

A Study on Necrotizing Fasciitis and Use of LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) For Its Diagnosis.

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Abstract:

Necrotizing fasciitis [NF] describes a variety of rare necrotizing soft tissue infection characterized by rapidly spreading inflammation and necrosis of the fascia, the subcutaneous tissue, the skin, including the muscles when treatment is delayed. It is critical that NF be differentiated from other skin infections due to its rapid progression and high risk of mortality. This study emphasizes to find various etiology, predisposing factors, treatment modalities and most importantly the search for a tool that reliably and rapidly identifies patients with NF and helps to decide for earlier effective therapy to modify clinical outcome.

Material & Methods : The study was done at RIMS, Ranchi in Dept. Of Surgery, between November 2017 and October 2019. Based on inclusion and exclusion criterias the patients were admitted and followed up.

Results and Conclusion : NF was most commonly seen in the elderly males, was insidious in most of the cases. Diabetic mellitus was the most common co-morbid factor. The disease most commonly involved extremities followed by perineum. The disease was most common during monsoon and in patients who were barefooted. The disease was most commonly polymicrobial. LRINEC scoring system has a better positive predictive value in identifying the onset of NF and risk stratification of the patients with severe soft tissue infections. There is a statistically significant association between Diabetes Mellitus and the severity of risk. The significance of LRINEC score in predicting the amputation and mortality was statistically significant.

Keywords: Necrotizing fasciitis, LRINEC

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I. Introduction

Necrotizing fasciitis [NF] describes a variety of rare necrotizing soft tissue infection [NSTI] characterized by rapidly spreading inflammation and necrosis of the fascia, the subcutaneous tissue, the skin,^[1] including the muscles when treatment is delayed^[2]

Specifically, NF primarily damages the subcutaneous fat layer (containing nerves and vascular structures) as well as the superficial and deep fascia layers.

NF affects all ages. Most commonly, NF occurs in diabetics, alcoholics, IV drug users, immunosuppressed patients, and patients with peripheral vascular disease^[3] but also often presents in young, healthy individuals.

Approximately 70-80% of such infection are polymicrobial, the remainder being caused by a single organism such as *Pseudomonas aeruginosa*, *Clostridium perfringens*, *Streptococcus species*.^[4]

It is critical that NF be differentiated from other skin infections due to its rapid progression and high risk of mortality. The time elapsed between onset of symptoms and initial operation significantly increases mortality rate. It is crucial to minimize this time and promote rapid diagnosis. Perhaps it is the most severe form of soft tissue infection potentially limb and life threatening.

These infections often are mistaken for cellulitis or innocent wound infections and hence, diagnostic delay. In spite of advances in antibiotic therapy and intensive care, the mortality of necrotizing soft tissue infections is still high. The current mortality rates ranges from 8.7% to 76%^[5] despite early recognition and intervention, and without treatment approaches 100%.^[6]

Beyond physical examination, diagnosis may be suggested with the help of laboratory and imaging tests. The confirm diagnosis for NF can only be made after surgical exploration and determination that the normally adherent fascia displays a lack of resistance to blunt dissection. A new technique LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score based on laboratory results indicates suspicion of NF diagnosis.^[7]

II. Aims And Objective

- Making an observation on necrotizing fasciitis and its relation with different age, sex, body part affected, socioeconomic status, seasonal variation, different etiological factors and bacteriological pattern.
- Use of LRINEC scoring system for its diagnosis.
- Study of various modes of management and prognosis

III. Material And Methods

The present work comprises a prospective observational study, carried out in Dept. of General Surgery at RIMS, Ranchi between November 2017 and October 2019.

The exclusion criteria were :

1. Patients with extremes of age [<15 years & >85 years].
2. Patients who have received antibiotic treatment in the last 48 hours.
3. Patient who has undergone surgical debridement for present episode of soft tissue infection.

IV. Observation And Results

Gender distribution :

The total patients in our study were 114 out of which 90 (79%) were males and 24[21%] were females. The ratio of male: female was 3.7: 1.

Age Distribution :

The disease was most common in age group between 51 and 60 years of age having about 32% patients. The mean age of patients presenting with NF was 54.5 years. Maximum mortality has been present in 6th decade.

TABLE 1. Age distribution of patients.

