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Independent Predictors of Mortality For Necrotising Fascitis – A Prospective analysis in a Single Institution

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Abstract

Background : Necrotizing soft-tissue infections (NSTIs) are infrequent but highly lethal infections. They can be defined as infections of any of the layers within the soft tissue compartment (dermis, subcutaneous tissue, superficial fascia, deep fascia, or muscle) that are associated with necrotizing changes. NSTIs are typically not associated with abscesses, although they can originate from an untreated or inadequately drained absccss. Establishing the diagnosis of NSTI can be the main challenge in treating patients with NSTI, and knowledge of all available tools is the key for early and accurate diagnosis**. Materials and Methods :** This descriptive and observational type of study was conducted at SCB Medical College and Hospital, Cuttack from the period of Sep 2021 to Oct 2022 and included 55 patients of clinically diagnosed necrotizing soft tissue infection presenting to the surgical OPD and emergency. The clinical characteristics and laboratory findings were analyzed with the purpose of identifying key features that help in reorganization of this disease. Laboratory risk indicator for NSTI (LRINEC) score was calculated for all the patients. **Discussion and Results :** Male preponderance was seen in patients of NSTI. Maximum number of patients were between the age of 41- 70 years. Majority of patients with NSTI were found to be afebrile (%), having normal blood pressure(69.09%) but having tachypneoa (56%). Local tenderness,swelling, skin discolouration was the most commonly noted examination finding of NSTI (87.3%), followed by edema of overlying skin (87%), warmth (64%) and exudative discharge (81.8%). Streptococcus pyogens (34%) and staphylococcus aureus (27%) were found to be the most common microbe's infections causing NSTI. High CRP was found in 65% patients of NSTl. Hyperglycemia is frequently encountered in NSTI. The LRINEC scoring for all the patients was done and it was observed that a higher score is more predictive of NSTI whereas a lower score (<5) does not rule out the possibility of NSTI (27 out of 55 patients had a score <5). A higher score should mandate more aggressive resuscitation, monitoring and surgical intervention. **Conclusuon** : Because of the potential fatal course of NSTI, prompt diagnosis is the key to a favorable outcome. Laboratory1 findings and other diagnostic tests may be useful adjuncts, but the diagnosis is still primarily a clinical one. and suspicion alone warrants early surgical intervention.

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Key Word - Necrotizing soft-tissue infections, LRINEC scoring system, Alanine Transaminase, Aspartate Transaminase, Alkaline Phosphatase,

Introduction

Necrotizing soft-tissue infections (NSTIs) can be defined as infections of deep subcutaneous tissue, superficial fascia, deep fascia, or muscle or any combination of the three and associated with necrotizing changes. NSTIs is charterised by sudden presentation and rapid progression. It is typically polymicrobial in nature They are usually caused by the synergistic presence of various aerobic or anaerobic, gas producing or not, bacteria. Their progression is often fulminant and it has been recognized for centuries. NSTI may appear in any anatomical region, multiple layers may be involved at times and, despite the portal of entry being a rupture in the skin continuity, sometimes this cannot be found **[1].**

The lower limbs, perineum and abdomen are the most common sites of NSTI infections. It may develop after any kind of operations like incarcerated inguinal hernias, perianal abscesses, urological operations and gynaecological operations **[2,3] .** Also NSTI has been reported after blunt or penetrating injury, postoperative complications, injection of intravenous drugs or subcutaneous insulin, animal bites and idiopathic causes **[4,5] .** A portal of entry as obvious as a tissue injury is required for the development of a NSTI. However, these infections may occur without such portal of entry. **[6]** After colonization the bacteria produces toxic proteolytic enzymes which allow for tissue invasion **[7] .**

Predisposing factors of NSTI include advanced age, diabetes mellitus, malnutrition, intravenous drug abuse, corticosteroid use, immunosuppression, AIDS and chronic venous or lymph insufficiency with tissue oedema **[8,9] .** The presence of a foreign body with dead soft tissue and extensive abdominal or perineal operations, as well as tissue ischemia most often due to tight sutures, haematomas, peripheral angiopathy, or irradiation and wide burns, are considered to be local predisposing factors **[10,11] .**

The purpose of this study was to develop a detailed clinical profile of necrotising soft tissue infections as an aid to diagnosis and for proper management.

AIMS AND OBJECTIVES:

- To study the Clinical profile of necrotizing soft tissue infections.
- To critically assess bulky waste operations by local authorities, including volumes/types of materials arising and current disposal/recovery routes.
- To classify and evaluate the operation of furniture recovery schemes nationally.
- To make recommendations to improve the operational effectiveness of, and to maximise recovery opportunities of bulky waste collection.

MATERIALS AND METHODS

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The present study was conducted in the Department of General Surgery at SCB Medical and Hospital Cuttack over a period from Sep 2021 to Oct 2022. Written and informed consent was taken from all the patients who participated in this study.

