

PREDISOPPING FACTORS; MANAGMENT AND OUTCOMES OF NECROTIZING FASCITIS Among patients who admitted to surgical ward at Al-Thawra hospital; January 2020 to January 2021

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Abstract: Background: Necrotizing fasciitis is a serious infection of skin and soft tissues that rapidly progresses along the deep fascia. It's a fatal infection with high mortality if treatment delayed. Early diagnosis, surgical debridement and broad-spectrum antibiotic therapy are the optimal treatments to reduce the mortality. Objective: The aims were to identify risk factors for Necrotizing fasciitis and to describe the outcome of management. Methods: A prospective descriptive study was conducted at AL-THAWRA HOSIPTAL located in Sana'a, Yemen. All medical records of patients with confirmed NF who admitted to surgical department between January 2020 and January 2021 were reviewed. Results: The study enrolled 54 patients diagnosed with Necrotizing fasciitis. Male patients were 43 patients (79.6%) and female patients were 11 patients (20.3%). The age rang was 9 – 75 years old and the peak age incidence was at 46–60 years (33.3%). The incidence of NF increases with aging, male gander (79.6%), in comorbid patients (64.9%) especially DM (37%). The etiologies of NF were trauma in (16.6%) and perianal abscess in (14.8%), but (27.7%) of NF patients hadn't specific cause. The defected wound was treated by skin graft in (32.5%) and primary closure in (27.5%). The mortality rate was (27.7% n=15); (60%) of them died on first 5 days. Septic shock was the reason of death in (73.2%). The higher mortality rate was seen at male gander (66.6%), age group > 60 years (46.6%), in patients who presented in shocked state (73.3%) and in comorbid patients (73.3%). Conclusion: Necrotizing fasciitis represents a life threatening condition with challenges in diagnosis. Incidence and mortality of NF are common in male gander, an elderly patient, or in who suffers of comorbidities; especially DM.

Keywords: Necrotizing fasciitis, Factors, Outcomes, Yemen.

العوامل المسببة؛ إدارة ونتائج التفتت الناخر؛ لدى عينة من المرضى في قسم الجراحة بمستشفى الثورة بصنعاء

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المستخلص: الخلفية: التهاب اللفافة الناخر هو عدوى خطيرة تصيب الجلد والأنسجة الرخوة التي تتطور بسرعة على طول اللفافة العميقة. تصبح عدوى قاتلة مع ارتفاع معدل الوفيات إذا تأخر العلاج. التشخيص المبكر، التدخل الجراحي والعلاج بالمضادات الحيوية واسعة النطاق هي العلاجات المثلى لتقليل الوفيات.

الهدف: دراسة وتحديد عوامل الخطر لالتهاب التفتت الناخر ووصف المعالجة ومخارجها. الطرق: تم إجراء دراسة وصفية استطلاعية في قسم الجراحة بمستشفى الثورة بصنعاء، حيث تمت مراجعة السجلات الطبية للمرضى الذين يعانون من التهاب اللفافة الناخر والذين ادخلوا قسم الجراحة بين يناير 2020 ويناير 2021 وتم تحليلها باستخدام SPSS 24. النتائج: اشتملت الدراسة على 54 مريضاً تم تشخيصهم بالتهاب التفتت الناخر. كان المرضى الذكور 43 مريضاً (79.6%) والإناث 11 مريضاً (20.3%). تراوح العمر بين 9 - 75 سنة وبلغت ذروة الحدوث في الفئة العمرية 46-60 سنة (33.3%). يزداد حدوث التهاب التفتت الناخر مع تقدم العمر، الذكور (79.6%)، وجود أمراض مصاحبة (64.9%) خاصة السكري (37%). أكثر المسببات لالتهاب التفتت الناخر كانت الرض أو أذى جسدي في (16.6%) وخراج حول الشرج في (14.8%) لكن (27.7%) من المرضى لم يكن لديهم سبب محدد. تم علاج الجروح الناجمة عن المعالجة بواسطة زراعة جلد في (32.5%) وإغلاق أولي في (27.5%). كان معدل الوفيات (27.7%): (60%) منهم توفي في الخمسة الأيام الأولى من الرقود. الصدمة الإنتانية كانت سبب الوفاة في (73.2%). لوحظ ارتفاع معدل الوفيات في كل من الذكور (66.6%)، الفئة العمرية < 60 عامًا (46.6%)، في المرضى الذين قدموا في حالة الصدمة (73.3%) وفي المرضى المصابين بأمراض مصاحبة (73.3%)

الخلاصة: التهابات التهابية الناقصة يمثل حالة تهدد للحياة مع صعوبات في التشخيص. الإصابة والوفاة شائعان في الذكور، أو المريض المسن، أو الذين يعانون من الأمراض المصاحبة: خاصة السكري.

الكلمات المفتاحية: التهاب اللفافة الناخر، العوامل، النتائج، اليمن.

Introduction.

Necrotizing fasciitis, which commonly known as flesh-eating disease, is characterized by angiothrombotic microbial invasion and liquefactive necrosis,^[1] that lead to develop of Progressive necrosis of the superficial fascia, deep dermis and fascia that infiltrated by polymorphonuclear leukocytes, with thrombosis of nutrient vessels and occasional suppuration of the veins and arteries; bacteria then proliferate within the destroyed fascia. its incidence has been varyingly reported worldwide, 0.4 cases per 100, 000 populations in Canada^[2] and 1.3 cases per 100, 000 populations in Florida, USA^[3]. In northern Thailand, *Hongladaromp et al*^[4] reported the incidence of NF was 7.45 cases per 100, 000 populations. Trauma is the most common identifiable etiology. The majority of patients have a history of minor or major traumas. Appendicitis with perforation, infection following the repair of an incarcerated hernia, perforated diverticulitis, necrotic cholecystitis, gastroduodenal perforation, small bowel perforation, and obstructive colon cancer with perforation rank among the most frequent causes of complicated intra-abdominal infections that can lead to NF. Fournier's gangrene is often the result of surgical wounds, a complication of colorectal disease, anorectal infection or pressure sores. In women, it has commonly been ascribed to Bartholin abscesses or vulvar skin infections. In Asia, consumption of raw or undercooked seafood or injury by fish fins can lead to NF^[5]. In this group of infections, bacteria such as *Vibrio spp.*, *Aeromonas spp.*, and *Shewanella spp.* are commonly involved and are usually known as "marine bacteria"^[6] The most frequent comorbidity in NF patients is DM. Its prevalence in patients with any type of NF

