Management and treatment of Fournier's gangrene.

Our Emergency Department Experience and literature review

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Sara Santillo, Edoardo De Meis, Gennaro Mazzarella, Greta Bracchetti, Paolo Ferrari, Monica Mansi, Gaia Cicioni, Marco Assenza

Department of Emergency Surgery, Surgical Fist Aid Unit, "Sapienza" University of Rome, Italy

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Fournier's Gangrene (FG) is an extremely serious condition of necrotizing soft tissue infection. The treatment of this critical condition is urgent but much debated, especially as regards the management of larger defects and wound closure, with various techniques being described in the current literature. Through a case series we aimed to present our surgical management of FG treated successfully with Negative Pressure Wound Therapy (NPWT) and performing a loop colostomy.

KEY WORDS: Fournier's gangrene, Loop colostomy, Negative Pressure Wound Therapy

Introduction

Fournier Gangrene (FG) is a necrotizing fasciitis that begins and proceeds from the perineal region and quickly expands. It is a rapidly progressing disease that can be potentially fatal; therefore, it should be treated as an emergency [1]. The first description of FG dates back to the 1025 from the Canon of Medicine by the famous Persian physician Avicenna 2: "Ulcers that occur in this region quickly become violent because these organs allow the corruption to spread rapidly" [3].
Men are more often affected than women, with a ratio of 10:1, and the disease can affect people of all ages (mean age = 50 years) [1]. The incidence of the disease is estimated at 1.6 men per 100 000. Mortality rate remains high at 20% to 40% despite improvements in medical care [1].

The etiopathogenetic causes are diabetes, chronic alcoholism, human immunodeficiency virus (HIV), lymphoproliferative diseases, chronic steroid abuse and cytotoxic drugs [5]. Therefore, host immunity creates a favourable environment to establish infection. Malnutrition and lower socioeconomic status have also been shown to be associated with the development of FG [4].

Material and Methods

We enlarge the case series of Assenza et al [5] to 8 cases of FG (all males, range: 38-73 yrs). Our strategy was based on medical treatment, surgical debridement and performing a colostomy (patients n=5) or positioning of fecal diversion (patient n=1), followed by negative pressure wound therapy (NPWT). We change the dressing every 3-4 days. We used hyperbaric oxygen therapy (HBOT) only on one patient; topical ozone applications on the affected areas were used in only one case.

Series Presentation

In all patients the most common comorbidity was hypertension, six of them were obese and diabetic. Two patients were paraplegics. One patient was affected by

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Correspondence to: Sara Santillo, MD, Department of Emergency Surgery, "Sapienza" University of Rome, Viale del Policlinico 155, 00161 Rome, Italy (e-mail: santillosara@gmail.com)

Table I - *Laboratory values*

	P. 1	P. 2	P. 3	P. 4	P. 5	P. 6	P. 7	P. 8
WBC (x103/ml)	14,68	16,75	13,98	14,83	19,01	18,65	16,34	7,9
NEUT (%)	86	79	67	89	88	83	12,55	
FIBR (mg/dl)	1151	742	813	1120	-	919	555	>555
ESR	64	-	80	116	62	60	-	-
PCR (mg/dl)	54	5,54	10,23	14,09	30	36,2	20,64	54,59
HB (g/dl)	10,9	10,8	12,9	8,3	7,5	12,1	14,7	
HGT (mg/dl)	139	580	81	356	112	146	118	
CREAT (mg/dl)	7,9	1,5	0,5	0,6	0,9	0,8	1	4,5
BUN (mg/dl)	38	45	18	14	20	8	21	

Table II - *Vital parameters (*antipyretic given)*

	P. 1	P. 2	P. 3	P. 4	P. 5	P. 6	P. 7	P. 8
BP(mmHg)	110/60	130/70	120/75	108/76	90/30	120/90	150/80	120/70
HR(bpm)	100	98	80	104	70	123	100	87
SATO2 (%)	97,5	97	99	98	96	97	98	96
TC(°C)	38,8	37,2*	38,2	38,8	339	39	36,9	37,3
GCS	15	15	15	14	10	15	15	15

