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A Review of "Flesh Eating" Bacteria Cases in the United States

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Abstract

This research reviews cases of necrotizing fasciitis which is commonly known as flesh eating bacteria, a rare bacterial infection. It can spread rapidly in the victim's body and can cause death. The literature shows that a high percentage of victims are affected by Group A Streptococcus (Group A Strep). Studies have shown that, many victims experience a break in the skin or blunt trauma. The disease is contracted when there is a break in the skin or when an open wound is exposed to coastal salt water. The studies show that anyone can get these bacteria, but victims are more likely to have other health problems such as diabetes, kidney disease and cancer. Once someone is infected by these fatal bacteria, early intervention such as surgery, antibiotic and proper wound care can stop the infection and prevent further injury or death.

Keywords: Necrotizing Fasciitis; Group A Streptococcal bacteria; Necrotizing soft tissue infection; gas gangrene; surgical debridement.

1. Introduction

Flesh eating bacteria is commonly known as necrotizing fasciitis. This infection is usually caused by Group A Streptococcus (GAS).

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In Cunningham's [1] article, he stated that the bacteria are an uncommon, critically serious infection of the subcutaneous tissue and fascia with relative sparing of the skin and muscle, both of which may be infected secondarily. Necrotizing soft tissue infections (NSTIs) are characterized by subepithelial invasion of the soft tissue by microorganisms, resulting in tissue edema, vascular thrombosis, and lymphocytic infiltration [1]. Group A Streptococcus (GAS) was first described in 1874 by Billroth, who demonstrated its presence in wound infections and erysipelas. Pasteur identified GAS as the cause of puerperal sepsis in 1879. In 1884, Rosenbach gave it the name Streptococcus pyogenes. Lancefield made a major contribution in the field of epidemiology in 1933, when she classified β-hemolytic streptococci in different groups [2]. Necrotizing fasciitis is potentially limb and life threatening soft tissue infection. It has been recognized clinically since the time of Hippocrates. It was first documented in modern surgical literature by Joseph Jones as "hospital gangrene." The British tabloids have recently coined the term ''flesh-eating bacteria'' to describe the Group A Streptococci (GAS) that cause invasive necrotizing infections and have suggested that epidemics of strep infections are imminent. Such aggrandizement is unfounded, yet it has served to heighten public awareness of this sporadic, but serious infectious disease [3]. In the 1990's it became popularly known in the media as the "flesh-eating bacteria" disease. This condition is associated with a high mortality rate, ranging from 9% to 29%. Various risk factors for mortality have been analyzed, however most of the literature studies combined incidence of necrotizing fasciitis involving both upper limb and lower limbs [4]. It should be noted that patients with flesh eating bacteria are always misdiagnosed during the initial stage of the disease. If diagnosed early, mortality and amputation rates could be reduced. Patients with necrotizing fasciitis usually present with the triad of pain, swelling and erythema. It is often diagnosed as cellulitis or abscess. The most consistent feature of early necrotizing fasciitis is that the pain is out of proportion to the swelling or erythema [5]. Chee and his colleagues conducted a study in 2009 with a total of forty one (41) patients presented with necrotizing fasciitis of the lower limb and reviewed cases over one year. Results show that the mortality rate for necrotizing fasciitis of the lower limb is quite high at 19.5%. Comparison among necrotizing fasciitis patients reveals that higher mortality rate is seen among those patients with advanced age and those presented with initial high pre-operative creatinine levels. Sex, pre-morbid diabetes mellitus, duration from initial symptoms to presentation for treatment and presence of Streptococcus Group A were not associated with an increased mortality rate [4].

Figure 1 [6]

Necrotizing fasciitis involving the dorsum of the foot of a three-year-old child following a recent Herpes Zoster infection

Figure 2 [7]

Necrotizing Fasciitis of the upper part of left arm

Since the 1980s, there has been a marked increase in the recognition and reporting of highly invasive Group A Streptococcal (GAS) infection associated with shock and organ failure, with or without necrotizing fasciitis [3]. Although flesh eating bacteria is fatal in most cases, early diagnosis and intervention is critical in saving the victim. Cunningham and his colleagues argued that the bacterium moves rapidly in the subcutaneous tissue and does not spare the skin and muscles. Necrotizing soft tissue infections (NSTIs) are characterized by subepithelial invasion of the soft tissue by microorganisms, resulting in tissue edema, vascular thrombosis, and lymphocytic infiltration. Muscle necrosis may result from untreated infection [1]. The diagnosis is often missed initially because of the paucity of clinical signs and symptoms or the clinician's lack of familiarity with the condition [1]. Once the diagnosis is suspected, the patient needs to be adequately stabilized and then taken to the operating room for surgical exploration and debridement. Negative outcomes result from delay in diagnosis, inadequate surgical debridement, and complications of sepsis [1].

