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Treatment and Reconstruction in Necrotizing Fasciitis: Our Clinical Approach

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ABSTRACT

Background: Necrotizing fasciitis is a rare but serious soft tissue infection that is often life-threatening. This infection is caused by various bacteria and spreads rapidly into deeper tissues. It usually starts with a small wound or cut in the skin and can progress very rapidly, leading to extensive tissue destruction, systemic toxicity and ultimately very high mortality rates.

Aims: This article will focus on the strategies we apply in clinical practice to prevent and manage necrotizing fasciitis.

Methods: Patients admitted to our clinic between January 2014 and December 2023 were retrospectively reviewed. Individuals whose initial diagnosis and treatment were from an external center and those with a follow-up period of less than six months after treatment were excluded from the study. This article included 127 patients. They were evaluated in terms of epidemiology, demographic characteristics, treatment timing, reconstruction options, return to daily life and complications.

Results: Necrotizing fasciitis was observed in the perineum in 92 cases, in the lower extremities in 22 cases, in the upper extremities in 7 cases and in the inguinal region in 6 cases out of 127 patients. The average laboratory risk indicator for necrotising fasciitis (LRINEC) score was 6.7. All patients underwent debridement after diagnosis. Reconstruction was not started until the LRINEC score was below 4 and culture negativity was achieved. As a reconstruction method, skin graft was used in 48 patients, local fasciocutaneous flap in 29 patients, medial circumflex femoral artery flap in 27 patients, free anterolateral thigh flap in 7 patients, singapore flap in 6 patients, scrotal advancement flap in 6 patients and pedicled anterolateral thigh flap in 4 patients. Partial flap loss occurred in 4 patients and surgical site infection occurred in 21 patients. There were no major complications. After reconstruction, the mean time to return to daily life was 14.3 days.

Conclusion: These results show that the need for surgical intervention in the treatment of necrotizing fasciitis varies according to the site of infection and the type of microorganism. Demographic factors had no significant effect on the number of surgical debridements. These findings may provide important clues to guide clinical practice and optimize treatment protocols.

Keywords: debridement, LRINEC, necrotizing fasciitis, soft tissue infection

Introduction

Necrotizing fasciitis is described as a rapidly progressive infection of soft tissues. It usually affects the skin, subcutaneous tissue and fascial tissue and often requires surgical debridement.[1] This infection can have high mortality rates even with early diagnosis and appropriate treatment. Various bacterial agents can cause necrotizing fasciitis, but generally polymicrobial infections or monomicrobial infections such as group A streptococci (GAS) are the most common agents.[2]

Necrotizing fasciitis typically occurs in immunosuppressed individuals or those with comorbid diseases. Compared to cellulitis, necrotizing fasciitis infects deeper tissues. Limited vascular supply in the fascia inhibits the immune response and slows leukocyte migration, allowing bacterial pathogens to proliferate rapidly.[4] Treatment usually requires broad-spectrum antibiotics and aggressive surgical debridements. The timing and extent of surgical intervention are among the most critical factors determining the patient's prognosis.[5] Early debridement (<12 hours) reduces mortality rates.[6] Debridements remove necrotic tissues with impaired vascularity. At the same time, the goal is to lessen the infectivity of the microbiologic agent. The site of infection and the microbiologic agent causing it play a crucial role in managing necrotizing fasciitis.[7,8]

The treatment steps for necrotizing fasciitis are early diagnosis, serial debridement, antibiotherapy, regulation of comorbid diseases and reconstruction after the infection control. However, there is no clear consensus in the literature on how to perform these steps or what affects them. This study aims to examine how we approach patients with necrotizing fasciitis, how we manage the treatment steps and what factors affect the treatment steps.

Material and Method

Patients who were diagnosed and treated with necrotizing fasciitis in our clinic between January 2014 and December 2023 were retrospectively reviewed. Individuals who were first diagnosed in our clinic and followed up for at least six months were included in the study. Patients with a follow-up period of less than six months or who were first diagnosed and treated in another center were excluded from the article. Demographic information, clinical characteristics, treatment modalities, mortality and time to return to normal life were obtained from electronic health records and patient files. The data collected were as follows: Age, gender, underlying diseases, initial symptoms, site of infection, laboratory risk indicator for necrotising fasciitis (LRINEC) scores, microbiologic agents, antibiotic regimens used, number and timing of surgical debridements, reconstruction option after debridement, mortality, time to return to normal life.