Age group(years)	No. Of Patients	Percentage (%)	Deceased patients
≤ 30	6	5.3	3
31 – 40	12	10.5	2
41 – 50	22	19.3	2
51 - 60	37	32.4	5
61 - 70	30	26.3	11
71 – 80	6	5.3	2
>80	1	0.9	1

Occupation of patients :

Most of the patients belonged to low socioeconomic status. NF was most common in farmers (41.3%) followed by unskilled workers (25.4%).

TABLE 2. Occupation of patients

Occupation	Patients	Percentage (%)
Farmer	47	41.3
Unskilled	29	25.4
Housewife	19	16.6
Skilled	11	9.7
Service	05	4.4
Not applicable	03	2.6

Month of Presentation :

Most of the cases (50.9%) of NF presented between July and September, which corresponds to rainy season and involvement of the rural population in farming.

TABLE 3. Month of presentation

Month of presentation	No. of patients	Percentage (%)
Q1 (JAN – MARCH)	16	14
Q2 (APRIL – JUNE)	23	20.2
Q3 (JULY – SEP.)	58	50.9
Q4 (OCT. – DEC.)	17	14.9

Site of involvement in NF :

Most commonly involved site in the study was lower limb in 50% cases followed by perineum in 36.8% cases. Upper limb was involved in about 10% cases.

TABLE 4. Site of involvement

Site of involvement	No. of patients	Percentage (%)	Survivors	Deceased
Lower limb	57	50	43	14
Upper limb	12	10.6	10	2
Perineum(F.G.)	42	36.8	34	8
Abdomen, back	3	2.6	1	2

Time duration between onset of symptoms and presentation :

About 54% patients presented within 5 days of onset of symptoms. Mean duration of presentation was 5.3 days.

TABLE 5. Time duration between onset of symptoms and clinical presentation.

Duration (days)	No. of patients	Percentage (%)
1-5	62	54.4
6-10	46	40.3
>10	6	05.3

Etiological factors of NF :

Most commonly NF was insidious (42.9% cases) in onset, followed by trauma (31.6%) and insect / snake bite (9%). Colorectal diseases were responsible for NF in almost 8% cases. NF following surgical intervention was responsible in 2.6% cases.

TABLE 6. Etiological factors.

Etiology	No. of patients	Percentage (%)
Insidious	49	42.9
Traumatic	36	31.6
Colorectal pathology	09	07.9
Snake/insect bite	10	08.8
Urogenital pathology	04	03.6
After surgical intervention	03	02.6
Cutaneous pathology	03	02.6

Co-morbidities associated with NF :

Most common co-morbid condition associated with NF was diabetes being present in almost 50% patients followed by alcoholism and smoking. However there were no identifiable risk factors in 27 (23.7%) cases.

TABLE 7. Comorbidities associated with NF

Co – morbidities	No. of patients	Percentage (%)
Diabetes	57	50
Alcoholism	43	37.8
Smoking	38	33.4
Hypertension (HTN)	30	26.3
CRF	18	15.8
PVD (peripheral vascular disease)	7	6.1
Immunodeficiency	4	3.5
No risk factors	27	23.7

Clinical features of NF :

The most common presentation was pain 96.4% cases followed by swelling (79.8%) and fever (66.7%). On examination there was presence of bullae and blisters in 18.4% cases and necrosis in 71% cases. Crepitation was present in the affected area in 24.6% cases.

TABLE 8. Clinical Features.

Clinical Features	No. of patients	Percentage (%)
Pain	110	96.4
Swelling	91	79.8
Fever	76	66.7
Blisters	21	18.4
Necrosis	81	71
Discharge	72	63.1
Crepitus	28	24.6

Microbiology in NF :

Most of the cases (79.8%) are due to polymicrobial infection. However in 7 cases (6.2%) the culture were negative for any pathogen

TABLE 9. Microbiology in NF

Bacteriology	No. Of cases	Percentage (%)
Polymicrobial	91	79.8
Monomicrobial	16	14
None	7	6.2

Various microbes in NF :

The most common organism isolated was *Streptococcus* which was present in 53 (46.5%) cases, followed by *Staphylococcus*. Other organism were E. coli, Klebsiella, Bacteroides. In 4 cases fungal infection was also present caused by *Candida* species

TABLE 10. various microbes in NF

Organism	Present in cases	Percentage (%)
Streptococcus spp.	53	46.5
Staphylococcus spp.	42	36.8
E. coli	27	23.7
Klebsiella	22	19.3
Enterococcus	20	17.5
Pseudomonas	15	13.1
Bacteroides	11	09.6
Candida	4	03.5

No. of microbes present in culture :

In 56.1% cases a minimum of 2 microbes were present. In 27 cases (23.7%), three or more microbes were present. However, in 7 cases the culture was negative for any microbe.

