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A Prospective Study of Surgical Management of Necrotizing Soft Tissue Infections

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Abstract:
Background*: Necrotizing soft tissue infections are a group of highly lethal infection that is characterized by widespread necrosis of skin, subcutaneous tissue and superficial fascia and typically occur after trauma or surgery. The essentials of successful treatment include early diagnosis, aggressive surgical debridement, antibiotics and supportive intensive treatment unit care. The two commonest pitfalls in management are failure of early diagnosis and inadequate surgical debridement. Grounded along the outcomes of this work, the aggressive treatment strategy resulted in decrease in overall mortality. Overall, more research is necessary to determine if the therapeutic options will change according to the demographic, predisposing, causative factors but present study demonstrates encouraging results in treatment of necrotizing soft tissue infection.*
Materials and Methods*: A prospective observational and analytical study of 99 patients who presented with necrotizing soft tissue infection to Wanless Hospital, Miraj, District-Sangli, Maharashtra under General Surgery unit during the period of 2 years were enrolled for the study . All patients were first seen in the emergency room or in the outpatient department . After taking a proper history and clinical examination careful record was made and all necessary investigations done. All seriously ill patients having clinically evident disease and severe infection with toxic signs were admitted in an intensive care unit for monitoring and initial resuscitation. All data was entered into a Microsoft Office Excel in a spreadsheet which was prepared and validated for the study data to avoid errors. Statistical analysis was done using the website socscistatistics.com. Chi Square test with Yates correction have been applied to assess statistical significance in the distribution of factors having major bearing on the mortality between survivors and non survivors. A probability(p) value <0.05 was considered significant.*
Results: *Most common initial surgical treatment was Debridement 100% and fasciotomy in 25.2% of patients while amputations major or minor were 10.1%. Commonest secondary surgery was skin grafting 32.3% and secondary suturing was 30.3% cases. Septicaemia/bacteremia was most common complication seen in 14% of patients ,ARDS 9.1%, renal dysfunction 4% and multiorgan failure 3% are the other complications seen. Common cause of death was septicaemia. In the present study major factors having bearing on the mortality are-Duration between onset of symptoms and presentation, systemic toxicity on admission, depth of infection, serum creatinine on admission. In the present study the mortality rate is 15%.*
Conclusion*: Early diagnosis, with aggressive medical and adequate surgical debridement play a important role in minimizing morbidity and mortality associated with necrotizing soft tissue infection. Septicemia, ARDS, ARF & Multiorgan failure are the common complications seen. Factors like late presentation, depth of infection, systemic toxicity, altered renal function were the major determinants of mortality of necrotizing soft tissue infection.*
Key Word*: Necrotizing soft tissue infection, Debridement, Fasciotomy, Septicaemia*

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I. Introduction

Necrotizing soft tissue infection is potentially lethal bacterial infection characterized by widespread necrosis of the skin, subcutaneous tissue, and superficial fascia[1,2]. This was known and recorded since the days of Hippocrates, Galen, Avicenna and Pare[3]. But the first clear description was given by Joseph Jones, an army surgeon who presented a monogram on this infection in a conference held in USA in 1871.He stated "Skin of an affected part melts away" [4.] However Fournier(1883)described it as "Fournier's gangrene", a necrotizing infection of the perineum[5]. Wilson(1952) was the first to coin the term "Necrotizing Fasciitis[6]" .Necrotizing soft tissue infection is characterized by widespread necrosis of fascial planes, subcutaneous tissue and resulting in the progressive destruction of fascia, fat and muscle[1]. These infections vary as per the predisposing, causative factors , anatomical location, offending bacteria and level of tissue involvement. It is the breach in the covering

