J Huazhong Univ Sci Technol［Med Sci］
DOI 10.1007/s11596-012-1024-4 32(5):719-723,2012

Experience in Management of Fournier's Gangrene: A Report of 24 Cases

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Summary: Fournier's gangrene (FG) is an extremely aggressive and rapidly progressive polymicrobial soft tissue infection of the perineum, anal area or genitalial regions with a high mortality rate. The objectives of this study were to share our experience with the management of this serious infectious disease over the last 15 years. This retrospective study examined 24 patients diagnosed as having FG who were admitted to our hospital between March 1996 and December 2011. The gender, age, etiology, predisposing factors, laboratory findings, treatment modality, hospitalization time and spread of gangrene of the subjects were all recorded and analyzed. The results showed that the mean age of the patients was 48.33 years, the male-to-female ratio was 5:1 and the mortality rate was 20.8% (5/24). The most common predisposing factor was diabetes mellitus in 10 patients (41.6%), followed by alcohol abuse, obesity, neoplasms and immunosuppression. The most common etiology was peri-anal and peri-rectal abscesses (45.8%), followed by lesions of urogenital origin (33.3%) and cutaneous (8.3%) origin. No local pathologies could be identified in 3 (12.5%) patients. The most commonly isolated microorganisms were *Escherichia coli* (62.5%), followed by *Enterococcus*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. The median admission Fournier's gangrene severity index (FGSI) score for survivors was 5.63±1.89 against 13.6±3.64 for non-survivors which was designed for predicting the disease severity in the series. Early diagnosis and immediate extensive surgical debridement were significant prognostic factors in the management of Fournier gangrene. Individualized reconstructive modalities for wound coverage were useful in that they repaired the tissue defect and improved the quality of life. We are led to conclude that Fournier's gangrene is a severe condition with a high mortality. The Fournier's gangrene severity index (FGSI) score at admission serves as a good predictor for the disease severity. Early diagnosis, surgical debridement and aggressive fluid therapy are significant prognostic factors in the management of Fournier gangrene. Individualized reconstructive surgery modalities for wound coverage are useful to correct the tissue defect and improve the quality of life.

Key words: Fournier's gangrene; surgical debridement; Fournier's gangrene severity index

Fournier's gangrene (FG) is an extremely aggressive and rapidly progressive polymicrobial soft tissue infection of the perineum, anal area or genitalia regions. It is caused by a synergy of aerobic and anaerobic bacteria, and it presents a fulminant necrotizing fasciitis with high mortality rate. The most important managements of FG are extensive surgical debridement, fascia incision, drainage of necrotic tissue and sufficient intravenous administration of broad spectrum antibiotics. In this report, we presented our experience with management of 24 patients suffering from FG.

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1 MATERIALS AND METHODS

The medical records of 24 consecutive patients with FG, who were treated and followed up at Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, between March 1996 and December 2011, were reviewed retrospectively.

Clinical diagnoses were based on the clinical profile, physical examination, laboratory data, and signs and symptoms on admission in accordance with the diagnostic criteria for necrotizing fasciitis[1]. All the results of biochemical, hematologic, and bacteriologic examination were recorded at admission. Etiology, predisposing factors,

laboratory findings and FGSI scores were also recorded at admission. The review of the medical records of those patients included the median time between the onset of symptoms and first debridement, number of surgical debridements, reconstructive modalities for wound coverage, culture findings, hospitalization time, and clinical outcome. Color Doppler ultrasound and computer tomography were routinely performed at admission.

When the diagnosis of FG was made with diagnostic criteria of FG, extensive surgical debridement and adequate open drainage were immediately performed. If necessary, repeated debridement should be considered without any delay. Colostomy and suprapubic cystostomy were performed, if the infection involved the adjacent regions such as peri-rectal or perianal area, peri--urethral area with urinary extravasation. Aggressive resuscitation and nutritional support were administered at admission to maintain water-electrolyte balance and to supply adequate energy. When patient's condition become stable, individualized reconstructive modalities for wound coverage were performed with split-thickness skin grafts or simple skin grafts.