Figure 3 [8]

The patient after complete surgical debridement, with extension of the resection from the left shoulder down, including some of the pectoralis, down to the iliac crest and extending to the midline anteriorly over the abdominal cavity.

Figure 4 [9]**:** Anterior (A) and posterior (B) views of the split-thickness skin graft.

The purpose of this research paper is to review various cases of "flesh eating bacteria" in the United States over a period of time. Demographic factors and co-morbid conditions associated with necrotizing fasciitis (flesh eating

bacteria) will be discussed; also early diagnosis and treatment methods.

2. Materials and Methods

Computerized literature searches were performed (Google Scholar 1990 to 2019; Pub Med Central 2014 to 2019; a database specialized in life science journals) to identify all studies on the subjects. Publications thus found were screened for further relevant articles in their bibliographies. In addition, leading experts and national societies were contacted and asked for further materials. Studies were admitted into the present review if they related to flesh eating bacteria in the United States over a specific period of time. Search terms included "flesh eating bacteria", "necrotizing fasciitis", "group A streptococcal bacteria", "necrotizing soft tissue infection", "gas gangrene" and "surgical debridement." Additional information was obtained by a detailed review of the references listed.

3. Results

Kehrl [10] reported a case of Group a Streptococcus Necrotizing Fasciitis recognized with Point of Contact Ultrasound and subsequent negative findings on computed tomography and magnetic resonance imaging. He argued that this flesh eating bacteria is challenging in diagnosing and ultrasound should be included in helping clinicians make early diagnosis to optimize outcomes. Figure 5 depicts the possible depths of involvement of skin and soft tissues infections and the accompanying diagnoses. Superficial infections such as erysipelas, impetigo, folliculitis, furuncles, and carbuncles are located at the epidermal layer, while cellulitis reaches into the dermis. Deeper infections cross the subcutaneous tissue and become fasciitis or myonecrosis. However, the depth of infection is difficult to discern on examination; laboratory studies can help with this assessment [10]. Points are allocated for high C-reactive protein, creatinine, glucose, and white blood cell count values and for low red blood cell counts and sodium levels. Patients with a score of five points or less are considered at low risk, while those with six or more points are considered to be at least at intermediate risk of necrotizing fasciitis [12].

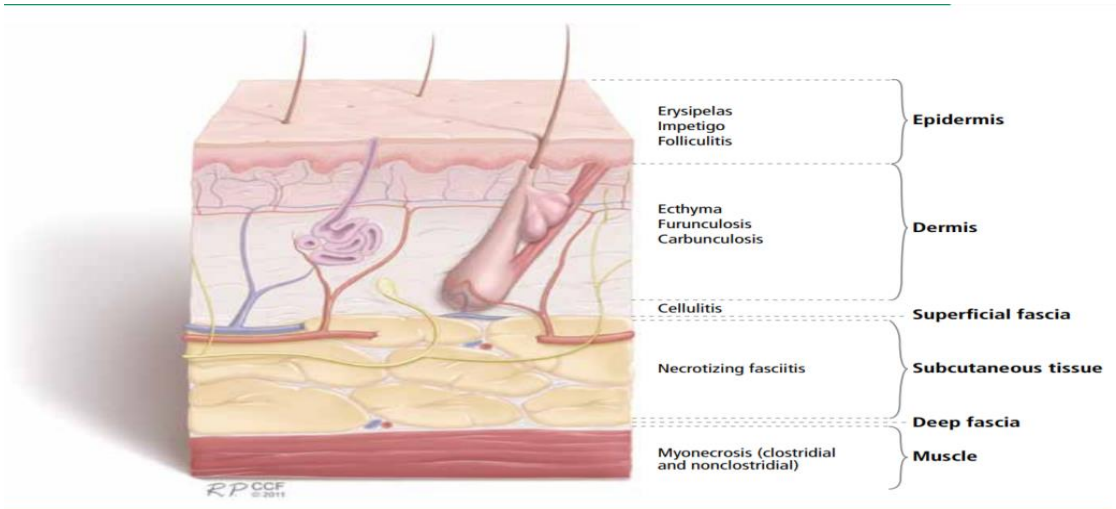

Figure 5 [11]