epithelium due to trivial trauma , post surgical , gynaecological, urological procedures, childbirths, blunt trauma, diabetes mellitus etc. These infections can have a fulminant presentation and their clinical course is unpredictable[6] as they may manifest as a low grade cellulitis that quickly deteriorates to life threatening infection. Without appropriate treatment there is likely to be a rapid evolution of cutaneous gangrene, sometimes with myonecrosis and an extension of the inflammatory process along the fascial planes. There are marked systemic symptoms that may include shock and organ failure. Clinical suspicion with hematological, microbiological, radiological investigation, frozen section biopsy helps to diagnose and provide timely and specific intervention.With early diagnosis and treatment one can drastically reduce high morbidity and mortality associated with it[7,9] . Broad spectrum antibiotics through parenteral route to be administered. Prompt surgical intervention such as debridement, fasciotomy prevents further complication and also definitive diagnosis (by providing material for culture and Gram staining, histo-pathological examination).In this prospective study attempt is made to analyze in more detail, the causative factors, clinical presentation, microbiologic assay and evaluate the outcome of surgical intervention of these necrotizing soft tissue infections. It is felt that such an analysis might provide the practicing surgeon an understanding for optimal surgical and medical care and prevent complications. ***AIMS AND OBJECTIVES*** Necrotizing soft tissue infection is a rapidly progressing fatal disorder, the prognosis of which depends on early diagnosis and management. The wide range of factors like demographic characteristics, predisposing factors, causative factors, microbiological flora, time of presentation to immediate surgical intervention have an impact on the mortality of necrotizing soft tissue infections. Thus, the aim of this present study is to evaluate the parameters causing the necrotizing soft tissue infections and how to effectively manage them. ***The primary objective*** is**:** Management of necrotizing soft tissue infections. ***The secondary objectives*** *are***:** 1.To assess the clinical presentation of Necrotizing soft tissue infections.2.To study the causative factors leading to Necrotizing soft tissue infections.3.To evaluate microbiological assay of Necrotizing soft tissue infections.4.To study the role of surgery in case of Necrotizing soft tissue infections.

II. Material And Methods

A prospective study of 99 patients who presented with necrotizing soft tissue infection to Wanless Hospital, Miraj, District-Sangli, Maharashtra under General Surgery unit during the period of 2 years were enrolled for the study. The equation for calculation of Sample Size(n) for finite population is

$$\frac{\frac{z^2 \times p(1-p)}{e^2}}{1+\left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

Where, Population Size, N = 987, The total population visiting surgical Opd or admitted in Wanless Hospital with necrotizing soft tissue infections. Confidence level = 95%, Zscore, z = 1.96, Margin of error, e = 5%,(for calculation 0.05),Population proportion, p = 7% (for calculation 0.07), Period of Study of sample population : 2 years, Commencement date: October 2018 ,Completion date: October 2020. After calculation ,the sample size (n) of 99 will be taken for the study.The study taken for reference :1)Shaikh Nissar[16]. Necrotizing fasciitis : A decade of surgical intensive care experience : Indian Journal of Critical Care,October2006, Vol : 10, issue : 4, page : 225-229.**2)** Mohammad Sadegh Fazeli,. Mohammad Reza Keramati[17] : Necrotizing Fasciitis : an epidemiologic study of 102 cases, Indian J. Surg ,Aug 2007,69(4): 136 -139.

INCLUSION CRITERIA 1)Age 20-82years 2)Gender both male and female 3)Pre-operatively and Intraoperatively diagnosed as necrotizing soft tissue infection. EXCLUSION CRITERIA 1)Patients below 20 yrs or above 82yrs of age.2)Patients who have received antibiotic treatment in the last 48 hours or a minimum of 3 doses of antibiotic prior to presentation.3)Patient who has undergone surgical debridement for present episode of soft tissue infection4)Patients with boils or furuncles with no evidence of cellulitis. All patients were first seen in the emergency room (casualty) or seen in the outpatient department (OPD). Informed consent was taken. After taking a proper history careful record made of age, sex, socioeconomic status, preexisting illness, presenting symptoms and duration before seeking medical care were made, general and local detailed examination was carried out. Patients having local findings such as erythema, edema, crepitus, induration, tenderness, bullae, skin necrosis, foul smelling discharge, gray and nonviable fascia, easy separations of fascia from subcutaneous tissue or muscle, frank myonecrosis were considered as cases of necrotizing soft tissue infection. All seriously ill patients having clinically evident disease and severe infection with toxic signs were admitted in an intensive care unit for monitoring and initial resuscitation. All others patients who were stable and having less severe infections were admitted to wards. In all patients necessary investigations were done and reports recorded.. Patients who were in septicaemic shock were treated aggressively and resuscitated with intravenous fluid administration with central venous pressure monitoring, ionotropic support and broad –