All culture samples at admission were transported, without delay, to our clinical laboratory. Before the bacterial culture results were obtained, broad-spectrum antibiotics therapies covering Gram-positive and -negative bacteria and anaerobes were intravenously administered empirically on admission to all patients, such as penicillin G, aminoglycosides or third-generation cephalosporin, metronidazole or tinidazole, and then the treatment was adjusted on the basis of the results of bacterial culture and sensitivity tests.

The Fournier's gangrene severity index (FGSI) score, which was created by modifying the Acute Physiology and Chronic Health Evaluation Ⅱ (APACHE Ⅱ) severity score[2], was used in our clinical evaluation. The FGSI assigns numeric scores to the different degrees of severities and predicts the outcome of the disease based on scales. Nine parameters are measured in the FGSI score, including temperature, heart and respiration rates, serum sodium and potassium, creatinine, white blood cell count, hematocrit, and bicarbonate levels, and the degree of deviation from normal is scored on a 0 to 4 scale. The FGSI scores of patients were obtained at admission and evaluated for survivors and non-survivors.

Statistical analysis was performed by using SPSS for Windows XP, (Ver. 18.0, SPSS Inc., Chicago, IL, USA). All data were analyzed by employing the *Chi*-square test, Fisher's exact test, and the Mann-Whitney U test. Results were considered statistically significant if a P value was less than 0.05.

2 RESULTS

A total of 24 patients were diagnosed and treated at Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, between March 1996 and December 2011. The mean age of patients who survived was 48.79±12.86 (range 20–67) years and that of the non-survivors was 46.6±14.08 (range 37–71) years. The difference in age between survivors and non-survivors was not significant. Of these patients, 20 (80%) were men and 4 (20%) were women, and 19 survived and 5 died, with a mortality rate of 20.8% (5/24). Five of the non-survivors were men.

Chief complaints included skin erythema in 24 patients (100%), peri-anal/scrotal swelling and pain in 23 (85.1%) patients, foul-smelling discharge in 16 (66.7%) patients, and septic shocks in 4 (16.7%) patients at admission. The median extent of the body surface area involved in the necrotizing process in patients who survived and died was 2.4% and 3.7%, respectively. The median admission time was 5.58 d (range 1–12 d). Significant difference was found in median admission time between patients who survived (4.52±1.98 days) and those who died (9.6±1.82 days). All these patients underwent immediate extensive surgical debridement with excision of all necrotic tissues and adequate open drainage (fig. 1). The mean number of surgical debridements was 1.3 times and there were no statistically significant differences between patients who survived and those who died. If the infection involved the adjacent regions, such as peri-rectal or peri-anal area, peri-urethral area with urinary extravasation, colostomy and supra-pubic cystostomy were performed. When the patient's condition become stable, individualized reconstructive modalities for wound coverage were performed with split-thickness skin grafts or simple skin grafts. Secondary healing or delayed primary closure was done in 4 patients with small skin defect that did not entail an additional reconstructive procedure. The split-thickness skin graft for reconstruction of the scrotal or abdominal defects was carried out in 10 patients with a large skin and soft tissue defects with a cosmetic consideration taken (fig. 2). Reconstruction with skin grafts from thigh were performed in 5 patients with a large scrotal defect who demanded to minimize the intraoperative wounds, and postoperatively, their defects healed very well. Postoperative follow-up showed that they had normal sexual function.

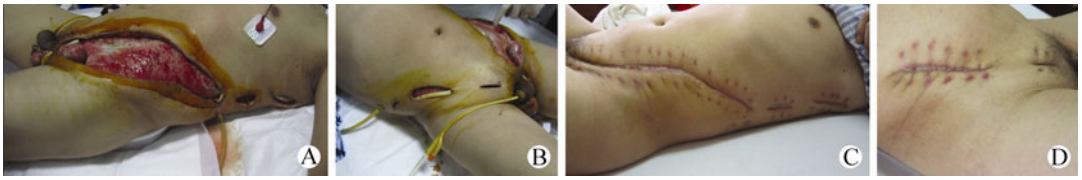

Fig. 1 The bilateral inguinal regions and the left lower back before and after operation

A and B: Condition of a patient on the first postoperative day without cystostomy and colostomy. FG involved extensive regions, including bilateral inguinal regions and the left lower back. The left testis was completely exposed; C and D: The patient underwent a relaxation suture on the 20th postoperative day and was discharged on the 59th postoperative day after repeated extensive surgical debridement, open drainage and antibiotic therapy.