ranges between 40 and 60%^{[5] [7]}. Other comorbidities include liver cirrhosis, chronic heart failure, CRF, obesity, alcohol abuse, immunodeficiency, SLE, Addison's disease, pre-existing hypertension, and peripheral vascular disease^{[8], [9]}. Elevated serum Creatinine, along with elevated blood urea, is also strongly associated with higher mortality rates^[9]. The use of (NSAIDs) or steroid drugs can suppress fever, thereby hampering the diagnosis of NF^[10]. Furthermore, *Martinschek et al.* have demonstrated that an increase of serum creatine kinase and lactate parameters, as well as a decrease of serum antithrombin III, proved by a low INR, are significant parameters for an unfavorable outcome, particularly in regard to Fournier's gangrene^[11]. Other risk factors, such as systemic acidosis, low hematocrit and albumin levels, are also strongly linked with a high mortality, while concomitant conditions increase the mortality rate further^[12]. But still DM, in particular, a disease, that often combines many of the above comorbidities, and is hence susceptible to the development of NF^[13]. A study by *Rea and Wyrick* reported a mortality rate of 67% in patients over 50 years of age and 4% in patients under that age 16. Fournier's gangrene shows male predominance with a reported rate of 96%^[14]. *Czymeketal* Found that mortality was significantly higher among females (50% F vs. 7.7% M)^[15]. However, studies involving a larger study population have concluded that there is no statistical correlation between female gender and increased mortality^[16]. NF can affect an entire extremity within 24 hour^[17] but it can also show slow progression over a period of several weeks. The factors that lead to the fulminant form of NF remain unidentified^[18]. Not with standing, the extension of gangrene to the abdominal wall has been reported to be directly related to increased mortality^[19]. Others studies have reported independent risk factors for mortality among NF patients including S. Creatinine level 2 mg/dL, WBC count 30, 000/mm³, hypoalbuminemia, presence of hemorrhagic bleb and skin necrosis^[20]. In newborns, several underlying conditions have been identified as contributing to the development of NF, including omphalitis, mammitis, balanitis, postoperative complications, septicemia, and necrotizing enterocolitis^[21]. Manifestation of NF can be with bullae, skin necrosis, pain beyond the margins of erythema, crepitus, hypotension, or signs of systemic inflammatory response syndrome. Common sites of origin are extremities, particularly the upper limb, (10 - 48%) of NF in large series, than Lower extremities (28%), perineum (21%), trunk (18%), and head or neck (5%).^[22] In newborns, NF most commonly involve the abdominal wall as the initial site, followed by the thorax, back, scalp, and extremities including the thigh and groin^[23]. NF is classified into types, based on microbiology. Type I is a polymicrobial infection, with at least one anaerobic species in combination with one or more facultative anaerobic species^[24] which typically located at the trunk, abdominal wall, perianal and groin areas, Type II is a monomicrobial infection, mostly caused by invasive *group A streptococci (GAS)-pyogene*. Predominant isolation sites are the head/neck and extremities. Type III, because of marine *Vibrio* species, reported as following minor injuries exposed to salt water, it is associated with a fulminant course.^{[25] [26]} Type IV is fungal in nature with mortality rate of 48%^[27]. Based on cutaneous manifestations, NF can be staging to three stages; stages 1 manifested by erythema, swelling, tenderness and hotness. Stage 2

showed skin fluctuance and induration, blister or bulla formation. Stage 3 showed Hemorrhagic bullae, crepitus, skin anesthesia or necrosis.^[21] Laboratory findings are nonspecific. Leukocytosis, low calcium, and elevated lactate, creatine kinase, and Creatinine may be seen. Advanced illness may bring on coagulopathy and acidemia. Blood cultures may or may not be positive. A retrospectively developed scoring system, called the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, which includes C-reactive protein (CRP), white blood cell (WBC) count, hemoglobin, plasma sodium, Creatinine, and glucose, can be of diagnostic assistance with a high sensitivity and specificity. In Yemen, necrotizing fasciitis remains one of the most important and most difficult medical problems facing the medical field, due to the lack of specialized centers, as well as the scarcity of research on this subject. In this study, we aim to study the predisposing Factors, management and outcomes of Necrotizing Fasciitis in patients who admitted to surgical department at AL-Thawra Modern General Hospital (AMGH) from January 2020 to January 2021 and to evaluate the Laboratory tests and their relation with Necrotizing Fasciitis and the prognostic value of the LRINEC score in Necrotizing Fasciitis patients

METHODOLOGY

Type of study and sitting

A prospective descriptive study of NF patients that conducted at AL-THAWRA GENERAL HOSIPTAL located in Sana'a Yemen. All medical records of patients with confirmed NF who admitted to surgical department between January 2020 and January 2021 were reviewed.

Study population and sample size

A total number of 54 patients were studies with confirmed diagnosis of NF by the presence of extensive necrosis involving at least the fascia and subcutaneous tissue that detected intraoperatively by surgeons. All patients were admitted through emergency department in surgical ward.

Method of data collection and study tools

Data was collected by questionnaire and history, physical examination from the patients diagnosed as NF.

Variable data

Variable data were (sex, age, activity, address, special habits, comorbidity, predisposing factors/causes, involving area, clinical presentation, and organisms involved) and laboratory data within the first day of admission, surgical intervention, and outcome were recorded.