Depth of involvement in skin and soft- tissue infections

Flesh eating bacteria is a rare condition but it is extremely serious. Around 1 in 4 affected individual die from it. Since its onset is spontaneous most people affected with it are generally in good health before infection [10]. Necrotizing fasciitis has a mortality rate of 23.5%, but this may be reduced to 10% with early detection and prompt surgical intervention [12]. Wong, Chin-Ho and his colleagues [14] created the LRINEC or Laboratory Risk Indicator for Necrotizing Fasciitis, which is done to determine the risk to the affected individual. Since necrotizing fasciitis is very difficult to diagnose, clinicians must maintain a high level of suspicion and use the Laboratory Risk Indicator for Necrotizing Score (LRINEC) score (Table 1) to trigger early surgical evaluation. Surgical exploration is the only way to definitively diagnose necrotizing fasciitis [12]. The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score was developed as a diagnostic tool to potentially aid practitioners in early detection of Necrotizing Fasciitis (NF). A LRINEC score between 0 and 13 can be calculated based on levels of serum leukocytes, glucose, sodium, C-reactive protein (CRP), creatinine, and hemoglobin. All six components of the LRINEC score are required for valid calculation. LRINEC scores ≥8 fall in the high-risk category, LRINEC scores of 6–7 are moderate risk, while scores ≤5 are considered low risk. Previous evidence suggested that a patient with a LRINEC ≥6 should be further evaluated for NF diagnosis [15].

Table 1: LRINEC [13]

The Laboratory Risk Indicator for Necrotizing Fasciitis score

VALUE	POINTS
C-reactive protein, mg/dL	
< 150	0
> 150	4
White blood cell count, × 10^9/L	
< 15	0
15–25	1
> 25	2
Hemoglobin level, g/dL	
> 13.5	0
11–13.5	1
< 11	2
Sodium level, mmol/L	
≥ 135	0
< 135	2
Creatinine level, mg/dL	
≤ 1.6	0
> 1.6	2
Glucose level, mg/dL	
≤ 180	0
> 180	1

RISK CATEGORY	POINTS	PROBABILITY
Low	≤ 5	< 50%
Intermediate	6–7	50%–75%
High	≥ 8	> 75%

REPRINTED FROM ANAYA DA, DELLINGER EP. NECROTIZING SOFT-TISSUE INFECTION: DIAGNOSIS AND MANAGEMENT. CLIN INFECT DIS 2007; 44:705–710, BY PERMISSION OF OXFORD UNIVERSITY PRESS.

Arif and his colleagues [16] estimated the mortality burden of necrotizing fasciitis in the United States over a 10-year period. They also sought to characterize demographic factors and comorbid associated with necrotizing fasciitis during this period. Data from the National Center for Health Statistics was used to obtain data on necrotizing fasciitis. Information from death certificate from all 50 states, including demographic and cause of death for the year 2003 – 2013 were included. A total of 9,871 necrotizing fasciitis deaths in the United States between 2003 and 2013 (Table 2) were identified. This corresponded to a summary mortality rate of 4·8 deaths/ 1 000 000 p-yr. Arif and his colleagues show necrotizing fasciitis was reported as the underlying cause in 4185 (42%) deaths, and a contributing cause of death in 5686 (58%) deaths. An autopsy was reported in 885 (9%) of 9871 deaths, and autopsy status was unknown in an additional 1034 (11%) deaths [16]. An underlying microbiological diagnosis was provided in 546 (6%) of 9871 deaths. Of these 546 deaths, streptococcal infection was identified in 260 (48%) deaths, staphylococcal infection in 119 (22%) deaths, Gram-negative infection in 114 (21%) deaths, gas gangrene in 28 (5%) deaths, anaerobic infection in 15 (3%) deaths, and a mixed infection was identified in 10 (2%) deaths. Thus, type II (mono-microbial) NF due to either Staphylococcus or Streptococcus was identified in 379 (69%) of 546 deaths where a microbiological diagnosis was included in the cause-of-death information [16]. Arif and his colleagues argued that advanced age was associated with an increasing rate of necrotizing fasciitis as compared to individuals who were 35-44 years. Men were 1.25 times greater than women to be infected by these bacteria. Blacks' mortality rate was doubled compare to whites. However, Arif and his colleagues demonstrate that the rate in Native Americans was nearly three times the rate in white individuals. For Asian there was a great contrast which showed the mortality rate was 28% more that white individuals. Arif and his colleagues used ICD-10 codes by block to describe the most common conditions included in the death certificates for necrotizing fasciitis related deaths. (Table 4). Diabetes mellitus was the most common comorbid condition, identified in 21% of all deaths. Renal disease, ischemic heart disease, and substance use were also frequently reported as comorbid conditions. Kehrl [10] reveals a 54-year-old diabetic woman who was seen in the Emergency Department with complaints of atraumatic right foot and lower leg pain associated with fever. There were concerns regarding necrotizing fasciitis and the patient had a point of contact ultrasound performed. The result was consistent with necrotizing fasciitis since there was a thickened deep fascia with fluid tracking along the deep fascial plane and fluid pockets measuring 6 mm in depth. Patient was referred for surgical consultation and a Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) of the patient's lower extremity were performed. Both tests interpretation by the radiologist was consistent with cellulitis. Patient eventually began to experience septic shock and multisystem organ started to fail. So patient was eventually taken to the operating room for further intervention. The findings conducted showed patient was infected with necrotizing fasciitis since cultures in the operating room were positive for Streptococcus pyogenes. Kehrl concluded that necrotizing fasciitis is a surgical emergency and it's critical to have early and accurate diagnosis so that aggressive management can be implemented for optimal outcomes.

