International Surgery Journal
Sharm PP et al. Int Surg J. 2016 Aug;3(3):1528-1533
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20162741

Research Article

Necrotizing soft-tissue infections: our experience at rural tertiary care centre

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Received: 21 May 2016
Accepted: 02 July 2016

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ABSTRACT

Background: Necrotizing soft-tissue infections are infection of any of the layers within the soft tissue compartment that are associated with necrotizing changes. These infections are highly lethal if not diagnosed. The purpose of this article is to assess the different diagnostic tools.
Methods: We carried out a retrospective study to assess the prevalence of soft tissue infections at Geetanjali medical college and hospital, Udaipur (Tertiary care rural centre) in last four years. Clinical details of the 216 patients with soft tissue infection were recorded from their case sheets and were analyzed with reference to their age, sex, risk factor, symptoms, etiology, microbiology, treatment employed, complication and final outcome etc.
Results: Pain and swelling were commonest presenting symptoms found in every case. Diabetes and Trauma were major predisposing factor in our series. NSTI differ from NNSTI with respect to presence of blister (50% versus 5.8%), Dusky discoloration (58.3% versus 0%), Necrotic skin (51.04% versus 0%) and Crepitance (6.2% versus 0%). In present series' most common organism causing NSTI in our institute is gram negative bacilli .Prompt resuscitation followed by early and adequate debridement remains the cornerstone of management of NSTI.
Conclusions: Diagnosis of necrotizing infection is challenging but there are enough tools including clinical findings, biochemical parameters, imaging aids and invasive procedures that can help make the diagnosis. When in doubt, exploration of the compromised tissue should be performed. The mainstay of treatment is early and adequate surgical debridement.

Keywords: NSTI- Necrotizing soft-tissue infections, NNSTI - Non- Necrotizing soft-tissue infections, Debridement

INTRODUCTION

Necrotizing soft-tissue infections (NSTIs) are highly lethal infections. These infections were first described by Jones in 1871 and termed as "hospital gangrene".[1] Since then, multiple descriptions of NSTI have been published, and a wide number of terms, definitions, and classifications have been used.[2-5]

In 1951, Wilson coined the term "necrotizing fasciitis" to encompass some of these infections that is rapidly spreading and potentially devastating infection of the superficial and deep fascia with secondary necrosis of the overlying skin.[6]

The early diagnosis is main challenge in treating patients with NSTI, and knowledge of various clinical sign and laboratory markers can be helpful for distinguishing between cases of cellulitis, which should respond to

medical management alone, and NSTI, which requires operative debridement in addition to antimicrobial therapy combined with close monitoring and supportive measure. Delay of diagnosis leads to higher mortality.

Various risk factors include: advance age, diabetes mellitus, intravenous drug use (IVDU), trauma, obesity, malnutrition, immune suppression, peripheral vascular disease, steroid use, post-bite and NSAIDs etc.[6,11] Multiple large series have reported associations between necrotizing soft tissue infections and the presence of chronic co morbidities, particularly the presence of diabetes mellitus and obesity (30-97% range).[3,6,11,13] Various etiologic factors like injection, trauma, insect bites, chronic wounds/ulcers (such as diabetic foot ulcer), postoperative infections, perirectal abscesses, etc. Idiopathic necrotizing soft tissue infections (those occurring in previously healthy patients without an obvious source) constitute up to 20% of causes in major series. Making a high level of suspicion a key factor in diagnosing the disease in patients that may not have a typical history.[3, 15]

The purpose of this article is to assess the different diagnostic tools. (Biochemical marker, physical signs) as prognostic factors to determine the course of disease and to assess various treatment modality for NSTIs. The mainstay of treatment is early and repeated surgical debridement, combined with antimicrobial therapy, close monitoring, and physiologic support.

METHODS

We carried out a retrospective study to assess the prevalence of soft tissue infections at Geetanjali medical college and hospital, Udaipur (Tertiary care rural centre) in last four years. Clinical details of the 216 patients with soft tissue infection were recorded from their case sheets and were analyzed with reference to their age, sex, risk factor, symptoms, aetiology, microbiology, treatment employed, complication and final outcome etc.

RESULTS

Pain and swelling were commonest presenting symptoms found in every case.

Table 1: Distribution of predisposing factors.

Factor	No. of NSTI (n=96)	% of NNSTI (n=120)
Diabetes mellitus	43	38
Trauma	14	2
VIDA	7	0
PVD	6	0
DVT	4	11
Immunosupression	4	7
Idiopathic	18	22

Pain and swelling were commonest presenting symptoms found in every case. In our series diabetes mellitus was predisposing factor in 44.79% of NSTI pt., trauma in 14.5 % cases while 18.7% cases were idiopathic.