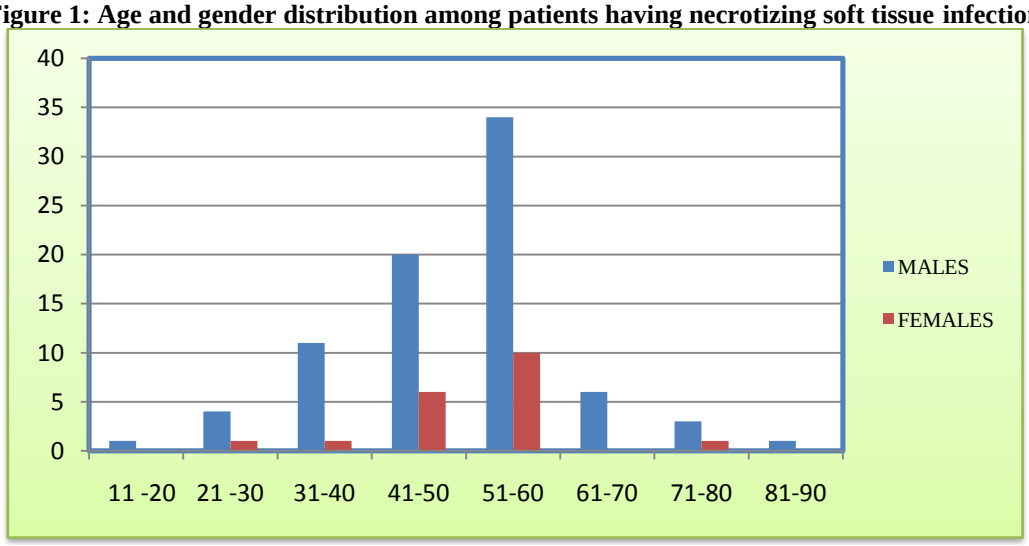
spectrum antibiotics and other supportive medical treatment was given. After stabilization of these patients, they were subjected for further assessment of extent of infection, investigations and surgical intervention such as debridement, fasciotomy , amputation etc was done. During treatment and stay in hospital careful note was made on all complications, morbidity, mortality and the cause of death. Patients were discharged and were asked to come for follow up at regular intervals .Any resultant morbidity or complications during follow-up were recorded. STATISTICAL METHODS: All data was entered into a Microsoft Office Excel (version 2016) in a spreadsheet which was prepared and validated for the study data to avoid errors. Data was entered and checked for errors and discrepancies. Statistical analysis was done using the website socscistatistics.com. Quantitative data like age is presented as mean, bar chart. All qualitative data like gender, presenting symptoms and signs, anatomical site, predisposing factors, causative factors are presented as percentages, bar chart . Chi Square test with Yates correction have been applied to asses statistical significance in the distribution of factors having major bearing on the mortality between survivors and non survivors. A probability(p) value <0.05 was considered significant

III. Result And Observations

Table 1 : Age distribution in patients of NSTI

AGE IN YEARS	NO.OF MALES	%	NO.OF FEMALES	%	TOTAL	TOTAL%
11-20	1	1	0	0	1	1.01
21-30	4	5	1	5.3	5	5.05
31-40	11	14	1	5.3	12	12.12
41-50	20	25	6	31.6	26	26.3
51-60	34	43	10	52.6	44	44.44
61-70	6	8	0	0	6	6.1
71-80	3	4	1	5.26	4	4.04
81-90	1	1	0	0	1	1.01
TOTAL	80	100	19	100	99	100
MEAN AGE	50.125		50.763			

Figure 1: Age and gender distribution among patients having necrotizing soft tissue infection