Table 2: Annual frequency and rate of necrotizing fasciitis related deaths in the U.S., 2003–2013 [16]

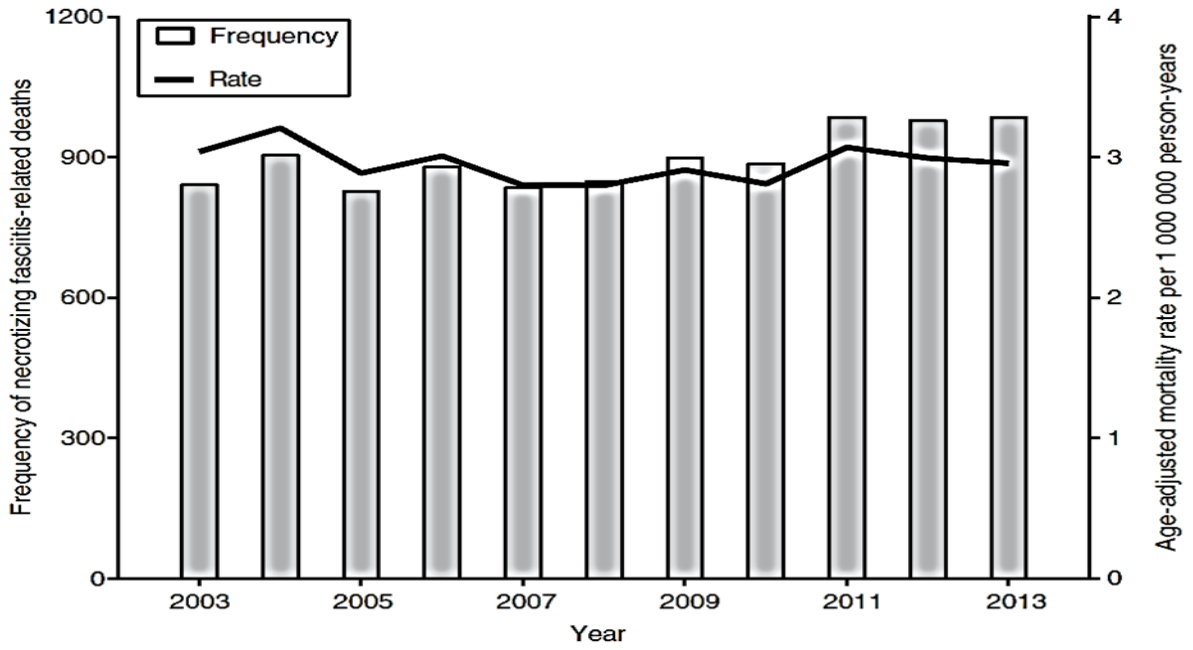

Table 3: Necrotizing fasciitis-related mortality rates/1 000 000 p-yr. [16]

Characteristic	Deaths *n* (%)	Age-adjusted mortality rate/1 000 000 p-yr (95% CI)	Age-adjusted mortality rate ratios (95% CI)
Age group, yr* ($N = 9870$)			
<1	34 (0·3)	0·77 (0·51–1·03)	0·45 (0·30–0·61)
1–4	5 (0·1)	0·03 (0·00–0·05)	0·02 (0·00–0·03)
5–14	34 (0·3)	0·08 (0·05–0·10)	0·04 (0·03–0·06)
15–24	73 (0·7)	0·15 (0·12–0·19)	0·09 (0·07–0·11)
25–34	297 (3·0)	0·67 (0·59–0·74)	0·39 (0·34–0·44)
35–44	794 (8·0)	1·71 (1·59–1·83)	Reference
45–54	1876 (19·0)	3·91 (3·74–4·09)	2·29 (2·10–2·48)
55–64	2461 (24·9)	6·56 (6·30–6·81)	3·83 (3·52–4·17)
65–74	1893 (19·2)	8·22 (7·85–8·59)	4·80 (4·41–5·20)
75–84	1585 (16·1)	10·99 (10·45–11·53)	6·42 (5·87–6·97)
⩾85	818 (8·3)	14·27 (13·29–15·25)	8·34 (7·52–9·15)
Sex			
Female	4807 (48·7)	2·65 (2·57–2·73)	Reference
Male	5063 (51·3)	3·31 (3·22–3·39)	1·25 (1·20–1·30)
Race/ethnicity			
White, non-Hispanic	6548 (66·4)	2·58 (2·51–2·65)	Reference
Black, non-Hispanic	1694 (17·2)	5·07 (4·88–5·26)	1·97 (1·87–2·06)
Hispanic	1209 (12·3)	3·67 (3·54–3·80)	1·42 (1·36–1·49)
Asian, non-Hispanic	255 (2·6)	1·87 (1·68–2·05)	0·72 (0·65–0·80)
American Indian or Alaskan Native, non-Hispanic	164 (1·7)	7·37 (6·46–8·27)	2·86 (2·50–3·21)

