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Necrotizing Fascitis

Dr. Vikas Agashe, Consultant Orthopaedic Surgeon ***Dr. Vivek Shetty,*** Consultant Orthopaedic Surgeon
Dr. Anurag Awasthi, Registrar Orthopedics ***Dr. Ganesh Mohrir,*** Registrar Orthopedics
P. D. Hinduja National Hospital, Mumbai, India.

Introduction

Necrotizing fascitis (NF) is an aggressive soft tissue infection spreading along fascial planes, with or without overlying cellulitis;, it is also popularly known as **'flesh eating disease'** [1]. Wilson coined the term 'necrotizing fascitis' in 1952. The disease is usually caused by bacteria of Streptococcus or Staphylococcus species; but other microbes including Pseudomonas are increasingly being observed. Pain out of proportion to the physical findings, may be the only early indication.

Severe systemic toxicity can be associated with NF and mortality rates can reach upto 75% [2,3] .

Pathophysiology

Organisms spread from the subcutaneous tissue along the superficial and deep fascial planes, presumably facilitated by bacterial enzymes and toxins. This deep infection causes vascular occlusion, ischemia, and tissue necrosis. Superficial nerves are damaged, producing the characteristic localized anesthesia [5]. Tissue necrosis develops rapidly behind advancing wall of inflammation that limits penetration by antibiotics; desquamation followed by gangrene may be relentless**. Dish – water pus** (Pic.1) seen as a intra-operative finding, is the result of **liquidative necrosis** in necrotizing fascitis [5] . In cellulitis, infection begins at the junction between the dermis and superficial fascia; but in necrotizing fascitis, it starts at the level of subcutaneous fat and deep fascia [4] and the dermal layers are spared in early stages. Septicemia ensues with systemic toxicity.

Clinical Presentation

NF tends to begin with constitutional symptoms of fever and chills. After 2-3 days, erythema is noted, and supralesional vesiculation or bullae formation ensues. Serosanguineous fluid may drain from the affected area. From a rapidly advancing erythema, ulcers may appear as the infection spreads along the fascial planes. A black necrotic eschar may be evident at the borders of the affected areas. In individuals with diabetes mellitus, crepitus is often evident.

The organisms causing necrotizing fascitis syndrome produce exotoxins (e.g., Streptococcus pyogenes); which when released into the blood circulation, are responsible for systemic manifestations like hypotension, disseminated intravascular coagulation and multiple organ failure [6].

This life threatening infection commonly involves the limbs [7] . NF spreads widely and deeply with relative sparing of skin and underlying muscles; the early symptoms and signs can therefore be non-specific and mis-leading [8,9] . However, pain is usually found to be out of proportion to the clinical findings when compared to cellulites; though this may not be a reliable indicator. NF may develop after skin biopsy; at needle puncture sites in those using illicit drugs; and after episodes of frostbite, chronic venous leg ulcers, open bone fractures, insect bites, surgical wounds, and skin abscesses. However, in many cases, no association with such factors can be made. NF may also occur in the setting of diabetes mellitus, surgery, trauma, or infectious processes.

Laboratory Diagnosis

Although the laboratory parameters vary in a given clinical setting, the following may be associated with NF:

- Elevated total leucocyte count > 14,000/μL.
- Elevated Erythrocyte sedimentation rate and C- reactive protein.
- The blood urea nitrogen level may be elevated > 15 mg/mL.
- Low serum sodium levels < 135 mmol/L.

Imaging Studies

- Standard radiographs are of little value unless free air is depicted, as with gas-forming infections.
- CT may be more sensitive than plain radiography in demonstrating subcutaneous air.
- Ultrasonography may facilitate the rapid diagnosis of NF; it usually demonstrates fluid collection along fascial planes extending beyond the clinical spread.
- Contrast enhanced CT scan helps in localization and extent of the lesion; but MRI has better specificity and sensitivity.
- T2-weighted MRI may show well-defined regions of high signal intensity in the deep subcutaneous tissues and fascial plane. MRI for demonstration of the extent of NF may be useful in directing rapid surgical debridement. It has high sensitivity but low specificity.

