Original Research

Necrotizing Fasciitis: A Vicious Soft Tissue Infection: Review Article

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Abstract

Background: Necrotizing fasciitis is rapidly progressive, lethaldestructive inflammation with polymicrobial infection and secondary necrosis. Though it is a disease described from the Hippocratic era, there is an increase in the incidence of necrotizing fasciitis. The most important factors determining the outcome of the disease are early diagnosis and aggressive debridement.

Materials and Methods: Cross-sectional descriptive study was conducted in a tertiary care teaching hospital's surgical ward. A total of 50 patients, diagnosed with necrotizing fasciitis based on the criteria set were included in the study. After detailed clinical and laboratory evaluation, appropriate and adequate surgical and medical interventions were administered and were followed to note the outcome.

Results: The majority of patients were over 40 years old and 74% of them were male. 72% of them had fever, 88% of them had tenderness. 68% of the patients had involvement of the lower extremities. Trauma was the predominant triggering factor and diabetes, the most commonly associated predisposing disease present in 72% of patients. 84% of the infections were polymicrobial and E. coli was isolated from 74% of them. 4 patients succumbed to the disease and 6 patients needed amputations as a life-saving measure. Acidosis and hypoalbuminemia were the most common independent predictive factors for mortality. Once sepsis is overcome and the granulation tissue is formed, the wound is covered with an SSG or flap cover.

Conclusion: The aggressive and destructive course of necrotizing fasciitis could lead to morbidity and mortality. Early recognition, aggressive debridement are the essential steps for recovery. Though broad-spectrum antibiotics started as empirical therapy to avoid the catastrophe of septic shock, appropriate antibiotics should be started as the disease is often polymicrobial. Acidosis, truncallocation, leucocytosis and decreased albumin were found to be factors strongly associated with mortality.

Key words: Necrotizing fasciitis, debridement, polymicrobial

Introduction

Necrotizing fasciitis represents a group of life-threatening, rapidly progressing bacterial infections associated with necrotic changes affecting the superficial fascia, subcutaneous tissue and deep fascia. This most aggressive form of necrotizing soft tissue infection is associated with a high mortality rate and can extend rapidly to the whole limb within hours[1,2]. The first surgeon to give a clear description of necrotizing fasciitis was Joseph Jones[1], a surgeon

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in the Confederate Army of the United States in 1871. The disease affected 2642 soldiers with a mortality rate of 46 % during the Civil War and was notified as "hospital gangrene". These lesions were referred as Fournier gangrene, acute hemolytic streptococcal gangrene, gas gangrene (clostridial myonecrosis), acute dermal gangrene, Meleney ulcer, suppurative fasciitis and synergistic necrotizing cellulitis.

Wilson in 1952 called it necrotizing fasciitis based on his observation of 22 patients who presented with edema, necrosis of subcutaneous fat and fascia without affecting the underlying muscles[3].

Necrotizing fasciitis has a varied presentation from mild to fulminant causing mortality in 6-76% of patients affected. A delay in diagnosis and the resultant delayed operative debridement often enhance mortality[4]. A high index of suspicion is warranted for the identification of red flag signs and the early prediction of fatal complications[5].

If adequate suspicion is not given, a delay in diagnosis will result. Another group of people may present without any underlying signs but with toxic features due to sepsis. Features ofedemasets in with tenderness. Skin surface will develop vesicles, bullaeand crepitus. The patches of discoloration with dusky blue lesions and gangrene sets in within four to five days. Along with the local signs, the disease will invoke systemic manifestations with altered mental status, tachycardia, dyspnoea, decreased urine output, fever, chills, hyperglycemia and metabolic acidosis[6].

It is a synergistic infection with aerobic, anaerobic or mixed flora[7]. Giuliano et al in 1977 grouped this into two microbiological groups of Necrotizing fasciitis. Currently necrotising fasciitis is classified on the basis of the involved microbes into the following four types

- Type I polymicrobial
- Type II Group A streptococcal
- Type III Gram-negative monomicrobial infection, mainly by *Clostridium* species. Marine organisms such as *Vibrio vulnificus* or *Aeromonashydrophilia* will also cause NF.
- Type IV fungi like Candida and Zygomycetes in immunocompromised patient

Pathogenesis:

Group A beta-hemolytic Streptococcus (GABS) is a major cause of monomicrobial infection with an underlying cause such as diabetes, atherosclerotic vascular disease or venous insufficiency with edema[8]. This monomicrobial Necrotizing fasciitis is more commonly reported in the extremities, abdomen, groin and perineum. The surface protein expression and toxin production are the main bacterial factors determining the severity. M-1 and M-3 surface proteins, enhances the adherence of the streptococci to the tissues and also protect the bacteria from phagocytosis by neutrophils.