The data were analyzed using SPSS (Statistical Package for the Social Sciences). Demographic and clinical characteristics were summarized with descriptive statistics. T-tests, ANOVA and chi-square tests were used to make comparisons between different groups. A value of $p<0.05$ was considered statistically significant.

Results

A total of 127 patients were included in the study. Their ages ranged between 21 and 80 years. The mean age was 51.28 years. The gender distribution was 110 males (86.6%) and 17 females (13.4%). In terms of comorbidities, 39 cases (30.70%) had no comorbidities. Comorbidities included diabetes mellitus (DM), hypertension, congestive heart failure, transient ischemic attack, rheumatoid arthritis, chronic kidney diease, major depressive disorder, benign prostatic hyperplasia, hypercholesterolemia, drug addiction and asthma. 44 patients (34.64%) had more than one comorbidity. The most statistically significant comorbidities were DM (51.1%) and hypertension (22%). Necrotizing fasciitis was observed in the perineum in 92 (72.4%) patients, in the lower extremities in 22 (17.3%) patients, in the upper extremities in 7 (5.5%) patients and in the inguinal region in 6 (4.8%) patients. Statistically, the most common site was the perineum, followed by the lower extremities. The initial symptoms were erythema in 57 cases (44.88%), pain in 38 cases (29.92%) and folliculitis in 32 cases (25.20%). According to this distribution, the most common initial symptom is ertyhema, followed by pain and folliculitis (Table 1).

Initial Symptom	Lower Extremity	Perineum	Upper Extremity	Inguinal
Erythema	16	38	3	0
Pain	3	35	0	0
Folliculitis	3	19	4	6

Table 1: Initial symptoms and infection site

The laboratory risk indicator for necrotising fasciitis (LRINEC) scoring system was used for effective follow-up and treatment guidance at the time of diagnosis. The mean LRINEC score of the patients followed up in our clinic was 6.7. Surgical debridement was performed in all patients as soon as the diagnosis was made. The wound culture revealed polymicrobial infections in 68 patients (53.54%), Escherichia coli infections in 17 patients (13.39%), Pseudomonas aeruginosa infections in 9 patients (7.09%), Acinetobacter baumannii infections in 6 patients (4.72%), Streptococcus pyogenes infections in 6 patients (4.72%), Candida glabrata infections in 4 patients (3.15%), Klebsiella pneumoniae infections in 4 patients (3.15%), Staphylococcus aureus infections in 4 patients (3.15%), Candida parapsilosis infections in 3 patients (2.36%), Corynebacterium amycolatum infections in 3 patients (2.36%), Streptococcus agalactiae infections in 3 patients (2.36%). Escherichia coli and

Enterococcus species were the most common polymicrobial growths (Table 2).

Perineum	Lower Extremity	Upper Extremity	Inguinal
Polymicrobial: 59	Polymicrobial: 9	Staphylococcus aureus: 4	Pseudomonas aeruginosa: 3
Escherichia coli: 13	Escherichia coli: 4	Streptococcus pyogenes: 3	Acinetobacter baumannii: 3
Candida glabrata: 4	Pseudomonas aeruginosa: 3		
Klebsiella pneumoniae: 4	Streptococcus pyogenes: 3		
Streptococcus agalactiae: 3	Candida parapsilosis: 3		
Pseudomonas aeruginosa: 3			
Acinetobacter baumannii: 3			
Corynebacterium amycolatum: 3			

Table 2: Causative microorganisms according to the site of infection

All patients were administered antibiotherapy according to their antibiotic susceptibility. Multiple antibiotics were used in patients with polymicrobial growth. Meropenem was used in 57 cases (44.88%), cefazolin in 35 cases (27.56%), clindamycin, vancomycin and piperacillin-tazobactam in 35 cases (27.56%). The mean duration of antibiotherapy use was found to be 26.49 days. The mean number of debridements was 4.20 (Table 3, Chart 1). Klebsiella pneumoniae (7.00) and Staphylococcus aureus (6.00) were the microorganisms with the highest mean number of surgical debridements.

