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Original Research

Predisposing Factors, Management and Outcomes of Necrotizing Fasciitis at Al-Thawra Modern General Hospital, Yemen

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Abstract

Background: Necrotizing fasciitis (NF) still a life-threatening condition in Yemen.
Aim: The aims of this study were to identify the predisposing factors, management and outcomes of NF among Yemeni patients.
Methods: A descriptive study was conducted at Al-Thawra Modern General Hospital located in Sana'a, Yemen. All medical records of patients with confirmed NF admitted to the Surgery Department between January 2020 and January 2021 were reviewed.
Results: The study enrolled 54 patients diagnosed with NF. Male patients were 43 (79.6%) and female patients were 11 (20.3%). The age range was 9 – 75 years old. The incidence of NF increased with age and the peak age incidence was at 46 – 60 years (33.3%). Similarly, the incidence of NF increased with male gander (79.6%), in comorbid patients (64.8%) especially diabetic mellitus (DM) (37%). The etiologies of NF were trauma (16.7%) and perianal abscess (14.8%). However, 27.8% of NF patients didn't have specific cause. Most involving areas were lower limb (53.5%) followed by perineum (14.4%). The defected wound after complete debridement treated by skin graft in (32.5%) and primary closure in (27.5%). The mortality rate was 27.7% (n = 15); 60% (n = 9) of them died on the first five days. The most reason of death was septic shock (73.2%). The mortality rate was 66.6% among male compared to 33.3% among female. The higher mortality rate was reported among patients who presented in shocked/toxic (73.3%), comorbid patients (73.3%), bedridden and restricted patients (66.6%), rural patients (66.6%) and patients aged > 60 years (46.6%).
Conclusion: NF still represents a life-threatening condition with challenges in diagnosis. Incidence and mortality rate of NF are common in male gander, an elderly patient, or in who suffers of comorbidities; especially DM.

Keywords: Necrotizing fasciitis, Predisposing factors, Outcomes, Management, Yemen

1. Introduction

Necrotizing fasciitis (NF) is commonly known as flesh-eating disease that characterized by angiothrombotic microbial invasion and liquefactive necrosis, [1] that lead to develop of progressive necrosis of the deep dermis and fascia than infiltrated by polymorphonuclear leukocytes, with thrombosis of nutrient vessels, bacteria then proliferate within the destroyed fascia. The incidence of NF is diversely reported around the world, 0.4 cases per 100,000 populations in Canada [2] and 1.3 cases per 100,000 populations in Florida, USA [3]. In Thailand, the incidence of NF was reported to be 7.45 cases per 100,000 populations [4]. Trauma is the most common identifiable etiology. Appendicitis with perforation, infection following the repair of an incarcerated hernia, and perforated diverticulitis are among the causes of complicated intra-abdominal infections that can lead to NF. In addition, Fournier's gangrene is often the result of surgical wounds, a complication of colorectal disease, or pressure sores. In

women, it has commonly been ascribed to Bartholin abscesses or vulvar skin infections. The most frequent co-morbidity in NF patients is DM with prevalence ranges between 40 and 60% [5, 6]. Other co-morbidities include liver cirrhosis, chronic heart failure, CRF, obesity, alcohol abuse, immunodeficiency, SLE, Addison's disease, pre-existing hypertension, and peripheral vascular disease [7,8.] Common sites of origin are extremities, particularly upper limbs (10 - 48%) than lower extremities (28%), perineum (21%) and trunk (18%) [9] In newborns, NF most commonly involve the abdominal wall followed by the thorax, back, scalp, and extremities [10]

NF is classified based on microbiology into four types, Type I is a polymicrobial infection, with at least one anaerobic species in combination with one or more facultative anaerobic species 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, cause by marine Vibrio species, reported as following minor injuries exposed to salt water. Type IV is fungal in nature.

