

Original Article

Fournier's Gangrene: A Retrospective Clinical Study in a Single Institution

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Key Words

Fournier's gangrene;
Fasciitis;
Debridement;
Hyperbaric oxygen therapy

Abbreviations

HBO, hyperbaric oxygen;
FGSI, Fournier's gangrene severity index;
HR, hazard ratio;
CI, 95 % confidence interval;
ATA, atmosphere absolute

Purpose. Fournier's gangrene is a fulminant necrotizing fasciitis, which affects the genital, perianal, and perineal regions. We present a retrospective analysis of the clinical presentation, treatment modalities, and overall mortality of Fournier's gangrene in a single institution.

Methods. Records of patients diagnosed with Fournier's gangrene between January 2007 and December 2012 were reviewed. Data on the demographics, medical history, clinical presentation, laboratory studies, treatment modality, duration of hospital stay, and clinical outcomes were analyzed.

Results. A total of 60 patients (49 males and 11 females) with a mean age of 58.2 ± 14.2 years were identified. The mortality rate was 21.7% (13 cases). Of the 60 patients, 46 underwent surgical debridement and antibiotic therapy, whereas 14 were treated with hyperbaric oxygen (HBO) therapy, surgery, and antibiotics. There was no statistically significant difference in the use of diversion stoma between the survival and non-survival groups ($p = 0.421$). Old age and septic shock were independent prognostic factors of Fournier's gangrene. Diversion stoma had no influence on the mortality rate of patients with septic shock (42.9% vs. 55.6% with and without stoma, respectively; $p = 0.680$). However, HBO therapy decreased the mortality rate in patients with septic shock (0.0% vs. 73.3% with and without HBO therapy, respectively; $p = 0.001$), and in all patients with Fournier's gangrene (0.0% vs. 28.3% with and without HBO therapy, respectively; $p = 0.027$).

Conclusions. These data do not support the routine use of diversion stoma in Fournier's gangrene. HBO therapy appears to provide a survival benefit to these patients.

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Fournier's gangrene was first described, as necrotizing fasciitis of the genitalia, by Baurienne in 1764.¹ In 1863 and 1864, French venereologist Four-

nier described the disease as specific to the scrotum.^{2,3} Today it is defined as "an infective necrotizing fasciitis of the perineal, genital or perianal regions".^{1,4}

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Necrotizing fasciitis is a life-threatening bacterial infection of the fascia that progresses rapidly to involve the skin primarily and the subcutaneous tissue secondarily.⁵

Standard treatment for Fournier's gangrene is urgent surgical debridement, antibiotics, and, often, delayed reconstruction. Despite the development and evolution of modern intensive care techniques and antibiotic therapy, the mortality rate from Fournier's gangrene remains high, at approximately 50%.^{6,7} The factors determining survival or death from Fournier's gangrene are controversial. To determine if certain factors predict the clinical outcome of patients with Fournier's gangrene, we reviewed the records of patients presenting to our institution during the last six years, and compared clinical variables between the survivors and non-survivors.

Patients and Methods

We conducted a retrospective analysis of the medical records of 60 consecutive patients who had a diagnosis of Fournier's gangrene at discharge from the Chi-Mei medical center between 2007 and 2012. The demographic and clinical data were collected from these medical records. The diagnosis of Fournier's gangrene was made according to the results of physical examinations, findings of computed tomography, or operative findings. Information on the original site of infection, vital signs of the patient, and results of the laboratory tests also was recorded. Additionally, the duration of stay in the intensive care unit; duration

of stay in the hospital; technique and number of operations; results of microbiologic tests; mortality rate; and the use of diverting colostomy, hyperbaric oxygen (HBO) therapy, and antibiotics was also noted. Surgical debridement procedures were performed by the urologist, plastic surgeon, or colorectal specialist. Fecal diversion was performed in patients based on the clinical judgments of the operator. According to the payment guideline of Taiwan's National Health Insurance, Fournier's gangrene is an indication of HBO therapy. The hospital physician consulted the hyperbaric oxygen specialist if the Fournier's gangrene progressed or the patient's condition deteriorated despite debridement and antibiotics.