Table III - *Etiology and local features*

Patient	Etiology and local features
1	Perianal and gluteal abscesses
2	Ulcerated scrotal wound following acute orchitis
3	Perianal abscess extending to the scrotum
4	Complicated sacral ulcer with extension to the scrotum and to the gluteal region bilaterally
5	Complicated right inguinal hernia repair with Mesh prothesis infection. Necrotizing fasciitis of the perineum, including the scrotum and the penis extending posteriorly to the back up to the IVth intercostals space.
6	Perineal and scrotal swelling following acute orchitis.
7	Colliquative necrosis exthending from the basal penile region to perineum and scrotum.
8	Perineal colliquative necrosis, including the scrotum but not extended to the anus.

schizophrenia. One case presents chronic renal failure in hemodialysis treatment and one presents advanced chronic heart failure. All patients at admission were suffering, in obliged supine position, six cases had fever (TC up to 39°C).

Laboratory values are reported in (Table I). Most of them were hemodynamically stable, two fell within the criteria of septic shock as shown by clinical assessment and vital parameters (Table II).

All the patients show at physical examination of the perineum the characteristic crepitus and tender lesions, scrotal swelling and a progressive skin erythema (Fig. 1); patients were affected by genital skin gangrene and purulent drainage from wounds (Table III).

We systematically performed a CT scan to evaluate the severity and the extension of the necrotizing fasciitis. In all cases CT scan reports signs of soft tissue infection pathognomonic for FG with corpuscular fluid collection, subcutaneous emphysema, and subversion of the perineum architecture.

Discussion

FG is an infective necrotizing fasciitis of the perineal, genital or perianal regions [6]. It is a rapidly progressing disease that can be potentially fatal; therefore, it should be treated as an emergency [1]. There are multiple sources of sepsis including colon, rectum, anus and urinary tract. According Rizos et al [7] an immediate diagnosis and multimodality treatment (including early aggressive debridement, antibiotic administration, haemodynamic resuscitation, nutritional support, and hyperbaric oxygenation) is the cornerstone for successful outcome.