TABLE 11. No. Of microbes

No. of microbes	No. of patients	Percentage (%)
0	7	6.1
1	16	14.1
2	64	56.1
≥3	27	23.7

Mean levels of blood parameters in NF :

The patients presenting with NF were anaemic with mean haemoglobin levels below 10gm/dl in deceased patients. Deceased patients of NF had mean CRP level of 184.5 mg/dl. Mean serum creatinine level was above normal, and deceased patients had mean level of 4.4 mg/dl. Mean blood glucose in deceased patients was 190.5 mg/dl.

TABLE 12. Mean level of blood parameters

Mean levels of	Total	Survivors	Deceased
Hemoglobin (g/dl)	10.2	10.4	9.5
CRP (mg/L)	135	120.5	184.5
Se. Creatinine (mg/dl)	2.2	1.6	4.4
Glucose (mg/dl)	158.3	148.9	190.5

Presence of footwear:

Out of 57 patients in whom lower limb was involved, 24 patients (42.1%) had history of wearing no foot wear, thus predisposing them to trauma, snake bite.

RISK CATEGORISATION OF PATIENTS BASED ON LRINEC SCORE:

62 patients (54.4%) presenting with NSTI were categorised as low risk & 23.7 % cases were categorised as high risk for progression to NF based on LRINEC score.

TABLE 13. Risk categorisation of patients based on LRINEC score

Category	Score	Total patients	Percentage
Low risk	<6	62	54.4
Intermediate risk	6 – 7	25	21.9
High risk	≥8	27	23.7

Gender wise risk categorisation of patients :

59 male patients (61.5%) were categorised as low risk, however, 9 female patients (50%) were categorised into high risk group for progression to NF

TABLE 14. Gender wise risk categorisation of patients :

Risk category	Patients	Male	Female
Low	62	59	3
Intermediate	25	19	6
High	27	18	9

Age wise risk categorisation :

Most of the patients categorised as high risk were aged between 61 and 70 years. However the disease is most common in age group of 51-60 years.

TABLE 15. Age wise risk categorisation

Age group (years)	Low risk	Intermediate risk	High risk
≤30	3	1	2
31- 40	9	2	1
41 - 50	15	3	4
51 - 60	21	11	5
61 - 70	12	6	12
71 - 80	2	2	2
>80	0	0	1

Presence of necrosis in different risk groups :

In high risk group 26 out of 27 patients (96.3%) necrosis was present in the affected area, whereas in low risk group only 54.9% had necrosis.

TABLE 16. Presence of necrosis in different risk groups

Risk category	Total patients in each category	Necrosis present	Percentage	Necrosis absent
Low	62	34	54.9	28
Intermediate	25	21	84	4
High	27	26	96.3	1

Presence of crepitus in different risk groups :

Crepitation was present in 48.2% patients in high risk category indicating gas forming organism and severity of disease

TABLE 17. Presence of crepitus in different risk groups

Risk category	Total patients in each category	Crepitus present	Percentage	Crepitus absent
Low	62	10	16.3	52
Intermediate	25	7	28	18
High	27	13	48.2	14

LRINEC PARAMETERS IN EACH RISK CATEGORY :

Table 18. Haemoglobin levels in different risk groups

Haemoglobin level (g/dl)	Low risk	Intermediate risk	High risk
<11	44	14	25
11-13.5	14	11	02
>13.5	04	-	-

Among the study patients, haemoglobin (Hb.) of <11 g/dl was present in almost 71% and 93% of intermediate and high risk patients respectively. Almost all the patients in each category had Hb. of 11 g/dl to 13.5 g/dl. So hemoglobin is considered as the important parameter in this score.

Table 19. Total count in different risk groups

Total count (x10 ³ cells/mm ³)	Low risk	Intermediate risk	High risk
<15	18	1	1
15-25	44	23	22
>25	0	1	4

Leucocytosis $>15000/\text{mm}^3$ was present in almost 96% cases of intermediate and high risk groups, which is an early indicator of sepsis.