Inclusion criteria

Based on any Necrotizing Fascitis case that defined by the presence of extensive necrosis involving at least the fascia and subcutaneous tissue that detected intraoperatively by surgeons

Exclusion criteria

Any case that didn't undergo debridement, or who underwent a surgical management in another hospital, any case with missed data or incomplete management.

Definitions:

The definition of mortality was death at the time or period of admission

The surgical interventions included incision, drainage, and debridement of the necrotic tissue, with or without other intervention (colostomy, laparotomy or amputation).

Toxic/shocked patient defined as who is in shock state with drop of systolic blood pressure less than 90 mmHg, tachycardiac, tackypnic, with oliguria and signs of sepsis. While an ill patient who is vitally stable but showed abnormalities in his/her lab. Result. Stable patient defined as who is vitally stable with normal paramedical result.

Normal active patients defined as who didn't have any type of mobile limitation. While restricted patients who had any type of mobile limitation such as limb deformity, Cerebral palsy or sever lower limb claudication. Bedridden patients defined as who is unable to leave his/her bed such as paraplegic patients.

LRINEC score (Laboratory risk indicator for necrotizing fasciitis) score

All debris tissue was dissected, and in some of the cases tissue culture was performed but others cases and anaerobic organism cultures were not performed because of the limitation of the culture process or it didn't request by surgeon.

Statistical methods

The Collected data were analyzed using SPSS VERSION V.24 by applying the following statistical tests.

Ethical consideration

Ethical consideration such confidential registrations, prior consent and Acceptance for including in this study and authority allowing for preforming this study under direct observation of Presidency of the Department of Surgery were taken into consideration.

Results

First, the demographic data

The study enrolled 54 patients diagnosed with Necrotizing Fascitis.

While Male patients were (79.6% n=43); Female patients were (20.4% n=11).

According to the age, the mean age was 45.07 ± 15.7 years, and the range was 9 –75 years. Peak incidence of NF was at Age group 46 - 60 years old (about 33.3% n=18), followed by Age group 31 – 45 years old (29.6% n=16), than Age group > 60 years old (18.5% n=10), Age group 16 – 30 years old (14.8% n=8), than Age group < 15 years old (3.7% n=2). Normal active patients were (62.9% n=34) while Restricted patients were (25.9% n=14) and Bedridden patients were (11.1% n=6).

Urban patients were (40.7% n=22) while Rural patients were (59.3% n=32).

Second; predisposing factors

Comorbidity

About (35.1% n=19) of NF patients hadn't any comorbidity status, while (64.9% n=30) had comorbidities; {Single comorbidity were (31.4% n=17) and multiple comorbidities were (33.3% n=18)}. The more frequented comorbidity were DM in (37% n=20), Heart diseases/HTN in (29.6% n=16), COPD in (7.4% n=4), STROK in (7.4% n=4), Peripheral arterial disorder PAD in (5.5% n=3), and Obesity in (5.5% n=3) Rest of comorbidities is shown on table 1.

Etiology

According to the etiologies; Patients who didn't have obvious etiology were (27.7% n=15). The most common etiologies were Trauma in (16.6% n=9), perianal abscess in (14.8% n=8), skin abrasion in (9.2% n=5), bed sore in (9.2% n=5) and Post-injection in (7.4% n=4). Penetrating abdominal wound injury was seen in (3.7% n= 2) and Post-Scorpion Bite was seen in (3.7% n= 2). The others etiology were dental crises; post radiotherapy; septic arthritis and post suprapubic catheterization

Involved area

Single involved area was seen in (75.9% n=41) while Multiple involved areas were seen in (24.1% n=13). The frequency of involved areas was left lower limb in (27.5% f = 19), Right lower limb in (26% f =18), perianal area in (14.4% f=10), abdomen in (13% f = 9), Trunk/back area in (5.8% f=4) than Fournier gangrene in (4.3% f = 3).

Table (1) Incidence of patients according to demographic date, etiology, comorbidities and involving areas

Character		n (%)	Character		n (%)
Gander	Male	43(79.6)	Comorbidity	None	19(35.2)
	Female	11(20.4)		Single comorbidity	17(31.4)
		Multiple comorbidities		18(33.3)	
Age category	<15 years	2(3.7)		DM	20(33.3)
	16-30 years	8(14.8)		HTN/IHD	16(26.7)
	31-45 years	16(29.6)		COPD	4(6.7)
	46-60 years	18(33.3)		STROK	4(6.7)

Character		n (%)	Character		n (%)
	>60 years	10(18.5)		OBESITY	3(5)
				P.A.D	3(5)
Activity status	Normal	34(62.9)		CLD	3(5)
	Restricted	14(25.9)		PARAPLAGIA	2(3.3)
	Bedridden	6(11.2)		CEREBRAL PULSY	2(3.3)
				CKD	2(3.3)
Address	Urban	22(40.7)		CANCER/ RTH	1(1.6)
	Rural	32(59.3)			
				Single	41(75.9)
Etiology	Unknown	15(27.7)	Involving areas	Multiple	13(24.1)
	Trauma	9(16.6)		Lt. L.L	19(27.6)
	Perianal Abscess	8(14.8)		Rt. L.L	18(26)
	Bed Sore	5(9.2)		Perianal	10(14.5)
	Skin Abrasion	5(9.2)		Abdomen	9(13)
	Post-injection	4(7.4)		Trunk / back	4(5.8)
	Pene. Abd. injury	2(3.7)		Fournier Gangrene	3(4.3)
	Post Scorpion bite	2(3.7)		Rt. U.L	3(4.3)
	Other	4(7.4)		Neck	2(2.9)
					Lt. U.L

Third, Clinical presentation

Duration of Illness before Presentation

The duration between the onset of NF and presentation to the hospital showed that patients who presented at 2-5 days post onset were about (37% n=20), patients who presented at 6-10 days were (31.4% n=17), who presented after 10 days were (25.9% n=14) and about (5.5% n=3) presented in first 2 days.

