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Original Research Article

To Evaluate Influence of Clinical Features, LRINEC Scoring System, Imaging and Microbiological Flora on the Outcome of Patients with NSTI

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Abstract

Introduction: Skin and/or subcutaneous tissue infections are highly diverse with regard to etiology, causative organisms, incidence, clinical features, severity and complications. Necrotising Soft Tissue Infection (NSTI) is a rapidly progressive infection primarily involving the fascia and the subcutaneous tissue. NSTI encompasses necrotising form of cellulitis, fasciitis and myositis depending of the depth of tissue involved. Specific terms are also used when specific sites are involved, such as Fournier's gangrene for genitourinary tract, Meleney's ulcer for anterior abdominal wall and Ludwig's angina for submandibular and sublingual spaces.

Aims: To study the influence of clinical features, LRINEC Scoring System, Imaging and Microbiological flora on the outcome of patients with NSTI.

Materials and Methods: This prospective observational study was undertaken taking all the patients admitted to the Department of Surgery, SCB Medical College, Cuttack from Nov 2018 to Oct 2020 with a provisional diagnosis of severe skin and soft tissue infection with high degree of suspicion for NSTI as study population. The Skin includes Epidermis and Dermis. The Epidermis consists of five layers. stratum corneum (keratin layer) stratum lucidum (present in soles and palms only) stratum granulosum (granular cell layer) stratum spinosum (prickle cell layer) and stratum basale (keratin layer). Epidermis contains no blood vessels so cells there derive nourishment by diffusion. The venous drainage of the skin is via both valved and unvalved veins. Unvalved veins allow oscillating flow in the subdermal plexus between cutaneous territories, equilibrating flow and pressure. The valved cutaneous veins drain via plexi to the deep veins.

Conclusion: NSTI are often fatal, characterized by extensive necrosis of the fascia and subcutaneous tissues. It is perhaps the most severe form of soft tissue infection potentially limb and life threatening. Early diagnosis of necrotizing fasciitis is essential to advocate timely management for the better wellbeing of the patient. LRINEC scoring system has a better positive predictive value in identifying the onset of necrotizing fasciitis and risk strategizing of the patients with severe soft tissue infections.

Keywords: Necrotising Soft Tissue Infection, Laboratory Risk Indicator For Necrotising Fasciitis, Microbiological Flora.

Background

Skin and/or subcutaneous tissue infections are highly diverse with regard to etiology, causative organisms, incidence, clinical features, severity and complications. Necrotising Soft Tissue Infection (NSTI) is a rapidly progressive infection primarily involving the fascia and the subcutaneous tissue. NSTI encompasses necrotising form of cellulitis, fasciitis and myositis depending of the depth of tissue involved. Specific terms are also used when specific sites are involved, such as Fournier's gangrene for genitourinary tract, Meleney's ulcer for anterior abdominal wall and Ludwig's angina for submandibular and sublingual spaces. [1] The term Necrotising Fascitis was proposed by Wilson. [2]

Initially the overlying skin is relatively normal but there is extensive necrosis of the subcutaneous tissues and fascia. The patient becomes extremely toxic and later the skin becomes painful, ulcerated and necrotic as it is deprived of its blood supply. Blood supply to the fascia is more tenuous than that of muscle or skin making it liable for necrosis and damage. [3] The fascial necrosis is usually wider than the skin involvement that is clinically visible. Pathophysiologically, it is a septic thrombosis of the vessels between the skin and the deep layers. Also, patients with Peripheral Vascular Disease and atherosclerosis have an increased risk of NSTI. [4]

When a patient presents with soft tissue infection, the clinician faces the challenge of establishing a specific diagnosis and prescribing definitive treatment. Even the experienced clinician may have difficulty distinguishing between the different forms of deep soft tissue infection during the early stages. Perhaps it is the most severe form of soft tissue infection potentially limb and life threatening. Patients frequently succumb in NSTI due to septicaemia and multiple organ failure. [5] 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 reported mortality of 6--76% reflects the inadequacy of early recognition of NSTI. [6]

Incidence of NSTI may be increasing due to greater reporting, increased bacterial virulence , increased antimicrobial resistance or all three factors. [7] A scoring system including clinical features and/or common laboratory investigations is need of the hour that would help in early diagnosis to bring down the morbidity and mortality of NSTI. In this study a conscious attempt is made to correlate clinical features, Laboratory Risk Indicator for Necrotising fasciitis (LRINEC) scoring system, imaging and microbial flora of affected site with the outcome and prognosis of NSTI. [8]

NSTI may occur as single or recurrent episode. The presentation varies depending on the organism responsible, depth of infection, anatomical location and organ system involvement. The patient may represent with early features of localised evidence of skin inflammation (pain, erythema, edema) or later with systemic symptoms of sepsis (pyrexia, tachycardia, hypotension, tachypnoea and altered mental state). [9]