Table 20. CRP level in different risk groups

CRP level (gm/dl)	Low	Intermediate	High
<150	59	14	3
>150	3	11	24

CRP levels were high in 44% and 89% cases in intermediate and high risk groups and less than 5% cases in low risk group.

Table 21. Serum Creatinine level in different risk groups

Se. creatinine (mg/dl)	Low	Intermediate	High
≤ 1.6	53	15	9
>1.6	9	10	18

High level of Se. Creatinine was present in almost 67% of high risk patients.

Table 22. Serum sodium level in different risk groups

Se. sodium (mg/dl)	Low	Intermediate	High
≥ 135	53	11	16
<135	9	14	11

Se. sodium levels was low in about 48% patients belonging to intermediate and high risk group.

Table 23. Blood glucose level in different risk groups

Se. Glucose (mg/dl)	Low	Intermediate	High
<180	39	11	7
≥ 180	23	14	20

In LRINEC score, under low intermediate and high risk groups 35.5%, 56%, and 78% patients were having diabetes respectively. So diabetes is an important risk factor for NF.

Table 24. Outcome of patients based on LRINEC score

Outcome	Alive	Death	Death %
Total patients	88	26	22.8
Low risk	58	4	6.5
Intermediate risk	21	4	16
High risk	9	18	66.7

The overall mortality rate in the study was 22.8%.

In patients with LRINEC score ≥ 8 , there is very high mortality rate (66.7%). 9 out of 18 patients with CRF required dialysis, out of which only 5 patients survived. 4 out of 26 deceased patients died during resuscitation.

Table 25. Number of debridement required in each group

Risk group	Mean no. of debridement
Low	2.8
Intermediate	3.3
High	3.4

Overall mean debridement required was 3.1 (range 1-6). More debridement was required in high risk group. 4 patients died during resuscitation without having debridement.

Table 26. Modes of surgical management in survivors

Risk category	Secondary closure	Skin grafting	Amputation	Colostomy	Healing with epithelialisation	Implantation	Flap
Low risk	14	35	2	0	6	1	0
Intermediate risk	1	8	9	2	0	1	0
High risk	1	2	4	0	0	1	1

47 patients (53.4%) required skin grafting. In 13 patients (14.8%) secondary closure of the wound was done. Orchidectomy was done in 2 patients of FG. Colostomy was done in 2 patients. Spontaneous closure of the wound with epithelialisation occurred in 6 patients in Low risk category. Amputation was done in 15 patients out of whom 13 had LRINEC score ≥ 6 . In 9 cases Guillotine amputation was performed which was later on closed by skin grafting. Testicular implantation into thigh was performed in 4 cases.

V. Discussion

The present work is intended to study the various aspects of NF and usefulness of LRINEC scoring. In this study 114 cases of NF were studied.

Sex incidence:

In present study most patients were males in comparison to females. The male to female ratio is 3.7: 1, showing male preponderance which is similar to other studies.

Male population have higher incidence of traumatic injury, higher workplace hazards and alcoholism, smoking among male population are the predisposing factors for higher incidence of NF in male population. Also Fournier's gangrene is most commonly present in male, which leads to increased cases of NF in males.

Table 27- Comparing Sex distribution

Study	Male %	Females %	Male : female
Hefny A.F. et al ^[8] (2007)	73	27	2.7 : 1
Proud D. et al ^[9] (2014)	63	27	2.4 : 1
Sheikh N. et al ^[10] (2015)	75	25	3 : 1
Present study	79	21	3.7 : 1

Age incidence:

In my study, maximum incidence of NF occurred between 51-60 years (32.4%), with mean age of patients being 54.5 years, which is similar to other studies.

This increase in the incidence with age might be due to higher occurrence of the risk factors in the older age group.

Table 28 - Comparing age distribution

Study	Mean age (years)
Nisbet M. et al ^[11] (2011)	54.9
Proud D. et al ^[9] (2014)	54.76
Gonullu D. et al ^[12] (2019)	57.5
Present study	54.5

Occupation of patients:

The incidence was highest among the farmers (41.3%). Unskilled labour and housewives form the major bulk along with the farmers. This pattern shows that with improving the hygiene, safety and the working environment and through proper training of manual labour the incidence of necrotizing fasciitis can be reduced.