Histological Findings

Sections show superficial fascial necrosis with blood vessels occluded by thrombi. A dense infiltration of neutrophils may be observed in deeper parts of the subcutaneous tissue and fascia. Subcutaneous fat necrosis and vasculitis are also evident. Excisional deep skin biopsy may be helpful in diagnosing and identifying the causative organisms.

"Disproportionate pain, patches of cutaneous necrosis, hypotension, as well as clinical signs of subcutaneous gas formation, absent significant epidermal involvement, (peau d'orange) are clues that should lead to the diagnosis of NF. (Tang 2001) [5]."

"Once the diagnosis of NF is confirmed, initiate treatment without delay. Because of the complexity of this disease, a team approach is best."

Medical Therapy

Necrotizing fascitis should be considered an emergency. The patient preferably be treated in consultation with infectious disease specialist and intensivist. Nutritional support alongwith broad spectrum antibiotics for coverage of aerobes (gram positive and negative bacteria) and anaerobes is required. Ampicillin +/- sulbactum or Ist generation cephalosporin alongwith Gentamicin/ Amikacin and metronidazole/clindamycin may be combined for adequate coverage, depending upon drug allergies and renal function. Vancomycin may be indicated if there is high prevalence of MRSA. The antibiotics should be administered parenterally for 2-3 weeks and followed by oral regimen for 6-8 weeks. The change of drug should be guided by the culture/ sensitivity reports.

Surgical Care

In all patients, examination by an experienced surgeon is critical. Once the clinical diagnosis is made, immediate surgical debridement is necessary. During 1st debridement, the infected tissue must be sent for culture/ sensitivity and histopathological evaluation routinely. Skin swabs are not representative of underlying infection and should be avoided.

This regimen outlined below is continued until further tissue necrosis stops and the growth of fresh viable tissue is observed. If a limb or organ is involved, amputation may be necessary because of irreversible necrosis and gangrene or because of overwhelming toxicity, which occasionally occurs. **Prompt surgery ensures a higher likelihood of survival.**

- The surgical incisions should be deep and extend beyond the areas of necrosis until viable tissue is reached.
- The entire necrotic area should be excised, including flaps of doubtful vascularity with internal degloving.

- The wound should be well irrigated.
- Hemostasis should be maintained, and the wound should be kept open for delayed skin coverage.
- Surgical debridement and evaluations should be repeated almost on a daily basis. Monitor the patient using parameters of clinical improvement, total and differential leucocyte counts and improvement in renal perfusion status.

Complications

Sepsis and renal failure are usual complications. Septicemia is typical and leads to severe systemic toxicity and rapid death unless appropriately treated.

Medicolegal Issues

Missing this diagnosis may prove fatal for the patient and lead to obvious medicolegal repercussions for his or her health care providers.

Study Design

We retrospectively reviewed records of twelve patients admitted to our hospital between September 2002 to September 2006 with mean age of 54 years (range 37-70 years). All patients were diagnosed as suffering from necrotizing fascitis, based on clinical presentation and positive histopathology report.

MRI was done in six and ultrasonography in six out of twelve patients. All the patients were evaluated pathologically for bacteremia by blood and urine cultures. Pus samples for culture/sensitivity were sent routinely at the time of admission and sequentially during debridements. All the tissues were subjected to histopathological examination, and final diagnosis rested on that report.

Early aggressive debridement was performed in all the cases, and the necrotic tissue was excised along with a margin of normal tissue, until punctate bleeding and contractile muscle tissue were identified. All the patients were put on broad spectrum parenteral antibiotics at admission, and later changed/continued depending on their culture/sensitivity report. Repeated debridement were done, as and when indicated. We also had multidisciplinary team for evaluation of patients, including infectious disease specialists and intensivists with required ICU back up.

