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RESEARCH ARTICLE
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EVALUATION OF NECROTIZING FASCIITIS IN DIABETIC AND NON-DIABETIC ADULT PATIENT

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ABSTRACT

Background: Necrotizing fasciitis (NF), often referred to as "flesh-eating disease," is a severe and rapidly progressing infection affecting the deep fascia and subcutaneous tissues. It can occur anywhere on the body, frequently stemming from minor trauma or surgical wounds. However, in up to half of cases, a definitive cause remains unidentified. Several comorbid conditions, including diabetes mellitus (DM), obesity, and smoking, are associated with an increased risk of developing NF. Diabetic patients, due to compromised wound healing and heightened susceptibility to infection, are believed to have more severe outcomes from NF.[1]

Aims and Objectives: This study aimed to evaluate necrotizing fasciitis (NF) in adult patients, specifically examining the influence of age, sex, symptom duration, affected body site, predisposing factors, causative organisms, length of hospital stay, and overall outcomes. A key focus was the comparison of these factors between diabetic and non-diabetic patient groups.

Methods: A prospective, hospital-based study was conducted at VIMSAR, Burla, Sambalpur, Odisha, between November 2022 and October 2024. Participants included all patients diagnosed with necrotizing fasciitis and admitted to the Department of General Surgery during the study period. Data collected pertained to demographic information, clinical presentation, predisposing factors, causative microorganisms, treatment strategies, and patient outcomes. The data were then analysed using appropriate statistical methods.

Results :The findings of this study indicated that older individuals are disproportionately affected by necrotizing fasciitis. Within the age range of 51 to 60 years, diabetic patients were most commonly affected, compared to 41-50 years for those without diabetes. Male patients were more frequently affected than females across both patient groups. While the aetiology of infection was often idiopathic in diabetic patients, minor trauma was a more a prominent precipitating factor in the non-diabetic group. The lower extremity was the most commonly involved site in all patients. In diabetic patients, Staphylococcus species and *E. coli* were commonly isolated, while *Klebsiella spp.* were frequently identified in the non-diabetic group. Diabetic patients experienced significantly higher mortality rates and longer lengths of hospital stay. Serial surgical debridement was a necessary treatment for most, and mortality was notably higher in diabetic patients who presented with advanced stages of the disease.

Conclusion: This study confirms that necrotizing fasciitis results in more severe clinical courses in diabetic patients compared to their non-diabetic counterparts. This is evidenced by increased mortality, prolonged hospitalizations, and a greater requirement for surgical debridement. Therefore, early identification and prompt, aggressive management are crucial for improving outcomes, especially in diabetic individuals presenting with this life-threatening condition.

Key Words- Necrotizing fasciitis, Diabetic, Debridement.

INTRODUCTION

Necrotizing fasciitis is a serious infection that deeply affects the fascia, a connective tissue that envelops muscles, nerves, and blood vessels. It is characterized by a swift progression and potentially severe consequences if not identified and treated without delay. [2] Diagnosis is usually made based on clinical findings due to its aggressive nature. The infection causes tissue necrosis, primarily involving the skin and subcutaneous tissue, and sometimes extending to deeper muscles (necrotizing myositis).The infection spreads via tissue planes. In severe cases, the bacteria may enter the bloodstream and lymphatic system, resulting in systemic complications, including sepsis and shock. [3] Diabetes is widely recognized as the most prevalent underlying condition predisposing individuals to NF, and it is frequently associated with both microvascular and macrovascular complications. Diabetic neuropathy, which leads to the degeneration of nerve fibres, impacts sensory, motor, and autonomic functions. This may contribute to the formation of pressure ulcers, which in turn may become infected. This cycle of events may result in an uncontrolled spread of infection, leading to necrotizing fasciitis. [4]