Table 2: Location of tissue infections.

Site	No. of NSTI (n=96)	No. of NNSTI (n=120)
Scalp	2	1
Chest	5	8
Abdomen	3	5
Back	1	0
Upper Limb	18	34
Lower Limb	54	57
Perineum, Groin and Scrotum	13	15

In our series NSTI usually occurs on extremities, mainly on lower limbs. Of the 96 pt. of NSTI, most common site was lower limb in 56.25% cases followed by upper limb in 18.75% cases.

Table 3: Distribution of clinical manifestations.

Clinical feature	No. of NSTI (n=96)	No. of NNSTI (n=120)
Erythema	80 (83.3%)	120 (100%)
Tense oedema	76 (79.1%)	86 (71.6%)
Bullae / blister	48 (50 %)	7 (5.83%)
Dusky Discoloration	56 (58.3%)	0
Necrotic Skin	49 (51.04%)	0
Discharge of pus	22 (22.9%)	0
Crepitus	6 (6.2%)	0

Table 4: Distribution of Microbial infection in NSTI patients.

Bacteria	No. of Pt.	% of Pt.
β-hemolytic streptococci	30	31.25
Staphylococci	14	14.58
Bacteroides sp	32	33.33
Clostridium	11	11.45
Pseudomonas	4	4.16
MRSA	2	2.08
Others	3	3.12

NSTI differ from NNSTI with respect to presence of blister (50% versus 5.8%), Dusky discoloration (58.3 % versus 0%), Necrotic skin (51.04% versus 0%) and Crepitance (6.2% versus 0%). So Bullae, necrotic skin, dusky discoloration and crepitance are strongly predictive of NSTI.

In present series' most common organism causing NSTI in our institute is gram negative bacilli followed by haemolytic streptococci. Most of the infection was polymicrobial in nature.

Table 5: Distribution of mode of treatment.

Management	No. of Pt.	% of Pt.
Multiple release incision and fasciotomy	26	27.08
Debridement	68	70.83
Amputation	2	2.08

In our series debridement was done in 70.8% of cases with in 8 hours of admission after initial resuscitation. Multiple release incision and fasciotomy was done in 22.9% of cases while amputation at mid-thigh level was done in 2 cases to save life of patient.

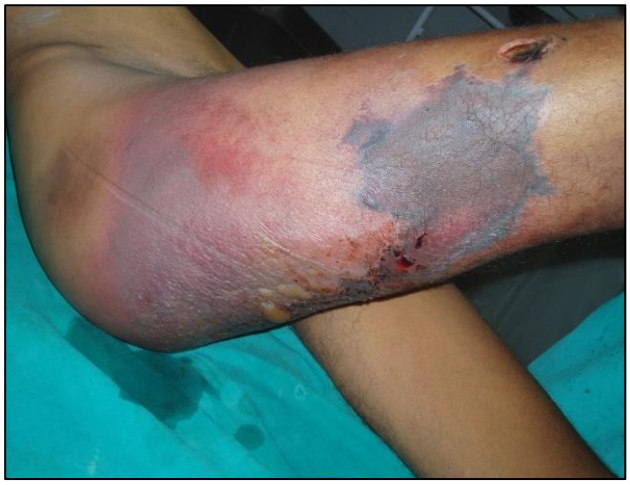

Figure 1: NSTI lower limb- showing blisters, dusky discoloration and skin necrosis.

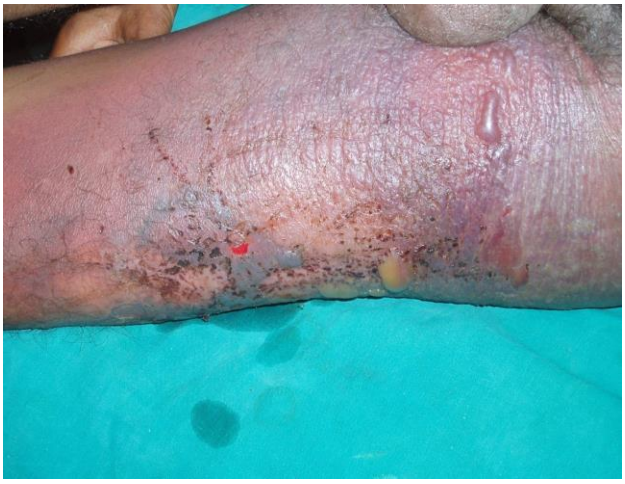

Figure 2: NSTI lower limb showing blisters fiied with toxic fluid and pus, dusky discoloration and skin necrosis.