Table (2) Duration of Illness before Presentation Categories

	days	No of patients (%)
Duration Of Illness Before Presentation Categories	<2 days	3(5.6)
	2-5 days	20(37)
	6-10 days	17(31.4)
	> 10 days	14(26)
Total		39(100%)

Clinical features

According to the general condition of patients at the time of admission; an ill patients were (55.5% n=30), Shocked/toxic patients were (27.7% n=15) and stable patients were (16.7% n=9).

The most frequent symptoms were pain (92.5% n=50), fever (88.8% n=48), swelling (72.2 n=39), redness (46.2% n=25), bad smell /discharge (38.8% n=21), ulcer (35.1% n=19) than bulla (18.5% n=10) and blackish discoloration/dusky (14.8% n=8).

The most frequent signs were tenderness (92.5% n=50), swelling (92.5% n=50), erythema (92.5% n=50), discharge / bad smell (46.2% n=25).

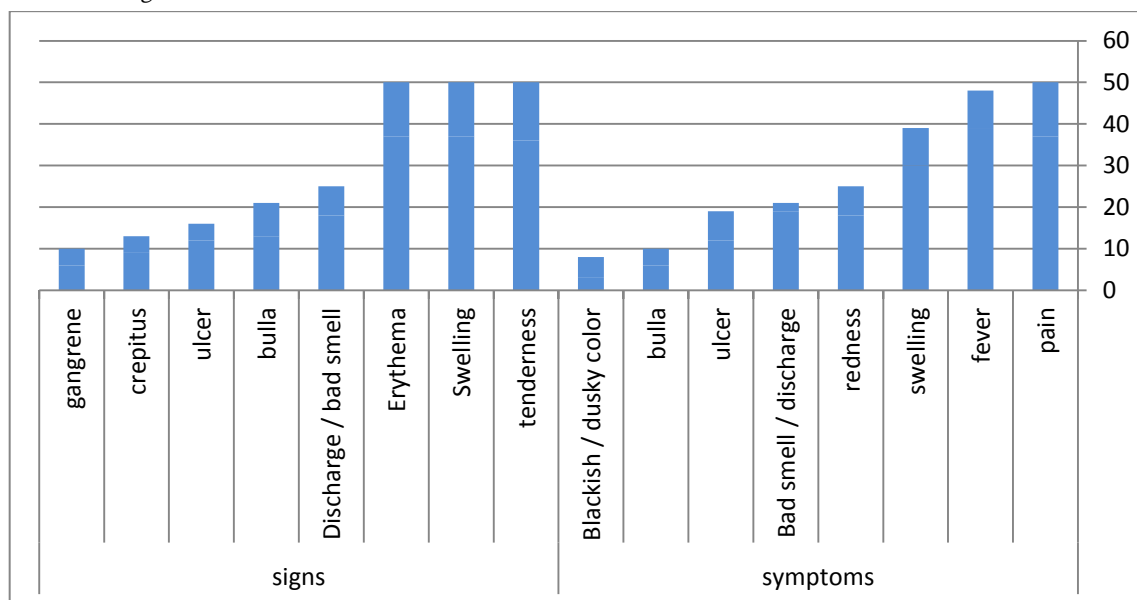


Figure (1) clinical features of NF patients

Fourth, Laboratory Results at presentation

According to laboratory result; about (66.6 % n=36) of NF patients had LRINEC SCORE less than 6 score and about (33.3 % n=18) had LRINEC SCORE more than 6 score.

Most of PT, INR, and PTT results showed no abnormalities. And no one of Questionnaire patients had HIV.

About (37% n=20) of NF patient showed increase in R.B.S level (> 10 mmol/l), with the mean of increase was 8.3 mmol/l with maximum result was 15.5mmol/l.

About (88.9% n=48) of patients showed drop in S. Albumin level (< 3.4 g/dl), with the mean of drop was 2.7 g/dl with minimal result was 1.8g/dl.

S. Creatinine showed increase in about (11.1% n=6) of NF patients (>10 micromole/l), with the mean of increase was 155.5 micromole/l, with maximum result was 441 micromole/l.

About (16.7 % n=9) of NF patients showed increase in S. potassium level (> 5.5 mEq/L) and about (14.8% n=8) dropped less than (3.4 mEq/l) with the mean of increase was 4.1 mEq/L with maximum result was (5.6 mEq/L) and minimum result was (2.5mEq/l).

About (59.3% n=32) of patients showed drop in S. Sodium level (less than 135 mEq/L) with the mean was (133.5 mEq/L) with minimal result was 122 mEq/L

Hemoglobin level showed drop in about (48.2% n=26) of NF patients (> 11g/dl), but the mean of HB was 11.5 g/dl with minimal result was 8 g/dl.

About (40.7 % n=22) of NF patients showed that WBC level was less than $15000 \times 10^9/L$ and (20.4% n=11) were more than $25000 \times 10^9/L$. but the mean of WBC was $17664 \times 10^9/L$ with minimal result was $7600 \times 10^9/L$ and maximum result was $31500 \times 10^9/L$.