MATRIAL & METHODS

A hospital-based prospective study was conducted at VIMSAR, Burla, Sambalpur, Odisha, from November 2022 to October 2024. The study included patients diagnosed with necrotizing fasciitis admitted to the Department of General Surgery. Data on demographic details, clinical presentation, precipitating factors, causative organisms, treatment regimens, and outcomes were collected and analysed. Minimal total sample size calculated as 50 in each group using following formula

$$p = \frac{p_1 + rp_2}{1 + r}$$

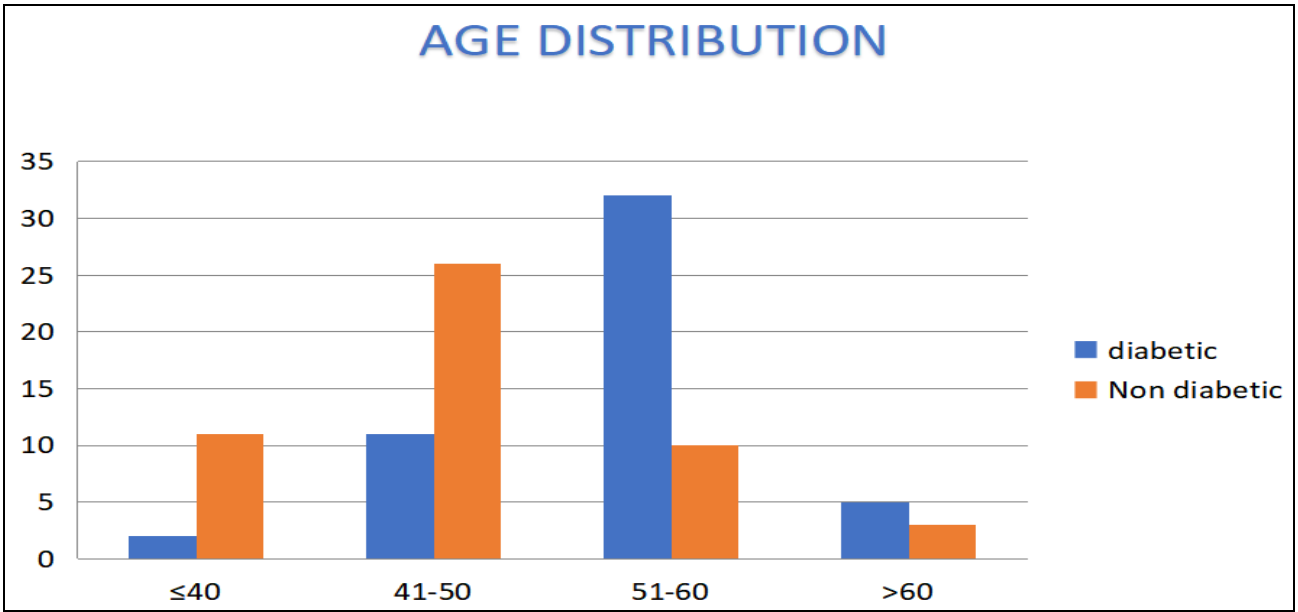
$$\boldsymbol{n \geq \frac{\left[Z_{1-\alpha/2}\sqrt{(r+1)p(1-p)} + Z_{1-\beta}\sqrt{rp_1(1-p_1) + p_2(1-p_2)}\right]^2}{r(p_2 - p_1)^2}}$$

Alpha (α) = 0.05, Beta (β) = 0.2
Proportion in group 1 (p_1) = 32.6% Group 1-diabetic
Proportion in group 2 (p_2) = 10% Group 2- Non-diabetic
Ratio (group1/ group2) = 1

NO conflict and financial requirement beared by researcher.