Microorganism	Average debridement cases
Klebsiella pneumoniae	7.00
Staphylococcus aureus	6.00
Escherichia coli	5.18
Acinetobacter baumannii	5.00
Polymicrobial	4.19
Candida glabrata	4.00
Corynebacterium amycolatum	4.00
Candida parapsilosis	3.00
Pseudomonas aeruginosa	2.50
Streptococcus pyogenes	2.50
Pseudomonas aeruginosa	2.00
Streptococcus agalactiae	2.00

Table 3: Mean number of surgical debridements by type of microorganism

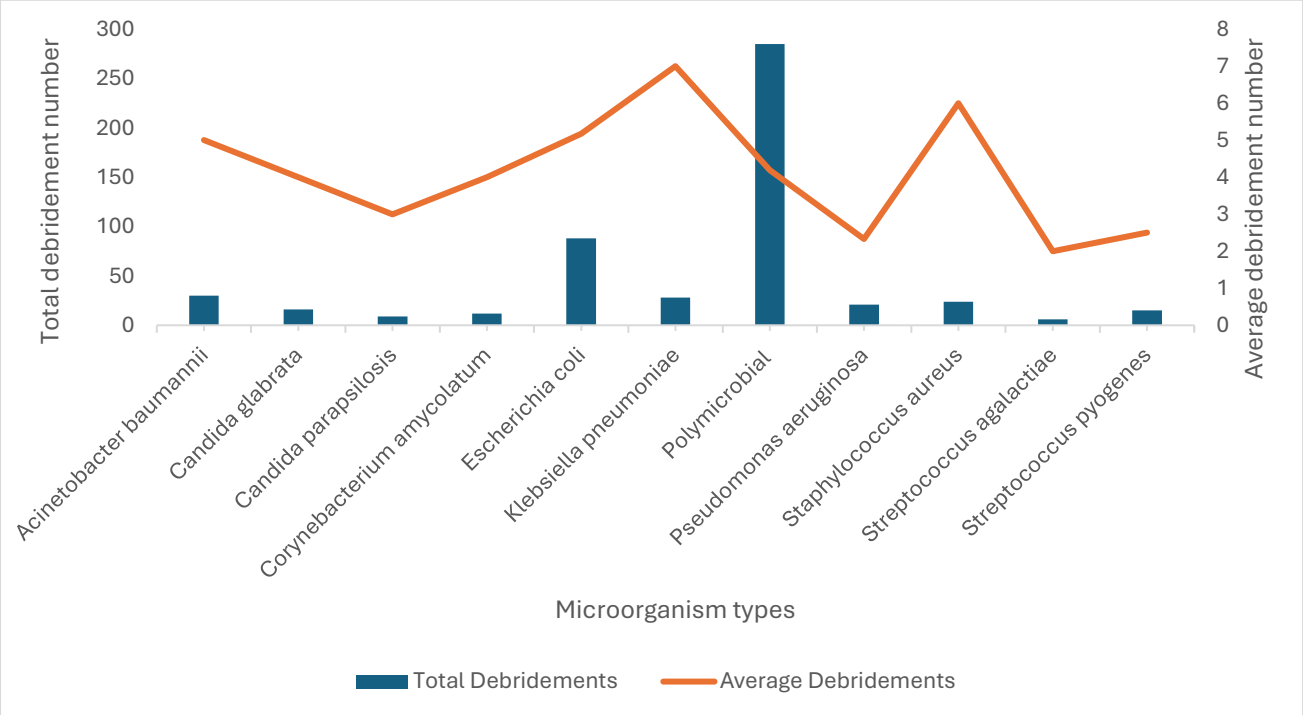

Chart 1: Total debridement number of microorganisms and average debridement number of microorganisms