TABLE IV - *Literature analysis*

n	Author	Year	Type	Population	Etiopathogenesis	Early Intervention	Wound Dressing	Additional Methods	Ostomy	Other Stool derivation system	Envolvemnt sphincters in colostomy group	Dressing Change	Closure	Mean hospitalization
1	Iacovelli et al. (7)	2020	Observational Analytical	92	No Information.	Surgical debridement in OR (within the first 12 h)	In "local" FG lesion (perineum) group: 19 NWPT therapy; 43 conventional dressing. In "Disseminated" FG lesion (out perineum): 14 managed with NWPT therapy and 16 with conventional dressing.	19 monolateral orchiectomy; 7 bilateral orchiectomy; 12 funiculectomy; 1 penile amputation, 30 perineal surgey; 5 inguinal surgery 8 suprapubic cistostomy.	20 colostomy; 3 ileostomy.	No Information.	Extensive abdominal surgery and bowel diversions most in disseminated FG patients.	In "local" FG: NWPT every 6 days (average). In "disseminated" FG : NWPT every 3,5 days (average).	"Disseminated" FG: higer rate of woung closure in NWPT than in no-NWPT patients. "Local" FG: wound closurerate in no-NWPT no signifcant differences than in NWPT therapy. No information on the method of closure.	Median LOS in NWPT group: "local" FG 28 days; "disseminated" FG 39 days. Median LOS in no-NWPT group: "Local" FG 18 days; "Disseminated" FG 30 days
2	Ozturk et al. (8)	2009	Observational Analytical	10	6 anorectal 4 urogenital	Surgical debridement in OR (immediate)	5 wet-to-dry dressing with saline; 5 NWPT closure	Epidural Catheter for pain control	6 patient recived colostomy due sphinters lesion	Small amount of food / Flexi-Seal FMS, Convatec, Princeton, NJ	6 patient that recived colostomy has sphinter involved	Every 2 days in Dressing Group; Every 0,5 in NWPT group.	6 tertiary closure; 4 skin grafting	LOS 13-14 days
3	Yanaral et al. (9)	2017	Observational Analytical	54	23 anorectal 31 urogenital	Surgical debridement in OR on 1st day	31 conventional dressing; 23 NWPT system closure	No Information.	No Information.	No information.	No Information.	Every 2 days in Dressing Group; Every 0,5 in NWPT group.	30 tertiary closure; 20 skin grafting	LOS 14-17
4	Yücel et al. (10)	2017	Observational Analytical	25	13 anorectal 4 urogenital 8 unclear etiology	Surgical debridement in OR	9 conventional dressing; 16 NWPT system closure	No Information.	One patient	No information.	1 patient that recived colostomy has sphinter involved	No Information.	Primary sutures or graft	LOS: 21,4 +/- 15,2 (days)
5	Czymek et al. (11)	2009	Observational Analytical	35	No Information.	Surgical debridement in OR as soon as possible	16 conventional dressing; 16 NWPT system closure	Urinary diversion: 23 transuretral catheter; 9 soprapubic catheter	24 patient require enterostomies(4 ileostomies/20 colostomies)	None	6 patient for sphincter involvement; 2 for a large wound; In 6 patients (rectal carcinoma) proctectomy + end stoma; 2 of these treted in other department.	No Information.	Reconstructive plastic surgery in 22 of the 28 surviving patients.	Conventional Dressing LOS : 27,8 days +/- 27,6 (days); NWPT System Closure LOS: 96,8 days +/- 77,2 (days)
7	Hong et al. (12)	2017	Retrospective study	20	12 Perianal or perineal infections; 2 genitourinary infection; 2 postoperative complications; 1 infection of sore; 1 trauma; 2 cancer-related radiotherapy	Surgical debridement in OR (immediate)	4 skin flap; 2 NWPT; other not specificated	No Information.	11 (55%) Colostomy	No Information.	Colostomy was required in 11 patients (55%) due to an anal sphincter impairment or contamination of a debridement wound.	No Information.	No Information.	Mean LOS: 36,9±41,3 (days); Mortality rate: Stoma Group: 18%; No Stoma Group 33%.
8	Planellas Gine et al. (13)	2017	Prospective study	46	12 anorectal abscess; 2 urological effects; 2 trauma; 2 colorectal neoplasm; 4 idiopathic	Surgical debridement in OR (immediate)	No Information.	5 sovrapubic cystostomy	22 colostomy for extensive wound: 8 immediate; 14 delayed.	None	No Information.	No Information.	No Information.	Mean LOS: Stoma Group: 29 ± 18 (days); Non Stoma Group: 25 ± 20 (days); Mortality rate: stoma group 23%; no stoma group 21%.
9	Çitgez et al. (14)	2019	retrospective study	48	25 urogenital 19 anorectal 4 skin-based	Surgical debridement in OR (immediate)	33 NWPT therapy, 14 split-thickness skin grafting	3 cystostomy	5 colostomy	No Information.	No Information.	The dressings were changed daily.	33 NWPT therapy, 14 were closed for third intection using split-thickness skin grafting.	Mean LOS: 36,7 (days); Mortality rate: Stoma Group 0%; No stoma Group 16%.
10	Tarchouli et al. (15)	2015	retrospective study	72	54 colorectal; 8 genitourinary; 1 psoas abscess; 4 traumatic; 5 unknown	Surgical debridement in OR	HBOT was used in 56 patients (78%); others not specified	None	14 colostomy	None	No Information.	No Information.	No Information.	Length of hospital stay, days: 22 Mortality rate : stoma group 29% no stoma group 14%
11	Lin et al. (16)	2019	retrospective study	60	1 anal fistula; 42 perianal abscess; 29 DM; 2 paraplegia/Hemiplegia; 4 Chronic renal failure	Surgical debridement	2 NWPT; other not specified	None	10 colostomy	None	No Information.	No Information.	15 directly closure 45 split-thickness skin graft	LOS: not specified; Mortality rate: stoma group: 10%; no stoma group: 0%

FG: Fournier Grangrene; LOS: Lenght Of Stay; HBOT: Hyperbaric Oxygen Therapy;or: Opertive Room; NWPT: Negative Pressure Wound Therapy;

Our management is based on three main point, including:
– a prompt massive fluid resuscitation and empirical antibiotic treatment associated with a parenteral nutritional support (NPT) and blood transfusions (BT) if necessary. (NPT 5 cases; BT 5 cases);
– urgent surgical debridement, necrosectomy and positioning of NPWT device;
– temporary colostomy or other strategies for fecal diversion, if the necrotic area is proximal to anus to improve the management.