NSTI is a clinical diagnosis and surgical emergency. In critically ill patient investigation should not delay surgical

intervention like fasciotomy and extensive debridement. Diagnosis is often made by combination of visual inspection and digital examination of tissue/finger sweep test (finger can be easily passed between fascial planes) [3]. When diagnosis is not clear laboratory tests and appropriate imaging studies can aid diagnosis. LRINEC score may be an effective tool to help distinguish NSTI from other soft tissue infection such as severe cellulitis or abscess. [10]

Plain film radiography can show gas within the soft tissues in presence of gas forming organism. Its absence doesn't exclude NSTI. USG can determine the presence or absence of an abscess and reveal subcutaneous gas and edema along fascial planes. MRI scans are highly sensitive, if no fascial thickening is found NSTI can be excluded. [11]

Antibiogram often shows the presence of multiple microbes responsible for the infection. Synergistic action of combined aerobic and anaerobic organisms leads to rapid progress of necrosis, thereby affecting the prognosis. So prompt and effective antibiotic therapy becomes necessity.

Aims and Objectives

To study the influence of clinical features, LRINEC Scoring System, Imaging and Microbiological flora on the outcome of patients with NSTI.

Materials and Methods

This prospective observational study was undertaken taking all the patients admitted to the Department of Surgery, SCB Medical College, Cuttack from Nov 2018 to Oct 2020 with a provisional diagnosis of severe skin and soft tissue infection with high degree of suspicion for NSTI as study population.

Exclusion criteria:

The following patients are excluded from the study

1. Very sick patients,
2. age ≥ 65 years
3. age ≤ 18 years age
4. already established cases of DVT

The Skin includes Epidermis and Dermis. The Epidermis consists of five layers. stratum corneum (keratin layer) stratum lucidum (present in soles and palms only) stratum granulosum (granular cell layer) stratum spinosum (prickle cell layer) ,and stratum basale (keratin layer). Epidermis contains no blood vessels so cells there derive nourishment by diffusion. The venous drainage of the skin is via both valved and unvalved veins. Unvalved veins allow oscillating flow in the subdermal plexus between cutaneous territories, equilibrating flow and pressure. The valved cutaneous veins drain via plexi to the deep veins. [12]

Host factors responsible for weakening resistance to bacteria, such as a compromise in the integrity of skin or mucosa, immunosuppression and hyperglycemia, facilitate bacterial growth. Bacteria spreads rapidly along superficial and deep fascial tissue planes facilitated by enzymes(hyaluronidase) that degrades the polysaccharides responsible for tissue adhesion. Excretion of exotoxins stimulates the production of cytokines damaging the endothelial lining and causes leaking of fluid into the extravascular space. Reduced intravascular blood flow results in vessel occlusion by microthrombi. [13]

Tissue becomes ischemic resulting in significant pain and causing overlying skin necrosis. Necrosis of soft tissues progresses as fast as 1 inch an hour, which may not be easily recognizable early because the necrosis of subcutaneous tissue and fascia is far more extensive than skin. [14] Patients frequently succumb in NSTI due to septicemia and multiple organ failure. [15]

Clinical Features include pain, warmth, swelling are three predominant symptoms of NSTI but these are not specific to the disease and also are not present in all cases. d alert the clinician to the possibility of NSTI.

There are certain hard clinical signs that are very specific to necrotizing fasciitis but these occur later in the course. [16] These include Bullae Ecchymosis of the skin followed by skin necrosis Gas in tissues by clinical or radiological examination and numbness. The systemic manifestations includes Toxic appearance, neuralgia, fever weakness/fatigue, chills, tachycardia, Tachypnea, constitutional symptoms ,shock decreased urinary output, Multiorgan system failure and Mental status changes

Death most important pieces of evidence to support the diagnosis of NSTI is the chronology of disease ascertained on history i.e. speed of disease progression which is contrast to patients with severe cellulitis or abscesses.

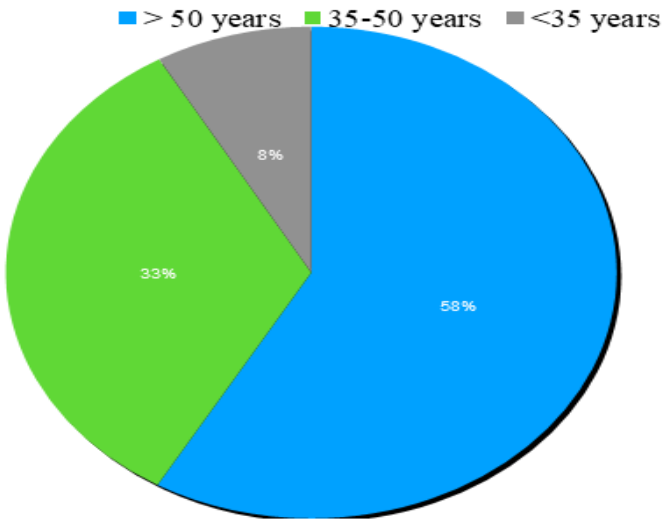
Assessment of parameters

All patients with severe skin and soft tissue infection were clinically examined after history taking and were counselled for investigation and treatment for NSTI and its complication.