The Fournier's gangrene severity index (FGSI) was created by Laor and colleagues in 1995.⁸ It is composed of nine parameters: temperature, heart rate, respiratory rate, serum sodium concentration, potassium concentration, creatinine concentration, bicarbonate concentration, hematocrit, and leukocyte count. On admission to the hospital, the nine parameters of each patient were scored by use of a 0-4 scoring system, as described in the Table 1.

Statistics

Data were stratified by the outcome (whether the patient survived or died). Continuous data were described by calculating the mean and standard deviation, and were compared by using two sample t-tests between groups. Categorical data were presented by count and percentage, and were compared by using

Table 1. Fournier's gangrene severity index

Physiological variables	High abnormal values			Normal			Low abnormal values		
	4+	3+	2+	1+	0	1+	2+	3+	4+
Body temperature (C)	> 41	39-40.9	-	38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	< 29.9
Heart rate	> 180	140-179	110-139	-	70-109	-	56-69	40-54	< 39
Respiratory rate	> 50	35-49	-	25-34	12-24	10-11	6-9	-	< 5
Serum sodium (mmol/L)	> 180	160-179	155-159	150-154	130-149	-	120-129	111-119	< 110
Serum potassium (mmol/L)	> 7	6-6.9	-	5.5-5.9	3.5-5.4	3-3.4	2.5-2.9	-	< 2.5
Serum creatinine (mg/100 mL)	> 3.5	2-3.4	1.5-1.9	-	0.6-1.4	-	< 0.6	-	-
Hematocrit (%)	> 60	-	50-59.9	46-49.9	30-45.9	-	20-29.9	-	< 20
Leukocytes (total/mm ³ × 1000)	> 40	-	20-39.9	15-19.9	3-14.9	-	1-2.9	-	< 1
Serum bicarbonate	> 52	41-51.9	-	32-40.9	22-31.9	-	18-21.9	15-17.9	< 15

chi-square or Fisher's exact test, where appropriate. To identify the predictors of survival, the hazard ratios (HR) were conducted by univariate (crude HR) and multivariate (adjusted HR) Cox regression analysis to predict the risk of mortality. *p*-values ≤ 0.05 were considered statistically significant. Data analyses were performed by using SPSS 17.0 (SPSS Inc., Chicago, IL, USA.).

Results

The records of 60 patients were analyzed in this study. The source of infection that caused the disease

is presented in Table 2. The most common site of infection was the anorectal area ($n = 28, 46.7\%$). Demographic and clinical features of the patients are presented in Table 3. Of the 60 patients in this study, 49

Table 2. Primary infection site of Fournier's gangrene (N = 60)

Identified primary site	No. of patients	%
Skin	9	15.0
Anorectum		
Perirectum	4	6.67
Anus	16	26.67
Buttock	8	13.33
Urogenital		
Scrotum	22	36.67
Penis	1	1.67