Between debridements, patients were treated with dressings or vacuum-assisted wound closure. The mean timing of reconstructive surgical intervention according to the site of infection was 23.93 days in the perineum, 23 days in the upper extremity, 21.55 days in the lower extremity and 20 days in the inguinal region. In all patients, the reconstruction phase was initiated when the LRINEC score dropped below 4 and there was no growth in the wound culture. As a reconstruction method, skin graft was used in 48 patients (37.8%), local fasciocutaneous flap in 29 patients (22.83%), medial circumflex femoral artery flap in 27 patients (21.26%), free anterolateral thigh flap in 7 patients (5.51%), singapore flap in 6 patients (4.72%), scrotal advancement flap in 6 patients (4.72%), pedicled anterolateral thigh flap in 4 patients (3.15%). Partial flap loss occurred in 4 patients and surgical site infection occured in 21 patients (Chart 2).

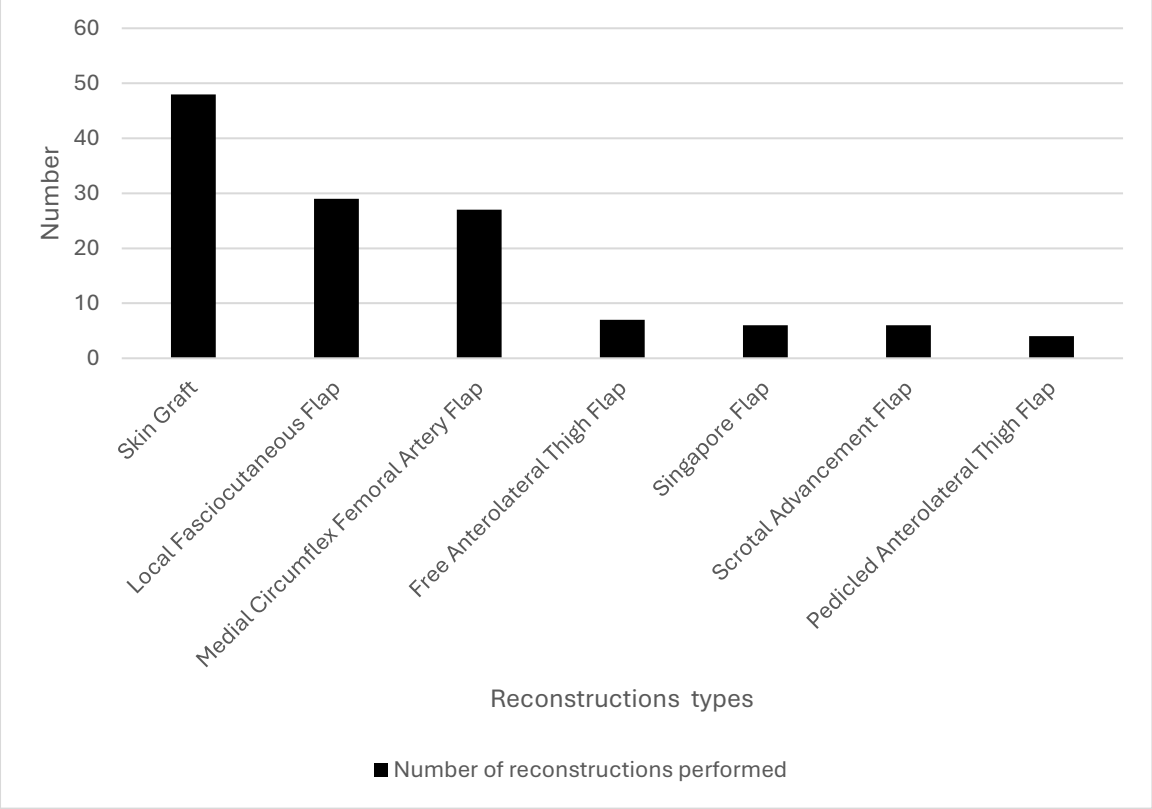

Chart 2: Number of reconstructions performed

There were no major complications, such as total flap loss. All patients with complications underwent debridement and secondary suturing. After reconstruction, the mean time to return to daily life was 14.3 days. No mortality was observed in any of the patients during the treatment and follow-up periods.