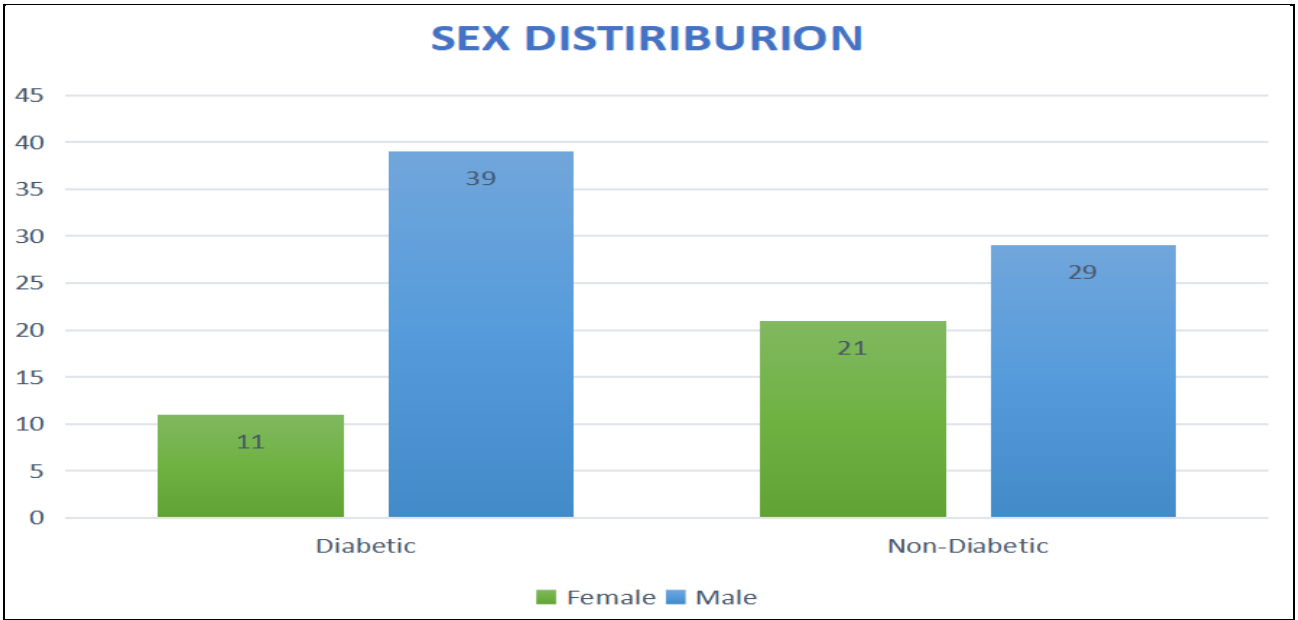
RESULTS

The age distribution of patients with necrotizing fasciitis was analysed, comparing diabetic and non-diabetic individuals. A statistically significant difference in age distribution was found between the two groups. The highest incidence of the disease in diabetic patients was observed in the 51-60 age group (64%), while in non-diabetic patients, the 41-50 age group had the highest incidence (52%). Specifically in the <=40 age group, 4% of diabetic patients and 22% of non-diabetic patients.



Graph 1

The study examined the sex distribution of patients with necrotizing fasciitis across diabetic and non-diabetic groups. A significant difference in sex distribution was observed between the groups. In diabetic patients, 78% were male and 22% were female, whereas in non-diabetic patients, 58% were male and 42% were female. Necrotizing fasciitis was more common in males in both diabetic and non-diabetic patients.



Graph 2

Duration of symptoms	Diabetic		Non-Diabetic		Total
	No	%	No	%	
1-7 Day	10	20 %	33	66%	43
8-14Days	32	64 %	11	22%	43
>14 Days	8	16 %	6	12%	14
TOTAL	50		50		

Table 1- Time between onset and hospital presentation

In this study of 50diabetic patient with necrotizing fasciitis, 32 patients (64 %) were presented to the hospital after a duration of 8-14 days from the time of onset of symptoms whereas in 50 nondiabetic patients with necrotizing fasciitis, 33 patients (66%) were presented to the hospitals within 7days of onset of symptoms.

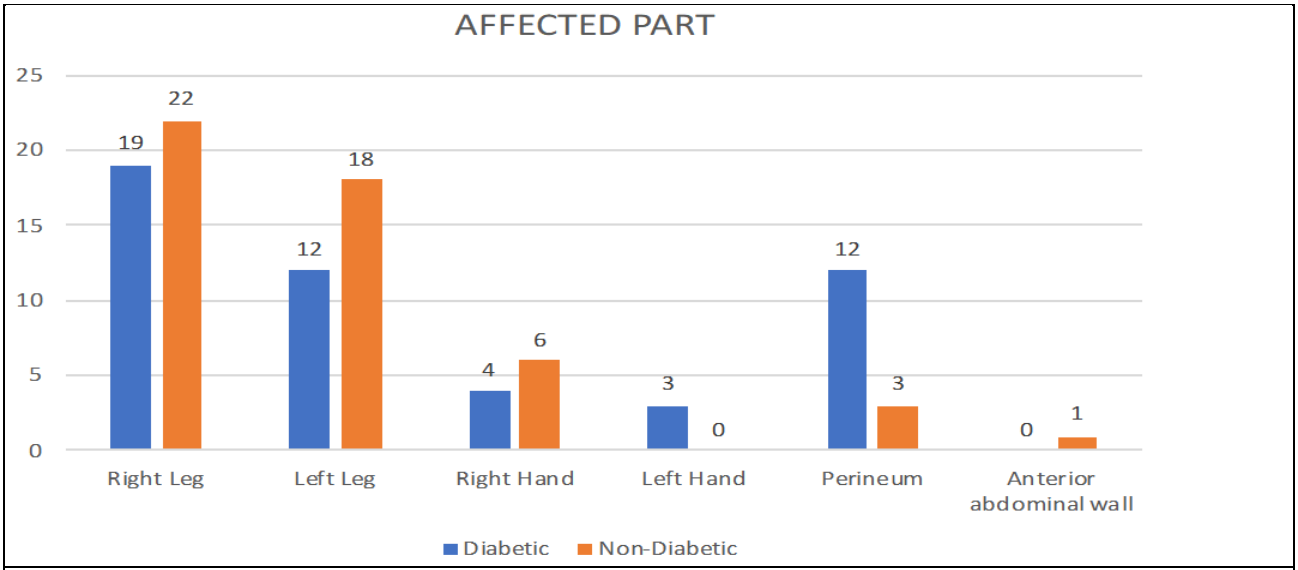
Predisposing factor	Diabetic		Non-Diabetic	
	No	%	No	%
Idiopathic	22	44%	16	32%
Post-surgery	5	10%	4	8%
Minor Trauma	18	36%	25	50%
Snake Bite	1	2%	2	4%
Thorn Prick	4	8%	3	6%
Total	50		50	