Result and Inference

We found that MR imaging is a useful tool in early diagnosis of NF, and it helps to decide the extent of involvement of fascial planes, contributing to the decision for extent of surgical debridement required. T2 weighted MR imaging is better than CT scan in delineation of **fluid collection in inter-fascial planes**, we found MRI positive in all the six patients in whom it was done, as compared to Ultrasonography that was positive in four out of six patients studied, this was in concordance with the study of Schmid MR et al in 1998 [10,11]. Still, bedside ultrasonography can serve as a useful & cost-effective tool, if MRI facilities are not available or patient is morbidly ill.

NF is usually caused by bacteria of Streptococcus and Staphylococcus group, but we had a completely different microbiological spectrum with Pseudomonas emerging as a leading pathogen, alongwith Staphylococcus. We had a higher incidence of Pseudomonas aeruginosa infections (three out of twelve cases) similar to the series reported by Christofer McHenry et al in 1995 [16]. We also had polymicrobial causation; other pathogens included Proteus, Acinetobacter species, and E. coli [12]. Staphylococcus is particularly known to cause rapidly progressing disease [13]. In 1924, Meleny documented 20 cases of hemolytic streptococcal gangrene which we now believe to be necrotizing fascitis. He described rapidly developing inflammatory skin lesions, including heat and erythema, as the early clinical features [14]. Weiss and Laverdiere suggested that formation of **bullae** was an early sign [15].

We, in our study, didn't have any evidence to suggest that the pathogenic strain is likely to affect the final outcome.

Raised leucocyte count (> 20,000) was seen in eight out of twelve of our patients at the time of admission, however no statistical relationship was

evident in terms of high TLC and extensive mutilating procedures performed as a life saving measure; although it did increase the total duration of hospital stay including ICU period and raised the total treatment cost. Among the treatment responders, total and differential leucocyte count was important indicator of improvement and correlated well with clinical status.

The operative findings, including necrosis of subcutaneous fat (brownish) and fascial plane (greyish), loss of normal resistance of tissue planes and 'dish-water' pus, are the result of **liquidative enzymatic necrosis**. Antibiotics may not reach the necrotic tissue because of thrombosis of the vessels. **WM Tang concluded that the most reliable guide to the extent of spread was the loss of normal tissue resistance [5].**

Stone et al[3] reported that 63% of the death from necrotizing soft tissue infections occurred within 7 days of hospital admission, and Rouse et al[17] found that 45% of death from Necrotizing soft tissue infections occurred within 10 days of initial debridement and resulted either from persistent infection after inadequate debridement or rapidly developing septicemia. In the series reported by Ledingham and Tehrani[18], early mortality occurred in only 2 out of 11 patients with fatal infections, and these deaths resulted from causes unrelated to underlying infection. In our study, mortality was seen in two out of twelve patients; both of them had presented to hospital after 7 days with septicemia and multiple organ failure.

We found that **Diabetes Mellitus was the single most important medical condition affecting prognosis;** especially those with evidence of micro-vascular complications had higher chances of amputation/disarticulation[19]. Seven out of twelve patients were diabetic, and there was higher rate of amputation(five of them) in these patients.

The major determinant of overall prognosis in our study was the time delay between the onset of illness and initiation of surgical debridement and appropriate antibiotic therapy based on culture reports. Four out of twelve patients presented to our hospital within one week, and had excellent outcome in terms of limb salvage and reduced hospital stay. Eight out of twelve patients presented after one week, two of them were salvaged, while six patients had poor prognosis in terms of amputation/disarticulation or death. Aggressive surgical debridement was performed in all the cases; however in those presenting late, the number of debridements didn't alter the worse outcome. The mortality rate in our study was two out of twelve cases. The world wide mortality rate which can be as high as 75%, reflects the severeity of infection and related to the percentage of body surface involved, the presence of systemic acidosis and hypotension[16], as well as the time delay between admission to hospital and first surgical debridement. As most of our patients were primarily treated at peripheral hospitals, an insight into the problem may help in earlier diagnosis and reduction of morbidity for the patient. Inadequate debridement or delay was an important reason contributing to morbidity.

