THE MEDICAL BULLETIN OF
SISLI ETFAL HOSPITAL

DOI: 10.14744/SEMB.2023.90757
Med Bull Sisli Etfal Hosp 2023;57(1):99–104

Original Research

What Has Changed in the History of Fournier's Gangrene Treatment: The Single-Center Experience

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Abstract

Objectives: Fournier's gangrene (FG) is a rapidly progressive infection that requires emergent intervention. Wound closure is an important treatment step after surgery, and vacuum-assisted closure (VAC) can be preferred as an alternative method for wound closure. FG severity index (FGSI) scales that can be developed to evaluate the prognosis in FG. This study aims to compare VAC therapy, which was used and developed in the historical development of FG therapy, with conventional wound dressing (CWD).

Methods: Data on who 85 patients treated at our hospital with a diagnosis of FG from January 2010 to July 2021. In the VAC group, the vacuum device was applied in a sealed manner. In the CWD group, mesh dressing was prepared. The VAC device was adjusted to subatmospheric pressure. Broad-spectrum antibiotics were administered to all patients during their follow-up. During the follow-up, as necrotic tissues were detected, redebridements were performed by providing appropriate analgesia and anesthesia. Demographic data of the patients were collected on the records. The clinical and laboratory data were obtained from the records at the 1st h, 72 h, and 1st week FSGI values were calculated. In statistical analysis, continuous variables were expressed as mean±standard deviation, ordinal variables were expressed as median [IQR], and categorical variables were expressed as n (%). In intergroup analyses, student's t-test was used if the data were normally distributed. If it did not show normal distribution, the Mann–Whitney U-test was applied.

Results: Fifty-five patients who were diagnosed with FG were included in our study. CWD was applied to 18 patients, and VAC was applied to 37 patients. The mean 1st h FGSI of the patients who used VAC was 7.05 (3.75–8), and the patients who had CWD were 5.5 (5–9) (p=0.067). Mean 72nd-h FGSI was found to be 5.35 (3.5–7) in the VAC group and 5.33 (4.75–6.25) in the CWD group (p=0.714). The mean 1st-week FGSI VAC group was 2.97 (1–5), and in the CWD group, it was 5 (4–6) (p=0.0001).

Conclusion: VAC significantly reduces the length of hospital stay. In our analysis, both groups observed a significant difference between the 1st-week FGSIs. This is the first study to evaluate FGSI, which is an essential predictor of the effect of VAC therapy used in treating FG. In the history of FG treatment, CWD has been replaced by VAC.

Keywords: Conventional wound dressing, Fournier's gangrene severity index, Fournier's gangrene, necrotizing fasciitis, vacuum-assisted closure

Please cite this article as "Kutsal C, Baloglu IH, Turkmen N, Haciosmanoglu T, Albayrak AT, Cekmece AE, et al. What Has Changed in the History of Fournier's Gangrene Treatment: The Single-Center Experience. Med Bull Sisli Etfal Hosp 2023;57(1):99–104".

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Submitted Date: January 09, 2023 **Revised Date:** January 22, 2023 **Accepted Date:** January 27, 2023 **Available Online Date:** March 21, 2023

Fournier's gangrene (FG) is necrotizing fasciitis of the perineum. It is a pathological condition, in which inflammation, thrombosis, and necrosis are observed that progresses with the involvement of the skin and subcutaneous tissues in the anogenital region. Baurienne first described FG in 1761.[1] However, the nomenclature was made by Dr. Alfred Fournier in 1883 based on 5 of his patients.[2] Diabetes mellitus (DM), age, alcohol/drug abuse, immunosuppression, urinary infection, malnutrition, and trauma are some predisposing causes.[1]

FG is mainly caused by polymicrobial infections, which contain aerobic and anaerobic microorganisms.[3] The infection leads to thrombosis in subcutaneous blood vessels, eventually conduce to skin necrosis.[4] The testicles and spermatic cords are usually not involved due to the different blood supplies to the skin and subcutaneous tissues.[5]