Management:

Wong et al in their retrospective study, revealed significantly increased mortality if there is a delay in surgery of more than 24 hours[4]. Treatment with IV Immunoglobulin and hyperbaric oxygen therapy was attempted with varied outcomes. Negative suction drainage is used in many centres.

Materials and methodology

A prospective cohort database analysis of the results of patients diagnosed and treated for necrotizing fasciitis between January 2021 and December 2022 in Kanyakumari Government Medical College. It is a descriptive-analytical study. Institutional ethical approval was obtained and bioethical principles of research were followed. Written consent was obtained from all participants of the study.

Inclusion criteria:

Adult patients (12 to 80 years old)with a suspected or proven diagnosis of necrotizing fasciitis with the following features,

- Classic triad of symptoms: local pain, swelling and erythema.
- Tachycardia (>100 beats/min)
- Fever.
- Hypotension (SAP < 100 mmHg)
- Tachypnoea (>20/min).
- Temperature greater than 38 ◦C.
- Heart rate greater than 110 beats/min.
- Urine output less than 30 mL/h.

- Mental confusion and disorientation regarding time, place and person.

Total number of patients included in this study was 50.

Treatment:

All patients were subjected to a complete blood count, coagulation profile, blood chemistry, blood culture for bacteria, a chest X-ray and electrocardiogram.

Radical and aggressive debridement is done by surgical procedure on an emergency basis within 2-6 hours of the diagnosis. Tissue culture has been done and pending report, broad spectrum cephalosporin injection is started. Depending upon the general condition and status of shock, patients are either managed in the intensive care unit or in the ward setting.

The collected information was entered and the Statistical package for social science (SPSS) program was used for data analysis. Study parameters including demographic profile were described using percentages for categorical variables and in the median, for continuous variables. The chi-square test was used for categorical variables at a 95% confidence interval. $P < 0.05$ is taken as a significant value.

The clinical and microbiological profiles of the patients were analyzed in relation to age, sex, clinical features, site of infection, risk factors, etiological factors, microbial characteristics and treatment outcome.

Results

In our study, 74 % of people were in the age group above 40 (odds ratio = 3.4, $P < 0.05$). The Males were affected more with the ratio of Male: Female was 3:1, as out of 50 patients in the study 37 were male.

Table 1: Demographic pattern

Factors	Category	Number (%)	Male	Female
AGE	12-25	3 (6%)	2	1
	25-40	10 (20%)	7	3
	40-50	12 (24%)	8	4
	>50	25 (50%)	20	5
		50 (100)	37	13

The median time taken by the patients to report to the hospital was 8 days and it ranged from 4 to 15 days. The median number of debridement performed per patient was 5. Four of the patients (8%) couldn't recover and succumbed to the disease. Major amputation was done in 6 patients and minor amputation in 7 patients. Mean duration of hospital stay of these patients was 19 days. 21 patients were treated with SSG and in 3 patients flap cover is given. 10 patients received treatment in intensive surgical care and in 15 patients vacuum therapy is used.

Table 2: Outcome and mode of treatment

Factors	Number	Frequency %
Recovery	46	92
Mortality	4	8
Major Amputation	6	12
Minor Amputation	7	14
SSG	21	42
Flap coverage	3	6
Vacuum therapy Dressing	15	30
ISCU Care	10	20
Mean Hospital stay	19 days	

In our study, the most common site involved was the lower extremity (68%) followed by the upper extremity (14%).5 (10%) wounds were over the perineum and in the buttock.2(4%) patients had the infection over the head, neck and back.