All patients underwent urgent surgical debridement, necrosectomy and positioning of the NPWT device (125-200 mmHg) (Figs. 2, 3).
Intraoperatively, aggressive surgical excision and debridement of the wound was performed under general anaesthesia. An important step was the drainage of abscesses in order to consent a sufficient cleansing of the perineum, the scrotum and the inguinal region. We performed cultural swabs in 6 out of 8 patients to administer targeted antibiotic therapy. Most common isolated microbiological spp were: Escherichia Coli, Pseudomonas Aeruginosa and Staphylococcus Aureus. We also performed urinocoltures which resulted negatives. Serial wound controls in analgosedation in the operatory room were performed to allow further necrosectomy. When and where it was possible, we performed a healing by first intention applying vicryl sutures. The choice of this type of suture is justified by the hydrolysis of the suture if the wound is infected. In five patients we also decided to perform a loop colostomy to avoid further contamination. One patient received HBOT in association

Fig. 1: Characteristic lesion of FG.

Fig. 3: View after NPWT for FG.

Fig. 2: Surgical debridement, necrosectomy.

Fig. 4: NPWT.

Fig. 5: Outcome of our treatment strategy for FG.

with NPWT. One patient received several bed-side medications with topical applications of ozone on the affected areas in association with fecal diversion due to the difficulty in preventing air leak in NPWT. Except for one patient dead because of cardiovascular complicated disease, all patients achieved a complete restitutio ad integrum. Patient discharge usually happened on the 22nd day after admission (range: 11-40 days). During the follow-up in our outpatient service the NPWT device was substituted by advanced wound care systems, mainly alginates and hydrocolloids, with final wound healing (Fig. 3). In one case we performed an autologous skin graft. All patients at discharge had good vital parameters (hemodynamically stables, laboratory inflammatory markers between the normal range, no fever, GCS 14-15, sterile culture swabs). Colostomy was reversed in three-six months.

Literature review of FG and treatments

In Table IV we collected information found in literature about FG epidemology, etiopathogenesis and treatment [8-17].

Role of Hyperbaric Oxygen Therapy (HBOT)

HBOT is a systemic therapy that exploits the physical solubility of oxygen in an environment controlled by pressure. It increases oxygen pressure in tissues, decreasing the number of anaerobic bacteria and reduced toxemia, diminishing the areas of necrosis. Moreover, HBOT restores the physiological phagocytic function of neutrophils, increases the proliferation of fibroblasts, and may even enable angiogenesis.

Literature on this subject is scarce and controversial. Féres's at al [18] retrospective comparative study shows how beginning HBOT as soon as possible increases the possibility of positive prognosis, in terms of both wound evolution and systemic improvement of the patients' septic condition. There was a decrease in morbidity and mortality and a shortened hospitalization period.
According to the systematic review on HBOT therapy in FG, Schneidewind et al [19].
Conclude that, despite the risk-of-bias, HBOT could be considered an adjunct in FG treatment, but it is challenging to carry out further studies or even RCTs due to the rareness of this disease, restricted availability of HBOT and the complex character of FG.

Role of Ozone Therapy

Topical applications of ozone on the affected areas leads to an improvement of oxygen metabolism and blood rheological properties, stimulation of the antioxidant defense system achieving the cell redox balance, modulation of the immunological system and nitric oxide, as well as its great germicide power. In our experience this management requires serial dressings even on the same day [20].

Role of colostomy and rectal diversion

A diverting stoma can improve wound healing by avoiding fecal contamination. It should be performed only in selected cases, such as FG involving the anorectal area and sphincter. In other local conditions (soft tissue gangrene far from anorectal area) we use Flexi-Seal proposed by Estrada for rectal diversion that can avoid the complications of performing a colostomy and the subsequent reversion [21]. However, we also perform this treatment strategy in different settings such as severe anorectal trauma [22]. In fact, we choose to perform a loop colostomy as soon as possible when FG involves the anorectal area and sphincter. This strategy allows faster healing thanks to an almost total exclusion of the perineal region from bacterial contamination.