The laboratory findings and FGSI scores were evaluated at admission. The items examined included the white blood cell count, hematocrit, platelet count, and serum urea, creatinine, serum sodium and potassium, alkaline phosphatase, albumin, lactate dehydrogenase, cholesterol, bicarbonate levels, emperature, heart and respiration rates. Significant difference was found in the FGSI score between survivors (5.63±1.89) and non-survivors (13.6±3.64) at admission. Predisposing factors found in 24 patients included diabetes mellitus (10/24, 41.6%), alcohol abuse (3/24, 12.5%), obesity (2/24, 8.3%), neoplasms (1/24, 4.17%), and immunosuppression (1/24, 4.17%). Predisposing factors could not be identified in seven patients.

The most common etiology was peri-anal and peri-rectal abscesses (45.8%), followed by those of urogenital origin (33.3%) and cutaneous (8.3%) origin, and no local pathologies could be identified in 3 (12.5%) patients. The most commonly isolated microorganisms were *Escherichia coli* (66.6%), followed by *Enterococcus, Pseudomonas aeruginosa* and *Staphylococcus aureus*. The mean duration of hospitalization was 40.58±14.04 (range 14–67) days for survivors and 15.00±11.64 (range 3–32) days for non-survivors (table 1 and 2).

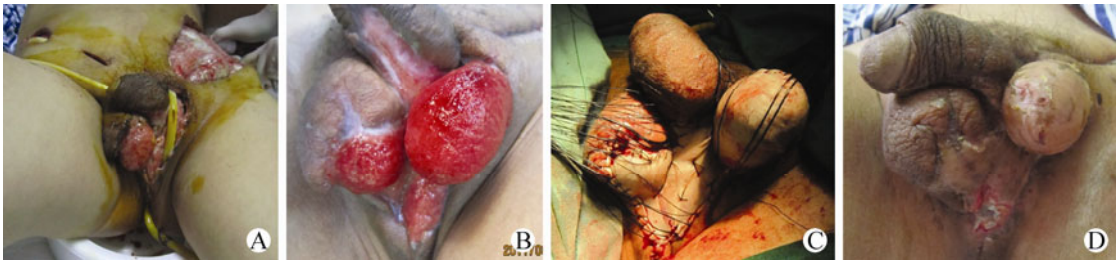

Fig. 2 The scrotum and perineum before and after operation
A and B: Postoperative scrotum and completely exposed testes. The left testis was completely exposed; C and D: Wound skin graft from the right thigh during operation (C) and 14 days after skin graft (D)

Table 1 Demographic and clinical characteristics of the patients

No.	Age (yr)/Sex	PF	Sources	Outcome	HST (days)	AT (days)	FGSI	Culture
1	20/M	Alcohol abuse	Peri-anal	H	62	6	7	*E. coli*
2	53/F	DM	Peri-rectal	H	38	3	5	*Enterococcus*
3	38/M	Obesity	Urogenital	D	32	8	12	*E.coli*
4	47/M	DM	Perianal	H	14	7	6	*E.coli*
5	65/M	None	Urogenital	H	27	2	4	*Enterococcus*
6	71/M	Rectal cancer	perirectal	D	12	9	17	*E.coli*
7	58/F	DM	Urogenital	H	23	5	5	*PA*
8	43/M	Alcohol abuse	Peri-anal	H	36	3	7	*E.coli*
9	61/M	None	Cutaneous	H	45	8	9	*SA*
10	49/M	DM	Peri-rectal	H	67	4	4	*E.coli*
11	46/M	DM	None	D	21	11	15	*E.coli*
12	50/F	DM	Perianal	H	47	7	3	*E.coli*
13	67/M	None	Peri-rectal	H	26	3	5	*E.coli*
14	42/M	DM	Cutaneous	H	43	5	7	*SA*
15	54/M	Immunosuppression	Urogenital	H	33	4	6	*E. coli*
16	32/M	Alcohol abuse	Urogenital	H	49	6	10	*SA*
17	59/M	DM	Peri-anal	H	52	1	4	*E. coli*
18	37/F	Obesity	None	D	7	12	16	*PA*
19	45/M	None	Urogenital	H	56	2	5	*E. coli*
20	41/M	DM	Urogenital	D	3	8	8	*Proteus mirabilis*
21	28/M	None	Peri-anal	H	36	5	7	*E. coli*
22	38/M	None	Peri-anal	H	54	7	3	*PA*
23	64/M	DM	Urogenital	H	35	5	6	*E. coli*
24	52/M	None	None	H	28	3	4	*E. coli*