Time of presentation:

Maximum incidence of NF 50.9% occurred between July and September which corresponds to rainy season in our state and most of the rural population is involved in farming which predisposes them to trauma, snake/insect bites. Also the weather is humid favouring growth of pathogens. There was no reference found for time of presentation.

Etiology :

In this study almost in 43% cases NF was insidious in onset, followed by history of trauma in 32.6% cases.

Colorectal causes like perianal abscess, fistula-in-ano, carcinoma rectum were responsible in almost 8% cases. Similarly urogenital causes like improper catheterisation, stricture urethra, phimosis were responsible for 3.5% cases.

NF following surgery was present in 2.6% cases. Snake/ insect bite leading to NF is responsible for almost 8% .2.6% cases developed NF after skin pathology.

Bulk of the cases of NF follow minor injury due to trauma, RTA, insect bite, thorn prick, etc. Poor care for the wound following the trivial trauma is the major cause for NF.

The foreign body that might get lodged or the deep inoculation that occurs with trauma, thorn prick and other cause forms a perfect incubator for the organisms to flourish this complemented by lowered host defence due to alcoholism, diabetes leads to fulminant local infection leading to NF.

Elliot et al (2000) reported that NF was insidious in onset in 42% cases followed by trauma in 27% cases.^[13] Anaya et al (2001) reported that in 18% cases NF was insidious in onset and due to trauma in 16% cases.^[14] The finding of the present series is in accordance with the findings of the above workers.

Predisposing factors :

The most common predisposing factor in the present study is diabetes in 50% cases, followed by alcoholism and smoking in 38.6% and 35% cases respectively. 26.3% cases had hypertension, 15.8% cases had CRF, in 6.1% cases PVD was present. Immunodeficiency was present in 4 cases(3.5%). However no identifiable predisposing factor were present in 23.7% cases.

Liu Y.M. et al (2005) found the most common morbidity was diabetes in 53.2% cases.^[15] Golger A. et al (2007) found that the most common co-morbidities were diabetes (30%) and immunocompromised status (17%).^[16] Singh G. et al (2015) reported the commonest predisposing factors were age > 50 years (58 % cases) and diabetes mellitus (52 % cases).^[17] Misiakos E.P. et al (2017) reported diabetes mellitus was the most common coexisting disease (40.3%), followed by hypertension (25.8%).^[18] The finding of the present series is in accordance with the findings of the above workers.

Site of involvement:

Extremities were the most sites involved in 60.6% cases, lower limb was involved in 50% cases followed by involvement of perineum in 36.8% upper limb in 10.6% and abdomen in 2.6% cases.

Almost 42% patients of lower limb involvement gave history of wearing no foot wear, which predisposed them to minor trauma, snake bites.

Anaya et al (2005) reported involvement of extremities in 57%, perineum in 12% cases.^[14] Nisbet M. et al (2011) reported involvement of extremities in 71% cases and perineum in 16% cases.^[11]

The findings of the present study are in accordance with the findings of other studies.

Clinical features:

In this study 96.4 % patients presented with pain followed by swelling in 79.8 % and fever in 66.7% cases. There were bullae/blisters in 18.4% cases, necrosis in 71%, discharge in 63.1%, and crepitus in 24.6% cases.

Singh G. et al (2002) reported local tenderness in 91%, oedema in 99%, erythema 72%, ulceration in 73%, and purulent or serous discharge in 72% cases.^[19] Salvador V.B.etal (2010) reported tenderness in 94%, warmth in 86%, oedema in 76%, skin necrosis in 75%, and ulceration in 68% cases.^[20] Chen K.J. et al (2017) found out that initial presentations included swelling (91.7%), erythema (86.7%), bullae (28.3%), petechiae (8.3%), and bruising (45.0%).^[21]

The finding of this series matches with the findings of the above workers.

Microbiology:

In the present study most of the cases were polymicrobial (79.8%) followed by monomicrobial in 14% cases. However in 7 cases (6.2%) the culture was negative for any pathogen.

The most common organism isolated was *Streptococcus* which was present in 53 (46.5%) cases, followed by *Staphylococcus* in 36.8% cases. In 4 cases fungal infection was also present.