Study Design:

The present study is prospective and observational type of study. The total cases included in this study were 55.

Inclusion Criteria:

All patients who presented with infections of any of the layers of the soft tissue compartment - dermis, subcutaneous tissue, superficial fascia, deep fascia, or muscle, that were associated with necrotizing changes and diagnosis confirmed by tissue biopsy.

Exclusion Criteria :

- Patients who refused to participate
- On investigation found not to be having NSTI

Study Tools:

Study tools used for this study included:

1. Clinical observation, sign and symptoms were documented
2. Relevant blood investigations, Biopsy for histopathological confirmation at the time of wound exploration and debridement, and tissue samples for bacteriological cultures and antibiotic sensitivity were sent.
3. LRINEC scoring system was used **[12] .**

Data Management & Statistical analysis:

Descriptive statistics were expressed as means and standard deviations.

OBSERVATION AND RESULTS

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Table 1 : Distribution of patients presenting with NSTI based on their age group

Age in Years	No. of Patients (n=55)	Percentage (%)
< 10	00	00
11 - 20	00	00
21 - 30	05	9.1
31 - 40	12	21.8
41 - 50	12	21.8
51 - 60	13	23.6
61 - 70	08	14.5
➢ 70	05	9.1

Mean age of the study population was 52±13.98 years. The youngest patient was 25 years of age, with the oldest being 85 years. Majority of the patients were seen to be between 31 to 60 years of age.

Maximum number of patients in the study group belonged to the age group of 51 to 60 years (23.6%), and 31 to 40 years(21.8%), 41 to 50 years (21.8%). Most of the study population was between the ages of 31 to 60 years (67.2%). Only 5 (9.1%) patient was aged more than 70 years. Almost nil prevalence of NSTI was seen in the younger age group with patients less than 10 years of age and between 10 to 20 years of age and 5 (9.1%) belonging to the age group between 20 to 30 years.

Table 2 : Distribution of cases based on their Hb levels

Hemoglobin level (g/dl)	No. of Patients (n=55)	Percentage (%)
➢ 13.5	00	00
11 – 13.5	22	40
8 – 10.9	33	60
< 10	00	00

Hemoglobin (Hb) within normal limits (>13.5 g/dl) was seen in any patients. 33(60%) patients had low hemoglobin levels of < 10.9g/dl, with 22(40%) of them having reasonable level of HB . The entire study population had a mean Hb of 10.6±1.6gm/dl.

Table 3 : Distribution of patients based on White blood cell count (W.B.C)

W.B.C. Range (per cumm)	No. of Patients (n=55)	Percentage (%)
< 15000	32	58
15000 - 25000	23	42
➢ 25000	00	00

Most of the subjects had white blood cell (WBC) counts within normal range, with 32 (58%) of subjects having WBC counts of less than 15,000/cumm. Very high WBC counts of more than 25,000/cumm were seen almost nil of the subjects of NSTI, at the time of presentation. The entire study population had a mean WBC count of 13,431 ±4,011/cumm.

Table 4 : Case distribution based on RBS value at the time of presentation

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RBS Range (mg/dl)	No. of Patients (n=55)	Percentage (%)
< 100	00	00
101 - 200	55	100
201 -300	00	00
301 - 400	00	00
401 - 500	00	00
➢ 500	00	00

All patients at the time of presentation had high random blood sugar between 100 to 200.

Table 5 : Case distribution based on Serum Creatinine

Serum Creatinine Range (mg/dL)	No. of Patients (n=55)	Percentage (%)
< 1.6	47	85
➢ 1.6	08	15

NSTI was associated with derangement of renal function 8(15%) of patients had serum creatinine of more than 1.6 mg/dl. 47 (85%) of patients showed a normal serum creatinine of <1.6 mg/dl and shows mean value of 1.23+ 0.27 mg/dl

Table 6 : Distribution of patients based on serum sodium level

Serum Sodium Range (mmol/L)	No. of Patients (n=55)	Percentage (%)
Normal (135 - 145)	37	67
Hyponatremia (<135)	17	31
Hypernatremia (> 145)	1	2

Table shows the distribution of cases based on serum sodium level. Normal serum sodium was seen in 37 (67%) of patients. Hyponatremia was the common abnormality seen in patients of NSTI with 17 (31%) patients having serum sodium < 135 mmol/l. 1 (2%) of patients were found to have hypernatremia. Mean serum sodium of the study population was 136±4.4mmol/l.