Hyperbaric O2 therapy is shown to improve the outcome in NF as illustrated in the study of Escobar SJ et al in 2005 [20], we however had no experience with that in our study.

The key factor reducing morbidity and mortality in this study, were early clinical suspicion supported by investigatory feed back, and prompt decision for thorough surgical debridements[21-25], alongwith back up with intensive care facilities and multidisciplinary approach for management.

❖ Illustrations ❖

FIGURE 1

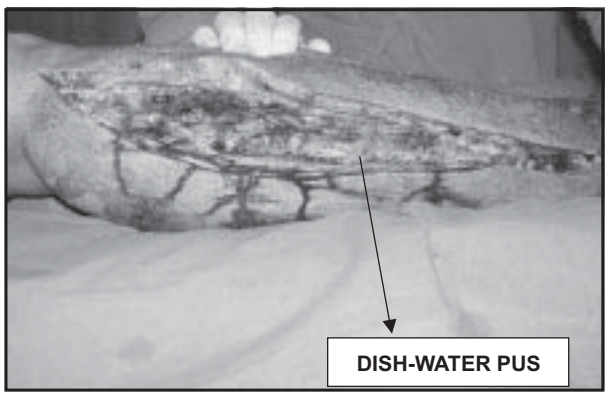


FIGURE 2 : M/70 diabetic, presented ten days after symptoms; diagnosed & treated as cellulitis before admission. Infection spreading rapidly along the plane of necrotic fascia.

Fig. 2A

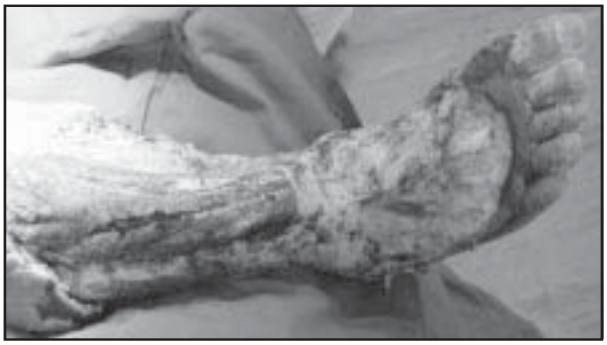
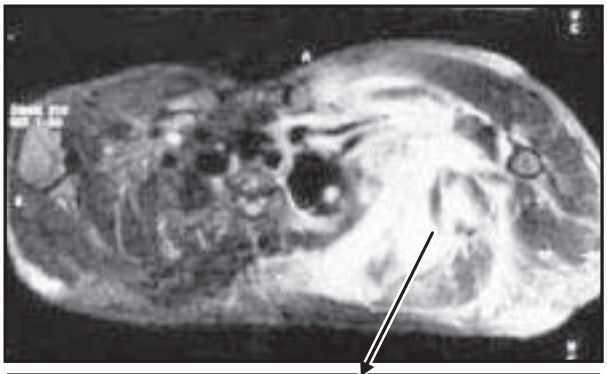


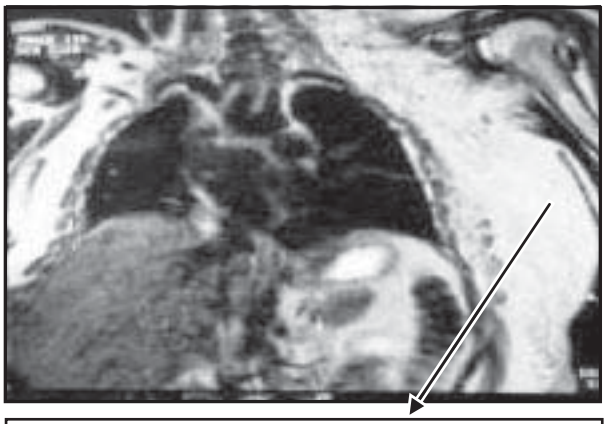
Fig. 2B

FIGURE 3 : Clinical presentation and MRI of 43/M presenting with necrotizing fascitis involving left chest wall; presented seven days after symptoms; septic focus at elbow and ankle with history of manipulation for erroneous diagnosis of posterior shoulder dislocation.