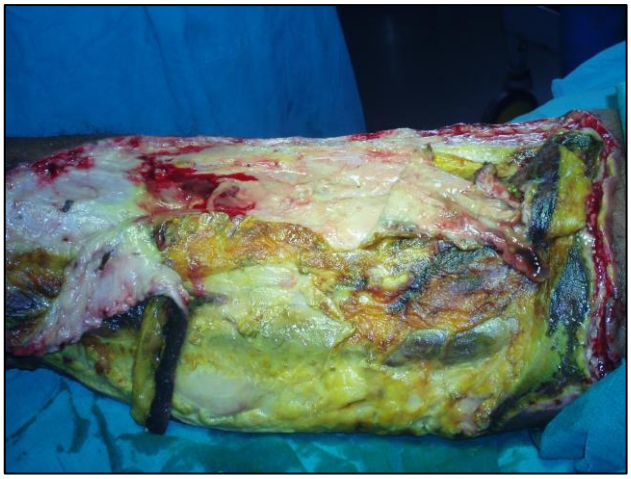

Figure 3: NSTI lower limb: debridement of necrotic tissue.

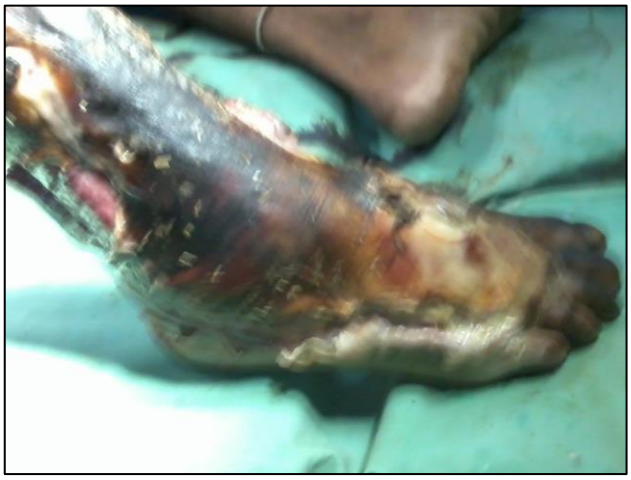

Figure 4: NSTI foot and lower leg; extensive necrosis of skin.

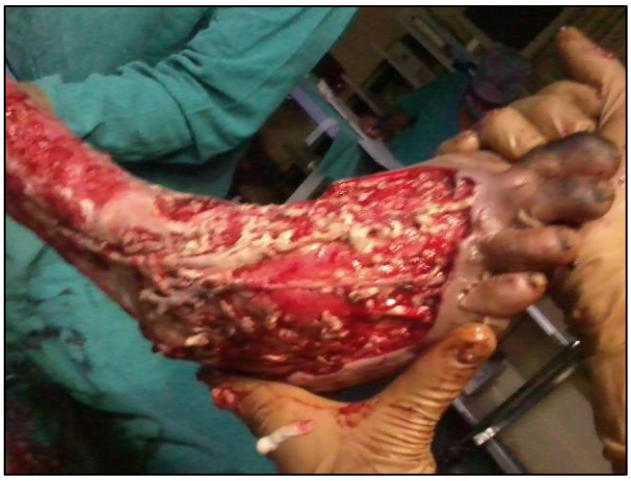

Figure 5: Figure NSTI foot and lower leg: extensive early and adequate debridement.

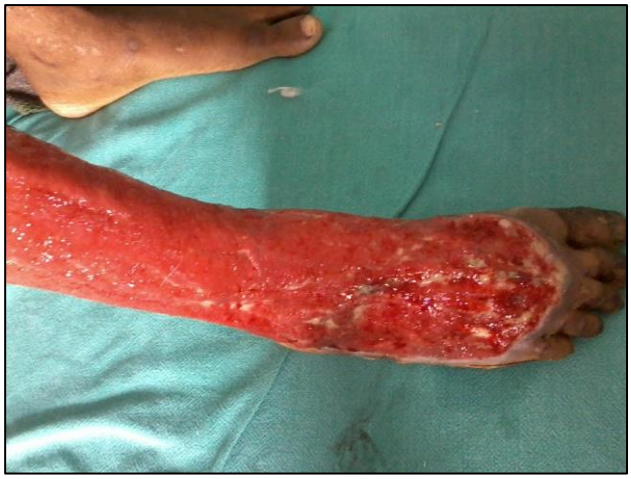

Figure 6: NSTI foot and lower leg; wound after serial debridement, plan for skin grafting.