PF: predisposing factor; DM: Diabetes mellitus; H: healing; D: dead; HST: Hospital stay time; AT: Admision time; PA: Pseudomonas aeruginosa; SA: staphylococcus aureus

Table 2 Admission parameters for survivors and nonsurvivors

Items observed	Survivors (n=19)	Non-survivors (n=5)	P
White blood cell count ($\times10^9$/L)	14.58±7.62	15.13±6.78	>0.05
Hemoglobin (g/dL)	12.65±2.8	8.21±1.97	<0.05
Hematocrit (%)	38.37±6.24	27.66±5.83	<0.05
Albumin (g/dL)	3.18±1.24	2.49±1.72	<0.05
Creatinine (mg/dL)	1.17±0.96	3.46±1.67	<0.05
Potassium (mmol/L)	3.78±1.34	3.92±1.54	>0.05
FGSI score	5.63±1.89	13.6±3.64	<0.05
Mean age (years)	48.79±12.86	46.6±14.08	>0.05
Median admission time (days)	4.52±1.98	9.6±1.82	<0.05
Mean hospital stay time (days)	40.58±14.04	15.0±11.64	<0.05

3 DISCUSSION

3.1 Overview

FG was first described as an a life-threatening necrotizing fasciitis of the male genitourinary tract in 1883 by Jean Alfred Fournier[3]. FG is an extremely aggressive and rapidly progressive polymicrobial soft tissue infection of the perineum, anal area and genitalia, which presents a fulminant necrotizing fasciitis with high mortality rate, ranging from 7.5% to 40%[4, 5]. FG affects both sexes, with the victims ranging from neonates to the elders, the mean age being about 40 to 50 years. Eke reported a review of 1726 cases of FG, showing that the ratio of males to females was about 10:1[6] The incidence is increased in the ageing population with higher morbidity and mortality rates. The predisposing factors include diabetes mellitus, malnutrition, chronic glucocorticoid therapy, cardiac disorders, alcohol abuse, immunosuppression, indwelling catheters, surgical procedure *etc*[7]. Co-existing diabetes mellitus were found in up to 10%–60% of these patients[6]. FG is generally a synergistic infection of aerobic and anaerobic microorganisms which leads to thrombosis in small subcutaneous vessels, obliterative endarteritis, and eventually extensive skin and subcutaneous tissue necrosis[8]. Propagation from anorectal, urogenital and skin infections is the main sources of infections. Propagation from anorectum is the result of colorectal abscess, peri-anal abscess, rectal instrumentation, colon perforation and trauma *etc*[9].The major urogenital factors causing FG are urinary extravasation, urethral stricture, transurethral instrumentation, inflammation of genitourinary tract and surgeries of the penis and scrotum *etc*. The sources of skin infection include ulceration of the scrotum, supurative hydroadenitis and complications of surgical procedures or serious traumas[8, 10]. The most common pathogens in both male and female patients were commensal flora of the gastrointestinal tract and perineum, including *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas*, and *Streptococcus viridians*[1]. The infection foci rapidly spread into fascias as perineal infection occurred. It's a result of the synergistic action of aerobic and anaerobic organisms, which can release various proteins and enzymes cleaving the fascial planes and accelerating the spread of infection[1]. These bacterial toxins and necrotic tissue frequently lead to sepsis, septic shock, acute renal failure and systemic failure, *etc*. The Infection tends to spread along superficial and deep fascial planes, and infection in the anal triangle can penetrate the Colles' fascia to involve the buttocks and thighs, and then along *dartos fascia* into the scrotum and penis. It can also spread through Scarpa's fascia to involve the anterior abdominal wall and other regions such as inguinal regions. If the Buck fascia is penetrated, infection can rapidly disseminate along Colles' and *dartos fasciaes*[7]. The rapid progression and the fulminant nature of the infection make it life-threatening[5].