Hyperintense Signals On T2 Weighted Images
Along Inter-fascial Planes (Transverse Section)

Fig. 3A



Hyperintense Signals On T2 Weighted Images
Along Inter-fascial Planes (Coronal Section)

Fig. 3B

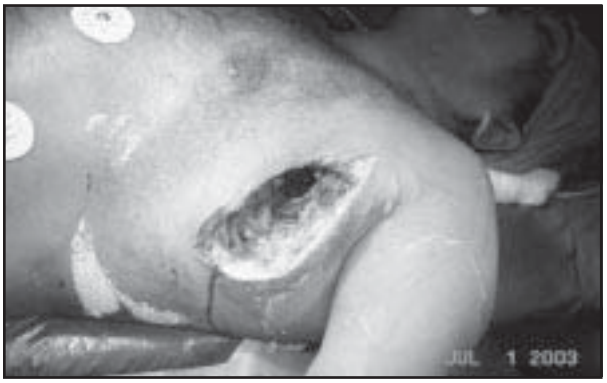


FIGURE 4 : 45/M, presenting with cellulitis of left leg progressively involving whole of left lower limb, and extending upto gtuteal region over 5 days, treated initially with antibiotics and multiple inadequate small incisions in subcutaneous plane. The patient presented in acute renal failure and had to undergo left hip disarticulation to control sepsis.

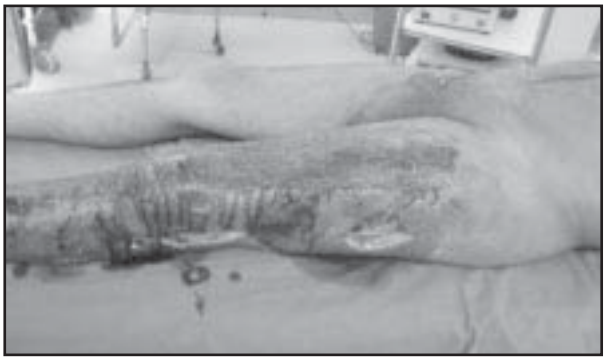


Fig. 4A

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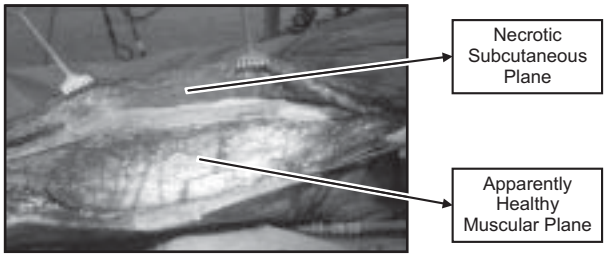

Fig. 4B

FIGURE 5 : 35 year lady presenting with history of swelling left ankle and foot, both medial and lateral aspect; admitted seven days after onset of symptoms; areas of necrosis evident at admission; patient was treated with extensive multiple debridements and split thickness skin grafting. Excision of a bridge of apparently normal skin with internal degloving resulted in rapid improvement.