Subsequently they were subjected to laboratory investigations such as C-reactive protein, Total White Cell Count, Haemoglobin, Sodium, Creatinine and Glucose and from these parameters LIRNEC Score was calculated . The LRINEC score is a robust score capable of detecting even clinically early cases of necrotizing fasciitis. The variables used are routinely measured to assess severe soft tissue infections. Patients with a LRINEC score of >6 should be carefully evaluated for the presence of necrotizing fasciitis

Results

A total of 60 patients with soft tissue infections were included in this study. They were evaluated on the basis of LRINEC score & were categorized as Low (75%), Moderate (13.3%) and High Risk (11.7%) for the onset of NSTI. The study population comprises 75 % males and 25% females.



Graph 1: Age wise distribution of soft tissue infections

Distribution of Diabetes Mellitus in relation to risk category of Soft Tissue Infections		Risk Category(Lirnec Score)	
		H+M	L
DM	Present	14 (63.6)	8 (36.4)

	Absent	1(2.6)	37 (97.4)
Chi-Square= 27.656, p value = 0.0001			

Distribution of Obesity in relation to Soft Tissue Infections		**Risk Category**	
		H+M	**L**
Obesity	**Present**	12 (75.0)	4 (25.0)
	Absent	3 (6.8)	41(93.2)
Chi-Square= 29.091, p value = 0.0001			

Distribution of Liver Disease/Alcoholism in relation to Soft Tissue Infections		**Risk Category**	
		H+M	**L**
Liver disease/alcoholism	**Present**	5(45.5)	6(54.5)
	Absent	10 (20.4)	39 (79.6)
Chi-Square= 3.006, p value = 0.083			

Distribution of Chronic Kidney Disease (CKD) in relation to Soft Tissue Infections		**Risk Category**	
		H+M	**L**
CKD	**Present**	10 (76.9)	3 (23.1)
	Absent	5 (10.6)	42 (89.4)
Chi-Square= 23.863, p<0.001			

Table 1: Distribution of Site of Soft Tissue Infections according to the Site.

LL	23(38.3%)
UL	13(21.6%)
PERINEUM	15 (25%)
TRUNK	7(11.6%)
Other areas	3(5%)

Table 1 shows the distribution of soft tissue infections according to the site which shows the lower extremities to be involved most commonly. In this study it was found out that 71.7% had their illness spontaneous onset and 28.3% had history of previous injury.

Table 2: Clinical features observed in the participants

Clinical Features	
Pain or tenderness	60 (100)
Swelling	44 (73.3)
Warmth	25 (41.7)
Fever ≥ 35-degree Celsius	23 (38.3)
Skin necrosis	15 (25.0)
Hypotension	13 (21.7)
Bullae	11 (18.3)
Crepitus	10 (16.7)

Number in parenthesis indicates percentages.

Similar findings were found by Nisbet *et al*, which found out 75% of the cases, swelling of NSTI was found out. Such findings was also found out in studies by Park *et al*.

Distribution of Tissue Diagnosis as per the Risk Category		Risk Category	
		H+M	L
Tissue biopsy	Positive	15 (75.0)	5 (25.0)
	Negative	0 (0)	40 (100)
Fisher Exact Test, p<0.001			

The above table shows that patients having Diabetes Mellitus, Liver disease/ Alcoholism and Chronic Kidney Disease are having High and Medium Risk than those who do not have such conditions . It was found to be statistically significant in those having Diabetes Mellitus and Chronic Kidney Disease. Similar findings were found out by the studies conducted by Elliot *et al* [6], Dworkin *et al* [7] and Wing *et al* [8] who found greater association of NSTI with Diabetes Mellitus.

Association of Positive Wound Culture With Risk category		Risk Category	
		H+M	L
Positive wound culture	Yes	15 (33.3)	30 (66.7)
	No	0 (0)	15 (15.0)
Fisher Exact Test, P=0.01			

Distribution of Gas shadow on Xray with Risk Categories			Risk Category	
			H+M	L
Gas on Xray	Present	Count	12 (80.0)	3 (20.00
	Absent	Count	3 (6.7)	42 (93.3)
p<0.001, Fisher Exact Test				

The above table shows Among the study groups, tissue diagnosis is positive in all of the high and moderate-risk patients based on LRINEC.