Table 4: Most common comorbid diagnoses in individuals with necrotizing fasciitis-related deaths in the United

States [16]

Comorbid condition	ICD-10 block codes	Deaths *n* (%)
Diabetes mellitus	E10–E14	2109 (21)
Other forms of heart disease	I30–I52	1972 (20)
Renal failure	N17–N19	1592 (16)
Other diseases of the respiratory system	J95–J99	1002 (10)
Mental and behavioural disorders due to psychoactive substance use	F10–F19	934 (10)
Ischaemic heart diseases	I20–I25	753 (8)
Hypertensive diseases	I10–I15	717 (7)
Diseases of liver	K70–K77	617 (6)
Obesity and other hyperalimentation	E65–E68	519 (5)
Chronic lower respiratory diseases	J40–J47	338 (3)
Influenza and pneumonia	J09–J18	323 (3)
Metabolic disorders	E70–E90	304 (3)
Malignant neoplasms of digestive organs	C15–C26	294 (3)
Malignant neoplasms, stated or presumed to be primary, of lymphoid, haematopoietic and related tissue	C81–C96	282 (3)

Table 5: Medical conditions associated with necrotizing fasciitis (NF) deaths in the United States, 2003–2013[16]

Condition	ICD-10 Codes	NF-related deaths (*N* = 9871) *n* (%)	Matched controls* (*N* = 98 710) *n* (%)	Matched OR (95% CI)
Diabetes mellitus	E10–E14	2109 (21)	10 316 (10)	2·37 (2·25–2·50)
Heart disease	I00–I99	3301 (33)	49 007 (50)	0·49 (0·47–0·51)
Renal failure	N17–N19	1695 (17)	8223 (8)	2·31 (2·18–2·45)
Substance use	F10–F19	934 (9)	12 076 (12)	0·74 (0·69–0·80)
Liver disease	K70–K77	617 (6)	5872 (6)	1·06 (0·97–1·15)
Obesity	E65–E68	519 (5)	1928 (2)	2·83 (2·56–3·13)

Table 6: Places in the United States Where People Have Reported Contracting Flesh-Eating Bacteria in 2019

Table 6 demonstrates that most people in the United States contracts necrotizing fasciitis (flesh eating bacteria) along the warm coastal waters of the states bordering the warm waters of the Gulf of Mexico. The map shows that the bacteria can also be found along the Atlantic and Pacific coasts.

3.1. Strain Specifics

A review of the literature demonstrates that there are many strains of bacteria that can cause necrotizing fasciitis. Streptococcus pyogenes, staphylococcus aureus, bacteroides fragilis, aermonas hydrophila, and the vibrio bacteria are among the many strains. Although the literature states that staphylococcus aureus is the most common strain, the Vibrio bacteria is now of great concern since these bacteria are becoming more deadly as a result of warmer temperature. All coastal waters and estuaries contain *Vibrio* bacteria. Although many *Vibrio* species are harmless, several can cause serious disease in humans or animals. *Vibrio vulnificus* and *V. parahaemolyticus* are the most common types of sometimes deadly foodborne and wound *Vibrio* infections. Recognized infections from *Vibrio* species are on the rise, and although there is some uncertainty, most researchers predict that climate change will increase cases [18]. Studies show that the Vibrio virus is contracted mostly from eating contaminated seafood, mainly shellfish or can be through an infection from an open wound while swimming in the ocean. Most people with weak immune system could be infected by this virus. Froelich and Noble suggest that most infections are unreported, and it is estimated that in the USA approximately 84,000 people contract a food-borne infection from *Vibrio* species every year, the highest rate since nationwide reporting began.