Role of Negative Pressure Wound Therapy (NPWT) device

According to the literature, the role of NPWT is still a matter of debate. Buenaventura et al [23], consider NPWT an effective method because it carries fewer dressing changes, less pain, and less need for analgesics though interventions requiring anesthesia. Besides, NPWT does not reduce the time from initial debridement to the closing of the wound, which is reflected in a longer hospitalization when compared to conventional dressing treat-

ment. On the other hand, according to Syllaios et al [24], NPWT facilitates the wound healing processes and reduces the duration of dressings and probably the hospital stay compared to the conventional method used. Previously, Assenza et al 5 suggest that NPWT represents a modern and fundamental key as it can remove infected fluids equally throughout the wound (Fig. 4). Furthermore, sub-atmospheric pressure might shorten the time of closure of the wound and induce collapse of smaller lymphatic vessels, reducing secretions from the wound site which may cause bacteria ingrowths and the need of multiple debridements [5]. Moreover, NPWT in association with other strategies can guarantee a faster restitutio ad integrum of the wound. (Fig. 5).

Role of autologous platelet-rich plasma

Autologous platelet-rich plasma (platelet rich plasma-PRP) gel consists in a separation of different blood fractions after various centrifugation and an extraction of PLTs concentrates (300% of normal blood levels) [25]. Platelets release substances that promote tissue repair, angiogenesis and inflammation. Degranulation of PLTs causes the release of active substances such as albumin, fibrinogen, osteonectin, osteocalcin, calcium ions, various clotting factors and locally active growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor-a (TGF-a), transforming growth factor-b (TGF-b), insulin-like growth factor (IGF), fibroblast growth factor (FGF), vascular endothelial growth factor (VEGF) and epidermal growth factor (EGF). All these substances are important for natural tissue healing [26]. The topical application of this gel guarantees faster healing rates, adequate tissue regeneration, less pain, no adverse reactions nor infections [27]. At least, in our experience the VAC therapy was applied first, to prepare the wound bed and to stimulate the granulation and then the PRP gel for the tissue regeneration.
In a subsequent study, it would be interesting to exploit the Fournier's Gangrene Severity Index (described by Laor in 1995), which according to Gubitosi et al [28] is an objective and easy to apply score for quantifying metabolic status and can be used to evaluate treatment options and outcomes.

Conclusions

Fournier Gangrene is a necrotizing fasciitis that begins and proceeds from the perineal region and quickly expands. It is a rapidly progressing disease that can be potentially fatal; therefore, it should be treated as an emergency. We confirm again that central principles of management are early diagnosis, aggressive hemodynamic stabilization, parenteral broad-spectrum antibiotics and urgent surgical debridement. In conclusion, in our experience our strength is to associate NPWT with colostomy, which guarantees a shorter hospitalization, ensuring a faster restitutio ad integrum of the wound.

Riassunto

La gangrena di Fournier (FG) è una condizione estremamente grave di infezione necrotizzante dei tessuti molli. Gli uomini sono più colpiti delle donne, con un rapporto di 10:1, e la malattia può colpire persone di tutte le età (età media = 50 anni). L'incidenza della malattia è stimata in 1,6 uomini ogni 100.000. Il tasso di mortalità rimane alto, dal 20% al 40%, nonostante i miglioramenti nell'assistenza medica. Le cause eziopatogenetiche sono il diabete, l'alcolismo cronico, il virus dell'immunodeficienza umana (HIV), le malattie linfoproliferative, l'abuso cronico di steroidi e i farmaci citotossici.
Pertanto, l'immunità dell'ospite crea un ambiente favorevole per stabilire l'infezione. Il trattamento di questa condizione critica è urgente ma molto dibattuto, soprattutto per quanto riguarda la gestione dei difetti più grandi e la chiusura della ferita, con diverse tecniche descritte nella letteratura attuale. Attraverso una serie di casi abbiamo mirato a presentare la nostra gestione chirurgica del FG trattato con successo con la terapia a pressione negativa (NPWT) e l'esecuzione di una colostomia ad anello.

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