Necrotizing Fasciitis: A Study of 48 Cases

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Abstract Necrotizing fasciitis represents a group of highly lethal infections characterized by rapidly progressing inflammation and necrosis. The aim of the study was to analyze the clinical profile, microbial flora, and predisposing risk factors in patients with necrotizing fasciitis. Lastly, we aimed to formulate a protocol for management of necrotizing fasciitis. Forty-eight cases of necrotizing fasciitis patients who reported to our hospital between April 2007 and September 2009 were included in the study. The commonest predisposing factors were age greater than 50 years (58 % cases) and diabetes mellitus (52 % cases). The commonest site involved was extremity (70.8 %). Majority of infections were polymicrobial (87.5 %). Repeated aggressive debridement was the commonest surgical procedure performed. Early and aggressive surgical debridement, often in multiple sittings, supplemented by appropriate antibiotics and supportive therapy, forms the key to a successful outcome in necrotizing fasciitis.

Keywords Necrotizing fasciitis · Surgical debridements

Introduction

Necrotizing fasciitis represents a group of highly lethal infections characterized by rapidly progressing inflammation and necrosis. The spectrum of the disease ranges from necrosis of the skin to life-threatening infections involving the subcutaneous tissue, fascia, and muscle [1, 2]. The first clear description of necrotizing fasciitis was given by Joseph Jones [1], a surgeon in the Confederate Army of the United States in 1871. He described it as “hospital gangrene” in

2,642 soldiers with a mortality of 46 % during the Civil War. Necrotizing fasciitis itself was described in 1952 by Wilson when he observed edema and necrosis of subcutaneous fat and fascia with sparing of the underlying muscle in a series of 22 patients [1, 3].

Necrotizing fasciitis usually involves the muscular fascia and subcutaneous tissue rapidly and extensively but can also affect the skin and muscle [4, 5]. These infections can have a fulminant presentation, and their clinical course is unpredictable [3]. They may manifest as a low-grade cellulitis that quickly deteriorates to a limb or life-threatening infection [6]. Necrotizing fasciitis is usually rapidly fatal unless there is a prompt recognition and aggressive surgical treatment [7]. They must be treated as an emergency with repeated surgical interventions and high doses of broad-spectrum antibiotics through parenteral route [8].

The aim of the study was to analyze the clinical profile of patients with necrotizing fasciitis presenting to us. The study also aimed to determine the microbial flora and the predisposing comorbid conditions of prognostic significance. We also aimed to formulate a protocol for management of necrotizing fasciitis.

Materials and Methods

Forty-eight cases of necrotizing fasciitis were examined and treated between April 2007 and March 2009. Institutional ethical committee approval was obtained to carry out this study. Informed consent was obtained from all the patients included in the study.

Each patient's history was recorded to determine any pre-existing illness, triggering factors, presenting symptoms with duration, relevant personal history, and predisposing factors. Cases were suspected on the basis of preliminary diagnosis made clinically. General examination was done, and findings were recorded to determine the presence of systemic toxicity.

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Fig. 1 Necrotizing fasciitis of breast

Systemic toxicity was defined as presence of any three of the following: [9]

1. Hypotension with systolic blood pressure less than 100 mmHg.
2. Temperature greater than 38 °C.
3. Heart rate greater than 110 beats/min.
4. Urine output less than 30 mL/h.
5. Mental confusion, disorientation regarding time, place, and person.

All patients were subjected to baseline hematological and biochemical investigations, to identify the predisposing conditions and indicators of poor prognosis. The following parameters and cutoffs were used in this study:

1. Anemia: hemoglobin level less than 10 mg/dL.
2. Leukocytosis: white blood cell count (WBC) greater than 10,000/mm³.
3. Hyperglycemia: random blood glucose level greater than 120 mg/dL.
4. Renal dysfunction: serum creatinine level greater than 2 mg/dL.

Fig. 2 Necrotizing fasciitis of face

Fig. 3 Necrotizing fasciitis of upper limb

5. Adult respiratory distress syndrome: radiological evidence of diffuse pulmonary edema.
6. Hepatic dysfunction: serum bilirubin greater than 3 mg/dL.
7. Multiorgan system dysfunction: acutely diminished function in two or more organ systems.
8. Acquired immunodeficiency syndrome (AIDS): post-serological [enzyme-linked immunosorbent assay (ELISA)] test for AIDS antibodies.
9. Blood urea nitrogen.
10. Radiological evidence of soft-tissue gas.

Patients having shock and systemic toxicity were treated aggressively and resuscitated with intravenous fluid administration with central venous pressure monitoring and inotropic support.