3.2. Treatment Schemes

Intravenous Venous (IV) Antibiotics

Once necrotizing fasciitis is confirmed, it is very important to start Intravenous Venous (IV) antibiotic without delay. Initial antibiotic selection should encompass agents with activity against a broad range of organisms, including aerobes, methicillin-resistant *Staphylococcus aureus* (MRSA) and anaerobes. Patient-specific factors such as previous antibiotic exposure, concomitant disease states, organ dysfunction, and allergies should be considered in the selection of antibiotics [19]. Hakkarainen and his colleagues [20] indicate that broad-spectrum antimicrobial therapy should be initiated in all cases of suspected NSTI. Initial empiric therapy should include gram-positive, gram-negative, and anaerobic coverage. Local incidence of MRSA infection should be considered and anti-MRSA coverage based on locoregional resistance patterns may be indicated [20]. In treating necrotizing soft-tissue infections, the authors have shown that Vancomycin is included for empiric coverage since there is a significant local incidence of MRSA infection in their institution's referral region. Our empiric therapy regimen consists of 4 antimicrobials: penicillin G, clindamycin, vancomycin, and gentamicin. Penicillin G has significant activity against streptococcal and clostridial species. As stated, vancomycin provided empiric coverage for MRSA infection. Clindamycin has relatively broad activity, but specifically it has been shown to decrease α-toxin production by clostridial species, reduce superantigen M protein by streptococcal species, and suppress lipopolysaccharide–induced tumor necrosis factor-α production by monocytes. Gentamicin provides broad coverage for many gram-negative rods and anaerobic species [20]. Hakkarainen and his colleagues also argued that fluoroquinolones is used instead of gentamicin if patients have a high creatinine level at initial evaluation. At this point there is a great concern for acute kidney injury and prevent patient from getting nephrotoxity of aminoglycosides. The authors explain that the regimen is continued until microbial culture allows appropriate narrowing of coverage, or until operative debridement is complete and the patients become hemodynamically stable with a normal or near-normal white blood cell count [20].

3.3. Surgical debridement

Surgical debridement is critical to save limbs that are infected. Nothing should delay emergent surgical debridement and antibiotic administration, as both are important in ensuring survival [19]. Misiakos and his colleagues explain that surgical management is indicated especially for patients displaying intense pain and skin color change, such as edema and/or ecchymosis, or signs of skin ischemia with blisters and bullae. They suggest that patients must be operated on urgently when they present with altered mental status, hypotension, and elevated band formed in the differential white blood cell count, and metabolic acidosis [21]. The authors explained that incisions are performed parallel to Langer's lines to achieve better surgical wound healing and less scarring. They revealed that surgery also minimizes the overall tissue loss as it inhibits infection spread to the fascial plane, reducing the need for amputation. After the release of pus and/or hemorrhagic fluid through incisions, ventricle incisions are made, keeping the wound open in order to allow drainage and to remove additional necrotic tissue. Misiakos and his colleagues [21] indicate that patients with necrotic fasciitis should be closely monitored during the next 24 hours and surgical wounds and tissue viability should also be checked. If the surgical wounds are complicated a "second -look" operation with radical surgical debridement will be performed. This type of

operation will actually eliminate any residual infection so that patient will be able to heal. Patients with necrotic fasciitis can require from 5 up to 40 additional operations, depending on the timing of the first surgical debridement, the adequacy of the primary debridement and necrosectomy, signs of hemodynamic instability, and concomitant illnesses, all of which are associated with a high mortality rate. Evidence of hemodynamic instability demands immediate resuscitation, transfer to an intensive care unit, nutritional support, and enteral feeding [21].

3.4. Hyperbaric oxygen (HBO) therapy

Hyperbaric oxygen treatment is another recognized therapy where oxygen is forced in the blood stream and healing of the tissue is repaired and return to normal. Hyperbaric oxygen (HBO) therapy is a treatment modality in which a patient is placed in a high- pressure chamber, resulting in delivery of oxygen at 2-3 times typical atmospheric pressure. This leads to arterial oxygen tension as high as 2000 mm Hg with resulting tissue oxygen tension of 300 mm Hg. This compares with arterial oxygen tension of 300 mm Hg and tissue oxygen tension of 75 mm Hg when breathing 100% oxygen at normal atmospheric pressure. The use of HBO is based on animal and human studies showing that elevated levels of oxygen at the tissue level reduce edema, stimulate fibroblast growth, increase the killing ability of leukocytes by augmenting the oxidative burst, have independent cytotoxic effects on some anaerobes, inhibit bacterial toxin elaboration and release, and enhance antibiotic efficacy[20]. Most patients diagnosed with necrotizing fasciitis usually experience shock. This is a life-threatening condition when the body is not getting enough blood flow. At this stage the cells and organs in the body can be damaged because of limited oxygen and nutrients. Main protocol to prevent shock is to use intravenous immunoglobulin (IVIG). Kadri and his colleagues [23] identified patients from 2010 to 2014 from 130 hospitals with a diagnosis of necrotizing fasciitis and were preparing to undergo surgical debridement. There were 4127 cases of debrided necrotizing fasciitis patients with a diagnosis of shock all from 121 centers. The study showed that 164 patients (4%) at 61 centers received IVIG but the subjects were younger with lower comorbidity indices, but had more severe illness. Clindamycin and vasopressor intensity were higher among IVIG cases, as was coding for toxic shock syndrome (TSS) and group a streptococcus. In-hospital mortality did not differ between matched IVIG and non-IVIG groups (crude mortality, 27.3% vs 23.6%; adjusted odds ratio, 1.00 [95% confidence interval, .55–1.83]; P= .99). Early IVIG (≤2 days) did not alter this effect (P = .99). Among patients coded for TSS, GAS, and/or *S. aureus*, IVIG use was still unusual (59/868 [6.8%]) and lacked benefit (P = .63). Median length of stay (LOS) was similar between IVIG and non-IVIG groups (26 [13–49] vs 26 [11–43]; P = .84). Positive predictive values for identifying true NF and debridement among IVIG cases using our algorithms were 97% and 89%, respectively, based on records review at 4 hospitals [23]. The authors concluded that adjunctive IVIG was administered infrequently in necrotizing fasciitis with shock and had no apparent impact on mortality or hospital LOS beyond that achieved with debridement and antibiotics [23].