FINDING	NO.OF PATIENTS WITH FINDING	PERCENTAGE
SYMPTOMS		
1.Pain at affected site	85	85.8
2.Swelling/edema	80	80.8
3. Fever	50	50.5
4.Foul smelling discharge	42	42.4
5.Wound /ulceration	27	27.2
SIGNS- Local		
6.Tenderness	88	88.8
7.Erythema	70	70.7
8.Induration	46	46.5
9. Skin discoloration	18	18.2
10.Bullae/vesicles	15	15.2
11.Cutaneous gangrene	15	15.2
12.Crepitus	10	10.1

SIGNS-General		
13.Tachycardia	**50**	**50.5**
14.Hypotension	**20**	**20.2**
15.Systemic toxicity	**15**	**15.2**
16.Altered mental status	**15**	**15.2**
17.Ketoacidosis	**3**	**3**

Table 2: Prevalence of physical findings

Table 3 : Anatomical sites involved in necrotizing soft tissue infection.

ANATOMICAL SITE	NO.OFPATIENTS	PERCENTAGE%
A. Extremities	50	50.5
1) Upper	10	10.1
2) Lower	40	40.4
B. Perineum	25	25.3
C. Abdomen	8	8.1
D. Involvement of Multiple sites	6	6.1
1)Buttock and Back	2	2
2)Abdomen and Perineum	2	2
3)Neck and Chest	2	2
E.Neck	5	5.1
F. Buttock	3	3
G. Back	1	1
H. Chest	1	1
I. Head and face	0	0

Table 4: Depth Of Infection

LEVEL OF INFECTION	NO.OF PATIENTS	%
LEVEL 1 (Skin)	0	0
LEVEL 2 (Subcutaneous tissue)	0	0
LEVEL 3 (Fascia)	72	72.7
LEVEL 4 (Muscle/Bone)	27	27.3

Table 5: Duration of symptoms from onset till presentation to the hospital

Duration of Symptoms	No. of patients	%
< 7 days	74	74.7
>7 days	25	25.3

Table 6: Predisposing factors in patients with necrotizing soft tissue infection

PREDISPOSING FACTOR	NO.OF PATIENTS WITH PREDISPOSING FACTOR	PERCENTAGE%
1. Poor personal hygiene	**53**	**53.5**
2. Diabetes mellitus	**50**	**50.5**
3. Age more than 50 years	**48**	**48.5**
4.Chronic alcoholism	**36**	**36.4**
5.Peripheral vascular disease	**16**	**16.2**
6.Smoking	**10**	**10.1**
7.Cardiovascular disease	**3**	**3**
8.AIDS	**3**	**3**
9.Paraplegia	**3**	**3**
10.Carcinoma	**0**	**0**
11.Steroid use	**0**	**0**
12.IV drug abuse	**0**	**0**

Table 7 : Causative factors in necrotizing soft tissue infections

CAUSATIVE FACTOR	NO.OF PATIENTS	PERCENTAGE%
A)TRAUMA		
1.Trivial	**33**	**33.33**
2.Post-operative	**2**	**2**
3.Injections	**2**	**2**
B) INFECTION		
4. Infected foot ulcer	**23**	**23.23**
5.Ch.infections of skin	**18**	**18.18**

6. Urogenital disease	**8**	**8.1**
7. Infected decubitus ulcer	**4**	**4**
8. Anorectal disease	**1**	**1**
C)OTHERS		
9. Strangulated hernia	**1**	**1**
10.Carcinomatous lesion	**0**	**0**
D)IDIOPATHIC	**6**	**6.1**

Table 8: Bacteriology of necrotizing soft tissue infection

BACTERIA	NO.OF PATIENTS FROM WHICH CULTURED	PERCENTAGE
1)Polymicrobial	**59**	**60**
2)Monomicrobial	**40**	**40.4**
3)Aerobic	**98**	**98.9**
4)Anaerobic	**28**	**28.3**