DISCUSSION

Various risk factors include: advance age, diabetes mellitus, intravenous drug use (IVDU), trauma, obesity, malnutrition, immune suppression, peripheral vascular disease, steroid use, post-bite and NSAIDs etc.[6,11] Multiple large series have reported associations between necrotizing soft tissue infections and the presence of chronic co-morbidities, particularly the presence of diabetes mellitus and obesity (30-97% range).[3,6,11,13] Various etiologic factors like injection, trauma, insect bites, chronic wounds/ulcers (such as diabetic foot ulcer), postoperative infections, perirectal abscesses, etc. Idiopathic necrotizing soft tissue infections (those occurring in previously healthy patients without an obvious source) constitute up to 20% of causes in major series. Making a high level of suspicion a key factor in diagnosing the disease in patients that may not have a typical history.[3,15]

A wide range of signs and symptoms can be seen in patients with necrotizing soft tissue infections. Initial findings include erythema, swelling of affected part followed by blister / bullae, discoloration of skin, necrosis of skin, discharge of toxic fluid / pus often associated with localized pain, fever and tachycardia. systemic signs include hypotension and associated finding consistent with severe sepsis and septic shock. Swelling , erythema and pain (typical finding for all soft tissue infections regardless of the severity) are the most common signs, present in 70 - 90 % of the cases .The presence of subcutaneous gas diagnosed either by physical exam or by radiological studies is also an ominous sign of necrotizing soft tissue infections and can be associated with virtually any bacteria (anaerobic metabolism) In our series erythema was present in 83.3%,tense oedema in 67.7%, bullae/blister in 50%, dusky discoloration in 58.3% and necrotic skin in 51.04% cases of NSTI.

Diagnosis of NSTI is not easy. The most important discriminative information to be established in patients with soft-tissue infection is the presence of a necrotizing component. Hard signs of necrotizing soft tissue infections including tense edema, crepitus, skin blisters/bullae, skin discoloration and necrosis, usually associated with symptoms representing severe sepsis or septic shock should arouse suspicion for NSTI. Various laboratory findings like TLC >15,000 cells/mm^3 or a serum sodium level <135 mmol/L and high blood urea and s. creatinine level was associated with NSTI. Even in the most experienced hands, clinical findings are not accurate enough for diagnosis, and both clinical clues and diagnostic tools should be used in combination to help make an early diagnosis.[10] In our series average TLC count was more than 16700 cells/ mm^3, average serum sodium level was less than 129 mmol/L and average s. creatinine level was more than 1.6 mg/dl in patient with NSTI.

Plain radiography, ultrasonography, CT, and MRI have all been used to help diagnose NSTI. Plain radiography can only help to identify subcutaneous gas. Most of findings of CT, MRI have shown increased thickness of the fascial layer with or without enhancement can be associated with NSTI.

Frozen section from the compromised site that includes deep fascia and possibly muscle is recommended as a means to achieve earlier diagnosis of NSTI in patients in some studies.[6] We prefer to explore the doubtful area during surgery on the basis of macroscopic findings consistent with NSTI. These findings include gray necrotic tissue, lack of bleeding, thrombosed vessels, “dishwater” pus, noncontracting muscle, and a positive “finger test” result, which is characterized by lack of resistance to finger dissection in normally adherent tissues. Once NSTI is confirmed, the incision is extended, and additional debridement is performed.

No specific combination of bacterial species is either diagnostic of NSTI or found in all cases. Wide spectrums of organisms are commonly recovered by culture. Approximately two-thirds of cases were polymicrobial and one-third were monomicrobial, with the great majority of monomicrobial cases being a result of gram-positive cocci. The three most common isolates are anaerobic bacteria (primarily bacteroides, Gram positive cocci and clostridium), staphylococcus and streptococcus species. Other less common reported isolates include pseudomonas, klebsiella, methicillin resistant, staphylococcus aureus. NSTI without a recognized precipitating factor has also been identified with community-acquired methicillin-resistant staphylococcal infection.[14]

Early and adequate debridement is cornerstone for the treatment of NSTI combined with appropriate broad-spectrum antibiotic coverage, adequate organ support and close monitoring. It is only the complete debridement of

infected tissue that controls the source of infection and allows for future recovery. Broad-spectrum antimicrobial therapy should be started early to include coverage for gram-positive, gram-negative, and anaerobic organisms. Special consideration for group A *Streptococcus* and *Clostridium* species should be taken. Acceptable regimens include monotherapy agents, such as imipenem, meropenem, ertapenem, piperacillin/tazobactam, and tigecycline. Multidrug regimens have also been described, including triple-drug therapy regimens, such as high-dose penicillin, high-dose clindamycin, and a fluoroquinolone or an aminoglycoside for coverage of gram-negative organisms. Vancomycin, daptomycin, or linezolid should be included in the regimen until methicillin-resistant staphylococcal infection has been excluded. Antimicrobial administration should be continued until no further debridements are needed and the patient's physiology has improved.