Singh G. et al (2002) reported that *Staphylococcus aureus* was the most common bacteria isolated (46%) followed by *Bacteroides fragilis* and anaerobic cocci (34% each). Cultures grew fungi in 9 patients.^[19]

Nisbet M. et al (2011) found out that *Streptococcus pyogenes* was isolated from tissue or blood cultures in 40% patients and 32% patients had polymicrobial infection.^[11] Singh G. et al (2015) found out that majority of infections in NF were polymicrobial (87.5 %).^[17] Van Stigt S.F. et al (2016) found that 60.3 % cases were due to polymicrobial infection and 39.7 % due to monomicrobial infection.^[22]

Finding of our series is similar to that of above workers.

Lab studies :

In this study Hb. level <11gm/dl was present in 70% cases, leucocytosis >15000/mm³ in 82.5% patients, CRP >150 mg/dl in 33.3% cases, hyponatremia <135mmol/l in 29.8% patients, diabetes in 50% patients.

Deranged renal profile was encountered in 38 cases (33.3%). 18 patients were having CRF in which 4 died during resuscitation. 7 patients had under gone acute renal failure after debridement, which may be due to release of myoglobin from the closed compartment leading to myoglobinuria and acute renal failure.

Haemoglobin <11g/dl was a significant indicator of mortality in NF patients (p-value 0.0411) in my study.

Blood glucose >180mg/dl, CRP >150mg/dl and Se. Creatinine >1.6mg/dl were significant indicator of mortality in patients with NF (p-value 0.025, 0.00 and 0.00 respectively).

Afifi R.Y. and El-Hindawi A.A. (2008) found that anaemia was the most commonly encountered laboratory findings in 75.6% cases.^[23] Nisbet M. et al (2011) found that risk factors significantly associated with mortality were, leucocytosis and hyponatraemia.^[11] V. K. et al (2013) found that raised serum creatinine >1.2mg/dl was significantly associated with mortality in NSTI.^[24]

Management and outcome :

In the present study there was mortality of 22.8% despite having aggressive management.

In all patients debridement was done except in 4 patients who died during resuscitation. The average debridement performed was 3.1. Debridement is done to reduce the septic load, remove the dead and necrotic tissue, reduce the compartment pressure to prevent compartment syndrome. Debridement with 'shameful' exposure of testicles was done in patients with extensive involvement of scrotum.

53.4% patients underwent skin grafting, 13.2 % (15 cases) were subjected to amputation of limb. In 3 patients testicular implantation in thigh was done, Colostomy was done in 2 patients and orchidectomy was performed in 2 patients.

More no. of debridement were required in patients having LRINEC score ≥ 6 with average debridement of 3.4.

Pham T. N. al (2009) reported the mean number of debridement for NF was 3.4.^[25] Awsakulsutthi S. et al (2010) reported that mean debridement required was 2.5, skin grafting was done in 59.9% and amputation of limb in 15.4% cases.^[26] Misiakos E. P. et al (2017) reported the mean debridement required was 4.8 and in 25.8% cases amputation was done.^[18]

The amputation rate in patients with low, intermediate and high risk was almost 13%, 60% and 27% respectively. LRINEC score ≥ 6 is associated with increased amputation (p-value 0.001) and mortality (p-value 0.00) and is statistically significant for predicting the amputation and mortality.

Su Y.C. et al (2008) reported that Patients with a LRINEC score of ≥ 6 have a higher rate of both mortality and amputation.^[27]

Corbin V. et al (2010) reported that the rate of complications were higher for patients with a LRINEC score >6 (54%) than for patients with a score <6 (12%, p=0.008).^[28]

Ballesteros-Betancourt J.R. et al (2017) The amputation rate in patients with low, intermediate and high risk was 10%, 25% and 66% respectively.^[29]

The findings of LRINEC scoring for predicting amputation and mortality is similar to other previous studies.

VI. Conclusion

NF is most commonly seen in the elderly males. It is insidious in most of the cases. Diabetic mellitus is the most common co-morbid factor. The disease most commonly involves extremities followed by perineum. The disease is most common during monsoon and in patients who are barefooted. The disease is most commonly polymicrobial, with gram-positive cocci (streptococci and staphylococcal species) being the most common isolates.

NF is a life threatening condition hence early recognition of disease, and thorough wound debridement and broad spectrum antibiotics is essential. Extensive raw area due to debridement can be managed by reconstructive procedures.

In spite of early diagnosis and aggressive management of disease there is significant mortality and morbidity. Surgical management must be aggressive and standard procedures to be followed.