Management of NF patients should begin with initial evaluation and resuscitation. Operative exploration and debridement should not be delayed. Broad-spectrum IV antibiotics should be started. Incisions should be made over the involved skin, parallel to neurovascular bundles, extending to and exposing the deep fascia to assess tissue viability. Necrotic tissue should be excised. Outcomes of NF Necrotizing fasciitis are verity between complete recovery; amputation and disability or death. The median mortality rate is (32.2%) which approaches 100% without treatment [11]. The mortality rates reported of 15% to 36% in Ohio, USA (1989–1994) [12], Taiwan (1995–2006) [13], USA (1999–2002) [14] and the Philippines (2004–2007) [15]. In Turkey, nine (41%) of 22 such patients had below- or above-knee amputations [16]. In the UK, out of 451 such patients, 22.3% underwent amputation or limb disarticulation [17]. In Taiwan, amputation was performed to control infections in 12% of patients out of a total of 59, [18].

In Yemen, however, little information is available about this life-threatening condition. Therefore, this study was aimed to highlight the predisposing factors, management and outcomes of necrotizing fasciitis among patients admitted with confirmed NF to the Surgery Department at Al-Thawra Modern General Hospital in Sana'a, Yemen, during the period between January 2020 and January 2021.

2. Methods

Study design and location

It was a descriptive study conducted at Al-Thawra modern General Hospital 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.

Participants

The study included 54 patients aged between 9-72 years old who were admitted to Surgical Department with diagnostic necrotizing fasciitis at Al-Thawra hospital in Sana'a city, Yemen. A purposive sample selection was used according to inclusion criteria, that were any Necrotizing Fasciitis case that defined by the presence of extensive necrosis involving at least the fascia and subcutaneous tissue that found at the time of debridement for suspected cases (detected intraoperatively by surgeons). Exclusion criteria were any case that didn't undergo debridement, underwent a surgical management in another hospital, missed data or incomplete management and follow up.

Variable data

Variable data were gender, age, activity, address, special habits, comorbidity, causes, involving area, clinical presentation, and organisms involved as well as laboratory data within the first day of admission, surgical intervention, and outcome were recorded.

Definitions

The 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, tachypneic, with oliguria and signs of sepsis. While an ill patient who is vitally stable but showed abnormalities in his/her laboratory 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.

Statistical Analysis

All data were reviewed and encoded to the computer using MS excel program (v. 2019). Data were transferred to SPSS v.25 software for analysis. Descriptive statistics were presented as frequencies and percentages in tables. Chi square test and Fisher's exact test were used for examining the correlation between categorical variables. The significance level was set at < 0.05.

3. Results

The study enrolled 54 patients diagnosed with necrotizing fasciitis. As shown in Table 1, Forty-three (43) patients were male (79.6%) and 11 were female (20.4%). Regarding the age of the patients, the mean age was 45.07±15.7 years, and the range was 9 – 75 years. Most frequent incidences of NF were at age group 46 - 60 years old (n= 18, 33.3%,), in normal active patients (n = 34,

62.9%) and in rural patients (n = 32, 59.3%). As well, 19 of NF patients (35.1%) hadn't any comorbidity status, while 30 (64.8%) had comorbidities; the more frequented comorbidity among the patients was DM (n= 20, 37%), heart diseases/HTN (n = 16, 29.6%).

Regarding the etiologies, 15 patients didn't have obvious etiology (27.7%), but the most common etiologies were trauma (n=9, 16.6%), perianal abscess (n = 8, 14.8%). Single involved area was seen in 41 patients (75.9%) while multiple involved areas were seen in 13 (24.1%). The most involved areas were lower limbs (n = 37; 53.6%), perianal area (n=10; 14.4%), abdomen (n = 9; 13%).

Accordingly, 36 patients (66.6%) had LRINEC SCORE < 6 score while 18 (33.3 %) had LRINEC SCORE > 6 score. The general condition of patients at the time of admission; was an ill patient (n = 30, 55.5%), shocked/toxic patients (n = 15, 27.7%) and stable patients (n = 9, 16.7%).