Table 2- Predisposing factors

In this study of 50 diabetic patient with necrotizing fasciitis predominant predisposing factor for developing necrotizing fasciitis was idiopathic (44%) followed by minor trauma (36%) were as in non-diabetic patient minor trauma was the predominant predisposing factor (50%) followed by idiopathic (32%).

Site of lesion

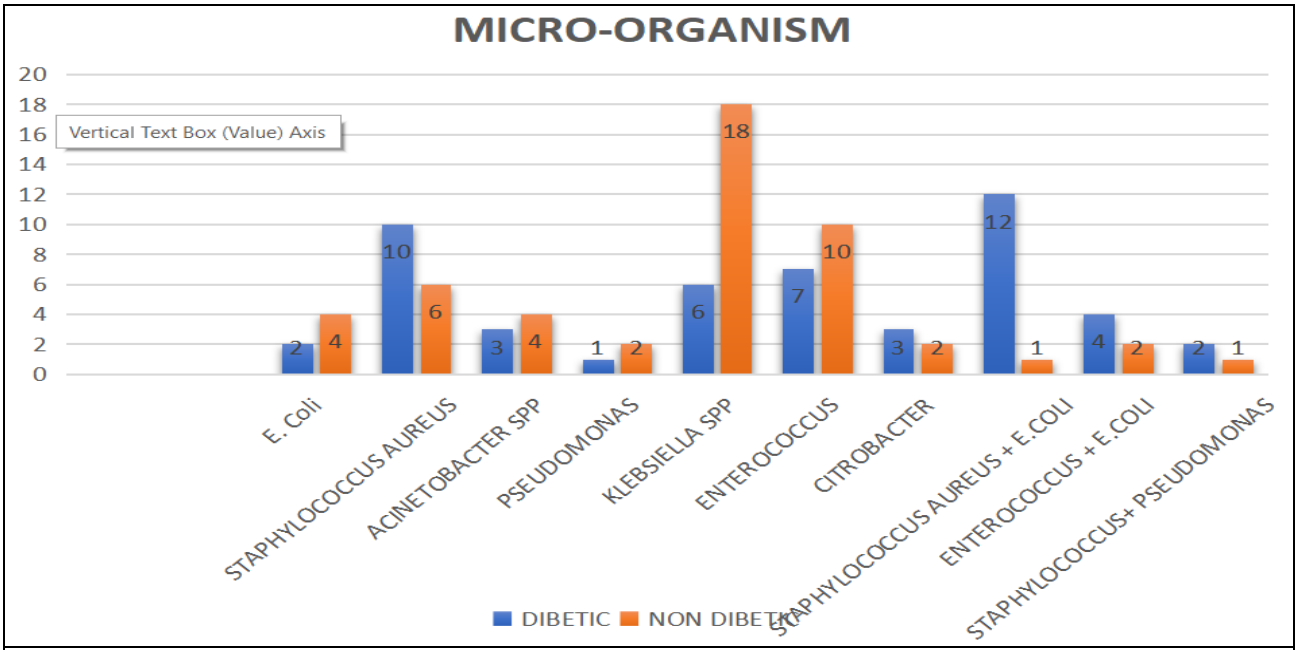
In diabetic patients, the most common site of necrotizing fasciitis was the lower limbs (62%), with the right leg being affected most frequently (38%). The perineum was the second most common site (24%). In non-diabetic patients, the lower limbs were also the most common site (80%), again with the right leg being affected more often (44%), while the perineum was only affected in 6% of patients.