Diagnosis of NF is mainly by clinical examination, and imaging techniques in selected cases. Diagnostic adjunct as LRINEC scoring system should also be used for early diagnosis since it not only helps in diagnosis but also in predicting the outcome.

LRINEC - Laboratory Risk Indicator for Necrotizing Fasciitis score is based on routine laboratory investigations that are readily available, at most centres that can help distinguish NF from other soft tissue infections.

LRINEC scoring system has a better positive predictive value in identifying the onset of necrotizing fasciitis and risk stratification of the patients with severe soft tissue infections.,

There is a statistically significant association between Diabetes Mellitus and the severity of risk. The significance of LRINEC score in predicting the amputation and mortality was statistically significant.

Further studies eg. HBOT (Hyperbaric Oxygen Therapy) and VAC (Vacuum Assisted Closure) are needed to determine whether additional interventions targeted to the high mortality risk group can lead to improved outcomes.

Finally, LRINEC score can be used as an adjunct in the management of soft tissue infections especially in secondary care hospitals and may prevent delayed referral to tertiary centres where experienced surgeons, infectious disease and hyperbaric specialists may guide immediate operative and ancillary management, thereby improving the clinical outcome of the patient. Multidisciplinary team approach is required for management of NF.

References

- [1]. A Richard "Sal" Salcido, MD, Necrotizing Fasciitis: Reviewing the Causes and Treatment Strategies, *advances in skin & wound care* vol.20 no.5, May 2007 288-93.
- [2]. Tsai CC, Lin SD, Lai CS, et al. A clinical analysis of necrotizing fasciitis: a review of 54 cases. *GaoxiongYiXueKeXueZaZhi*. 1995;11:673-677.
- [3]. Conly J. Soft tissue infections. In: Hall JB, Schmidt GA, Wood LDH, et al, eds. *Principles of Critical Care*. New York: McGraw-Hill, 1992; 1325-34.
- [4]. Sawyer MD, Dunn DL: Serious bacterial infections of the skin and soft tissues. *Curr Opin Infect Dis*, 1995, 8:293.
- [5]. Green RJ, Dafoe DC, Raffin TA. Necrotizing Fasciitis. *CHEST* 1996. 110:219-29.
- [6]. Misiakos E, Bagias G, Patapis P, Sotiropoulos D, Kanavidis P, Machairas A. 2014. Current Concepts in the Management of Necrotizing Fasciitis. *Frontiers in Surgery* 2014;1.
- [7]. Wong CH, Khin LW, Heng KS, Tan KC, Low CO. The LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score: a tool for distinguishing necrotizing fasciitis from other soft tissue infections. *Crit Care Med*. 2004 Jul;32(7):1535-41.
- [8]. Hefny AF, Eid HO, Al-Hussona M, Idris KM, Abu-Zidan FM. Necrotizing fasciitis: a challenging diagnosis. *Eur J Emerg Med*. 2007 Feb;14(1):50-2
- [9]. Proud D, Brusino Raiola F, Holden D, Paul E, Capstick R, Khoo A. Are we getting necrotizing soft tissue infections right? A 10-year review. *ANZ J Surg*. 2014 Jun;84(6):468-72.
- [10]. Shaikh N, El-Menyar A, Mudali IN, Tabeb A, Al-Thani H. Clinical presentations and outcomes of necrotizing fasciitis in males and females over a 13-year period. *Ann Med Surg (Lond)*. 2015 Sep 14;4(4):355-60.
- [11]. Nisbet M, Ansell G, Lang S, Taylor S, Dzendrowskyj P, Holland D. Necrotizing fasciitis: review of 82 cases in South Auckland. *Intern Med J*. 2011 Jul;41(7):543-8.
- [12]. Gönüllü D, Ilgun AS, Demiray O, Sayar S, Er AM, Kir G, Koksoy FN. The Potential Prognostic Significance of the Laboratory Risk Indicator for the Necrotizing Fasciitis (LRINEC) Score in Necrotizing Fasciitis. *Chirurgia (Bucur)*. 2019 May-Jun;114(3):376-383.
- [13]. David Elliot, MD, Joseph A. Kufera MA, Roy A. M. Myers, MD, Baltimore, Maryland and Fort Lewis, Washington, The Microbiology of Necrotizing Soft Tissue Infections, *Am J Surg*. 2000;179:361-366.
- [14]. Daniel A. Anaya, MD; Kerry McMohan, MD; Avery B. Nathens, MD, MPH; Stephen R. Sullivan, Hugh Foy, Eileen Bugler, Predictors of Mortality and Limb Loss in Necrotizing Soft Tissue Infections, *Arch Surg*. 2005;140:151.
- [15]. Liu YM, Chi CY, Ho MW, Chen CM, Liao WC, Ho CM, Lin PC, Wang JH. Microbiology and factors affecting mortality in necrotizing fasciitis. *J Microbiol Immunol Infect*. 2005 Dec;38(6):430-5.
- [16]. Golger A, Ching S, Goldsmith CH, Pennie RA, Bain JR. Mortality in patients with necrotizing fasciitis. *Plast Reconstr Surg*. 2007 May;119(6):1803-7.
- [17]. Singh G, Bharpoda P, Reddy R. Necrotizing Fasciitis: A Study of 48 Cases. *Indian J Surg*. 2015 Dec;77(Suppl 2):345-50. Author information.
- [18]. Misiakos EP, Bagias G, Papadopoulos I, Dianas N, Patapis P, Machairas N, Karatzas T, Arkadopoulos N, Toutouzakis K, Alexakis N, Konstantoulakis MN, Zografos G, Smyrniotis V, Kouraklis G, Machairas A. Early Diagnosis and Surgical Treatment for Necrotizing Fasciitis: A Multicenter Study. *Front Surg*. 2017 Feb 7;4:5.
- [19]. Singh G, Sinha SK, Adhikary S, Babu KS, Ray P, Khanna SK. Necrotising infections of soft tissues--a clinical profile. *Eur J Surg*. 2002;168(6):366-71.
- [20]. Salvador VB, San Juan MD, Salisi JA, Consunji RJ. Clinical and microbiological spectrum of necrotizing fasciitis in surgical patients at a Philippine university medical centre. *Asian J Surg*. 2010 Jan;33(1):51-8.
- [21]. Chen KJ, Klingel M, McLeod S, Mindra S, Ng VK. Presentation and outcomes of necrotizing soft tissue infections. *Int J Gen Med*. 2017 Jul 31;10:215-220.
- [22]. Van Stigt SF, de Vries J, Bijker JB, Mollen RM, Hekma EJ, Lemson SM, Tan EC. Review of 58 patients with necrotizing fasciitis in the Netherlands. *World J Emerg Surg*. 2016 May 27;11:21.
- [23]. Afifi RY, El-Hindawi AA. Acute necrotizing fasciitis in Egyptian patients: a case series. *Int J Surg*. 2008 Feb;6(1):7-14.
- [24]. V K, Hiremath BV, V A I. Necrotising soft tissue infection-risk factors for mortality. *J Clin Diagn Res*. 2013 Aug;7(8):1662-5.