About type of admission, 31 of the patients (57.5%) admitted to surgery ward. All patients underwent debridement, incision and drainage for pus, necrctomy and fasciectomy. Other surgical interventions were colostomy, laparotomy, above knee amputation, penectomy and below knee amputation. Table 2 shows that most frequent management of defected wound after healing were skin graft (n=13, 32.5%), followed by primary closure (n = 11, 27.5%).

Figure 1 shows that the mortality rate was 27.7% (n = 15), and the survival rate was 72.2% (n = 39). As illustrated in Figure 2, the common cause of death was septic shock (n = 11, 73.3%). Among the fatalities, 9 patients (60%) died within five days of admission (Table 3).

Table 1: Incidences of necrotizing fasciitis among the patients at Al-Thawra Modern General Hospital, Sana'a, Yemen (n = 54)

Character	n (%)	Character	n (%)
Gander		**Comorbidity**	
Male	43(79.6)	None	19 (35.2)
Female	11(20.4)	Single comorbidity	17 (31.5)
Age/ Year		Multiple comorbidities	18 (33.3)
< 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)	Stroke	4 (6.7)
> 60 years	10 (18.5)	Obesity	3 (5)
Activity status		PAD	3 (5)
Normal	34 (62.9)	CLD	3 (5)
Restricted	14 (25.9)	Paraplegia	2 (3.3)
Bedridden	6 (11.2)	Cerebral palsy	2 (3.3)
Address		CKD	2 (3.3)
Urban	22 (40.7)	Cancer/RTH	1 (1.6)
Rural	32 (59.3)	**Involving areas**	
Etiology		Single	41 (75.9)
Unknown	15 (27.7)	Multiple	13 (24.1)
Trauma	9 (16.6)	Left lower limb	19 (27.6)
Perianal abscess	8 (14.8)	Right lower limb	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)
Penetrating abdominal injury	2 (3.7)	Fournier gangrene	3 (4.3)
Post scorpion bite	2 (3.7)	Right upper limb	3 (4.3)
Others	4 (7.4)	Neck	2 (2.9)
General condition		Left upper limb	1 (1.4)
Stable	9 (16.7)	**LRINEC score**	
Illness	30 (55.5)	< 6	36 (66.6)
Shocked/toxic	15 (27.7)	> 6	18 (33.3)
Type of admission			
Ward	31 (57.5)		
ICU	23 (42.5)		

DM: Diabetic mellitus; HTN/IHD: Hypertension/ischemic heart disease; COPD: Chronic obstructive pulmonary disease; PAD: Peripheral arterial diseases; CKD: Chronic kidney diseases; CLD: Chronic liver diseases.

Table 2: Plastic repair of necrotizing fasciitis among the patients at Al-Thawra Modern General Hospital, Sana'a, Yemen (n = 33)

Character		n (%)
Plastic Operation	Skin Graft	13 (33.3)
	Primary Closure	11 (28.3)
	Delayed closure	8 (20.5)
	Skin Flap	7 (17.9)

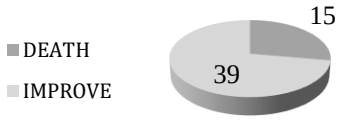

Figure 1: Outcome of necrotizing fasciitis at Al-Thawra Modern General Hospital, Sana'a, Yemen (n = 54)

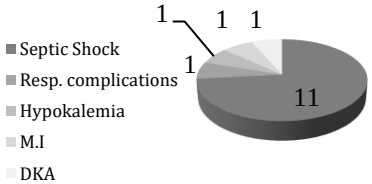

Figure 2: Reasons of death in necrotizing fasciitis patients at Al-Thawra Modern General Hospital, Sana'a, Yemen (n = 15)

Table 3: Mortality among necrotizing fasciitis patients at Al-Thawra Modern General Hospital, Sana'a, Yemen (n = 15)

Character	n (%)	Character	n (%)
Time of death/days		Reasons of death	
Died within 2	5 (33.3)	Septic shock	11 (73.2)
Died within 2 – 5	4 (26.7)	Resp. complications	1 (6.7)
Died within 5 - 10	2 (13.3)	Hypokalemia	1 (6.7)
Died after 10	4 (26.7)	MI	1 (6.7)
		DKA	1 (6.7)