1. Necrotizing fasciitis of left arm

2. After debridement

Figure 6 [24]

A Necrotizing fasciitis of the left arm demonstrating ruptured bullae with clear fluid, fixed discoloration and skin gangrene. **B** Thorough debridement of the involved fascia showing underlying tendons and muscle bellies; note the extent of the debridement

1. Necrotizing fasciitis of left foot

2. After debridement

Figure 7 [25]

Necrotizing Fasciitis of the left foot and after debridement

3.5. Rehabilitation

Although necrotizing fasciitis is fatal in most cases, some victims survive since the bacterium was identified in the early stage. But survival does not mean that these victims will have positive outcome and live normal lives after hospitalization. Many of these victims have undergone amputation and now have to face the rehabilitation process which can be long and painful. In order to gain independence victims have to learn to walk with new prosthesis and be able to function independently again. Many victims could end up with a caretaker if they are unable to care for themselves. After an extended hospitalization, multiple dressing changes and surgical procedures, the survivor of necrotizing soft-tissue infections faces months of continued physical therapy to regain functional independence [22]. Light and his colleagues [26] conducted a study on long-term follow-up of a registry of patients from 1989 to 2006 who survived a hospitalization for necrotizing fasciitis. The last date of follow up was January 1, 2008 in a University-based Burn and Trauma Center. The authors linked the data from the Department of Health, Department of Motor Vehicle and the University Hospital Medical Records Department in January 2008 to obtain follow up and vital status data. The authors concluded that patients who survive an episode of necrotizing fasciitis are at continued risk for premature death; many of these deaths were due to infectious causes such as pneumonia, cholecystitis, urinary tract infections and sepsis. Hakkarainen and colleagues [22] conducted interviews with 18 survivors of necrotizing soft-tissue infection. The main focus was to understand the patients' experience after diagnosis of the infection. The main areas that the authors focused on were individual factors, relational factors and societal factors. The factors were divided into two categories: factors affecting the disease process and recovery and factors that were outcomes of the disease process. Each category resulted between one and seven themes which were physical, psychological, relationship, and employment aspects. Patients who were interviewed revealed that their quality of life was significantly affected by their disease and recovery. The results also demonstrate that many outcomes of importance for patients are not easily assessed by traditional measures of outcomes. Hakkarainen and his colleagues work illustrates the multidimensional nature of recovery from critical illness. It also represents a massive transition period in the lives of survivors that affects the patients, and their family and the patient's ability to interact with society [22]. Kruppa and his colleagues [27] conducted a study to evaluate the midterm outcomes after survival of necrotizing fasciitis. The authors argued that immediate radical surgical intervention followed by antibiotic treatment and intensive care is necessary to save the patients' lives. However, the scars, amputations, anus sphincter, and the large areas with mesh graft transplantation or free tissue flaps to restore the integument after extremity salvation may lead to permanent disability due to joint contractures or hypo- or hyperesthesia. In addition assistive devices and permanent need for care might be necessary [27]. A recent study conducted by Pham and his colleagues [28] reported on the functional outcomes of patients surviving necrotizing fasciitis. The authors evaluated the management and assess factors associated with decreased physical function in patients who survived this life-threatening infection. The authors reported extremity involvement as an independent factor of a higher functional limitation in patients after survival of necrotizing fasciitis. However they also show that a performed amputation had no further impact on the functional limitation. Thirty percent of the patients in the population study presented with mild-to-severe functional limitations.