Discussion

In this study, the demographic, clinical and treatment characteristics of 127 patients diagnosed and treated for necrotizing fasciitis were analyzed. The findings on the distribution of types of reconstructive surgical interventions and the effectiveness of these methods provide important clues for the evaluation and improvement of treatment approaches.

Necrotizing fasciitis progresses quickly and is a life-threatening infection.[1] Risk factors such as diabetes, obesity, chronic kidney disease and alcoholism play an important role in the development of the disease.[3] In our study, the most common comorbidities with statistical significance were DM (51.1%) and hypertension (22%). These rates are in similar to those found in the literature.

Studies have shown that necrotizing fasciitis is more common in males.[9,10] In our study, it was determined that it was more common in males. This finding is consistent with the literature.

Local pain and erythema were found to be the most common symptoms in a study by Misiakos et al.[11] This study showed that perineal infections were more common, while lower extremity infections were less common. In our study, the most common initial symptom among patients was erythema (44.88%), followed by pain (29.92%) and folliculitis (25.20%). A significant correlation was also found between initial symptoms and sites of infection ($p<0.05$). This suggests that certain symptoms are more common at certain infection sites. The perineum was the most common site of initial symptoms, such as erythema, pain and folliculitis. This suggests that infections in the perineum present a wider spectrum of symptoms. The lower extremity region is notable, because symptoms such as erythema and pain are less (Table 1). The inguinal region is particularly associated with folliculitis. These differences may play an important role in determining treatment strategies. Understanding the regional distribution of symptoms may contribute to clinical practice in terms of early diagnosis and the selection of appropriate treatment methods.

Studies have shown that necrotizing fasciitis is more common in the perineum.[12] Perineal necrotizing fasciitis is

called Fournier gangrene.[13] In our study, 72.4% of the patients had necrotizing fasciitis in the perineum, 17.3% in the lower extremity, 5.5% in the upper extremity and 4.8% in the inguinal region. Statistically significant necrotizing fasciitis was most common in the perineum, followed by the lower extremity.

A colostomy may be performed in patients with perineal infection and debridement area extending around the anus. A colostomy is a surgical procedure that directs the flow of feces from the infected area. It has been reported that infection control and wound healing are more successful in patients with colostomies.[14] A colostomy helps infection control by reducing contamination of the infected area, while increasing reconstruction success and the quality of life of patients. Performing these procedures with the right indications has a positive impact on the patient's prognosis.[15] In our patients with necrotizing fasciitis involving the anal region, we performed a colostomy to control infection and increase reconstruction success. After the first debridement, we consulted the patients to general surgery. Since the first debridement operation was performed under emergency conditions, colostomy preparation could not be performed, so colostomy operation was performed simultaneously with the second debridement. After the reconstruction operation, we again consulted the patients to general surgery for colostomy follow-up and colostomy closure.

The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) is a scoring system made up of six common laboratory tests. It was initially used to differentiate necrotizing fasciitis early on from other serious soft tissue infections.[16] Numerous studies have evaluated the effectiveness of LRINEC in early necrotizing fasciitis diagnosis, revealing its ability to identify and categorize necrotizing fasciitis patients into various risk groups, thereby enabling effective hospital resource management.[17,18] In our clinic, we use LRINEC scoring for the diagnosis and follow-up of necrotizing fasciitis patients. In this scoring, six independent laboratory parameters associated with necrotizing fasciitis are used (Table 4). According to this method, patients are classified as low (<5), medium (6-7) and high (>8) according to their LRINEC scores, and the probability of necrotizing fasciitis is determined as 50%, 50-75% and >75%, respectively.[2] In the patients in our study, the mean LRINEC score calculated at the time of diagnosis was found to be 6.7. This score was followed up to evaluate the efficacy of the initiated treatment. In all patients, debridements and antibiotherapy were continued until the score dropped below 4. Afterwards, the reconstruction phase started.