MI: Myocardial infarction; DKA: Diabetic ketoacidosis

As shown in Table 4, significant ($P < 0.05$, $P < 0.01$ and $P < 0.001$) differences in the rate of outcomes vs. mortalities between the necrotizing fasciitis patients were indicated, according to their age categories, activity status, comorbidity, etiology, general condition, LRINEC score, prothrombin time-internationalized ratio (PT-INR), serum potassium level, serum creatinine level, c- reactive protein (CRP) and first day admission. On the other hand, the results showed insignificant ($P > 0.05$) differences in the rate of outcomes vs. mortalities between the necrotizing fasciitis patients according to their gender, involving areas and partial thromboplastin time (PTT); levels of serum albumin, random blood sugar (RBS), serum sodium, platelet per microliter, hemoglobin (Hb) and white blood cells (WBC); and their addresses.

4. Discussion

The study enrolled 54 patients (9–75 years) diagnosed with necrotizing fasciitis at Al-Thawra Modern General Hospital, Yemen. The incidence of NF was higher among male gander, normal active patients and rural patients with peak incidence at age group 46 - 60 years old and notable increase incidence of NF with aging. This was in agreement with a previous study carried by David et al. [19] on patients of age range 12 – 90 years which showed that male patients have higher rate of NF than female (69.1% and 30.9 %, respectively). As well, Sheikh et al. [20] reported male to female ratio of 3:1 with more likely to occur in males (74.3 %) than females (25.7 %). These results could be due to a higher rate of exposure between normal active, male and rural residency to risk factors such as working outside or trauma.

As well, 64.8% of NF patients had comorbidities The most frequent comorbidities were DM and Heart diseases. David et al. study indicated 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. Sheikh et al. mentioned that the most common morbidities were DM (51.7%), hypertension (35.6 %) then kidney disease (15 %). This was comparable with the results of the present study and could be attributed to the effects of comorbidities in weakened the immune system and incidence of NF between comorbid patients. More than a quarter (27.7%) of NF patients didn't have specific cause (unknown), while trauma was the cause in (16.6%) then perianal abscess and skin.

In the study of Sheikh et al. [20], 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. The present study showed similar incidence of trauma, but difference in rate of unknowing cause. About thirty-four of NF patients had single involving area and the most involving areas were lower limbs then perianal and abdominal areas. David et al. showed that the most common sites of necrotizing soft tissue infections were the perianal region (Fournier's gangrene was reported in 36% of cases) and foot ulcerations and infections (generally among diabetics, 15.2 % of patients). In the study of Sheikh et al., the most frequently involving sites of NF were lower limbs (52.9%) followed by perineum and genitalia (33.7%). Our results also showed that lower limbs and perineum had the higher rate of incidence, and this could be due to a higher rate of exposure, higher rate of contamination or may be a bad hygiene. Regarding the general condition of patient at presentation, the present study exhibited that 27.7% of NF patients were in a shocked/toxic state and most (57.5%) of NF patients admitted at ward on the first day admission.

The present study also revealed that the most frequent surgical interventions after debridement and fasciectomy were colostomy, laparotomy, limb amputation and penectomy. The surgical options for treating the defected wounds after their wound had been healed were skin graft then primary closure. It also showed that mortality rate was 27.7 % and 60% of these cases died in first five days post admission and the most reason of death was septic shock (73.2%). The mortality rate was higher among male patients, age category > 60 years, bedridden and restricted groups and rural resident, patients with comorbidity especially DM and heart disease. The findings of the present study showed differences in the rate of outcomes and mortalities between the necrotizing fasciitis patients according to their health and clinical risk factors. However, some of these factors didn't show significant differences. This could be due to some limitations that can be associated with the small size of the study sample.