All the patients were started on intravenous antibiotics once the clinical diagnosis of necrotizing fasciitis was made. The first-line antibiotics used in our study were intravenous crystalline penicillin, gentamicin, and metronidazole. This choice of antibiotics was adopted after reviewing the

Fig. 4 Necrotizing fasciitis of chest wall

Fig. 5 Necrotizing fasciitis of lower limb: at the time of presentation

common organisms and the sensitivity reported in the institute. In patients with deranged renal parameters, intravenous cefotaxime replaced gentamicin. The second-line drug used in our study was clindamycin, which was used in case of poor clinical response or deterioration of clinical condition with the first-line drugs. The antibiotics were changed according to culture and sensitivity report where progress was unsatisfactory. The wound was cleaned with hydrogen peroxide and povidone iodine preoperatively.

All patients were operated, and radical and aggressive debridement was done. Excision was carried out until normal tissue was visualized or finger dissection could separate subcutaneous tissue from the fascia. All necrotic tissue was removed [1, 10].

Primary closure was not done in any case, and all the wounds were left open. In the postoperative period, change of dressings was done twice or thrice daily. During each

Fig. 6 Debridement of the lesion, second sitting (day 4)

Fig. 7 Healthy wound after three debridements and regular dressings: ready for skin graft (day 20)

dressing, the wound was inspected to detect any progressive necrosis or presence of infection. Repeated debridements were done in cases showing fresh appearance of unhealthy or necrotic tissue. On appearance of healthy granulation tissue, reconstructive procedures were done as indicated.

Every case was followed up until the wound healed completely. Any resultant morbidity or complications during follow-up were recorded.

Results

A total of 48 cases of necrotizing fasciitis were studied (Figs. 1, 2, 3, 4, 5, 6, 7, and 8). Most patients were in the age group of 40–60 years, of whom 32 patients were males (Graph 1).

The most common predisposing factors included age greater than 50 years (60.4 % cases) and diabetes mellitus (54.16 % cases) (Table 1).

The most common anatomical sites involved included the lower extremity (56 %) followed by the upper extremity (14 %) and perineum (8 %) (Graph 2). The most common symptoms included pain at affected site (100 %), fever (100 %), and swelling (79.16 %), and the most common signs included tenderness (100 %), tachycardia (83.33 %), erythema (79.16 %), and induration (62.5 %). The other notable clinical features included skin discoloration and bulla formation. However, crepitus (12.5 %) was not a common finding.

Most infections were polymicrobial (87.5 %). The most common organisms isolated included *Escherichia coli* (77.08 %), *Streptococcus* (72.9 %), and *Staphylococcus* (50 %) (Table 2). No anaerobic organisms were isolated. Histological presence of necrosis was proved in all the patients included in the study. The most common deranged laboratory finding was leukocytosis (100 %) followed by anemia (66.7 %) and hyperglycemia (66.10 %) (Table 3).

Fig. 8 Patient at the follow-up visit after skin grafting (2 months)

The most common complication noted was septic shock (22.9 %) (Graph 3).

Graph 1 Age distribution of patients with necrotizing fasciitis

Table 1 Predisposing factors

Predisposing factor	Percentage
Chronic alcoholism	20
Diabetes	26
Vascular disease	7
Peripheral vascular deficiency	12
Acquired immune-deficiency syndrome	0
Age >50 years	29
Poor personal hygiene	38

Repeated debridement (97.9 %) was the mainstay of the treatment. The average number of procedures per patient was recorded as 2.57. The maximum number of debridements required in one patient was 6, whereas the minimum number was 1. A total of 31 patients needed amputation at different levels out, of whom three had to be revised to higher level in view of the spreading nature of infection. Skin grafting was needed in 22.9 % of the patients.

Discussion

A total of 48 cases of necrotizing fasciitis were studied over a period of 2 1/2 years. The incidence of necrotizing fasciitis has been rising.

Greater number of cases were reported in the middle-age group, and the great majority were males. Other studies have also reported maximum incidence of the disease in the age group of 42–55 years [11, 12]. There were only three pediatric cases in our study. The rarity of this disease among pediatric population may be attributed to the lower incidence of almost all the predisposing factors in this age group.

The most common predisposing factors noted in the study included advanced age and diabetes mellitus. Majeski and co-workers also reported a similar profile of predisposing risk factors [13]. Both these conditions are associated with a progressive decrease in immunity, which may be responsible for the infections in the tissue planes. Diabetic

Graph 2 Anatomical sites involved in necrotizing fasciitis

Table 2 Infecting organisms

Bacteria	Number of patients	Confidence interval
Streptococci	35	59.11–84.03 %
Staphylococci	24	36.035–63.9 %
<i>Escherichia coli</i>	37	63.675–87.32 %
<i>Klebsiella</i>	11	12.685–36.33 %
<i>Pseudomonas</i>	10	11.1–34.00 %
<i>Proteus</i>	3	1.615–16.07 %

microangiopathy is well known to reduce the vascularity to the extremities, thereby reducing the immunity and allowing the spread of infection. Diabetic neuropathy further increases the risk of injuries, which are very often the triggering factors in cases of necrotizing fasciitis.

Pre-existing chronic liver dysfunction, chronic renal failure, thrombocytopenia, hypoalbuminemia, and postoperative dependence on mechanical ventilation represent poor prognostic factors in monomicrobial necrotizing fasciitis [14].