Table 3. Demographics and clinical data of 60 patients with Fournier's gangrene

	Total (N = 60)	Survivors (N = 47)	Non survivors (N = 13)	<i>p</i> -value
Age (year-old)	58.2 \pm 14.2	56.3 \pm 13.7	65.2 \pm 14.2	0.057
< 75	51 (85.0%)	44 (93.62%)	7 (53.85%)	0.002
≥ 75	9 (15.0%)	3 (6.38%)	6 (46.15%)	
Gender				
Male	49 (81.67%)	38 (80.85%)	11 (84.62%)	1.000
Female	11 (18.33%)	9 (19.15%)	2 (15.38%)	
Primary origin				
Skin	9 (15.0%)	6 (12.8%)	3 (23.1%)	0.141
Anorectum	28 (46.7%)	25 (53.2%)	3 (23.1%)	
Urogenital	23 (38.3%)	16 (34.0%)	7 (53.9%)	
Underlying disease				
Diabetes mellitus	45 (75.0%)	34 (72.34%)	11 (84.62%)	0.485
Hypertension	24 (40.0%)	16 (34.04%)	8 (61.54%)	0.073
Uremia	6 (10.0%)	3 (6.38%)	3 (23.07%)	0.109
Liver cirrhosis	5 (8.33%)	2 (4.26%)	3 (23.07%)	0.063
Malignancy	2 (3.33%)	1 (2.13%)	1 (33.33%)	0.414
Operation (sessions)				
1-3	41 (68.33%)	32 (68.09%)	9 (69.23%)	1.000
> 3	19 (33.67%)	15 (31.91%)	4 (30.77%)	
Clinical course				
ICU admission				
No	26 (43.33%)	26 (55.32%)	0 (0.00%)	< 0.001
Yes	34 (56.67%)	21 (44.68%)	13 (100.0%)	
Septic shock*	23 (38.33%)	12 (25.53%)	11 (84.62%)	< 0.001
Acute renal failure	5 (8.33%)	2 (4.26%)	3 (23.08%)	0.063
Ventilator use	7 (11.67%)	0 (0.0%)	7 (53.85%)	< 0.001
Diversion stomy				
No	29 (48.33%)	24 (51.06%)	5 (38.46%)	0.421
Yes	31 (51.67%)	23 (48.94%)	8 (61.54%)	
< 48 hours	22 (70.97%)	21 (91.30%)	1 (12.5%)	< 0.001
≥ 48 hours	9 (29.03%)	2 (8.70%)	7 (87.5%)	
Hypercarbic oxygen therapy	14 (23.33%)	14 (29.79%)	0 (0.00%)	0.027
Hospital stay (days)	31.57 \pm 22.86	29.94 \pm 20.34	37.46 \pm 30.57	0.415
Fournier's gangrene severity index	5.48 \pm 3.58	4.77 \pm 3.29	8.08 \pm 3.48	0.002
Mortality	13 (21.67%)			

* Patient with vasopressor agents used at initial diagnosis of Fournier's gangrene was defined as shock.

(81.7%) were male and 11 (18.3%) were female, and the mean age was 58.2 ± 14.2 years. Mean age of the patients who survived was 56.3 ± 13.7 , whereas mean age of the patients who died was 65.2 ± 14.2 years ($p = 0.057$). Forty-five patients had diabetes mellitus (75.0%), however the effect of diabetes mellitus on mortality was not statistically significant ($p = 0.485$). Twenty-four (40.0%) patients had hypertension. Other co-morbidities included uremia, liver cirrhosis, and malignancy.

Fluid resuscitation, and a single, double, or triple antibiotic therapy was initiated, according to the culture and antibiotic-sensitivity results. Wide debridement of the necrotic tissue, repeated sequentially, was applied to all patients. The majority ($n = 41$, 68.3%) of patients required 1-3 sessions of debridement. Thirty-four patients were admitted to the intensive care unit. Septic shock, acute renal failure, and respiratory failure with the requirement of ventilator were the most common reasons for admission in the ICU. There were significantly more ICU admissions among patients who died than among those who survived ($p < 0.001$). In addition to surgical debridement, intestinal diversion was also applied where required. Diverting colostomy was performed in 23 patients (48.9%) in the group of patients who survived, whereas it was performed in only 8 patients (61.5%) in the group of patients who died. The number of surgical debridement procedures and the need for diverting colostomy did not have an effect on the post-operative mortality. However, delayed colostomy formation (> 48 hours) was associated with an increased risk of mortality of patients with Fournier's gangrene requiring stoma ($p < 0.001$). Of the included patients, 46 underwent surgical debridement and antibiotic therapy alone, and 14 were treated with HBO therapy, surgery, and antibiotics.

The overall mean FGSi was 5.48 ± 3.58 . The mean FGSi of surviving patients (4.77 ± 3.29) was significantly lower than of non-surviving patients (8.08 ± 3.48 , $p = 0.002$). The overall mortality rate was 21.7% (13 patients). The mean length of hospital stay was 31.6 ± 22.9 days (6-94), and there was no statistically significant difference between the two groups (29.9 ± 20.3 days vs. 37.5 ± 30.6 days, $p = 0.415$).

The Cox regression analysis identified two inde-

pendent predictors associated with Fournier's gangrene: age ≥ 75 year-old (adjusted hazard ratio (HR): 25.78, 95% confidence interval (CI): 1.79-371.00, $p = 0.017$) and septic shock (adjusted HR: 16.01, 95% CI: 1.37-187.05, $p = 0.027$) (Table 4).