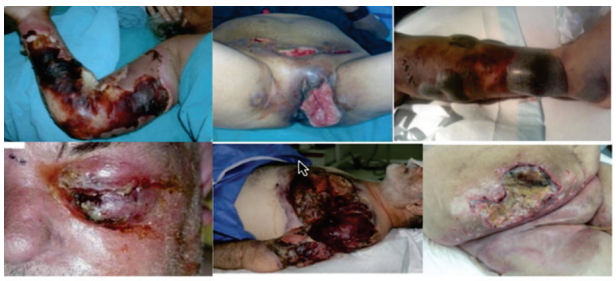

Fig 1: The different sites involved.

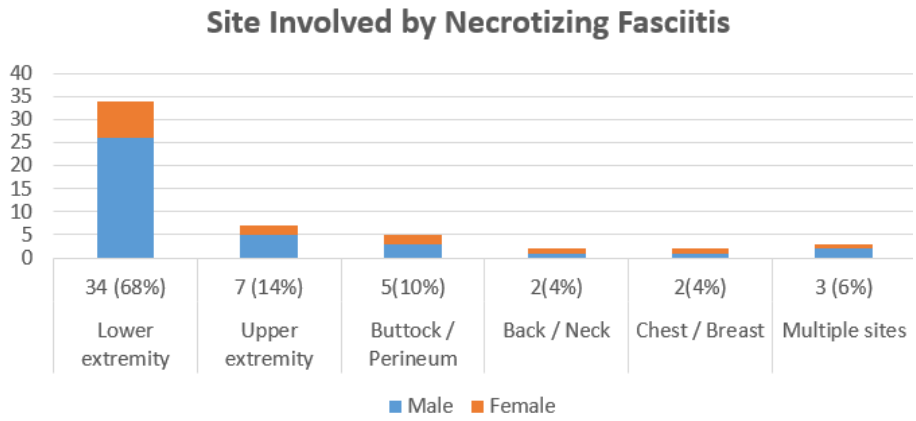

Fig 2: The different sites involved

In ten of the patients, a definite history of triggering factors was not noted. However 17 patients (34%) had a history of trauma and 10 patients (20%) had pre-existing soft tissue infection.5 patients had associated diabetic foot and infected burn wounds was there in two patients. One patient had a snake bite lesion, 2 had insect bite and 3 of them had previous surgery.

Most of the patients had concomitant diseases which was predisposing this dreaded infection. 72% had diabetes mellitus, 40% had history of alcohol intake, 24% had smoking, 20% had chronic kidney disease and another 20% had cardiovascular disease. 16% had peripheral vascular disease and 4% had portal hypertension.

Table 3: Laboratory findings of study participants

Category	Factors	N (%)	95 % CI
Biochemical Tests	Anaemia	32(62)	49.1 – 77.1
	Leucocytosis	48(96)	86.2 – 99.5
	Hyperglycaemia	31(62)	47.1 – 75.3
	Creatinine > 2mg	15(30)	40.5 – 74.4
The pattern of microbes	Polymicrobial	42 (84)	70.8 – 92.8
	Monomicrobial	8(16)	7.1 – 29.1
	Aerobic	50	98-100
Microbial Organism	E.coli	37	49.1 – 77.1
	Staphylococcus	24	40.5 – 74.4
	Streptococcus	22	38.4-70.4
	Proteus	11	9.8 – 39.1
	Klebsiella	10	9.1 – 30.1

Ten factors were taken as predictive indicators of severity and assessed for correlation with mortality. It includes the age of the patients above 40 years, metabolic status of diabetes, associated hypotension, the lesion located in the trunk, biochemical factors like anaemia mg/dL), leucocytosis, thrombocytopenia, acidosis, hypoalbuminemia, increased creatinine levels.

Table 4: Risk factors for mortality in patients with necrotizing fasciitis

Factors	Patients number/%	Positive on deceased patients in %	P-value
Age ≥ 40 yr.	37 (74%)		0.178
Acidosis(pH < 7.35)	32(64)	76.5	0.002
Leucocytosis(> 12 × 109/L)	48 (98%)	67.6	0.039
Truncal location	4 (8%)	23.5	0.036
Hypoalbuminemia(< 30g/L)	25 (50%)	67.6	0.004
Anemia(< 10mg/dL)	32(64%)	20.6	0.152
Thrombocytopenia(<100x10^9/L)	4(8%)	0.6	0.149
Hypotension	10(20%)	8.8	0.496
Diabetes mellitus	31(62)	17.6	0.953
Creatinine(> 2mg)	15(30%)	47.1	0.093

Discussion

According to the demographics of the patients in our study, the majority were over the age of 40, with a male-to-female ratio of 3: 1. Wilson et al in 1952 reported an increased incidence of necrotizing fasciitis in patients over the age of 40 years[9].