Graph 3

Organisms grown on culture

Most common organism found in diabetic patient with necrotizing fasciitis was poly microbial (36%) the commonest being Staphylococcus and E. Coli (24%) followed by Enterococcus and E. coli (8%), were as in non-diabetic patient the commonest organism is Klebsiella (36%).



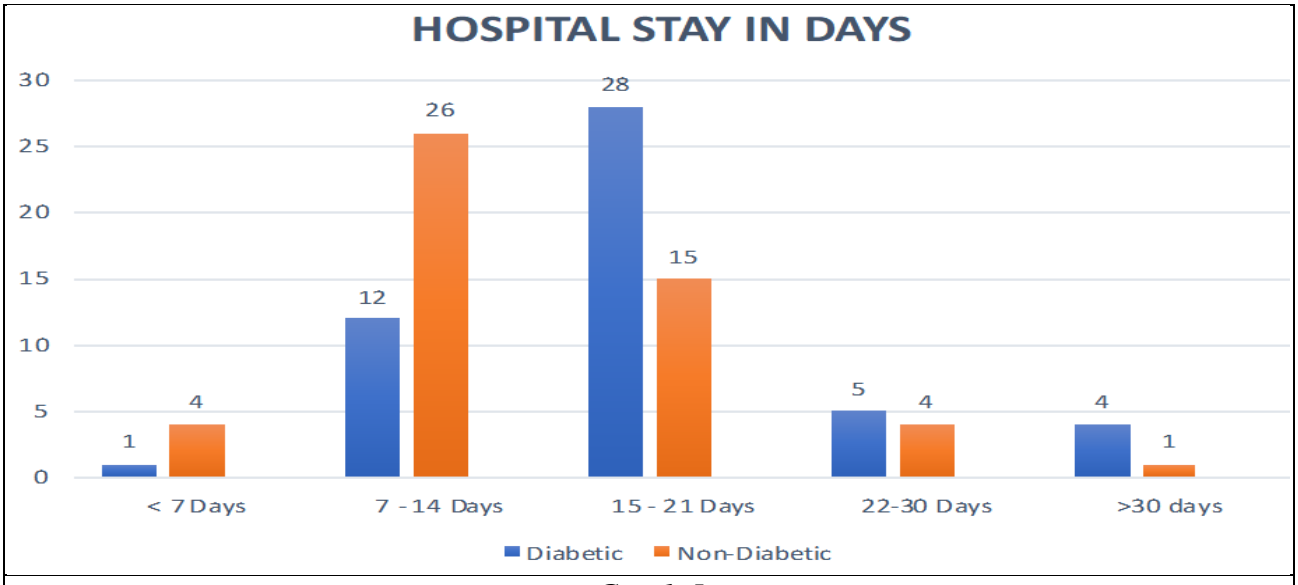
Graph 4

Number of debridement	Diabetic (N=50)		Nondiabetic (N=50)		Statistic
	No	%	No	%	
0	2	4	1	2	The chi-square statistic = 24.34 P value-<0.001 [P<0.05] Significant
1-3	5	10	9	18	
4-7	20	40	28	56	
>8	25	50	12	24	

Table 3: Number of debridement on both group

There was a statistically significant difference in the number of debridement procedures between diabetic and non-diabetic patients (chi-square = 24.34, $p < 0.001$). Diabetic patients were more likely to require a higher number of debridement's, with a high percentage needing 4-7 (40%) or more than 8 debridement's (50%). Non-diabetic patients more frequently required fewer debridement's.

Duration of hospital stay



Graph 5

The duration of hospital stay was significantly different between the two groups ($\chi^2 = 12.88$, df = 4, $p < 0.01$). Diabetic patients had a mean hospital stay of 18.06 ± 6.90 days (median 18-24 days), while non-diabetic patients had a mean stay of 13.88 ± 6.42 days (median 13-19 days). Unpaired t-test revealed a statistically significant difference in mean hospital stay duration between the two groups ($t=3.13$, df=98, $p<0.001$).