Demographic and clinical data of patients with Fournier's gangrene who did and did not receive HBO therapy are listed in Table 5. There was a statistically significant difference between the mortality rates of the groups that received and did not receive HBO therapy (28.3% vs. 0.0%, $p = 0.027$). To evaluate the effects of different treatment modalities in Fournier's gangrene further, the result of HBO therapy and diverting stoma in patients with different clinical outcomes is presented in the Tables 6 and 7. The use of diverting stomas did not influence overall survival, or the survival in the shock group and non-shock groups ($p = 0.421$, $p = 0.680$, $p = 0.115$, respectively). HBO therapy decreased the overall mortality rate in patients with Fournier's gangrene (0.0% vs. 28.3% with and without HBO, respectively; $p = 0.027$), as well as in patients with septic shock (0.0% vs. 73.3% with and without HBO, respectively; $p = 0.001$).

Discussion

Fournier's gangrene is a rapidly progressive, necrotizing fasciitis of the perineum and external genitalia, which is associated with a high mortality and morbidity. The reported mortality rate of 16-50%^{6,7,9} is consistent with our rate. It is therefore important to identify the predictors of mortality in the patients who die of this disease. Advanced age, diabetes mellitus, chronic liver disease, chronic renal failure, alcoholism, smoking, and immunosuppressive conditions are reported risk factors for Fournier's gangrene.^{10,11} The most common predisposing factor is diabetes mellitus. Chemotaxis, phagocytosis, and cellular digestion are impaired in diabetic patients, which increase their susceptibility to infections. The most common concomitant disease in our study also was diabetes. Diabetes, female gender, the presence of malignancy, and the time since onset of the disease until the first surgical treatment are reported to be independent risk factors

Table 4. Crude and adjusted hazard ratios (HR) and 95% confidence intervals (CI) for prognostic factors associated with risk of Fournier's gangrene death

	Crude HR (95% CI)	<i>p</i> -value	Adjusted HR (95% CI)	<i>p</i> -value
Age (year-old)				
< 75	1.00		1.00	
≥ 75	12.57 (2.54-62.20)	0.002	25.78 (1.79-371.00)	0.017
Gender				
Male	1.30 (0.24-6.94)	0.757		
Female	1.00			
Underlying disease				
Diabetes mellitus	2.10 (0.41-10.80)	0.373		
Hypertension	3.10 (0.87-11.04)	0.081		
Uremia	4.40 (0.77-25.10)	0.095		
Liver cirrhosis	6.75 (0.99-45.85)	0.051		
Malignancy	3.58 (0.20-60.21)	0.388		
Clinical course				
ICU admission*	-	-		
Septic shock	16.04 (3.10-82.96)	0.001	16.01 (1.37-187.05)	0.027
Acute renal failure	6.75 (0.99-45.85)	0.051		
Ventilator use*	-	-		
Diversion stomy				
No	1.00	0.424		
Yes	1.67 (0.48-5.86)			
≤ 48 hours	0.61 (0.13-2.75)	0.515		
> 48 hours	3.07 (0.62-15.08)	0.168		
Hyperbaric oxygen therapy (HBO)*	-			
Hospital stay	1.01 (0.99-1.04)	0.296		
Fournier's gangrene severity index (FGSI)	1.32 (1.08-1.62)	0.006	1.24 (0.97-1.57)	0.082

* Because the events of frequency cell is zero, the hazard ratio could not be calculated.

for mortality in Fournier's gangrene.¹² Canbaz et al.¹¹ have reported that the period of time before treatment was significantly longer in fatal cases than in the others, and mortality was increased if this period is longer than five days. The authors attributed this finding to the rapid and aggressive course of the disease. In our series, diabetes mellitus was not an independent factor of prognosis. According to the Cox regression analysis, older age (≥ 75 year-old) and septic shock were the only independent predictors of postoperative mortality. ICU admission, septic shock, and ventilator use were factors significantly different between the survivor and non-survivor groups ($p < 0.001$). However, since there were no events in the ICU admission group, ventilator group, and HBO group, the hazard ratio for these data could not be calculated.