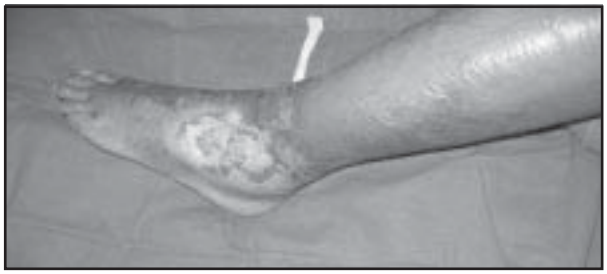

Fig. 5A

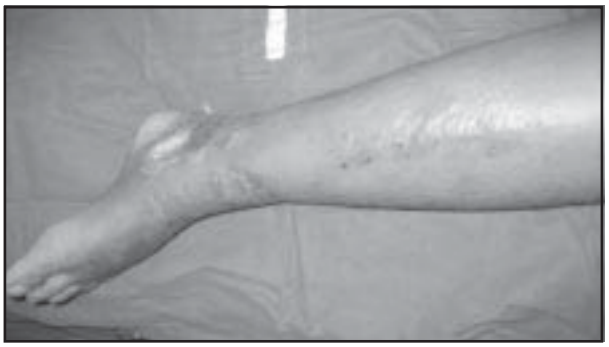

Fig. 5B

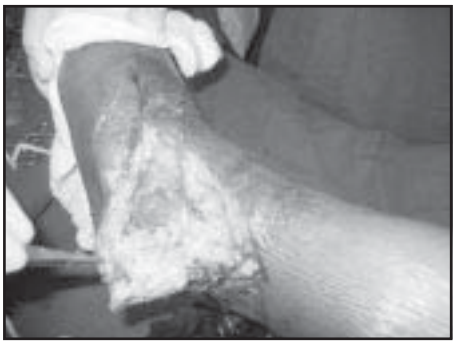

Fig. 5C

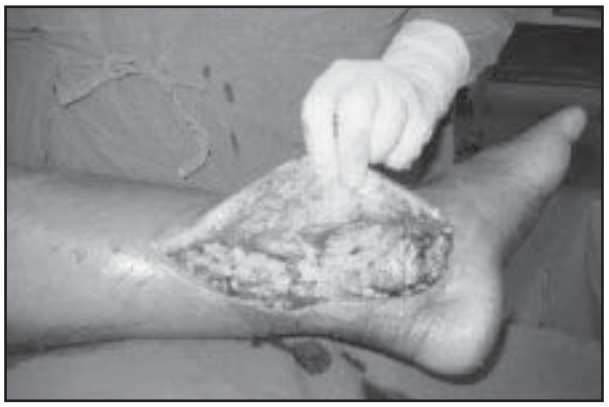

Fig. 5D

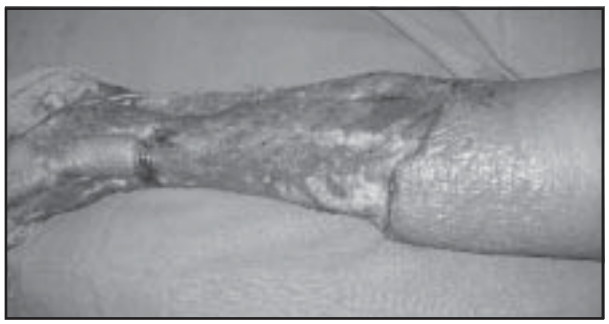

Fig. 5E

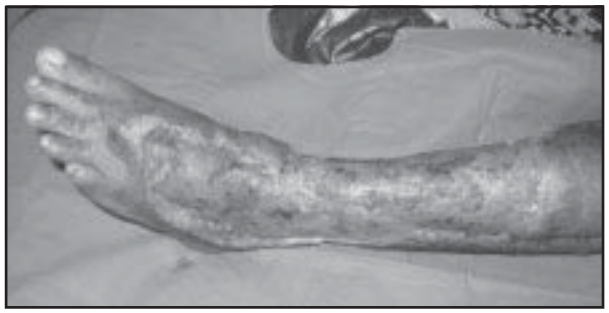

Fig. 5F

References

1. Fernandez Guerrero ML, Martinez Quesada G, et al. Streptococcal gangrene and so called flesh eating bacterial disease. Rev Clin Esp. 1999 Feb;199(2):84-8.