Parameter	Score
C-Reactive Protein (mg/L)	
< 150	0
≥ 150	4
White Blood Cell Count (10^3/mm^3)	
< 15	0
15-25	1
> 25	2
Hemoglobin (g/dL)	
> 13.5	0
11-13.5	1
< 11	2
Sodium (mmol/L)	
≥ 135	0
< 135	2
Creatinine (mg/dL)	
≤ 1.6	0
> 1.6	2
Glucose (mg/dL)	
≤ 180	0
> 180	1

Table 4: LRINEC scoring system

Diabetes mellitus (DM) is the most common comorbidity of necrotizing fasciitis, which occurs in 18-60% of patients.[3] In our study, DM was the most common comorbidity with a rate of 51.1%. It was followed by hypertension at a rate of 22%.

The causative microorganism in necrotizing fasciitis is usually polymicrobial.[12,19] Generally, gram-positive cocci (e.g., Staphylococcus aureus, Streptococcus pyogenes) and gram-negative bacilli (e.g., Escherichia coli, Pseudomonas aeruginosa) are among these agents.[14] In our study, polymicrobial infections were found in 53.54%, Escherichia coli infections in 13.39%, Pseudomonas aeruginosa infections in 7.09%, Acinetobacter baumannii infections in 4.72%, Streptococcus pyogenes infections in 4.72%, Candida glabrata infections in 3.15%, Klebsiella pneumoniae infections in 3.15%, Staphylococcus aureus infections in 3.15%, Candida parapsilosis infections in 2.36%, Corynebacterium amycolatum infections in 2.36%, Streptococcus agalactiae infections in 2.36%. The most frequently found species among polymicrobial growths were Escherichia coli and Enterococcus. The site of infection revealed differences between the causative microorganisms (Table 2). The most common infection was polymicrobial. The prevalence of polymicrobial infections in the perineum suggests that this region has more

complex microbial ecologies. These findings are important for shaping treatment approaches.

In our study, the mean number of debridements was 4.20. The mean number of surgical debridements differed according to the type of microorganism (Table 3, Chart 1).

According to these data, the mean number of surgical debridements was higher in Klebsiella pneumoniae and Staphylococcus aureus infections. This finding suggests that infections caused by these microorganisms may be more aggressive or resistant, requiring more intensive surgical intervention. There was no statistically significant difference in the number of surgical debridements between age groups. There was no statistically significant difference in the number of surgical debridements between genders. There was a statistically significant correlation between the site of the infection and the number of surgical debridements. A statistically significant correlation was also found between the number of surgical debridements and the type of microorganism. This indicates a relationship between the infection site and the type of microorganism, which influences the necessity for surgical debridement.

The mean number of debridements was 6.00 in the inguinal region, 4.22 in the perineum, 3.86 in the upper extremity and 3.77 in the lower extremity. According to these data, the average number of surgical debridement cases was the highest in inguinal region infections. Because this region is mobile and has dense fascial content, debridement is less effective in managing the infection. Debridement in this site is more conservative because it contains large vascular and neurologic structures. This suggests that infections in the inguinal region may be more aggressive or require more surgical intervention. The timing of reconstructive surgery is parallel to the number of debridements. This is due to the regularity of debridement intervals.

Each region has its own characteristics during the reconstruction phase. These characteristic features should be taken into account in reconstruction.[21] For example, skin grafts cannot be used in male when the testicular tissue is exposed in the perineum or when the tunica vaginalis is not intact.[22] Contracture is also common in skin grafts.[23] Muscle and musculocutaneous flaps are bulky, making them unsuitable for scrotal reconstruction. In addition, donor site morbidity is high.[24] Scrotal advancement flaps are a good option when defect size is less than 50% of the scrotal skin.[25]

These criteria were considered while evaluating reconstruction options in our clinic. When reconstructing the tissues, the reconstruction option that will cause the least morbidity to the patient, provide maximum harmony in the tissue to be reconstructed, and minimize the complication rate is preferred. Upon analyzing various types of reconstructive surgery for the treatment of necrotizing fasciitis, we found that skin graft was the most commonly used method, with 48 cases (42.1%) indicating this as the most commonly preferred intervention. Local fasciocutaneous flap ranked second with 29 cases (25.4%), followed by medial circumflex femoral artery flap with 27 cases (23.7%), free anterolateral thigh flap with 7 cases (6.1%), singapore flap with 6 cases (5.3%), and scrotal advancement flap with 6 cases (5.3%). The most rarely used method was pedicled anterolateral thigh flap with 4 cases (3.5%). These data demonstrate the diversity of surgical approaches and the distribution of preferred methods for treating necrotizing fasciitis. In our study, skin grafts were the most commonly used type of reconstructive surgery (Chart 2). The medial circumflex femoral artery flap has the following advantages: minimal donor site morbidity, single-stage surgery, good skin quality, and a color similar to the scrotum.[19] For this reason, the medial circumflex femoral artery flap has been the most preferred flap for reconstruction of large defects in the perineum. In small defects, local fasciocutaneous flaps and scrotal advancement flaps were preferred.