A combination of double and triple broad-spectrum antibiotics is recommended in the medical treatment of Fournier's gangrene, followed by either continuation of the same treatment or altering the antibio-

tics according to the culture and sensitivity results.¹² Patients in our study were started on double or triple antibiotic therapy in the preoperative period, and the antibiotics were changed according to the results of antibiogram.

Consistent with literature reports, the anorectal area was the most common primary site of infection in our patients. Colostomy is very effective in the postoperative period in preventing contamination of the wound with fecal matter and in enhancing wound care. The need for fecal diversion in Fournier's gangrene is covered extensively in the published literature, but the timing of diversion has not been widely addressed. Moorthy et al.¹³ reported that colostomy improved the condition of patients with Fournier's gangrene, but others¹³⁻¹⁵ have reported an increased mortality in those who require a stoma.¹³⁻¹⁵ In our study, colostomy was performed in 51.7% of patients. Colostomy, combined with the first debridement session, was reserved for patients with involvement of the anorectal region

Table 5. Demographics and clinical data of Fournier's gangrene patients with or without HBO therapy

	Non-HBO (N = 46)	HBO (N = 14)	<i>p</i> -value
Age (year-old)			
< 75	38 (82.6%)	13 (92.9%)	0.671
≥ 75	8 (17.4%)	1 (7.1%)	
Gender			
Male	37 (80.4%)	12 (85.7%)	1.000
Female	9 (19.6%)	2 (14.3%)	
Primary origin			
Dermatology	6 (13.0%)	3 (21.4%)	0.375
Anorectum	20 (43.5%)	8 (57.1%)	
Urogenital	20 (43.5%)	3 (21.4%)	
Underlying disease			
Diabetes mellitus	36 (78.3%)	9 (64.3%)	0.309
Hypertension	20 (43.5%)	4 (28.6%)	0.319
Uremia	6 (13.0%)	0 (0.0%)	0.320
Liver cirrhosis	3 (6.5%)	2 (14.3%)	0.582
Malignancy	2 (4.4%)	0 (0.0%)	1.000
Operation (sessions)			
1-3	34 (73.9%)	7 (50.0%)	0.111
> 3	12 (26.1%)	7 (50.0%)	
Clinical course			
ICU admission			
No	21 (45.7%)	5 (35.7%)	0.511
Yes	25 (54.4%)	9 (64.3%)	
Septic shock*	15 (32.6%)	8 (57.1%)	0.098
Acute renal failure	3 (6.5%)	2 (14.3%)	0.582
Ventilator use	7 (15.2%)	0 (0.0%)	0.184
Diversion stomy			
No	23 (50.0%)	6 (42.9%)	0.640
Yes	23 (50.0%)	8 (57.1%)	
< 48 hours	34 (73.9%)	7 (50.0%)	0.111
≥ 48 hours	12 (26.1%)	7 (50.0%)	
Hospital stay	32.59 ± 25.05	28.21 ± 13.55	0.403
Fournier's gangrene severity index	5.70 ± 3.63	4.79 ± 3.45	0.409
Mortality	13 (28.3%)	0 (0.0%)	0.027

* Patient with vasopressor agents used at initial diagnosis of Fournier's gangrene was defined as shock.

and the anal sphincter. Colostomy may be preferred in the initial period (< 48 hours) in order to reduce contamination. We reserved colostomy after ≥ 48 hours for patients with disease that had progressed to the anal region or in order to ameliorate the difficulties in nursing care. Of these patients, 71% received a colostomy within 48 hours after admission, whereas 29% received a delayed colostomy formation (> 48 hours). There was no difference in survival between patients who received colostomy and those who did not (*p* = 0.241). However, there were significantly more colo-

stomies in the non-survivors group (*p* < 0.001), which may be evidence of their more extensive disease, in which mortality ordinarily is high.