Outcomes

- **Amputation:** A higher percentage of diabetic patients (6%) underwent amputation compared to non-diabetic patients (2%).
- **Mortality:** Diabetic patients experienced a significantly higher mortality rate (24%) compared to non-diabetic patients (8%).
- **Secondary Suture:** The incidence of secondary suture was similar between the two groups, with a slightly higher incidence in non-diabetic patients.
- **Skin Graft (SSG):** A higher percentage of non-diabetic patients (72%) received skin grafts, although a notable number of diabetic patients also underwent this procedure

DISCUSSION

The global incidence of necrotizing fasciitis (NF) is on the rise. This condition presents a growing challenge for healthcare providers due to its complex diagnosis and management. Early identification of NF is notoriously difficult, even for experienced clinicians, as it often mimics cellulitis initially, a condition that can progress with variable speed. The challenge lies in differentiating between these two conditions. In severe cases, hematogenous and lymphatic dissemination of the causative microorganisms can lead to sepsis and septic shock. Systemic toxicity, marked by high fever, disorientation, and lethargy, is characteristic of advanced NF. Patients with pre-existing conditions like diabetes mellitus, peripheral vascular disease, compromised immunity, and a history of intravenous drug use are at significantly elevated risk for NF and its associated mortality. NF is rapidly fatal if not diagnosed and treated aggressively as an emergency, requiring repeated surgical debridement and high-dose parenteral broad-spectrum antibiotics. Therefore, enhancing awareness of risk factors and clinical symptoms is crucial to prompt early medical intervention.

This study examined 100 patients with NF, comprising 50 with diabetes and 50 without, admitted to VIMSAR Burla between November 2022 and October 2024. Among diabetic patients, the highest incidence (64%) occurred in the 51-60 year age group, with a mean age of 52.8 ± 7.22 years. Conversely, in non-diabetic patients, the 41-50 year age group had the greatest incidence (52%) with a mean age of 44.9 ± 9.53 years. These findings are consistent with prior studies. For example, Elliot et al.[5] (1996) found the highest incidence of NF in the 40-60 age range, with a mean age of 51 years, and Wong et al. [6] (2003) reported a higher incidence in the 50-60 age group, with a mean age of 56 years. Similarly, an Indian study by Singh & Bharpoda et al. [7] reported a higher incidence in the 40-60 year age group. The trend of increasing NF incidence in older age groups, as observed in the current study and in those from Stone HH and Martin ID et al. [8], may be attributed to the declining immune function associated with aging. Thus, these findings suggest that NF is most common between the fourth and sixth decades of life; the higher incidence in older individuals might be due to an increased presence of risk factors.

In the current study, male predominance was noted, with 78% of diabetic and 58% of non-diabetic patients being male. This finding is corroborated by the study of Singh & Bharpoda et al. [7] who reported a higher incidence in males. Studies by Elliot et al. [5](1.4:1 male to female ratio) and Rangaswamy M et al. (4:3 male to female ratio) also demonstrate a higher prevalence of NF in males. However, a study by Lancerotto et al. [9] found no sex predilection. The higher incidence in males might be associated with higher rates of smoking and alcohol consumption and greater occupational exposure to trauma.

Regarding clinical presentation, our study revealed that fever was more common in diabetic patients (80%) compared to non-diabetic patients (40%). Localized tenderness and erythema were less common in diabetic patients at 56% and 66% respectively compared to non-diabetic patients at 84% and 88%, respectively. Skin changes were slightly more common in diabetic patients (84%) than in non-diabetic patients (76%). Altered sensorium was seen more frequently in diabetic patients (56%) than in non-diabetic patients (24%). These findings vary from those of Elliot et al.[5], whose study reported fever in 31.6% of patients, localized tenderness in 72.9%, erythema in 66%, and skin necrosis in 31% of their patients , or Wong et al. (2003) who reported fever in 53%, localized tenderness in 98%, erythema in 100% and skin necrosis in 14% of patients or Singh et al. (2002) [10]reported fever in 37%, localized tenderness in 91% , erythema in 72% of the infected patients. The lower extremity and perineum were the most common sites involved, which is consistent with literature [1]. The increased vulnerability of these regions may be attributed to higher rates of injury and impaired vascularity in patients with diabetes mellitus.