Table 7 : Distribution of patients based on serum potassium levels

Potassium Range (mmol/L)	No. of Patients (n=55)	Percentage (%)
Hypokalemia (< 3.5)	06	11
Normal (3.5 – 5.5)	49	89
Mild hyperkalemia (5.1 – 6)	00	00
Moderate hyperkalemia (6.1 – 7)	00	00
Severe hyperkalemia (> 7)	00	00

Majority of patients with NSTI, 49(89%) had normal serum potassium. 6 (11%) patients had hyperkalemia, with serum potassium > 5 mmol/1. Hypokalemia was seen in 7 (15%) of patients. Mean serum potassium of the study population was 3.88±0.32mmol/l.

Table 8 : Liver Function tests of the study population

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Lab Value	Mean ± SD	UNIT
Serum Bilirubin	1.20 ± 0.19	mg/dl
ALT	45.94 ± 7.13	IU/L
AST	45.55 ± 8.38	IU/L
ALP	45.78 ± 6.58	IU/L
PT	13.35 ± 1.19	Seconds
INR	1.17 ± 0.19	Ratio

According to Table, the mean value of serum Bilirubin, AIT, AST, ALP, PT and INR arc found to be lying in normal range, suggesting that liver function test comes out to be normal in maximum patients affected by NSTI, at the time of presentation to hospital pointing in the direction that NSTI does not directly affects liver in early stage.

Table 9 : Percentage distribution of cases based on C Reactive Protein

CRP Range (mg/L)	No. of Patients (n=55)	Percentage (%)
< 150	19	35
➢ 150	36	65

Table(14) shows the distribution of NSTI cases based on CRP value. High CRP value of more than 150 mg/l was seen in 36(65%) of cases.Whereas 19(35%)patients had CRP value of <150 mg/l.

Table 10 : Percentage distribution of patients based on LRINEC score

LRINEC Score	No. of Patients (n=55)	Percentage (%)
<= 5	27	49
6-7	11	20
>= 8	17	31

In this study there are 27(49 %) of cases having the LRINEC score <=5, while 11(20 %)of cases have score of 6-7, only17(31 %)have score of 8 or above, suggesting that 49 % of cases are expected to have <50 % expectancy of having NSTI, while 20 % cases are expected to have NSTI to about 50-75 % and 31 % cases have chance of having NSTI by 75 % and above having mean value of 6.6 ± 2.5.

Description

AGE

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The present study was conducted on subjects with a mean age of 52+_13.98 years. This data was comparable to the study conducted by Yi-chun Su et al (68) in which a total of 209 patients were enrolled and the mean age came out to be 56.8 + 15.7 years. David Wilkinson et al **[13]** in their study on NSTI showed a mean age of 48 years. Similar age group of NSTI patients was reported by Daniel A Anaya et al **[14,15] .**

From this data it is seen that NSTI afflicts the middle aged individuals to a greater extent than either extreme of age. This may be due to the increased environmental exposure outside the home in adult patients.

HEMOGLOBIN

The mean hemoglobin level was 10.6+_1.6 g/dl which is consistent with various other studies David C. Elliott et al **[16] ,** James A. Majeski et al. David Wilkinson et al **[17]** with Hb levels of 11.5 g/dl, 10 g/dl and 11.6 g/dl respectively.

WHITE BLOOD CELL COUNT

In the study subjects a mean WBC count of 13,431_+ /mm3 was noted, a finding which is consistent with other studies done by D. J. Tilkorn et al, David Wilkinson et al **[17] ,** Krieg, A. Rohrbornct al. Extreme elevation or depression of WBC count was not encountered in this study.

RANDOM BLOOD SUG

In this series of 55 patients, 16.3% were diabetic (RBS > 180mg/dl). This shows higher prevalence of NSTI in diabetic patients as compared to the general population. The mean value of RBS in this study is 149.14.+-23 mg/dl which is consistent with study done by Anaya et al **[15]** in which mean value of RBS is 149.14+_23.75(SD)mg/dl. This observation is consistent with the percept that diabetic patients are more prone to develop soft tissue infections as they have a compromised immune status.

SERUM CREATININE

In this study majority of the patients (85%) affected with NSTI have scrum creatinine value of < 1.6mg/l. Mean value of creatinine is 1.23+-0.27 mg/l,comparable to other published series of Chin- Ho Wong et al **[12]** & Daniel A. Anaya et al **[15]** with a mean serum creatinine of 1.38±1.03 mg/dl and 1.5-lmg/dl respectively.

POTASSIUM LEVEL

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The scrum potassium level showing maximum cases affected by NSTI does not have deranged potassium level in serum and mostly lying between 3.5 to 5 mEq/L (75%). These values show mean value of 4.04 + 0.94 which is under normal range of Potassium. Similar finding is seen in the study done by Chin-Ho Wong et al **[12]** patients had mean value of serum potassium level of 4.2^0.92 mEq/1.