The most common site involved was lower extremity, which is consistent with other studies [1]. The higher chance of injury, combined with the higher affection of vascularity of this region due to diabetes mellitus, is the likely reason for the same. The other areas affected were the upper extremity and the perineum. The study also encountered four cases of necrotizing fasciitis of breast, which has rarely been reported in other studies [15].

The microbiological profile of the patients revealed polymicrobial infections in the majority of patients, which is consistent with other studies [1, 16]. The most common organisms included *E. coli*, *Streptococcus*, and *Staphylococcus*. There was no case of anaerobic infection in the whole study. The microbiological profiles regarding aerobic organisms have been comparable to that documented in other studies [1]. The reason for the lack of positive anaerobic cultures remains unclear. It may at best be attributed to the policy of aggressive and early management. Community-associated methicillin-resistant *Staphylococcus aureus* has emerged as a prominent causative pathogen in community-acquired necrotizing fasciitis, occurring in 9 of 31 cases of

Table 3 Investigations

Investigations	Number of patients	Confidence interval
Anemia	32	52.15–78.86 %
Leukocytosis	48	93.95–100 %
Serum creatinine >2 mg/dl	9	9.555–31.63 %
Hyperglycemia	31	50.37–77.08 %
Histological confirmation of presence of necrosis	48	93.95–100 %
AIDS (ELISA)	0	0

Graph 3 Complications in patients with necrotizing fasciitis

necrotizing fasciitis over 15 months in one series [17, 18]. Other organisms associated with community-acquired necrotizing soft-tissue infections (NSTIs) include *Aeromonas* species and *Vibrio* species, including *Vibrio cholera*, *Vibrio vulnificus*, and *Vibrio parahaemolyticus*, and they are found classically in patients with cirrhosis with water and marine animal exposure [19]. *Candida*, *Aspergillus*, *Cryptococcus*, *Rhizopus*, and *Apophysomyces* have all been cultured from NSTIs [20].

Other organisms such as vibrios and fungi, which have been documented in other studies, [21] were not encountered in our study.

The laboratory risk indicator for necrotizing fasciitis score can be used for predicting a necrotizing component to a soft-tissue infection (Table 4) [22].

Though specific, subcutaneous gas on radiographs is not very sensitive; in one series, it was found in only 17 % of patients, and it is often a late finding [23, 24].

In patients with a low index of suspicion, ultrasound, computed tomography (CT) scan, and magnetic resonance imaging (MRI) have the advantage of providing additional anatomic information and possibly identifying other sources of infection [25].

Frozen-section biopsy was not performed. However, necrosis was confirmed histopathologically in all cases.

Aggressiveness remains the key to successful outcome in necrotizing fasciitis [26]. Aggressive debridement, often in

Table 4 The laboratory risk indicator for necrotizing fasciitis score [22]

Parameter	Value	Score
Serum C-reactive protein (mg/L)	≥150	4 points
WBC count (cells/μL)	15,000–25,000	1 point
	>25,000	2 points
Hemoglobin (g/dL)	11–13.5	1 point
	<11	2 points
Serum sodium (mmol/L)	<135	2 points
Serum creatinine (mg/dL)	>1.6	2 points
Serum glucose (mg/dL)	>180	1 point

multiple sittings, was the primary operative procedure used as curative procedures in all the cases in this study. Aggressive debridement is the first-choice treatment in necrotizing fasciitis and is recommended in almost all previous studies [2, 9]. In the present study, three amputations at progressively higher levels were required in one patient. The percentage of amputations in patients of necrotizing fasciitis as quoted in certain studies is as high as 33 % [9]. However, in the present study, amputation was required in only one patient, which may be attributed to a combination of early diagnosis, aggressive debridement, and use of broad-spectrum antibiotics. Skin grafting was the reconstructive procedure used in 22.91 % of patients in our study, whereas the other cases were healed by secondary suturing or by secondary intention. The average number of procedures per patient was 2.47, which was due to the repeated aggressive debridements. Apart from the aggressive surgical management, adequate antibiotic coverage, regular dressings, and adequate nutritional support were provided to all patients.

These patients would need constant monitoring and possible respiratory and nutritional support.

Septicemia was the most common complication recorded in the study. The mortality rate in the present study is 2 %, which is considerably lower than that of the earlier studies [1, 11, 12]. Early presentation of the cases with prompt and aggressive management strategies may be the factors responsible for the reduced mortality recorded in our study. The major determinants of mortality included delayed presentation, diabetes mellitus, and systemic toxicity on admission.

Conclusion

Necrotizing fasciitis is a lethal soft-tissue infection mostly affecting males in middle-age group. Major predisposing factors include poor personal hygiene, age more than 50 years, and diabetes mellitus. Lower extremity is the most common site affected. Most infections are polymicrobial, with *E. coli* being the most common bacteria isolated. Early and aggressive debridements, often at repeated sittings, are the mainstay in the treatment of necrotizing fasciitis, supplemented by adequate antibiotics and supportive measures.

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