Table 9 : Laboratory Investigations on Admission

Blood Parameters	No. of patients	%
1. Haemoglobin(gm%)		
>10	**29**	**29.3**
<10	**70**	**70.7**
2. WBC(thousand cells/mm3)		
<11	**13**	**13.1**
>11	**86**	**86.8**
3. Glucose level(mg/dl)		
<180	**34**	**34.3**
>180	**65**	**65.6**
4. Creatinine (mg/dl)		
< 1.6	**73**	**73.7**
>1.6	**26**	**26.3**
5. Sodium(mEq/L)		
<128	**87**	**87.8**
>128	**12**	**12.1**
6. BUN(mg/dl)		
<50	**59**	**59.6**
>50	**40**	**40.4**
7. CRP(mg/dl)		
<150	**40**	**40.4**
>150	**59**	**59.6**
8. Histological confirmation of necrotizing soft tissue infection	**99**	**100**
9. AIDS(ELISA)	**3**	**3**
10. X-ray showing gas	**10**	**10.1**

Table 10 : Operative procedure in patients with necrotizing soft tissue infection

OPERATIONS	NO.OF PATIENTS	PERCENTAGE%
INITIAL OPERATIONS		
1)Debridement	**99**	**100**
2)Deb + Fasciotomy	**25**	**25.2**
3)Deb + Amputation	**10**	**10.1**
4)Deb + Colostomy	**1**	**1**
RECONSTRUCTIVE OPERATIONS		
5) Skin Grafting	**32**	**32.3**
6)Secondary Suturing	**30**	**30.3**
7)Abdominal mesh reconstruction	**1**	**1**

Table 11: Complications in necrotizing soft tissue infection

COMPLICATIONS	NO.OF PATIENTS AFFECTED	PERCENTAGE%
1)Septicaemia	**14**	**14**
2) Acute Respiratory distress syndrome	**9**	**9.1**
3)Renal dysfunction	**4**	**4**
4)Multiorgan failure	**3**	**3**
5)Cardiac failure	**1**	**1**
6)Hepatic dysfunction	**1**	**1**

Total no. of pts having complications---------- 15 Numbers

Table 12: Overall Mortality in patients of necrotizing soft tissue infection

PATIENTS	NO.OF PATIENTS	PERCENTAGE%
Survivors	**84**	**84.8**
Non survivors	**15**	**15.2**

Table 13: Cause of Death

CAUSE OF DEATH	NO.OF PATIENTS	PERCENTAGE%
1.Septicaemia	**7**	**46.6**
2.Septicaemia and ARDS	**3**	**20**
3.Septicaemia and ARF	**2**	**13.3**
4.Septicaemia and ARF and ARDS	**2**	**13.3**
5.Cardiac Failure	**1**	**6.66**
Total	**15**	

Table 14 : Mortality in relation to duration

Mortality in relation to duration	No. of patients (Total)	No. of patients died	Percentage %
1) Mortality during first 7 days of admission	99	5	5
2) Mortality after first 7 days of admission	99	10	10

Table 15: Age Factor On Mortality

Age	Survivor	Non Survivor	Total
<50	40(37.33)[0.19]	4(6.67)[1.07]	44
>50	44(46.67)[0.15]	11(8.33)[0.85]	55
Total	84	15	99(Grand total)

The chi-square statistic is 2.2629. The p-value is .132509. Not significant at p < .05.The chi-square statistic with Yates correction is 1.4938. The p-value is .221622. Not significant at p < .05, hence this factor is Statistically Insignificant.

Table16: Gender Factor on Mortality

	Survivor	Non-Survivor	Total
Male	67 (67.88) [0.01]	13 (12.12) [0.06]	80
Female	17 (16.12)[0.05]	2 (2.88) [0.27]	19
Total	84	15	99(Grand Total)

The chi-square statistic is 0.3913. The *p*-value is .531641. *Not* significant at *p* < .05.The chi-square statistic with Yates correction is 0.0727. The *p*-value is .787458. *Not* significant at *p* < .05,hence this factor is Statistically Insignificant.

Table: 17: Factor of Late Presentation on Mortality

	Survivor	Non Survivor	Total
<7days	69 (62.79) [0.61]	5 (11.21) [3.44]	74
>7days	15(21.21) [1.82]	10(3.79) [10.19]	25
Total	84	15	99(Grand Total)

The chi-square statistic is 16.0636. The *p*-value is .000061. Significant at *p* < .05. The chi-square statistic with Yates correction is 13.5818. The *p*-value is .000228. Significant at *p* < .05, hence this factor is Statistically Significant.