The high mortality rate in Fournier's gangrene has been a catalyst for the use of a number of ancillary therapies to improve patient outcome. Sroczyński et al.¹⁶ stressed the importance of HBO therapy in addition to the aforementioned treatment methods. HBO is a form of medical treatment in which the patient is enclosed in a chamber and breathes 100% oxygen at a pressure of 1 atmosphere absolute (ATA). Tissues at rest require 60 mL oxygen/L blood flow to maintain adequate cellular metabolism. At normal atmospheric pressure, plasma oxygen concentration is only 3 mL/L,¹⁷ and oxygen is delivered to the tissues mainly by hemoglobin. If the concentration of oxygen in the inspired air is increased to 100%, the amount of oxygen dissolved in plasma will increase to 20 mL/L. At a hyperbaric pressure of 3 ATA (304 kPa), the dissolved plasma oxygen increases to 70 mL/L, which exceeds the resting tissue oxygen requirement and does not require a contribution from hemoglobin.¹⁸ HBO therapy results in enhanced oxygenation of the arterial blood and tissues. Benefits of HBO include optimal neutrophil phagocytic function; inhibition of anaerobic bacterial growth; increased fibroblast proliferation and angiogenesis; reduction of edema by vasoconstriction; and increased intracellular transportation of antibiotics.¹⁹ In our hospital, HBO therapy consisting of cycles of 95 minutes at 2.0 ATA pressure was applied. To further evaluate the role of diversion colostomy and HBO in treatment of Fournier's gangrene, the mortality rate in different treatment modalities was analyzed, as illustrated in Tables 6 and 7. Diversion colostomy decreases the difficulties in nursing care, particularly in intensive care units. With diversion colostomy, the patients can receive nutrition by the use of a nasogastric tube as soon as possible. Prior research has shown the advantages of early enteral feeding.²⁰ Experimental studies on burn animals showed that immediate enteral feeding was associated with a decrease in the hypermetabolic state, suppression of the catabolic hormones, and less bacterial translocation from the intestinal tract.²¹⁻²⁵ However, in our experience, a diversion stoma had no

Table 6. Role of diversion stomy and hypercarbic oxygen therapy (HBO) in mortality of Fournier's gangrene

	Overall (N = 60)			Shock (N = 23)			Non-Shock (N = 37)		
	Alive N = 47 (%)	Death N = 13 (%)	<i>p</i> -value	Alive N = 12 (%)	Death N = 11 (%)	<i>p</i> -value	Alive N = 35 (%)	Death N = 2 (%)	<i>p</i> -value
Stomy (+)	23 (74.19%)	8 (25.81%)	0.421	8 (57.14%)	6 (42.86%)	0.680	15 (88.24%)	2 (11.76%)	0.115
Stomy (-)	24 (82.76%)	5 (17.24%)		4 (44.44%)	5 (55.56%)		20 (100%)	0 (0.0%)	
HBO (+)	14 (100%)	0 (0.0%)	0.027	8 (100%)	0 (0.0%)	0.001	6 (100%)	0 (0.0%)	1.000
HBO (-)	33 (71.74%)	13 (28.26%)		4 (26.67%)	11 (73.33%)		29 (93.55%)	2 (6.45%)	

* *p*-value was calculated based on Pearson's Chi-square test or Fisher's exact test if the expected value was less than five.

Table 7. Treatment modality in mortality of Fournier's gangrene

	Overall (N = 60)		Shock (N = 23)		Non-Shock (N = 37)	
	Alive N = 47 (%)	Death N = 13 (%)	Alive N = 12 (%)	Death N = 11 (%)	Alive N = 35 (%)	Death N = 2 (%)
Stomy (+)/HBO (+)	8 (100%)	0 (0.0%)	6 (100%)	0 (0.0%)	2 (100%)	0 (0.0%)
Stomy (+)/HBO (-)	15 (65.21%)	8 (34.78%)	2 (16.67)	6 (54.55)	13 (86.67)	2 (13.33%)
Stomy (-)/HBO (+)	6 (100%)	0 (0.0%)	2 (100%)	0 (0.0%)	4 (100%)	0 (0.0%)
Stomy (-)/HBO (-)	18 (78.26)	5 (21.74%)	2 (16.67)	5 (45.45)	16 (100%)	0 (0.0%)
<i>p</i> -value	0.121		0.007		0.459	

influence on the survival of patients with Fournier's gangrene, even in those with septic shock. The diversion stoma may decrease wound contamination and allow oral feeding early, but it does not stop the progression of gangrene. Aggressive resuscitation, use of broad-spectrum antibiotics, and early surgical drainage are paramount in the treatment of Fournier's gangrene. All necrotic tissue is removed with debridement, which is repeated as needed to control the infection.