Though the commonest factor triggering or initiating disease is trauma, in 10 patients (20%), there was no triggering factor. Madumita et al. stated in their study that trauma of various kinds is the predisposing initiator for the development of necrotizing fasciitis[10].

In our study, diabetes was present in 72% of patients. The immune compromise, microangiopathy, diabetic vascular disease and neuropathy all accentuate the progression of the disease. People who have the habit of taking alcohol in excess and are associated with cirrhosis weaken the intestinal-portal route barrier, which enhances the entry of bacteria into the systemic circulation and renders patients susceptible to various infectious diseases such as NF. In their study, Gupta Y et al[11] reported a high incidence of necrotizing fasciitis in diabetics. In their study, MchenryCR et al[12] highlighted the role of alcoholism and cirrhosis in accelerating the progression of this disease.

The most common anatomical site involved in the disease in our study is the lower limb, both right and left, in 34 (68%) patients. Most of the Indian studies also depict the same picture [13]. However, there have been reports of a high incidence in the perineum in Western countries [14].

In our study, in 100% of the blood cultures, there was growth, and most of the growth patterns were polymicrobial. The commonest organisms isolated were E. coli (74%), followed by Staphylococcus aureus 24 (48%). The most common organisms isolated in the monomicrobial infection were Beta-hemolytic Streptococcus. In the majority of the published literature, it is evident the pattern of infection is polymicrobial however, the most common organism isolated was shown as Staphylococcus aureus[15]. Harikrishnan et al and Madhumita et al in their studies, have reported E. coli as the most common organism[11]. S. aureus and S.pyogenes are two more high-yielding bacteria. Variation in the isolates between studies is most probably due to the use of different antibiotics and culture techniques.

Aggressive, radical surgical debridement involving all the involved tissues is the essential treatment and it is effective when it is done as soon as the disease is suspected[16]. Amputation may be required when there is extensive involvement of an extremity that results in septic shock and leads to further complications[17]. Six patients in our study had amputations as a life-saving measure, while seven others had minor amputations.

When sepsis is fully controlled, care must be given to the nutrition and electrolyte balance to enhance recovery. Wounds that had extensive slough and discharge were subjected to negative suction therapy and responded well. 15 of our patients received vacuum-assisted dressings. Birbal et al published a series of cases comparing conventional therapy to vac-assisted wound dressing for NF and found significant improvement[18].

After the infection has been controlled and healthy granulation tissue starts appearing, the wound can be covered using either a split skin graft or flaps. In our study, 21 patients (42% of the total) received SSG and 3 patients underwent flap surgery with a good outcome. Long-term mortality rates for necrotizing fasciitis survivors are higher, according to Cheng NC et al[19]. More research is needed to identify the cause and pathogenesis of the disease.

In our study using regression analysis, it was found that acidosis and hypoalbuminemia are the independent factors strongly associated with high mortality. It is also noted that other factors like truncal location and leucocytosis are also important predictive factors. Liu et al discovered that there may be more than one comorbidity, with thrombocytopenia and anemia being the most common. Also mentioned was the 24-hour delay from the onset of symptoms to surgery and an age greater than 60 was independently associated with mortality[20]. Elliott et al found that age > 60 years, female gender, increased creatinine levels, the delay in first debridement from admission, the body surface area of the disease and multiple organ failure on admission will significantly increase the risk of death[21].

Conclusion

The aggressive and destructive course of necrotizing fasciitis could lead to lethal morbidity and mortality. Early recognition, aggressive treatment and radical debridement are the steps to recovery. Though antimicrobial therapy with broad-spectrum antibiotics started as empirical therapy to avoid the catastrophe of septic shock, based on the tissue culture, adequate appropriate antibiotics should be started as the disease is often polymicrobial. Acidosis and decreased albumin were found to be factors strongly associated with high mortality. Other possible factors include truncal location and leucocytosis.

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Conflict of Interest: Nil

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