Table 18: Factor Of Anatomical Site On Mortality

	Survivor	Non Survivor	Total
Extremities	44 (42.42) [0.06]	6 (7.58) [0.33]	50
Non Extremities	40 (41.58)[0.06]	9 (7.42) [0.33]	49
Total	84	15	99(Grand Total)

The chi-square statistic is 0.7805. The *p*-value is .377002. *Not* significant at *p* < .05.The chi-square statistic with Yates correction is 0.3637. The *p*-value is .546433. *Not* significant at *p* < .05, hence this factor is Statistically Insignificant.

Table 19: Systemic Toxicity on Mortality

Systemic Toxicity	Survivor	Non Survivor	Total
Absent	79 (71.27) [0.84]	5 (12.73) [4.69]	84
Present	5 (12.73) [4.69]	10 (2.27) [26.27]	15
Total	84	15	99

The chi-square statistic is 36.4936. The *p*-value is 0.00001. Significant at $p < .05$.The chi-square statistic with Yates correction is 31.9237. The *p*-value is 0.00001. Significant at $p < .05$, hence this factor is Statistically Significant

Table 20: Diabetes Mellitus on Mortality

Diabetics	Survivor	Non Survivor	Total
Present	39 (42.42) [0.28]	11(7.58) [1.55]	50
Absent	45 (41.58) [0.28]	4 (7.42) [1.58]	49
Total	84	15	99(Grand Total)

The chi-square statistic is 3.6855. The *p*-value is .054887. *Not* significant at $p < .05$.The chi-square statistic with Yates correction is 2.6878. The *p*-value is .10112. *Not* significant at $p < .05$, hence this factor is Statistically Insignificant.

Table21: Depth of Infection On Mortality

Depth of Infection	**Survivor**	**Non-Survivor**	**Total**
Level 3	72(67.03)[0.37]	7(11.97)[2.06]	79
Level 4	12(16.97)[1.46]	8(3.03)[8.15]	20
Total	84	15	99 (Grand Total)

The chi-square statistic is 12.0375. The *p*-value is .000521. Significant at $p < .05$.The chi-square statistic with Yates correction is 9.7372. The *p*-value is .001806. Significant at $p < .05$,hence this factor is Statistically Significant

Table 22: Serum Creatinine On Mortality

Serum Creatinine	**Survivor**	**Non-Survivor**	**Total**
>1.6	18(22.06)[0.75]	8 (3.94) [4.19]	26
<1.6	66(61.94)[0.27]	7 (11.06)[1.49]	73
Totals	84	15	99 (Grand Total)

The chi-square statistic is 6.6899. The *p*-value is .009696. Significant at $p < .05$.The chi-square statistic with Yates correction is 5.1438. The *p*-value is .023329. Significant at $p < .05$,hence this factor is Statistically Significant.

IV. Discussion

Table 23

STUDY	MEAN AGE (years)
1) Nissar Shaikh16.	48.6
2) Elliot et al 14	51.5
3) Stone and Martin10.	54
4) Spirnak et al 13.	54.6
5) Clayton et al22	55
6) Freeman et al23	46
7) Harikrishnan C.P. 19	55

8)	Present study	50

The mean age in present study was 50 yrs. Youngest patient was 20 yrs old while the oldest patient was 82 yrs old.

Table 24

STUDY	NO.OF MALES	NO.OF FEMALES
1)Mc Henry and others7	33	32
2)Elliot, Kufera and Myers14	137	84
3)Nissar Saikh16	71	23
4)Gurujit Singh18	32	16
5)Present study	80	19

Necrotizing soft tissue infection was higher in males 80 cases(80%) while in females 19 cases(19%).The male: female ratio is 4:1.