3.1 Clinical Manifestations and Diagnosis

The early diagnosis of FG is often difficult, because the early symptoms and signs of the disease are not typical. Thought still controversial[11, 12], the FGSI was helpful in predicting the disease severity and the prognosis of FG in our series. The early stage of FG goes as follows: the scrotum, penis, peri-anal and perineal regions develop the stabbing pain, itching, local swelling and redness[14]. The swelling, shiny scrotum skin was the typical early symptom of scrotum infection, and the foul-smelling pus was discharged from the ulcer or charcoal grey necrotic lesions of scrotum. If the infection is caused by the aerogenes, subcutaneous emphysema and crepitus would be palpable at the involved areas of skin[8]. Doppler ultrasound could detect subcutaneous emphysema of the scrotum, scrotal abscess, filmy scrotal wall in early stage, and it can help to identify testis torsion, orchitis, epididymitis, scrotal hematoma and incarcerated inguinal hernia as well[15]. CT and MRI may be useful in diagnosing and determining the scope of FG, direct the surgical debridement and drainage[7, 16]. Based on typical clinical symptoms, signs and the findings of imaging, the diagnosis of FG is not difficult to make.

3.2 Treatment

FG occurs and progresses rapidly. Early diagnosis and immediate extensive surgical debridement are the key to the treatment of FG. Delayed treatment may lead to high mortality rates[17]. We found that the median admission time between patients who survived and died was significantly different. The five basic principles of the treatment include: early diagnosis and debridement, use of broad-spectrum antibiotics, aggressive resuscitation, multiple debridement, and aggressive nutritional support[18]. Thorough debridement consists of two aspects: complete removal of necrotic tissues, and adequate drainage of necrotic areas[1]. Scrotum and other affected regions should be treated with extensive surgical debridement and completely drained in order to minimize the absorption of toxins. When necessary, repeated debridement should be performed without any delay. The wound could be repeatedly washed with 3% hydrogen peroxide and 0.9% normal saline, and then antiseptic dressings containing metronidazole should be applied on daily basis[19]. With the ablation of necrotic tissues, and the formation of healthy granulation tissue, reconstructive surgery could be performed[20]. We found that individualized reconstructive modalities for wound coverage helped to correct the tissue defect and improve the quality of life (such as secondary relaxation suture, simple

skin graft or split-thickness skin grafts, *etc*), varying with the size and depth of the wound defects. If the infection is accompanied with rectal perforation or urethral injury urethral stricture, colostomy or supra-pubic cystostomy should be seriously considered[21]. However, some authors attempted to prevent wound contamination from stool by administering intravenous hyper-alimentation, without performing colostomy[22]. Broad-spectrum antibiotics were intravenously given before operation to fight both Gram-positive and -negative bacteria, and were then adjusted according to the results of bacterial culture and sensitivity test. Metronidazole or tinidazole should be routinely used, since FG is often accompanied by anaerobic infections. Aggressive fluid therapy was of critical importance, including rehydration, blood transfusion, albumin and nutritional support, and should be started as early as possible to maintain water-electrolyte balance and provide sufficient energy. Reports in the literature showed that intravenous injection of immunoglobulin[23], α-recombinant human protein kinase[24], hyperbaric oxygen adjuvant therapy[25], and vacuum assisted closure (VAC) treatment[26] can promote rehabilitation of the FG patients, and decrease the mortality rate and hospitalization time. The factors responsible for poor prognosis of FG included: Progressively rising serum creatinine, severe hypoxemia, metabolic alkalosis or acidosis and age of over 50 years old. The FG patients may die from septic shock, acute renal failure, severe lung infection, or severe multi-organ failure[27]. With better understanding of the disease and increased treatment experience, the mortality rate of FG will further lowered in future.

Acknowledgments

The authors are indebted to Jiaming SUN of Plastic Surgery, Hai ZHENG of Emergency Surgery for their surgical assistance, and we thank nurses of Union Hospital who were involved in the postoperative care of the patients.

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(Received May 4, 2012)