average A1c of 10.3. The observed 20% increase in average A1c—from 8.6% in the pre-pandemic group—was statistically non-significant. Given the fact that the 113% increase in total cases was accompanied by a similar proportion of diabetic patients and slightly worse A1c values (compared with previous years), it is possible the pandemic had an indirect impact on disease burden; likely by way of inadequate health surveillance, particularly in the context of glycemic control. For example, among those with previously diagnosed diabetes mellitus, only one patient had received a previous A1c test within 6 months of admission. This is concerning given that the standard for diabetic patients is to monitor glycemic status every 6 months. Additionally, only one of the patients had an A1c value under 7.5. While there is continued debate over an ideal target A1c, most physicians would consider a value greater than 7.5 to be “poorly-controlled.” Two patients were neither diabetic, nor obese, but struggled with substance use disorders, another important risk factor for necrotizing fasciitis.

Our analysis provides further evidence in support of the need for continued health maintenance visits, despite the presence of a pandemic and accompanying social distancing policies. We believe that such dire consequences necessitate a more thoughtful approach to patient outreach by our government, media, and healthcare institutions.

Study Strengths and Limitations

This is the first study, to our knowledge, that reports on the incidence of necrotizing fasciitis that occurred over the year following the announcement of the worldwide coronavirus pandemic. Since the state of Vermont led the nation in its rapid adoption of strict lockdown measures and social distancing policies, this provides a unique opportunity to analyze the effects of the COVID-19 lockdown. This study is not without limitations. Our sample size is small, making it difficult to extrapolate our findings to larger populations. Many of our patients did not see primary care providers affiliated with our hospital network, limiting our ability to review outpatient visits prior to their admission for necrotizing fasciitis. We can only postulate that these patients were neglecting their general health maintenance through proxies such as their A1c value and BMI's. Future studies should examine the case volume of necrotizing fasciitis at a national level, and provide additional analysis of patient behavior during the months prior to their admission.

Conclusion

The COVID-19 pandemic has had widespread effects; hospitals were overwhelmed, economies were halted, mental health was greatly impacted, and many individuals lost their lives. While strict lockdown measures and social distancing policies were essential in slowing the spread of the virus, the resultant fear and social isolation kept many patients from seeking appropriate medical care for non-COVID-19 illness. The pandemic also had significant effects on mental illness, drug and alcohol abuse, dietary habits, and general health maintenance. As a result, while many patients managed to avoid COVID-19, other aspects of their health and well-being were neglected. As coronavirus precautions dominated headlines, there was little communication regarding these concerning health trends. Necrotizing fasciitis is one of many conditions influenced by the pandemic. While there are previous case-reports describing delayed presentations of necrotizing fasciitis, our study demonstrates an overall increase in incidence, as well as a concerning increase in case-fatality rate. Going forward, healthcare institutions should consider increasing patient outreach to combat the secondary negative effects of an overarching narrative hyper-focused on social distancing and isolation.

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