Table (3) LABERATORY RESULTS

Lab. test		No of patients (%)		Lab. test		No of patients (%)	
PTT	Normal	53(98.1)		S. Creatinine micromole/l	<140	35(64.8)	
	Elevated	1(1.9)			141-310	13(24.1)	
	TOTAL	54(100)			>310	6(11.1)	
INR	Normal	49(90.7)		Platelet per microliter	TOTAL	54(100)	
	Elevated	5(9.3)			<150	10(18.5)	
	TOTAL	54(100)			150-450	33(61.1)	
PT	Normal	49(90.7)		HB g/dl	>450	11(20.4)	
	Elevated	5(9.3)			TOTAL	54(100)	
	TOTAL	54(100)			<11	26(48.2)	
S. Albumin g/dl	Below 3.4	48(88.9)		WBC $\times 10^9/L$	11-13.5	24(44.4)	
	3.5-5.5	6(11.1)			>13.5	4(7.40)	
	Total	54(100)			TOTAL	54(100)	
R.B.S mmol	<4	6(11.1)		CRP mg/l	<15000	22(40.7)	
	4-6.7	19(35.2)			15000-25000	21(38.9)	
	6.7-10	9(16.7)			>25000	11(20.4)	
	>10	20(37.0)			TOTAL	54(100)	
	TOTAL	54(100)			<50	19(35.2)	
S. Potassium mEq/L	<3.4	8(14.8)		LRINEC SCORE	50-100	25(46.3)	
	3.5-5	37(68.5)			100-150	7(13.0)	
	>5	9(16.7)			>150	3(5.5)	
	TOTAL	54(100)			TOTAL	54(100)	
S. Sodium mEq/L	<135	32(59.3)		LRINEC SCORE	<6	36(66.6)	
	135-145	20(37.0)			>6	18(33.3)	
	>145	2(3.7)			TOTAL	54(100)	
	TOTAL	54(100)					

About (18.5% n=10) of NF patients showed that platelet count was less than 150000 per microliter and (20.4% n=11) were more than 450000 per microliter. The mean of platelets counts was 292.2 per microliter with minimal result was 30000 per microliter and maximum result was 675000 per microliter

C-reactive protein showed no significant increasing in its level above 150mg/l (5.5% n= 3) in NF patients; but about (35.2% n=19) of NF patients had CRP level more than 50 mg/l and (46.3% n=25) had CRP between 50-100 mg/l.

FIFTH, MANAGMENT

Admission

About first day admission, (42.5% n=23) of NF patients admitted on an ICU while (57.5% n=31) admitted to Surgical ward.

The duration between admission and first debridement

The duration between admission and first debridement showed that (37% n=20) of patient had their first debridement at 8-16 hours post admission, (37% n=20) of patients had their first debridement at 16-24 hours post admission. About (22.2% n=12) of patients had their first debridement after 24 hours of admission, and about (3.7% n=2) had their first debridement in first 8 hours post admission.

Surgical Intervention

All patients underwent debridement, incision and drainage for pus, necrectomy and fasciectomy. There were other surgical intervention such as colostomy in five patients, Laparotomy in two patients, and above knee amputation, Penectomy and below knee amputation were performed in one patient for each one. The surgical options for treating the defected wounds after they had been healed were skin graft in (32.5% n=13), primary closure in (27.5% n=11), skin flap in (17.5% n=7), and delayed closure in (22.5% n=9).

Number of debridement during admission period showed that (50% n=27) of patients underwent 3 – 5 surgical debridement during admission period, about (46.2 %n=25) of patients underwent less than 3 surgical debridement during admission period (n=10) and about (3.7% n=2) of patients underwent more than 6 surgical debridement during admission period.

Table (4) Duration between Presentation & Debridement

Duration between Presentation & Debridement	No of patients (%)
<8 hours	2 (3.7)
8-16 hours	20 (37)
16-24 hours	20 (37)
24-36 hours	6 (11.1)
>36 hours	6 (11.1)
Total	54(100)

TABLE (5) Number of Debridement

	No of patients (%)	
Number of Debridement Categories	<3 times	25(46.2)
	3-5 times	27(50)
	>6 times	2(3.7)
Total	54(100)	

Table (6) Plastic Operation

		Frequency (%)
Plastic Operation	Primary Closure	11 (28.3)
	Delayed closure	8 (20.5)
	Skin Graft	13 (33.3)
	Skin Flap	7 (17.9)
	Total	39 (100)

Pus Results

Pus sample was send in (40.7% n=22) of patients only and (59.3% n=32) didn't send. About (54.5% n=12) of sent pus didn't return back.

The return pus results (n=10) showed that Staph. Aurous was (35.2% n=6), Klebsilla and Candida; E.coli and Candida; Klebsilla alone and E.coli alone were (5.8 % n=1) for each one.

Table (7) Result of Pus Culture

		No of patients (%)
Pus Culture	NOT SEND	32(59.3)
	SEND	22(40.7)
	TOTAL	54(100)
	No result	12(54.5)
	<i>Staph. aurous</i>	6(27.4)
	<i>Klebsilla</i>	1(4.5)
	<i>E. coli</i>	1(4.5)
	<i>Klebsilla + Candida</i>	1(4.5)
	<i>E. coli + Candida</i>	1(4.5)
	Total	22(100)

Sixth, Mortality

The mortality rate was (27.7% n=15), and the survival rate was (72.2% n=39).

Among the fatalities, (33.3% n=5) died within 2 days of admission, (26.7% n=4) died within 2 to 5 days of admission, (13.3% n=2) died within 6 to 10 days of admission, and (26.7% n=4) died after 10 days of admission.

The cause of death were Septic Shock (73.3% n=11), Respiratory Complication, hypokalemia, Myocardial Infarction, and DKA as (6.7% n=1) for each one.

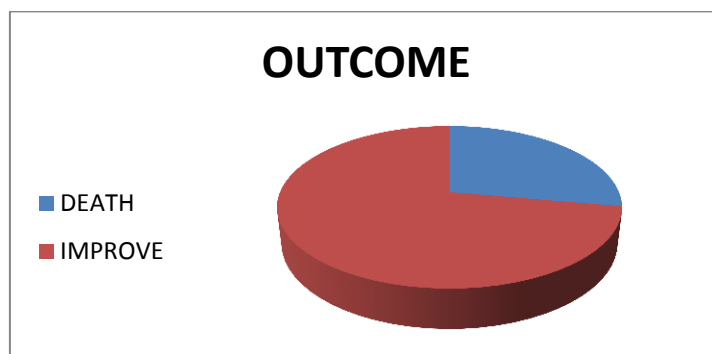


Figure (2) outcome

Table (8) Mortality

	Character	n (%)		Character	n (%)
Time of Death	Died within 2 days	5(33.3)	Reasons of Death	Septic Shock	11(73.2)
	Died within 2 – 5 days	4(26.7)		Resp. complications	1(6.7)
	Died within 5 - 10 days	2(13.3)		Hypokalemia	1(6.7)
	Died after 10 days	4(26.7)		M.I	1(6.7)
					DKA