Table 25

Clinical features on admission	Mc Henry & others%[7]	Elliot,Kufera Myer's%[34]	Gurujit Singh%[18]	Present Study%
SYMPTOMS				
1)Pain at affected site	72	72.9	100	85.8
2)Swelling/ edema	75	75	79.16	80.8
3)Fever	60	31.6	100	50.5
4)Foul smelling discharge	-	46.8	-	42.4
5)Ulceration/ Wound	-	31.1	-	27.2
SIGNS- Local				
6)Tenderness	68	-	100	88
7)Erythema	72	66.3	79.16	70.7
8)Induration	-	45.3	62.5	46.5
9)Skin discolouration	38	18.4	-	18.2
10)Bullae/vesicles		23.7	-	15.2
11)Cutaneous gangrene				15.2
12)Crepitus	29	36.5	12.5	10.1
SIGNS-General				
13) Tachycardia	-	-	83.33	50.5
14)Hypotension	-	11.1	-	20.2
15)Systemic Toxicity	-	21	-	15.2
16)Altered mental status	7.6	17.9	-	15.2
17)Ketoacidosis	-	-	-	3

Patients who were toxic had tachycardia, hypotension and altered sensorium as distinct general signs.

Table 26

Duration between onset of first symptom and presentation	Mean (Days)
1) Michael et al24	5
2) Elliot et al14	4
3) Clayton et al22	5
4) Nissar Shaikh16	3.4
5) Present study	4.72

Average duration between onset of symptoms and presentation was 4.72 days

Table 27

Anatomical Site	Nissar Shaikh%16	Mohammad Sadegh Fazeil, Mohammad Reza Keramati %17	Gurujit Singh%18	Present study%
1) Extremities		-	-	50.5
A) Upper	7.5	33.3	14	10.1
B)Lower	54.3	9.8	56	40.4
2) Perineum	20.2	68.62	8	25.3
3) Abdomen	2.1	33.3	-	8.1
4)Involvement of multiple sites				6.1
A. Buttock and Back	8.5	-	-	2
B.Abdomen& Perineum	-	-	-	2
C.Neck& Chest	-	-	-	2
5)Neck	5.3	-	-	5.1
6)Buttock	-	-	-	3
7) Back	-	-	-	1
8)Chest	8.5	-	-	1
9)Head & Face	-	-	-	0

Extremities were the most common involved site in 50.5% cases in which lower extremity was far more common than upper extremity

Table 28

Causative Factor	Elliot Kufera andMyers%14	Thomas L Bosshardt,MD%1	Present study %
A) Trauma			
1) Trivial	14.6	11.11	33.33
2) Post operative	9.09	8.88	2
3) Injections	3.53	56	2
B) Infection			
1) Infected foot ulcer	15.15	11.11	23.23
2)Ch.infections of skin		-	18.18
3)Urogenital disease	4.04	-	8.1
4)Infected decubitus ulcer	2.02	-	4
5)Anorectal disease	10.6	8.88	1
C)Others			
1)Strangulated hernia	1.01	-	1
2)Carcinomatous lesion	-	2.22	0
D)Idiopathic	3.53	2.22	6.1

Trauma was the most common causative factor of necrotizing soft tissue infection followed by infected foot ulcer, chronic skin infections.

Table 29

Level of infection	Troy E.Callahan,MD%21	Present study %
Level 1(Skin)	48.57	0
Level 2 (Subcutaneous tissue)		
Level 3 (Fascia)	31.42	72.7
Level 4 (Muscle)	20	27.3

In majority of the cases 72.7% the infection extended upto Level 3 i.e. involving upto fascia while 27.3% extended upto Level 4 i.e. upto muscle & bone

Table 30

Investigations	Sudarsky and others%9	Elliot, Kufera and Myer's%14	Gurujit Singh%18	Present study%
1)Anemia	64	42	66.7	70.7
2)Leukocytosis	88	78.28	100	86.8
3)Hyperglycaemia	-	80.3	66.10	65.6
4)Serum creatinine>1.6 mg/dl	-	16	18.75	26.3
5)Hyponatremia	-	-	-	87.8
6)Blood urea>50mg/dl	-	20	-	40.4
7)CRP >150	-	-	-	59.6
8)Histological confirmation of necrotizing infection	100	100	100	100
9)AIDS(ELISA)	3.03	4	0	3
10)Xray showing gas	24	56.84	-	10.1

In majority of patients laboratory investigations showed anemia 70.7%, leukocytosis 86.8%, hyperglycaemia 65.6%. Deranged serum creatinine was noted in 26.3% while deranged blood urea nitrogen in 40.4 %.