2. Sekeres LA. Necrotizing Fascitis: A perioperative care study. Crit. Care Nurs Clin North Am 2000 June; 12(2): 181-6

3. Stone HH, Martin JD Jr. Synergistic necrotizing fascitis. Ann Surg 1972;175:702-

4. Green RJ, Dafoe DC, Raffin TA. Necrotizing fascitis. Chest 1996;110:219-2

5. WM Tang, PL Ho, KK Fung, et al. Necrotizing fascitis of a limb. J Bone Joint Surg(Br) 2001;83-B:709-14

6. Louie L, Simor AE, Louis M, McGeer A, Low DE. Diagnosis of group A streptococcal necrotizing fascitis by using

PCR to amplify the streptococcal pyrogenic exotoxin B gene. J Clin Microbiol 1998;36:1769-71

7. Gonzalez MH. Necrotizing fascitis and gangrene of the upper extremity. Hand Clin 1998; 14:635-45

8. Jarrett P, Rademaker M, Duffill M. The clinical spectrum of necrotizing fascitis: a review of 15 cases. Aust NZJ Med 1997;27:29-34

9. Stamenkovic I, Lew PD. Early recognition of potentially fatal necrotizing fascitis.

N Engl J Med1984;310:1689-93.

10. Schmid MR, Kossman T, Duewell S . Differentiation of necrotizing fascitis and cellulites using MR imaging .AJR Am J Roentgenol 1998;170:615-20.

11. Loh NN, Ch'en IY, Cheung LP, Li KC. Deep fascial hyperintensity in soft-tissue abnormalities as revealed by T2-weighted MR imaging. AJR Am J Roentgenology1997;168: 1301-4

12. 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

13. Lee YT, Chou TD, Peng MY, Chang FY. Rapidly progressive necrotizing fasciitis caused by Staphylococcus aureus. J Microbiol Immunol Infect. 2005 Oct;38(5):361-4.

14. Meleney FL . Hemolytic streptococcus gangrene. Arch Surg 1924;9:31

15. Weiss KA, Laverdiere M. Group A streptococcus invasive infections: a review Can J Surg 1997;40:18-25

16. McHenry CR, Piotrowski JJ, Petrinic D, Malangoni MA. Determinants of mortality for necrotizing soft tissue infections.Ann Surg 1995;221:558-63

17. Rouse TM, Malangoni MA, Schulte WJ. Necrotizing fascitis: a preventable disaster. Surgery 1982;92:765-70

18. Ledingham I McA, Tehrani MA Diagnosis, clinical course and treatment of acute dermal gangrene. Br J Surg 1975;12:364-372

19. Kanuck DM, Zgonis T, Jolly GP. Necrotizing fasciitis in a patient with type 2 diabetes mellitus. J Am Podiatr Med Assoc. 2006 Jan-Feb;96(1):67-7

20. Escobar SJ, Slade JB Jr, Hunt TK, Cianci P. Adjuvant hyperbaric oxygen therapy (HBO2)for treatment of necrotizing fasciitis reduces mortality and amputation rate. Undersea Hyperb Med. 2005 Nov-Dec;32(6):437-43

21. Ward RG, Walsh MS. Necrotising Fascitis; 10 years' experience in a district general hospital. Br J Surg 1991;78:488-9

22. Voros D, Pissiotis C, Georgantas D. Role of early and extensive surgery in the treatment of severe soft tissue infection. Br J Surg 1993;80:1190-1

23. Freischlag JA, Ajalat G, Busuttil RW. Treatment of necrotizing soft tissue infections Am J Surg 1985;149:751-5

24. Taviloglu K, Cabioglu N, Cagatay A, Yanar H, Ertekin C, Baspinar I, Ozsut H, Guloglu R. Idiopathic necrotizing fasciitis: risk factors and strategies for management. Am Surg. 2005 Apr;71(4):315-20.

25. Schroeder JL, Steinke EE. Hutchinson Medical Center, Kan, USA. Necrotizing fasciitis—the importance of early diagnosis and debridement. AORN J. 2005 Dec;82(6):1031-40.

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