Most patients in shock need vasopressor agents to maintain hemodynamic stability. However, the induced vasoconstriction may worsen the tissue ischemia, resulting in extension of the gangrenous area. HBO therapy improves the perfusion and oxygen supply of ischemic tissues and neovascularization, and has an antimicrobial effect on anaerobic bacteria.

A scoring system (FGSI) has been developed by Laor et al.⁸ to determine the severity of infection and prognosis of patients with Fournier's gangrene, by the use of vital signs and laboratory data. Using this system, the mortality rate is 75% if the FGSI is over 9, whereas the survival rate is 78% in scores of less than 9. Kara et al.²⁶ showed a significant increase in mortality in patients with a FGSI value of ≥ 7 . The mean FGSI of our surviving patients was 4.77 ± 3.29 , whereas that of non-surviving patients was $8.08 \pm$

3.48 ($p = 0.002$).

This study was limited by its retrospective design, insufficiency of some data in the registry, and inability to access all the data. Daily blood gas analyses were not available in some cases, so our FGS values were less than those in studies in the literature.

In our series, the mean duration of hospital stay in survivors and non-survivors with septic shock was 36.33 ± 18.87 and 42.55 ± 30.57 days, respectively ($p = 0.5696$). The mean number of operation sessions of these two groups was 4 ± 2.44 and 3 ± 1.61 , respectively ($p = 0.1890$). Therefore, we have no evidence to support that the non-survivors with septic shock did not receive HBO therapy due to their critical condition. In our HBO chamber, we have an oxygen supply for patients on ventilator. However, not every physician treating the patients with Fournier's gangrene had confidence of HBO therapy as an effective treatment option for the disease. Thus, the effectiveness of HBO therapy in treating Fournier's gangrene should be tested in a double blind, prospective study.

Conclusion

Fournier's Gangrene is a rapidly progressive dis-

ease, which is difficult to treat and is associated with a high incidence of mortality and morbidity. In patients with Fournier's gangrene, older age and septic shock are associated with a poor prognosis and mortality. Early diagnosis, aggressive treatment with surgical debridement, and appropriate antimicrobial therapy has a positive influence on the prognosis of the disease. Our study does not support the routine use of diversion stoma in the treatment of Fournier's gangrene, but hyperbaric oxygen therapy has a survival benefit.

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原 著

弗尼爾氏壞疽：我們的經驗和目前的做法 —— 一個來自單一機構的回顧性臨床研究

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目的 弗尼爾氏壞疽是一種猛爆性的壞死性筋膜炎，牽涉到生殖器，肛周及會陰部的區域，並與迅速蔓延的嚴重敗血症相關。為了研究弗尼爾氏壞疽的表現，治療方法和總死亡率，我們從一個單一機構提出回顧性的研究。

方法 蒐集從 2007 年 1 月至 2012 年 12 月出院診斷為弗尼爾氏壞疽的患者。關於病患的特徵，病史，臨床表現，入院實驗檢查，治療方式，住院天數和結果進行分析。

結果 總共有 60 名弗尼爾氏壞疽的病患，其中包含 49 例男性，11 例女性，他們的平均年齡為 58.2 ± 14.2 歲（範圍：29-88）。總死亡率為 21.67%（13 例）。在這些患者中，46 例接受手術清創和抗生素治療，其餘 14 例接受手術清創、抗生素治療和高壓氧治療。腸造口在存活組與非存活組並無統計學上顯著差異（ $p = 0.421$ ）。年老（ ≥ 75 歲）和敗血性休克是弗尼爾氏壞疽的獨立預後因素。腸造口並沒有影響敗血性休克患者的死亡率（42.86% 比 55.56%， $p = 0.680$ ）。高壓氧治療可以降低弗尼爾氏壞疽死亡率（0.0% 比 28.26%， $p = 0.027$ ），包括敗血性休克的病人（0.0% 比 73.33%， $p = 0.001$ ）。

結論 這些結果並不支持對於弗尼爾氏壞疽病患，給予常規腸造口手術。然而，高壓氧治療對弗尼爾氏壞疽患者有生存上的助益。

關鍵詞 弗尼爾氏壞疽、筋膜炎、清創、高壓氧治療。