As on table 9; male mortality was (66.6% n=10) while female mortality was (33.3% n=5) (P=0.142). The mortality were high at Age category > 60 years old (46.6% n=7), followed by Age category 46 – 60 years old (20% n=3), then Age categories 31 – 45 years old and 16 – 30 years old with (13.3% n=2) for each one (P = 0.015). The results showed that (46.6% n=7) of dead patients were restricted patients then (33.3% n=5) were normal active patients, and (20% n=3) were bedridden patients (P = 0.020). About (66.6% n=10) of dead patients were rural patients and (33.3% n=5) were urban patients (P = 0.492). The mortality rate among patients who didn't had any comorbidities was (26.6% n= 4) while it was (73.3% n=11) among patients with comorbidity {it was (13.3% n=2) in who had single comorbidity and about (60% n=9) in who had multiple comorbidities} (P=0.030). The frequented comorbidity that cause death were DM in (46.6% n=7), Heart diseases in (33.3% n=5) and COPD which showed mortality rate (20% n=3), (P=0.449). The most common etiologies associated with mortality were bed sore (26.6 % n=4), perianal abscess in (13.3% n=2), then Penetrating abdominal wound (13.3% n=2), Post-injection (6.6% n=1) and Post Scorpion Bite in (6.6% n=1) (P=0.022). The mortality rate were (20% n=3) in patients who present in first 2 days, it was (33.3% n=5) in patients who presented during 2-5 days post the onset of complain, and (26.6% n=4) in patients who presented during 6-10 days post the onset of complain, and about (20% n=3) in patients who presented after 10 days post the onset of complain. (P=0.040). Single involved area had (60% n=9) mortality while multiple involved areas had (40 % n=6) of total death (p=0.090). The most frequented areas that associated with mortality were lower limbs, abdomen than perineum (P=0.315). According to the general condition of patients at admission; the mortality rate were (26.6% n=4) in an ill patients. Shocked/toxic patients had mortality rate (73.3% n=11) and stable patients

had no mortality. (P = 0.000). The higher mortality rate was seen in patients who underwent debridement 8-16 hours post admission (40% n=6), than in patients who underwent debridement 16-24 hours (26.6% n=4), and it was (26.6% n=4) in patients who underwent debridement after 24 hours. The mortality rate in patients who underwent debridement in first 8 hours was (6.6% n=1) (P = 0.856).

The mortality rate among patient who had LRINEC Score > 6 score was (60% n=9) in comparing with who had LRINEC Score < 6 (40% n=6) (P = 0.010). Most of PT - INR results showed a relation between death and their results as (26.6% n=4) of mortalities showed elevated in INR-PT value (P = 0.006). About (60% n=9) of died patients showed increase in R.B.S level (> 6.7 mmol/l), with the mean of increase was 11.4 mmol/l and maximum result was 15.5mmol/l. (40% n=6) of died patients showed increase in RBS level >10mmol/l with the mean of increase was 12.8 mmol/l. (P = 0.871). About (60% n=9) of died patients showed drop in S. Albumin level (< 3.4 g/dl), with the mean of drop was 2.1 g/dl and minimal result was 1.8g/dl (P = 0.107). S. Creatinine showed increase in about (73% n=11) of died patient (> 140 micromole/l), with the mean of increase was 294 micromole/l, and maximum result was 410 micromole/l. About (33.3% n=5) of died patient showed increase in S. Creatinine level (> 310 micromole/l). (P = 0.000).

Table (9) Outcomes vs. Mortalities

Character	Survive	Death	P. value	Character	Survive	Death	P. value		
Gender	Male	33	0.142	First day admission	Ward	31	0.000		
	Female	6			ICU	8		15	
Age categories	<15 years	1	0.015	LRINEC SCORE	<6	30	0.010		
	16-30 years	6			>6	9		9	
	31-45 years	14		PTT	Normal	38	15	0.531	
	46-60 years	15			Elevated	1	0		
	>60 years	3			7				
Address	Urban	17	0.492	PT-INR	Normal	38	0.006		
	Rural	22			10	Elevated		1	4
Activity status	Normal	29	0.020	S. K mEq/L	<3.4	6	0.001		
	Restricted	7			7	3.5-5		31	6
	Bedridden	3			3	>5		2	7
Comorbidity	None	15	0.030	S. ALBU. g/dl	Below 3.4	39	0.107		
	Single	15			2	3.5-5.5		0	6
	Multiple	9		9	R.B.S mmol	<4	4	2	0.871
	DM	13	7	4-6.7		15	4		
	HTN/IHD	11	5	6.7-10		6	3		
	COPD	1	3	>10		14	6		
	STROK	2	2	0.449					

Character		Survive	Death	P. value	Character		Survive	Death	P. value
	OBESITY	2	1		S. SODIUM mEq/L	<135	20	12	0.076
	P.A.D	1	2			135-145	18	2	
	CLD	2	1			>145	1	1	
	PARAPLAGIA	1	1		S. CREAT. micromole/l	<140	31	4	0.000
	CEREBRAL PULSY	2	0			141-310	7	6	
	CKD	1	1			>310	1	5	
	CANCER/ RTH	1	0						
Etiology	Unknown	11	4	0.022	Platelet per microliter	<150	4	6	0.041
	Trauma	9	0			150 -450	26	7	
	Perianal abscess	6	2			>450	9	2	
	Bed sore	1	4		HB g/dl	<11	17	9	0.216
	Skin abrasion	5	0			11-13.5	20	4	
	Penet. Abd. Injury	0	2			>13.5	2	2	
	Post injection	3	1						
Involving areas	Single	32	9	0.090	WBC × 109/L	<15000	14	8	0.448
	Multiple	7	6			15000- 25000	17	4	
	L.L	27	10	0.315		>25000	8	3	
	Perianal	7	3		CRP mg/l	<50 NR	13	6	0.022
	Abdomen	4	5			50-100	21	4	
	Trunk / back	2	2			100-150	5	2	
	Fournier Gangrene	3	0			>150	0	3	
	U.L	2	2		General condition	Stable	9	0	0.000
	Neck	2	0	Illness		26	4		
			Shocked/toxic	4		11			