FG is seen 10 times more frequently in men than women, and the annual incidence in males is 1.6/100000. FG is most commonly seen between 50 and 80 years.[6] Physical examination is indispensable and often diagnostic for FG.[7] Pain, hyperemia, edema, subcutaneous crepitations, ecchymotic or necrotic appearance in the affected area, and fetor are characteristic findings of physical examination.[7]

FG is a rapidly progressive infection that requires emergent intervention and has a 40% mortality rate.[8] The infection quickly spreads to nearby tissues through fascial planes if it is not treated in time. The lack or delay of treatment is associated with a high mortality rate of up to 90% due to septic shock and related complications.[9] As for treatment, rapid surgical debridement of the affected tissues, which might be repetitive, must be performed, and broad-spectrum antibiotics must be given to the patient.[10] Wound closure is an important treatment step after surgery. Although conventional methods can be used, Vacuum-assisted closure (VAC) therapy can be preferred as an alternative method for wound closure.[11] Mallikarjuna et al.,[12] reported that VAC works by exposing a wound to subatmospheric pressure for an extended period to promote debridement and healing. Hyperbaric oxygen therapy (HBOT) is another treatment option. It has a direct antibacterial impact on anaerobes and decreases the activity of endotoxins by creating a media with high oxygen levels.[13] If the perineal or anorectal regions are affected, colostomy might be preferred, because it prevents fecal contamination and causes faster-wound healing.[14]

Various scales are used to determine the prognosis of Fournier's gangrene. In the last 20 years, FG severity index (FGSI), laboratory risk indicator for necrotizing fasciitis (LRINEC), Charlson comorbidity index (CCI), and Uludag Fournier's gangrene severity index (UFGSI) are some scales that can be developed to evaluate the prognosis in FG.[15,16]

This study aims to compare the patient groups diagnosed with FG who were treated with current VAC treatment and conventional wound closure methods that we use in our clinic and to reveal the factors affecting the treatment and the historical development of these treatments.

Methods

Ethics Approval

The Local Ethics Committee approved this study in accordance with the Declaration of Helsinki: (Date: March 08, 2022, Approval Number: 3441).

Patients Selection

Data on 85 patients treated at our hospital with a diagnosis of FG between January 2010 and July 2021 were analyzed retrospectively. Figure 1 shows the patient selection method. Anamnesis, physical examination, blood and urine samples, and imaging methods were used for diagnosis when necessary.

Age at the time of disease (year), demographic data, hospitalization time, number of debridgements, time of diagnosis 1-h, 72 h, and 1-week FSGI for the patients were obtained and analyzed. FSGI score was performed with the described technic of Laor et al.,[17] Fever, heart rate, respiration rate, blood sodium level, blood potassium level, blood creatine level, blood bicarbonate level, blood hematocrit level, and white blood cell level were calculated. These nine parameters were degreed from 0 to 4.

Statistical Analysis

The SPPS program 26 (IBM; USACorp, Armonk, NY) was used for statistical analysis. The normal distribution of qualitative data was evaluated with one sample Kolmogorov–

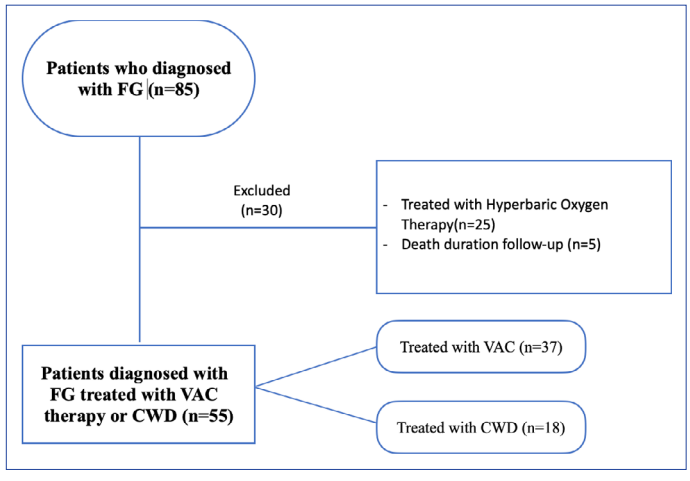

Figure 1. Flowchart of the patient selection process.