Table 31

Operations	Mc Henry and others%7	Peter R. Carroll, MD, Eugene V. Cattolica,MD%20	Gurujit Singh%18	Present study%
A)Initial operations				
1)Debridement	100	100	97.9	100
2)Debridement+ Fasciotomy	-	-	-	25.2
3)Deb+Amputation	50	-	-	10.1
4)Debridement + Colostomy	4.61	29	-	1
B)Reconstructive operations				
1)Skin grafting	-	57	22.9	32.3
2)Secondary suturing	-	29	-	30.3
3)Abdominal mesh reconstruction	4.61	-	-	1

Most common initial surgical treatment was Debridement 100%and fasciotomy in 25.2% of patients while amputations major or minor were 10.1%. Commonest secondary surgery was skin grafting 32.3% and secondary suturing was 30.3% cases.

Table 32

Complications	Elliot,Kufera and Myers %[34]	Nissar Shaikh%[16]	Gurujit Singh%[18]	Present study
1)Septicaemia	47.2	-	22.9	14
2)ARDS	29.1	-	-	9.1
3)Renal dysfunction	31.6	5.3	-	4
4)Multiorgan failure	21	46.8	-	3
5)Cardiac failure	1.01	6.4	-	1
6)Hepatic dysfunction	-	-	-	1

Septicaemia/bacteremia was most common complication seen in 14% of patients ,ARDS 9.1%, renal dysfunction 4% and multiorgan failure 3% are the other complications seen. Common cause of death was septicaemia.

Table 33

Sr.no	Year	Authors	No.of cases	No. of mortalities	Percentage%
1)	1952	Wilson6	23	2	9
2)	1970	Rea &Wyrick8	44	13	30
3)	1972	Stone & Martin 10	63	48	76
4)	1982	Rouse et al11	27	20	73
5)	1983	Majeski& Alexander12	30	10	33
6)	1984	Spirnak et al13	20	9	45
7)	1985	Pessa & Howard3	33	11	33
8)	1987	Sudarsky et al11	33	2	6
9)	1995	Mc Henry et al7	65	19	29
10)	1996	Bosshardt et al1	45	12	27
11)	1996	Elliot et al14	198	50	25.3
12)	2004	Chin-Ho Wong15	89	19	21.3
13)	2007	Nissar Shaikh16	94	15	16
14)	2007	Mohammad Sadegh Fazeli17	102	13	10.8
15)	2013	Gurujit Singh18	48	1	2
16)	2020	Present Study	99	15	15

There is a decrease in mortality in recent years probably due to better understanding of disease and early diagnosis and radical surgical management. In the present study the mortality rate is 15%.
In the present study major factors having bearing on the mortality are-Duration between onset of symptoms and presentation, systemic toxicity on admission, depth of infection, serum creatinine on admission.

IV. Conclusion

Necrotizing soft tissue infection is a serious life threatening soft tissue infection which is commonly seen in old age group and in males. Poor socioeconomic status, associated diabetes mellitus, alcoholism, PVD were seen as some of the important predisposing factors. Disproportionate pain, swelling and pyrexia were the most common presenting features. Tenderness, erythema, induration were common local signs while bullae, skin discoloration, crepitus, cutaneous gangrene were less common. Systemic toxic signs were important in late presentation. Laboratory findings of Anemia, Leukocytosis and deranged renal function with radiological evidence of subcutaneous air are important diagnostic features. Histopathological confirmation plays important role in differentiating necrotizing soft tissue infections from other infections. Necrotizing soft tissue infection was bacteriologically mostly Polymicrobial and Aerobic infection. Early diagnosis, with aggressive medical and adequate surgical debridement play a important role in minimizing morbidity and mortality associated with necrotizing soft tissue infection. Septicemia, ARDS, ARF & Multiorgan failure are the common complications seen. Factors like late presentation, depth of infection, systemic toxicity, altered renal function were the major determinants of mortality of necrotizing soft tissue infection.

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