3.6. Discussion

Center for Disease Control (CDC) website [29] explains that necrotizing fasciitis is not a nationally notifiable condition. This means that the disease is not required to be reported by the law. This disease can be caused by a variety of bacteria. CDC tracks necrotizing fasciitis caused by group A strep with a special system called Active Bacterial Core surveillance (ABCs). Since 2010, approximately 700 to 1200 cases occur each year in the United States. This is likely an underestimate. According to ABCs data, the number of annual group A strep necrotizing fasciitis infections reported to ABCs do not appear to be rising [29]. This data could be an underestimate of the people actually affected by the bacteria. Since the CDC does not require this disease to be reported, the numbers of victims affected could be higher. The actual data shows a lower number of people affected by the actual disease as a result of CDC reporting requirement. Kehrl recommends using ultrasound to help clinician make early diagnosis of necrotizing fasciitis. This method can be very expensive for patients without health insurance and physicians might be reluctant to use this as first method in diagnosing the disease as a result of cost saving. The literature shows that black mortality rate is doubled compare to whites. One can argue that the lack of health insurance and limited health care access might be the main cause of the high mortality rate among blacks. So, one could also state that the rate of necrotizing fasciitis will show limited reduction from the use of ultrasound since most of the deaths are from blacks with limited access to health care. The literature shows that cellulitis is frequently diagnosed instead of necrotizing fasciitis. A review of the diagram (Figure 5) on the involvement in skin and soft-tissue infection, it is very clear that patients could be misdiagnosed since the symptoms are so similar. As a result of this similarity in symptom, it is critical that the correct diagnosis be made in the initial assessment since the delay in diagnosis can be critical and cause death or amputation. Table 5 identifies the most common condition included on the death certificate for all necrotizing fasciitis patients is diabetes. Patients with diabetes are already immunosuppressed since this is a life-threatening condition. It is important that the healthcare system provide adequate outreach programs so that this condition can be managed and patients will have a better understanding of diet and exercise and the overall proper care of themselves. All the other co morbid conditions should be addressed by educating patients on their conditions and therefore reduce the number of patients presented with necrotizing fasciitis.

4. Conclusion

The current treatment for flesh eating bacteria includes, antibiotics, surgery and intravenously administered immunoglobulins. Table 1 provides healthcare professional as well as laboratory personnel the ability to collaborate and discuss patients' risk factors by reviewing blood test results. As a result, an early diagnosis can be made and patients will be given the appropriate treatments according to the severity of infection. Numerous reports demonstrate that flesh eating bacteria can cause death if diagnosis is delayed. Therefore health care professional should be trained with the current treatments that are available. Since this bacterium is so rare, but fatal, most health care professional usually diagnose the patient's bacteria with cellulitis and as a result of this wrong diagnosis, patients' limbs are amputated or they die. There is no time to waste with these rapid moving bacteria. Necrotizing fasciitis is a very rare disease and health care professional are not up to date with the appropriate treatment since the disease is so infrequent. In the past decade, this disease is now brought to the forefront as a result of improved access to information. Since there are now newer techniques being developed

to help in early and accurate diagnosis, health care manager should ensure that their staff is adequately trained so that Staphylococcus A bacteria will always be diagnosed correctly and a patient will not experience unnecessary pain. Since clinical manifestation is very important in diagnosing these bacteria, laboratory personnel should be aware of the various lab values and report abnormal results to the physician so that a plan of care can be immediately implemented. In conclusion, necrotizing fasciitis is difficult to diagnose in the early stage since there are nonspecific signs such as swelling, tenderness and erythema at the affected site. The study confirms that this soft tissue infection has similar presentation as cellulitis, it should be diagnosed without delay. For infected patients, surgical debridement is critical and this procedure should be implemented immediately to save limbs and lives. This review is important because it describes how the current literature is related to prior research on necrotizing fasciitis (flesh eating bacteria). This study advances the study of necrotizing fasciitis by reviewing current treatment that did not exist in previous years.

5. Constraints/limitation of the Study

There are potential limitation to this study. There could be bias from the survey conducted on morbidity of patients who have been diagnosed with "flesh eating" bacteria. Some patients might not have answered the questions correctly as a result of not understanding the survey questions. In addition, as a review article only, no hypothesis was tested, and all reports are necessarily anecdotal without specific independent analysis of medicals.

6. Recommendations

The research revealed that "flesh eating bacteria" is fatal in most cases. However if the bacterium is identified early, the patient will not suffer amputation or death. Based on these findings, future research should be conducted so that the medical community will have a better understanding of the current treatment modalities being used as well as testing requirements. It is also critical that information be distributed to the public concerning typical areas of risk and necessity of carrying hydrogen peroxide for puncture wound cleaning and application to cuts.

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