About (46.6% n=7) of died patient showed increase in S. potassium level (> 5.5 mEq/L) with the mean of increase was 5.4 mEq/L and maximum result was 5.6 mEq/L. (P = 0.001). About (80% n=12) of died patient showed drop in S. Sodium level (< 135 mEq/L) with the mean of drop was 128.7 mEq/L and minimal result was 122 mEq/L (P = 0.076). Hemoglobin level showed drop in about (60% n=9) of died patients (> 11g/dl), but the mean of HB was 9.5g/dl and minimal result was 8.1g/dl. (P = 0.216). About (53.3% n=8) of died patient showed that WBC level was less than 15000 × 109/L but the mean of WBC was 11300× 109/L with minimal result was 8500× 109/L. (P = 0.448). About (40% n=6) of died patients

showed their platelet count were less than 150000 per microliter and the mean of platelets counts was 50000 per microliter and minimal result was 35000 per microliter ($P = 0.041$). C-reactive protein showed no significant increasing in its level above 150mg/l in (20% n= 3) of died patients; but about (60% n=9) of died patients had CRP level > 50 mg/l. ($P = 0.022$).

Discussion

Necrotizing fasciitis still represent a life threatening condition with global incidence range between 0.4 - 7.4 per 100000 population

Our study enrolled 54 patients diagnosed with Necrotizing Fasciitis that reveals the incidence of Necrotizing Fasciitis was more in male gender (79.6%) with male to female ratio was 4: 1, in normal active patients (62.9%) and in rural patients (59.3%) and Peak incidence was at Age group 46 - 60 years old (33.3%) with mean age was 45.07 ± 15.7 years, and range was 9 – 75 years. *A study of David C. Elliott and his collage*,²⁸ (that preformed between March 1985 and June 1993 as retrospective chart review of 198 consecutive patients with documented necrotizing soft tissue infections); showed that male patients were (69.1%) and female patients (30.9 %). The average age of all patients was 51.5 years (range, 12-90 years) while *Nissar sheikh and his collage*²⁹ study (that preformed between January 2000 and December 2013 as retrospective chart review of 331 NF patients at Hamad Medical Corporation) showed male to female ratio was 3: 1 with more likely to occur in males 74.3 % and females 25.7 % and mean age was 51 ± 15 years. When comparing our study with the two mentioned studies above; the incidence of NF was convergent, and that is due to the higher rate of exposure to risk factors such as working outside or trauma between normal active, male gender especially if they are rural residency.

Regarding to comorbidities, about (64.9%) of NF patients had comorbidities. The most frequented comorbidities were DM (37%) and Heart diseases (29.6%). *A David C. Elliott and his collage study mentioned* that Diabetes mellitus was the most common pre-existing medical condition (56.4%). Eleven patients had combined diabetes mellitus and chronic renal insufficiency. Nineteen had both diabetes and peripheral vascular disease. While *Nissar sheikh and his collage study* mentioned that the most common morbidities was DM (51.7%), Hypertension (35.6 %) then kidney disease (15 %). And as shown previously; the results of the three studies are similar and they are attributed to the effects of comorbidities in weakening the immune system and its role in increasing the incidence of NF between comorbid patients.

Regarding to etiologies, about (27.7%) of NF patients didn't have specific cause (unknown). but the most known etiologies were Trauma (16.6%), then perianal abscess and skin abrasion. *In study of Nissar sheikh and his collage*; (13%) of NF patients had history of trauma, (1.5%) had history of intramuscular injection. However, (85.5%) were not having any history or event leading to occurrence of

NF. So both studies showed similarity in incidence of trauma, but difference in rate of unknowing cause and both showed that trauma was the leading cause of NF.

The duration between the onset of NF and the presentation showed that the majority of patients present after 2 days of onset, and that showed no significant value when comparing with its mortality rate.

According to the involving areas, about thirty-four of NF patients had single involving area and the most involving areas were lower limbs then perineum and abdomen. *David C. Elliott and his collage* study showed that the most common sites of necrotizing soft tissue infections were the perianal region (Fournier's gangrene, (36%) of cases) and foot ulcerations and infections (generally among diabetics, (15.2%) of patients). While in study of *Nissar sheikh and his collage*; most frequently involving site of NF was lower limbs (52.9%) followed by perineum and genitalia (33.7%). And when comparing the three studies to each other, the results showed that lower limbs and perineum had the higher rate of incidence, and this due to the higher rate of exposure, higher rate of contamination or may be a bad hygiene.

According to the general condition of NF patients at time of presentation; about (27.7%) of NF patients were in a Shocked/toxic state and The most frequent clinical feature of NF were pain, tenderness, swelling, erythema, fever, redness and bad smell /discharge. *David C. Elliott and his collage study* showed that the nonspecific inflammatory signs of pain, swelling, and erythema occurred most commonly, whereas the most specific signs, crepitus and blistering, existed in less than (40%) of patients and *Nissar sheikh and his collage study* mentioned that majorities of NF patients presented with local swelling (78 %), pain disproportionate to local swelling 68.4 % and fever (66.8 %) and so All studies showed no specific presentation in majority of NF patients.

Regarding to laboratory results, LRINEC Score mean was (4.3). About (66.6%) of NF patients had LRINEC Score < 6.