Debridement of the necrotic tissue should be undertaken as soon as possible as it is probably the most important determinant of outcome in necrotizing soft tissue infections. This was well described in a study by Bilton, et al in which patients with necrotizing soft tissue infections who had adequate surgical debridement (early and complete) were compared to those with either delayed or incomplete debridements. The mortality in the latter group was 38% compared to 4.2% in the group receiving adequate surgical treatment.[14] During the operation, a generous incision is performed and if needed, the incision is extended to allow for complete debridement of the infected or necrotic tissue. Occasionally, amputation of a limb is necessary to achieve this goal to save life of patient. Healthy, viable, bleeding tissue should be present at the edges of the excision site, and aggressive resuscitation should accompany the perioperative period. Once the initial debridement has been done, management in an intensive care unit is recommended, and scheduled debridements at intervals of 6-48 h should be performed until no further necrosis or infected tissue is seen. Finally, physiologic support, combined with close monitoring in an intensive care unit is encouraged. It is not uncommon to see patients with NSTI develop organ failure, such as acute renal failure and acute respiratory distress syndrome, which require replacement therapies.

The most important discriminative information to be established in patients with soft-tissue infection is the presence of a necrotizing component. This will confirm NSTI, and by definition, will identify patients that require surgical debridement. The first and most important tool for early diagnosis of NSTI is to have a high index of suspicion. When in doubt, exploration of the compromised tissue should be performed. Intravenous drug user are found to be high-risk group for developing necrotizing soft tissue infections, and when evaluated for soft tissue infections they should undergo a thorough assessment that can confidently rule out a necrotizing infection. The mainstay of treatment is early and adequate surgical debridement with scheduled returns to the operating room. We have also observed that cases of NSTI without a recognized precipitating factor are more likely to be caused by group a streptococcal infection. More recently, NSTI without a recognized precipitating factor has also been identified with community-acquired methicillin-resistant staphylococcal infection.[14]

Since the first description by Jones, mortality in patients with NSTI remains high. He reported a mortality rate of 46%, and a recent pooled analysis determined it to be ~34%.[1,15] More recent series have reported mortality rates with a range of 16%, 24%, a rate that, although lower than the rate 100 years ago, still accounts for high mortality associated with NSTI. In our series mortality rate was 16.66 % .This low rate is related with early and adequate debridement within 8 hours of admission and aggressive critical care of these pt.

Bosshardt, et al published a series of patients with predominantly intravenous drug use-related necrotizing soft tissue infections over a 5-year period and showed that the incidence more than doubled when compared to the first years of the study.[20]

CONCLUSION

We also draw following conclusion. Pain and swelling were commonest presenting symptoms found in every case. Diabetes and Trauma were major predisposing factor in our series. NSTI differ from NNSTI with respect to presence of blister (50% versus 5.8%), Dusky discoloration (58.3 % versus 0%), Necrotic skin (51.04% versus 0%) and Crepitance (6.2% versus 0%). So Bullae, necrotic skin, dusky discoloration and crepitance are strongly predictive of NSTI. Four laboratory criteria that are strongly suggestive of NSTI ($P< 0.001$) i.e. statistically significant. Total Leucocytes Count more than 15 X 10 9/L. S. Creatinine more than 1.5 mg/dl.Serum Na+level less than 130 mmol/L. Presence of gas in x-ray of affected part. In present series' most common organism causing NSTI in our institute is gram negative bacilli followed by haemolytic streptococci. Most of the infection was polymicrobial in nature. Prompt resuscitation followed by early and adequate debridement remains the cornerstone of management of NSTI. Wound inspection after 24 hours to confirm the adequacy or to complete debridement. In conclusion of our study we would like to say that lack of awareness among clinician may play a major role in delay of diagnosis and institution of therapy that leads to subsequent high mortality and morbidity. The most important factor in survival in present series was related to rapidity of debridement within 8 hrs of admission after initial resuscitation. Utilizing these principal the morbidity and mortality of patients with NSTI should be substantially reduced.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Sharma PP, Jhanwar A, Sharma D, Sharma S, Tripathi A. Necrotizing soft-tissue infections: our experience at rural tertiary care centre. Int Surg J 2016;3:1528-33.