Smirnov test. Students t-test was used if the data were normally distributed. If it did not show normal distribution, The Mann–Whitney U-test was applied. If $p<0.05$ was considered significant association.

Treatment

Patients diagnosed with FG underwent emergency debridement after broad-spectrum antibiotic therapy. Antibiotherapy was applied by an infectious diseases specialist, choosing from 3rd-generation cephalosporins, metronidazole, vancomycin, linezolid, and meropenem group antibiotics. Debridement was applied to the necrotic tissues by providing appropriate analgesia and anesthesia under operating room conditions. As necrotic tissues were detected in the post-operative follow-up, rebridements were performed. Depending on the vitality of the testicles, the testicles were preserved, or orchiectomy was performed. In patients with penile or urethra involvement, a urinary diversion was performed by inserting a cystostomy. A colostomy was performed in patients with involvement of the anal sphincter or in whom stool contamination may occur in the debrided area.

In the VAC therapy group, the vacuum device was applied in a sealed manner, and the pressure value was brought to a subatmospheric average value of 100–125 mmHg. In the conventional wound dressing (CWD) group, mesh dressing prepared with rifampicin and nitrofurantoin ointment was applied 2 or 3 times a day. During wound dressing and VAC therapy, epidural anesthesia or narcotic analgesic was performed. Before wound dressing, the wound area was cleaned with hydrogen peroxide-isotonic sodium chloride solution.

Moreover, VAC therapy is also renovated in the VAC systems during debridements. In cases where the degree of necrosis increases, more frequent debridement was applied. The debridements were applied until the start of tissue granulation. If the wound lips match the end to end, reconstruction was performed with the primary suturation. Patients with broad loss of tissue were reconstructed with the free flap technique.

Results

Fifty-five patients who were diagnosed FG were included in our study. Five patients were excluded from the study due to death. Twenty-five patients were excluded from follow-up due to HBOT in another center. CWD was applied to 18 patients, and VAC therapy was applied to 37 patients. Since gynecologists in our center followed up female FG patients, all patients included in the study were male. The median age was revealed to be 58 years. About 78% of the patients diagnosed with FG had a known chronic disease. Of these, 43.6% had DM, 16.2% had malignancy, and 20% had chronic renal failure. It was determined that the average hospitalization time of the patients during the treatment period was 30.1 days. The mean body mass index measured at the initial diagnosis was 29.4 kg/m^2. The mean number of necrotic tissue debridements was calculated as 2.69 (Table 1).

The mean hospitalization time was 19.1 (17–25) for patients using VAC therapy and 46.2 (38–57) for patients using CWD ($p=0.0001$). In the evaluation made according to the initial site of the infection, the starting site was determined as genital region in 39 patients, perineal region in 12 patients, and inguinal region in four patients. Moreover, it was determined that the site of infection onset did not affect the length of stay in the hospital ($p=0.05$). The mean 1st h FGSI of the patients who used VAC therapy was 7.05 (3.75–8), and the patients who had CWD were 5.5 (5–9) ($p=0.067$). The mean 72nd-h FGSI was found to be 5.35 (3.5–7) in the VAC group and 5.33 (4.75–6.25) in the CWD group ($p=0.714$). The mean 1st-week FGSI VAC group was 2.97 (1–5), and in the CWD group, it was 5 (4–6) ($p=0.0001$). The intergroup evaluation of debridement numbers was determined as 2.2 (1–3) in the VAC group and 3.8 (2–5.25) in the CWD group. 1st h mean FSGI was calculated as 0.86±0.045 in the VAC group and 0.87±0.065 in the CWD group. It was calculated as 0.86±0.045 in the 1st h mean neutrophil-lymphocyte ratio (NLR) VAC therapy group and 0.87±0.065 in the CWD group ($p=0.70$). The 72nd-h NLR was calculated as 0.84 (0.73–0.87) in the VAC therapy group and 0.79 (0.77–0.90) in the CWD group ($p=0.06$). No significant difference was observed in the 1st week's average NLR evaluation. It was found to be 0.77±0.08 in the VAC therapy group and 0.72±0.14 in the CWD group ($p=0.16$). There was no difference between the mean platelet-lymphocyte ratio (PLR) values of the 1st h, 72nd h, and 1st week between the VAC applied to group and the CWD applied group (253.85;199.05;189.07 vs. 278.04;221.65;258.97) ($p=0.68$; $p=0.16$; $p=0.32$) (Table 2 and Fig. 2).