5. Conclusion

Necrotizing fasciitis stills represent a life-threatening condition with high incidence among male gander, older patients especially those aged 46 - 60 years, active or rural patients, comorbidity especially diabetes mellitus. The mortality rate is 27.7%, among the fatalities, nine patients died within five days of admission. Septic shock is the reason of death in majority of cases. The mortality was high among male gander, patients older than 60 years old, restricted/bedridden or rural patient, who had comorbidities especially diabetes mellitus, who admitted in shock/toxic state or who had LRINEC Score > 6. 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 standard in dealing with necrotizing fasciitis, especially the patients who at highly risk such old patients, female gander or who has comorbidities. Developing LRINEC Score for more accurate diagnosis and prognosis of necrotizing fasciitis outcome is required. Effective guidelines for pus sampling and culturing and antibiotics using are required with publication updating.

Table 4: Outcomes vs. mortalities among necrotizing fasciitis patients at Al-Thawra Modern General Hospital, Sana'a, Yemen (n = 54)

Character	Survive	Death	*P* value	Character	Survive	Death	*P* value
Gander				**LRINEC score**			
Male	33	10	0.142	< 6	30	6	0.010
Female	6	5		> 6	9	9	
Age categories				**PTT**			
< 15 years	1	1	0.015	Normal	38	15	0.531
16-30 years	6	2		Elevated	1	0	
31-45 years	14	2		**PT-INR**			
46-60 years	15	3		Normal	38	11	0.006
> 60 years	3	7		Elevated	1	4	
Activity status				**Serum potassium m Eq/L**			
Normal	29	5	0.020	< 3.4	6	2	0.001
Restricted	7	7		3.5-5	31	6	
Bedridden	3	3		> 5	2	7	
Comorbidity				**Serum albumin g/dl**			
None	15	4	0.030	Below 3.4	39	9	0.107
Single	15	2		3.5-5.5	0	6	
Multiple	9	9		**R.B.S. mmol**			
DM	13	7	0.449	< 4	4	2	0.871
HTN/IHD	11	5		4-6.7	15	4	
COPD	1	3		6.7-10	6	3	
STROK	2	2		> 10	14	6	
OBESITY	2	1		**Serum sodium mEq/L**			
P.A. D	1	2		< 135	20	12	0.076
CLD	2	1		135-145	18	2	
PARAPLAGIA	1	1		> 145	1	1	
CEREBRAL PULSY	2	0		**Serum creatinine micromole/l**			
CKD	1	1		< 140	31	4	< 0.001
CANCER/ RTH	1	0		141-310	7	6	
Etiology				> 310	1	5	
Unknown	11	4	0.022	**Platelet per microliter**			
Trauma	9	0		< 150	4	6	0.041
Perianal abscess	6	2		150 -450	26	7	
Bed sore	1	4		> 450	9	2	
Skin abrasion	5	0		**Hb. g/dl**			
Penet. Abd. Injury	0	2		< 11	17	9	0.216
Post injection	3	1		11-13.5	20	4	
Involving areas				> 13.5	2	2	
Single	32	9	0.090	**WBC × 10^9/L**			
Multiple	7	6		< 15000	14	8	0.448
Lower Limbs	27	1	0.315	15000-25000	17	4	
Perianal	7	3		> 25000	8	3	
Abdomen	4	5		**CRP mg/l**			
Trunk / back	2	2		< 50 NR	13	6	0.022
Fournier Gangrene	3	0		50-100	21	4	
Upper Limbs	2	2		100-150	5	2	
Neck	2	0		> 150	0	3	
General condition				**First day admission**			
Stable	9	0	< 0.001	Ward	31	0	< 0.001
Illness	26	4		ICU	8	15	
Shocked/toxic	4	11		**Address**			
				Urban	17	5	0.492
				Rural	22	10	

PTT: partial thromboplastin time; PT: prothrombin time; INR: internationalized ratio; RBS: random blood sugar; Hb: hemoglobin; WBC: white blood cells; CRP: c-reactive protein; Penet. Abd. Injury: Penetrating Abdominal Injury.

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Competing interests
The authors declare that they have no competing interests.

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