In our study, the predominant infectious profile in diabetics was polymicrobial (36%), with Staphylococcus and E. coli (24%) being the most common combination, followed by Enterococcus and E. coli (8%). Monomicrobial infections in diabetic patients were caused by Staphylococcus (20%), Klebsiella (12%), Enterococcus (14%), Acinetobacter (6%), and Citrobacter (6%). In non-diabetic patients, the most common organism was Klebsiella (36%). These results are similar to those of Elliot et al, who found 84% polymicrobial and 16% monomicrobial infections with *Streptococcus pyogenes* predominating in monomicrobial infections. Similar to those of Singh and Bharpoda, most of the NF infections in their study were polymicrobial (87.5%). They found the most common isolates to be *Escherichia coli* (77.08%), *Streptococcus* (72.9 %), and *Staphylococcus* (50%). Hsiao et al. found that 23.4% of all isolates were polymicrobial and 53.4% were monomicrobial.

This study highlights important demographic and clinical features of NF in our region. Variations in microorganism profiles between studies might be due to geographical factors and healthcare practices. Further research is warranted to identify region-specific risk factors and optimize prevention and management strategies.
This study found that diabetic patients required more debridement procedures than non-diabetic patients. Specifically, a higher percentage of diabetic patients underwent 4-7 debridement's (40%) or more than 8 debridement's (50%). In contrast, non-diabetic patients were more frequently treated with 0 or 1-3 debridement's. The mean number of debridement's for diabetic patients was 7.4 ± 3.15, compared to 5.84 ± 2.76 for non-diabetic individuals. Consistent with these findings, serial debridement was the primary treatment approach in most study cases, with the majority of patients requiring more than three debridement procedures. These results emphasize that necrotizing infections often require repeated surgical intervention.

Importantly, a single debridement procedure was associated with a 7.5-fold increase in mortality risk. Furthermore, a delay of more than 24 hours between symptom onset and the first debridement led to a 9-fold increase in mortality risk. This is supported by the literature where infection is rarely eradicated after a single debridement, and serial debridement's are almost always needed. Studies have also demonstrated the beneficial effect of early intervention, with one study reporting that survivors had a shorter delay between admission and first debridement (1.2 days vs. 3.1 days on average). In other study a delay before the 1st debridement of more than 24 h correlated with an increased mortality rate. Amputation rates were elevated in diabetic patients (6%) compared to their non-diabetic counterparts (2%). While some studies like one at Padova, Italy report low amputation rates associated with necrotizing infections, others have reported rates as high as 33%.[11] In this study, the overall amputation rate was 22%. This contrasts with another study conducted at Coimbatore Medical College, where only one patient required amputation; that may have been attributable to a combination of early diagnosis, aggressive debridement, and use of broad- spectrum antibiotics. Secondary suture rates were similar between the groups, with a slight increase in non-

diabetic patients (18% vs. 16% in diabetics). Skin grafting was more common in non-diabetic patients (72%) compared to diabetic patients (54%) suggesting a difference in reconstructive needs. This study had a mortality rate of 24% in diabetic patients and 8% in non-diabetic patients. Other studies show variable mortality rates, with a retrospective study reporting that mortality rate among diabetes (30.9%) was higher than Non diabetics (18.9%). Similar outcomes were seen in other studies , where the mortality rate ranged from 19.2% to 27%. The mortality rate of necrotizing fasciitis ranges from 20 to 75%. These studies support that mortality can be high with necrotizing fasciitis and is often affected by factors such as late surgical debridement. This study strongly indicates negative effect of diabetes on the survival rate of patient with necrotizing fasciitis. Furthermore, the current study highlights that mortality rate in this population is similar to the upper limit of the mortality rates as documented in the literature.

CONCLUSION

This study observed that necrotizing fasciitis more frequently affected older individuals. Diabetic patients in the 51-60 year age range were commonly affected, whereas non-diabetic individuals were typically between 41 and 50 years old. Males were more frequently affected in both groups. In diabetic patients, idiopathic causes were the most common predisposing factor, whereas minor trauma was more common in non-diabetic individuals. The lower extremity was the most frequently affected site in both groups. Staphylococcus was the predominant organism in diabetic patients, followed by E. coli, while Klebsiella spp. was more common in non-diabetic patients. Early and serial surgical debridement was essential for treatment. Diabetic patients experienced higher mortality rates, particularly those who presented late, with a mortality rate of 24%.

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