- [25]. Pham TN, Moore ML, Costa BA, Cuschieri J, Klein MB. Assessment of functional limitation after necrotizing soft tissue infection. *J Burn Care Res.* 2009 Mar-Apr;30(2):301-6.
- [26]. Awsakulsutthi S. A retrospective review of Necrotizing fasciitis in Thammasat University Hospital. *J Med Assoc Thai.* 2010 Dec;93Suppl 7:S246-53.
- [27]. Su YC, Chen HW, Hong YC, Chen CT, Hsiao CT, Chen IC. Laboratory risk indicator for necrotizing fasciitis score and the outcomes. *ANZ J Surg.* 2008 Nov;78(11):968-72.
- [28]. Corbin V, Vidal M, Beytout J, Laurichesse H, D'Incan M, Souteyrand P, Lesens O. Prognostic value of the LRINEC score (Laboratory Risk Indicator for Necrotizing Fasciitis) in soft tissue infections: a prospective study at Clermont-Ferrand University hospital. *Ann DermatolVenereol.* 2010 Jan;137(1):5-11.
- [29]. Ballesteros-Betancourt JR, García-Tarriño R, Rfos-Guillermo J, Rodriguez-Roiz JM, Camacho P, Zumbado-Dijeres A, Domingo-Trepal A, Llusá-Pérez M, Combalia-Aleu A, García-Ramiro S, Soriano-Viladomiu A. Necrotizing fasciitis attended in the Emergency Department in a tertiary Hospital: Evaluation of the LRINEC scale. *Rev Esp Cir OrtopTraumatol.* 2017 Jul - Aug;61(4):265-272.

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