As shown on table 3; most notable results at time of admission were drop of S. Albumin, drop of S. Sodium, drop of HB level and increase of WBC count and RBS level with an invaluable role for CRP, S. Potassium, S. Creatinine, PT, PTT –INR and Platelets. *David C. Elliott and his collage study* showed Admission laboratory parameters found not to reflect survivability; included leukocyte count, serum glucose levels, and albumin levels. Leukocyte counts exceeding 11, 000/mm³ in (78.2%); elevated serum glucose levels existed in (80.3%) of patients while *Nissar sheikh and his collage study* showed that the majority of patients had low serum sodium (133 ± 5.6 mmol/l) and hyperglycemia (serum glucose 12.5±10.3 mmol/l) and their LRINEC Score was (5). And regarding to the laboratory results of the three studies, LRINEC Score and its individual parameter had not any role in suspecting or prognostic of NF patients and they didn't approve a valuable prognosis with little similarity RBS, WBC and albumin results.

According to the first day admission; majority of NF patients admitted at ward (57.5%) (Mean 22.7 ± 16.3 days, range 3-83 days), while (42.5%) admitted at ICU (mean 7.46 ± 7.5 days, range 1-34

days). In study of Nissar sheikh and his collage; the median duration of ICU and hospital stay were 5.5 (1-75) days and 16 (2- 295) days respectively.

All patients underwent debridement, incision and pus drainage, necrectomy and fasciectomy but some patients underwent other surgical intervention such colostomy, laparotomy, limb amputation and Penectomy, while The frequented surgical options for treating the defected wounds after they had been healed were skin graft than primary closure.

About (40.7%) of NF patients had send pus cultures, and only (29.5%) of them get back their results which showed Staph. Aurous (60%), Klebsilla, Candida; and E.coli were the most frequent microbes that found in culture with unacceptable defect on sending pus (59.3%). *David C. Elliott and his collage* study showed that the most common bacteria, in order of appearance, were aerobic streptococci, Bacteroids spp., staphylococci, and enterococci. Facultative anaerobic gram-negative rods also grew out on culture commonly while *Nissar sheikh and his collage* study mentioned that streptococcus (38.4%), staphylococcus (36.6%) and bacteroids (21.5%) were the most frequented microbe. At comparing the three studies with each other, we find that our study differs, and this may be attributed to the small number of those who took a pus sample from them in our study, as well as to the presence of a defect in guideline of pus taken and sending.

Regarding to mortality; our study showed that mortality rate between NF patients were (27.7 %) with (60%) of them died in first 5 days post admission. The most reason of death was Septic shock (73.2%). The mortality rate was (66.6%) in male patients and about (33.3%) in female patients ($P = 0.142$), but Female patients had higher mortality rate in their group (about 45%) in comparing with that in male group (23.2 %).

Regarding to age categories, mortality rate were high at age category > 60 years than age category 46-60 years ($P = 0.015$), while it was (66.6%) in bedridden and restricted groups ($P = 0.020$) and (66.6%) in rural residency (66.6%) ($P = 0.492$).

According to comorbidities, the mortality rate was (73.3%) in patients with comorbidity. ($P = 0.030$) and it's increased strongly in patients who suffered of DM (46.6%) or heart disease (33.3%). *David C. Elliott and his collage* study showed that Diabetes mellitus was the most common pre-existing medical condition in mortality patients (56.4%) Eleven patients had combined diabetes mellitus and chronic renal insufficiency, six of whom died (54.6%) Nineteen had both diabetes and peripheral vascular disease, eight of whom died (42.1%). When the conditions of diabetes, acute renal failure, and age greater than 60 years were combined, the mortality rate increased remarkably (64.7% among 17 patients, respectively). As comparing between our study and *David C. Elliott and his collage study* the results are similar and both are attributed to the effects of comorbidities in immune system and increase the chance for developing of sepsis and septic shock and increasing of mortality.

The leading cause of death according to etiology were bed sore, penetrating abdominal wound injury, than perianal abscess, but The mortality in patients who didn't have an obvious cause was (26.6%) (P = 0.022).

The mortality rate was (60%) in patients who complain of single involved area (P = 0.090) and about (73.3%) in patient who admitted Shocked/toxic state (P = 0.000).

The mortality rate among patients who admitted to the ward on the first day of admission was zero, and all patients who admitted to ICU on the first day of admission expired (P = 0.000)

There no significant value when comparing the mortality rate to first debridement as mortality rate among patients who underwent debridement 8-16 hours post admission were (40%), then (26.6%) in patients who underwent debridement 16-24 hours or after 24 hours (26.6% n=4) for each group (P = 0.856).

The mortality rate was (66.6%) among the patients who get < 3 times of debridement, and (20%) among the patients who get 3-5 times of debridement (p = 0.006) and this need more evaluation to identify the reasons as its maybe shortening and au improper and an inadequate debridement.

About (60%) of mortality patients had LRINEC Score > 6 (P = 0.010). with notable increase of mortality rate with Increasing S. Creatinine > 140 micromole/l (p = 0.000), or CRP > 50 mg/l (0.022) or dropping of S. Albumin <3.4 g/dl (p = 0.107), S. Sodium < 135mEq/l (p = 0.076), or HB < 11g/dl (p = 0.216).

Conclusion

Necrotizing fasciitis still represent a life threatening condition with high incidence in male gender, old age, active or rural patient, or who had comorbidity; especially DM with peak incidence at ages 46 - 60 years. The mortality rate was 27.7%; and Septic Shock was the reason of death in majority of cases. The mortality was highly in male gender, patients older than 60 years old, restricted/bedridden or rural patient, who had comorbidities especially DM, who admitted in shock/toxic state, who had LRINEC Score >6.who had Increase of S. Creatinine or CRP or dropping of S. Albumin, S. Sodium or HB

Recommendation

Early presentation and recognition with highly index of suspicion and awareness are very important in NF management.

Aggressive debridement with more effective management of Necrotizing Fasciitis patients must be the gold stander in dealing with necrotizing fasciitis, especially the patients who at highly risk such old patients, female gender or who has comorbidities.

Developing the LRINEC Score for more accurate diagnosis and prognosis of NF outcome is required.

Effective guidelines for pus sampling and culturing and Antibiotics using are required with publication updating.

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