In the study population, pus c/s had organism growth in both moderate and high-risk patients and in low risk patients, pus c/s are positive for around 75% of patients. The exudate from wound, on gram staining usually reveals a mixture of organisms or chains of gram-positive cocci in the case of streptococcal gangrene.

Discussion

Necrotizing soft tissue infections are fatal progressive infectious processes, most prevalent among diabetic patients, impoverished obese diabetic patients, CKD and alcoholics/ liver diseases with a varied spectrum of clinical course associated severe sepsis.

Early diagnosis of necrotising fasciitis is very much essential in halting the progression of the disease and for better prognosis. Late detection is almost always associated with a grave prognosis.

The associated systemic inflammatory response syndrome in the setting of sepsis causes changes in the biochemical parameters in a predictable manner.

The LRINEC score is a measure of these changes and predicts the presence of NSTI. Other soft tissue infections (e.g. Cellulitis and abscesses) rarely cause an inflammatory state severe enough to cause such disturbances in the laboratory variables

We have diagnosed necrotising fasciitis whenever there is a necrosis of subcutaneous tissues extending through the fascial planes. Paucity of cutaneous findings early in the course of disease makes it difficult to diagnose the condition early. often the disease is masqueraded as cellulitis or abscesses. In these patients diagnosis has been made when the infection progressed despite treatment with broad spectrum intravenous antibiotics.

It has been shown by numerous studies in the past that early recognition and surgical intervention at the earliest is the sole factor in preventing the morbidity and mortality in patients with necrotising fasciitis. The paucity of specific cutaneous signs to distinguish necrotising fasciitis from other soft tissue infections such as cellulitis makes the diagnosis extremely difficult.

So, a scoring system which is easy to follow and cost effective with high positive and negative predictive value is required. One such scoring system is the LRINEC scoring system devised by Wong. *et al* in 2005. [17] In this study a conscious attempt is made to correlate clinical features, Laboratory Risk Indicator for Necrotising fasciitis (LRINEC) scoring system, imaging and microbial flora of affected site with the outcome and prognosis of NSTI.

This Prospective study of 60 patients with soft tissue infections included males (75%) and females (15%). The mean age group was 51 years which is similar to those found in Elliott *et al*. studies. [18] The mean age of presentation in Hsiao *et al* and Huang *et al*. are 61 and 59.6 years which is slightly higher than the present study. [19,20]

Diabetes Mellitus was the most common comorbidity (22 cases). Other comorbid conditions included CKD (13 cases), OBESITY (16 cases), Liver disease / alcoholism (11 cases). Diabetes mellitus is the most common co-morbidity. Obesity and CKD are other co morbidities having significant p values (0.0001, 0.0001) which are similar to those found in Nisbet *et al* and Singh *et al*. The incidence of diabetes is more in Hsiao *et al* and Huang *et al*. (58.6 & 52.1 %). [19,20]

The important manifestations at presentation were erythema, edema, tenderness, bullae, necrosis, tachycardia and hypotension.

Incidence of pain or tenderness is similar to that of Park *et al*., [21] incidence of fever is similar to that of Singh *et al*. incidence of bullae and crepitus are similar to that of Nisbet *et al*. [22,23]

Extremity was the most common site involved followed by scrotum and perineum which is similar to that of Dworkin *et al*. [24]

About 43 cases (71.7%) had soft tissue infections of unknown origin and the remaining 17 cases (28.3%) were attributed injury as a cause.

Mean number of debridements done on patients in the present study was 0.86 times which is comparatively low when compared to all the other studies – Nisbet *et al* (2 times), [23] Wong *et al* (2.7 times) [17] and Hsiao *et al*. (2.6 times). [19] Early presentation, early diagnosis and early aggressive surgical debridement has a favorable outcome.

Mean duration of hospital stay in the present study was 9.88 days, which is low compared to all the other studies mentioned above.

Conclusion

NSTI are often fatal, characterized by extensive necrosis of the fascia and subcutaneous tissues. It is perhaps the most severe form of soft tissue infection potentially limb and life threatening. Early diagnosis of necrotizing fasciitis is essential to advocate timely management for the better wellbeing of the patient.

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

LRINEC - score is based on routine laboratory investigations that are readily available, at most centers that can help distinguish Necrotizing Fasciitis from other soft tissue infections especially in secondary care hospitals and may prevent delayed referral to tertiary centers where experienced surgeons may guide immediate operative and ancillary management, thereby improving the clinical outcome of the patient. There is a statistically significant association between Diabetic Mellitus, CKD obesity and the severity of risk.

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