Table 1. Descriptive data of patients

Hospitalization time (day)	30.1
Number of debridements	2.69
Mean BMI (kg/m^2)	29.40
Presence of chronic disease (%)	78
DM	43.6%
Malignancy	18.2%
KBY	20%

DM: Diabetes mellitus; BMI: Body mass index.

Table 2. Variation of parameters according to VAC application groups

Hospitalization	19.1 (17–25)	46.2 (38–57)	P=0.0001
1st h FGSI	7.05 (3.75–8)	5.5 (5–9)	P=0.067
72nd h FGSI	5.35 (3.5–7)	5.33 (4.75–6.25)	P=0.714
1st week FGSI	2.97 (1–5)	5 (4–6)	P=0.0001
Number of debridements	2.2 (1–3)	3.8 (2–5.25)	P=0.002
1st h NLR	0.86±0.045	0.87±0.065	P=0.70
72nd h NLR	0.84 (0.73–0.87)	0.79 (0.77–0.90)	P=0.06
1st week NLR	0.77±0.08	0.72±0.14	P=0.16
1st h PLR	253.85 (171.69–326.47)	278.04 (161.78–340)	P=0.68
72nd h PLR	199.05 (122.40–248.54)	221.65 (88.38–282.44)	P=0.16
1st week PLR	189.07 (138.57–266.52)	258.97 (152.36–372.61)	P=0.32

FGSI: Fournier's gangrene severity index; NLR: Neutrophil-lymphocyte ratio; PLR: Platelet-lymphocyte ratio; VAC: Vacuum-assisted closure.

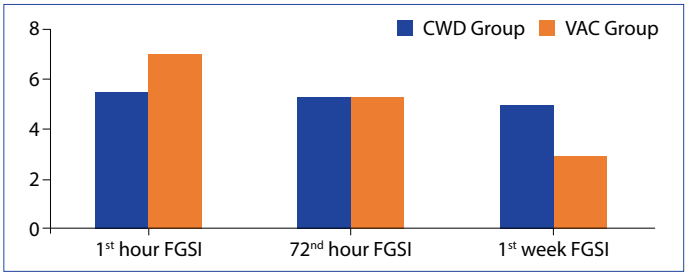

Figure 2. 1st h, 72nd h, and 1st week mean FGSI.

Discussion

FG is a rapidly progressive infection that causes high mortality and morbidity and requires urgent surgical intervention. First, negative pressure was used to accelerate the bedside healing of wounds. Then, Morkywas et al. evaluated the effects of negative pressure on local blood flow, bacterial elimination, granulation tissue formation, and tissue viability in a series of animal studies. In the following periods, they used vacuum pump foam dressing with intermittent and continuous negative pressure application.[18,19] VAC therapy is frequently used in cases such as Fournier Gangrene, bedsores, diabetic foot, skin graft fixation, burns, and crush injuries. Studies have shown that with VAC treatment, the growth of granulation tissue increases, the wound area decreases, the blood flow increases, and the inflammatory response is regulated.[18,20] These effects accelerate wound healing. The perfusion decreases with the contact of the foam in the tissue, which is tightened by the negative pressure. This effect provides vasodilation due to nitric oxide release.[21]