SERUM SODIUM LEVEL

In the serum sodium level of the patients affected by NSTI, we can see that the mean value of serum sodium comes out to be .136+_4.4 mEq/1 also consistent with study by Daniel A. Anaya et al,showing mean value of133±6 mEq/1 in 175 patients taken into account. Another study done by Daniel A. Anaya et al **[14]** showing the mean value of 132±9.8 mEq/1.

BILIRUBIN LEVEL

Explains the distribution pattern of serum bilirubin level in the patients affected by NSTI and it is apparent that the mean the maximum number of patients have normal range of bilirubin (0.2-1 mg/dl) which is 70% and the mean comes out to be 0.97±0.69(S.D) mg/dl also commented upon by Elliot D.C. et al **[18]** in his paper showing mean value of 1.5 ± 0.2 mg/dl in 168 patients suggesting that bilirubin level might or might not be affected since there is large variation in patients affected by NSTI.

PT and INR

According to Table (15) based on PT time in seconds, we can see that coagulation profile of patients maximum cases show deranged PT value mostly falling in the range of 13.1 to 15s (59%). taking the normal value to be 11.5 to 13.7 s. The mean value comes out to be 14.1 + 2.4 and similar finding is shown in the study done by Elliot D.C. et al **[18]** in his paper showing mean value of 13.7 + 0.3 s in 179 patients suggesting that PT is affected in most patients. Although INR is not affected in most of the patients. The calculated mean value comes to be 1.19 which is normal again showing NSTI does not affect INR.

CRP value

In this study there are maximum number of patients having the value of >150 approximating to about 65 % and having mean value of 202.5 2. 88.7 mg/1. while the study done by D. J. Tilkorn et al showing the mean value of 282 mg/1. Another study done by A. Krieg et al showing the mean value of 269 ± 135 mg/1 in 26 patients. The high discrepancy seen in the value of CRP is due to the confounding factor of pre-existing heart disease which is found in most patients in studies showing high mean value. Similar findings are noticed by Chin- Ho Wong ct al **[12]** showing CRP mean value of 254.3 ± 84.1 mg/1.

Also, in this current study, maximum cases have liver function test result falling in normal range showing 48 % of ALP in range of 45 to 115 U/L, 80 % in range of 8-45 U/L in AST and 82 % in range of 7 -55 U/L in ALT suggesting that most cases fall under normal range, Mean value lying in normal range in each of them further signifies the same.

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LRINEC Score

The mean value of LRINEC score is 6.6 + 2.5 in our study. Similar findings arc seen in the study by D. J. Tilkorn et al in which 25 out of 30 patients (83.3%) had a LRINEC scorc> 6. Only in 5 patients (16.7%), the LRINEC score was < 6, also it showed the LRINEC mean value of 7.3 against the values in our study showing 27(49%) in<6 score and 28 (51 %) patients.

Similarly in a study done by Chin-Ho Wong et al **[12] ,** using the LRINEC score, he stratified the patients into three groups, low (LRINEC score <5), moderate (LRINEC scorc 6- 7). or high (LRINEC score >8) risk categories for NSTI. These risk groups corresponded to a probability of developing NSTI of <50%. 50-75%, and >75% respectively. 51% of patients with NSTI had a LRINEC score of >6 whereas only 49% had a score of <6, comparative to our study having 49% of patients having <6 scorc and 51% patients having score >6. The mean value of our study- was 6.6 + 2.5, comparable to Wong's value of 7.

This finding shows the LRINEC score is capable of detecting early- cases of NSTI among patients with severe soft tissue infections. A LRINEC scorc of >6 should raise the suspicion of NSTI, and a score of >8 is strongly predictive of this disease.

The LRINEC score can significantly decrease the time to diagnosis by stratifying patients into risk categories for NSTI warranting immediate further evaluation. Clinical variables alone are often nonspecific early in the course of the disease and can potentially lead to fatal delay in operative treatment. A diagnostic score that includes clinical as well as laboratory variables would inevitably favor advance cases of NSTI (where clinical recognition is usually not a problem) and risk missing early cases of NSTI (where early diagnosis would profoundly affect outcome). An objective diagnostic tool based on laboratory' variables alone to assess for the possibility of NSTI is therefore advocated.

Conclusion:

For the diagnosis of NSTI the local clinical findings viz tenderness, skin discoloration, swelling of paramount importance rather than clinical features of systemic toxicity such as fever and tachycardia. Simple laboratory evaluation using the LRINEC scoring system is useful for diagnosing NSTI. A higher score (>6) is highly predictive of presence of NSTI, but LRINEC score of (< 5) does not altogether rule out the possibility of NSTI. The microbiology of NSTI reveals majority of infections being monomicrobial and caused by skin based organisms (staphylococci and streptococci). Therefore tissue culture and gram positive coverage are vital for NSTI patients.

Conflict of Interest – NIL

Funding - NIL

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