The probability of complications after infection, which can be life-threatening, is not few.[26] Partial flap loss occurred in four patients and surgical site infection developed in 21 patients. There were no major complications, such as total flap loss. All patients with complications underwent debridement and secondary suturing. After reconstruction, the mean time to return to normal daily life was 14.3 days. No mortality was observed in any of the patients during the treatment and follow-up periods.

Conclusion

These results show that the need for surgical intervention in the treatment of necrotizing fasciitis varies according to the site of infection and the type of microorganism. Demographic factors, such as age and gender, had no significant effect on the number of surgical debridements. There is a significant relationship between the microorganisms grown in culture, the site of infection and the number of surgical debridements. In parallel with this relationship, there is a direct correlation between the time to start reconstruction and the time to return to normal daily life. These findings may provide important clues to guide clinical practice and optimize treatment protocols.

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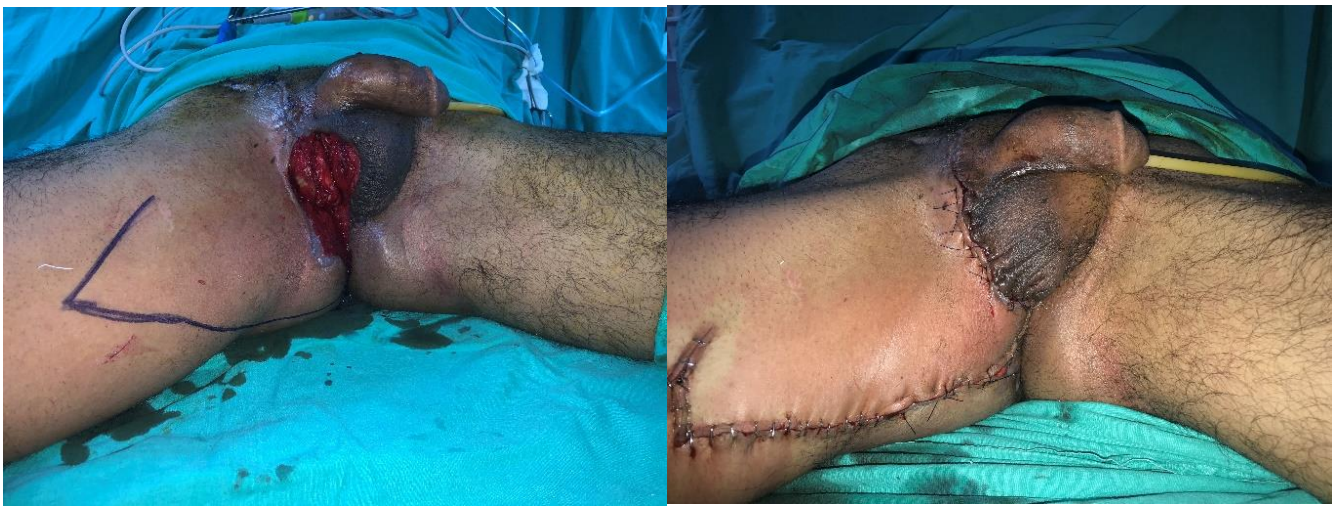
Picture 1: The first picture shows a foot of a patient diagnosed with necrotizing fasciitis. The second picture is after debridement. The third picture is after reconstruction with a skin graft.



Picture 2: The first picture is of a patient with necrotizing fasciitis of the scrotum after debridement. The second picture is of the patient after reconstruction with a local fasciocutaneous flap.

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