The classical dressing method used in treating FG in the historical process has left its place in modern methods such as hyperbaric oxygen and VAC treatment. However, the superiority of VAC therapy is controversial. VAC therapy significantly reduces the length of hospital stay. Synder et al. applied VAC therapy to a patient with FG for the 1st time in 2001. They stated that VAC treatment significantly reduced hospitalization time.[22] In another study by Yücel et al., in 2015, 25 patients were evaluated. The hospital stay was significantly longer in patients who underwent VAC.[7] However, in our study, a significant decrease was observed in terms of hospital stay compared to CWD in patients who underwent VAC. In a study published in 2009 by Czymek et al., in which 35 patients were evaluated, polyhexanide and wound dressing were compared with VAC treatment. This study showed that VAC treatment is associated with longer hospitalization and lower mortality.[23]

Contrary to this study, we observed that VAC therapy significantly reduced hospitalization time. Another study showed equally effective VAC and conventional therapy.[24] We think that this is due to the fact that the knowledge and experience about VAC applications have increased in the historical process.

Diabetes mellitus(DM, which one of chronic disease, is a predisposing factor for FG. Our DM incidence in patients with FG was similar to a study examining the effect of DM on FG.[25] Studies in patients with FG have shown that renal function is an important prognostic indicator. Moreover, renal failure has been reported to be associated with higher mortality. Although no mortality assessment was made in our data, a high rate of chronic renal failure was observed.[26]

FGSI is an essential predictor of the severity of FG. Yalcinkaya et al. evaluated the quality of questionnaires to predict FG mortality. Furthermore, FGSI has been identified as an essential scoring system for mortality.[27] In the study conducted by Oguz et al., patients diagnosed with FG were divided into two groups and evaluated. The analysis determined that FGSI is an essential predictor in determining the prognosis.[28] In our analysis, there was no difference between the groups between the 1st h and 72nd h FGSI, but

a significant difference was observed between the 1st week FGSIs between the both groups.

FG can be disseminated and evaluated locally. In a multicentric study, Iacovelli et al. stated that VAC treatment might increase the probability of cumulative wound closure in disseminated FG but not in local FG.[29] In another study conducted by Gül et al., in which mortality assessment was included, it was reported that no significant difference was observed in mortality in VAC treatment.[30] Patients who died in our study were excluded from the study due to a lack of follow-up. For this reason, a mortality assessment was not performed. To the best of our knowledge, this is the first study to evaluate FGSI, which is an essential predictor of the effect of VAC therapy in treating FG. However, the limitations of this study are that there is no distinction between local and disseminated FG, the entire patient population consists of male patients, lack the mortality assessment, and it is a retrospective study. One more limitation of this study is no evaluation of the impact of HBOT on FGSI. In the future, intercalarily to FGSI, studies that evaluate scales such as the LRINEC, CCI, and UFGSI can be performed. In addition, there is a need for studies with larger series, in which local and disseminated FG is differentiated. The impact of HBOT on FGSI can be evaluated in the future.

In the historical development of FG treatment, CWD has been replaced by VAC treatment. VAC therapy reduces the number of debridements and length of hospital stay. While VAC treatment does not change the 1st and 72nd-h mean FSGI compared to CWD, it causes a significant decrease in the 1st week's mean FGSI. However, there is a need for studies with larger series, in which local and disseminated FG is differentiated.

Disclosures

Ethics Committee Approval: The Local Ethics Committee approved this study in accordance with the Declaration of Helsinki: (Date: March 08, 2022, Approval Number: 3441).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – C.K.; Design – N.T.; Supervision – S.G.; Materials – A.E.C., T.H.; Data collection &/or processing – A.E.C., T.H.; Analysis and/or interpretation – I.H.B., A.T.A.; Literature search – C.K.; Writing – I.H.B.; Critical review – A.T.A.

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