Submitted: 21 April, 2021 Accepted: 26 May, 2021 Online Published: 09 August, 2021 DOI:10.31083/jomh.2021.089

JOMH Journal of Men's Health

Original Research

Evaluation of the effectiveness of vacuum-assisted closure in the treatment of Fournier gangrene

Mehmet Demir[1,*], İsmail Yağmur[1], Bülent Katı[1], Eyyup Sabri Pelit[1], Adem Tunçekin[1], Halil Çiftçi[1]

[1]Department of Urology, Harran University, 63500 Sanliurfa, Turkey

***Correspondence:** drdemir02@gmail.com (Mehmet Demir)

Abstract

Background and objective: To evaluate the effectiveness of vacuum-assisted closure (VAC) in the treatment of Fournier gangrene (FG).

Material and methods: Forty-eight male patients treated for Fournier gangrene were included in the study. The patients were divided into two groups (Group I: conventional dressing, Group II: VAC therapy). Characteristics of the patients, laboratory parameters, number of debridement procedures, daily number of dressings, visual analogue scale (VAS) during dressing, analgesic requirement, colostomy requirement, time from the first debridement to wound closure, wound closure method, length of hospital stay, and mortality rates were compared.

Results: Group I comprised 33 patients and Group II comprised 15 patients. The number of dressings, VAS score and daily analgesic requirement were statistically significantly lower in Group II ($p < 0.05$) than in Group I. The number of debridement procedures, colostomy requirement, orchiectomy rate, time from first debridement to wound closure, length of hospital stay, wound closure method and mortality rate were similar between these two groups ($p > 0.05$).

Conclusion: The clinical results of conventional dressing and VAC therapy were similar for treating FG. VAC therapy is an effective postoperative wound care method that offers less requirement for dressing changes, less pain, less analgesic requirement and more patient satisfaction compared to conventional dressing.

Keywords

Fournier gangrene; Debridement; Vacuum-assisted closure; Wound therapy; Mortality

1. Introduction

Fourier gangrene (FG) [1], which was first reported by Jean Alfred Fournier in 1883, is a polymicrobial disease that results in endarteritis and gangrene in the perineal and urogenital skin and subcutaneous tissues [2, 3]. The focus of infection in FG is idiopathic in 36%, skin in 24%, colorectal area in 21% and urogenital area in 19% of the cases [2]. Progression of the infection is extremely rapid and may not progress to the anterior abdominal wall, pelvic area and retroperitoneal area because of the facial plane. While the general incidence is 1.6 per 100,000, it is 3.3 per 100,000 in men after the age of 50 [4]. Although predisposing factors such as diabetes mellitus (DM), advanced age, end-stage liver disease, vasculopathy, malignancy, chronic alcoholism, obesity, paraplegia, chronic renal failure, immune suppression and Human Immunodeficiency Virus (HIV) infection have been defined for FG development, 30%–50% of patients do not have any comorbidities [5]. Despite advancements in surgical treatment and novel treatment methods, the reported mortality rate varies between 4% and 80% [6, 7]. The most common symptoms in patients are scrotal pain, swelling and redness. Systemic results such as fever and tachycardia often accompany these symptoms. Common examination results

include purulent discharge, crepitation, oedema, and islands of necrotic tissue [8]. Broad-spectrum antibiotic therapy and surgical debridement form the basis of treatment in FG. Using these treatments, it is aimed to eliminate microorganisms that cause infection, to reduce systemic toxicity and to stop disease progression [2, 8]. Because repeated debridement is usually required, the wounds of patients are left open and dressing is performed at frequent intervals for a prolonged duration. For postoperative care, treatments such as conventional dressing, raw honey, hyperbaric oxygen therapy and vacuum-assisted closure (VAC) therapy are used [9]. The VAC device is a wound care system that provides continuous negative pressure with a portable pump attached to a foam sponge placed in the wound and can be renewed every 48–72 h. VAC therapy, which is less painful and more comfortable than conventional dressing, removes exudate and infective material from the wound, reduces oedema and aids wound healing [10]. This study aimed to evaluate the effectiveness of VAC therapy by comparing conventional dressing with VAC therapy in FG treatment.

2. Methods

Hospital records of male patients who were diagnosed with FG and treated between December 2010 and February 2021 were retrospectively reviewed. FG was diagnosed based on the presence of necrotising fasciitis in the scrotal or perineal region. Patients with simple inflammation, missing clinical data and patients with FG outside the scrotal or perineal region were excluded from the study. In total, 48 male patients whose full data could be accessed were included in the study. At presentation, intravenous fluid and electrolyte replacement, third generation cephalosporin and metronidazole antibiotic therapy were initiated. On the day of presentation, all patients underwent aggressive surgical debridement until the perfused viable tissues were seen. Antimicrobial treatment was revised based on the results of tissue culture and antibiogram. The patients were categorised into two groups: those who received conventional dressing (Group I) and those who received VAC therapy (Group II) after debridement. In Group I patients, wounds were closed with a dressing containing an antiseptic (povidone iodine and saline) after performing debridement. The dressing was changed twice daily and wound care was continued until a healthy granulation tissue was formed. The procedures took place between December 2010 and January 2017. In Group II patients, VAC therapy was initiated after performing surgical debridement. A silver nitrate sponge was then placed in the wound and a dressing was placed over the sponge (Fig. 1A). Aspiration was performed by applying continuous negative pressure to the wounds. The pressure was initially set at 50 mm Hg and increased to a maximum of 125 mm Hg. VAC dressings were changed every 48–72 h. VAC therapy was then continued until healthy granulation tissue was formed (Fig. 1B). The procedures took place between February 2017 and February 2021. Repeated debridement procedures were performed in both groups where there was progressive necrosis. There was no mobilization restriction in both groups. Following treatment, small wounds were closed with tertiary wound closure, and large wounds were closed with skin flap or graft surgery. Characteristics of the patients (age, body mass index (BMI), and predisposing factors), Fournier Gangrene Severity Index (FGSI), number of surgical debridement procedures, number of VACs, number of daily dressings, visual analogue scale (VAS) during dressing, analgesic requirement, time from initial surgical debridement to wound closure, wound closure method, length of hospital stay and mortality rates were analyzed.

3. Statistical methods

Mean, standard deviation, median, minimum, maximum value, frequency and percentage were used for descriptive statistics. The distribution of variables was verified using Kolmogorov–Smirnov test. Independent samples *t* test and Mann–Whitney U test were used for comparing quantitative data. Chi-square test was used for comparing qualitative data, and SPSS 27.0 (IBM Corp., Armonk, NY, USA) was used for statistical analyses.

4. Results

The mean age of 48 male patients included in the study was 57.5 (55.3 $\pm$ 14.3) years, and the mean number of debridement procedures performed was 2 (2.1 $\pm$ 0.7). Of the patients, 66.7% had comorbidities and 16.7% had a history of anorectal/scrotal surgery. Colostomy was performed in five patients (10.4%) and unilateral orchiectomy was performed in 10 patients (20.8%). After treatment, wounds of 33 patients were closed with tertiary intention and of 15 patients with flap/graft. Mortality rate in the study was reported to be 6.3%. Bacterial growth occurred in 75% of the tissue samples obtained from the patients, and the most commonly isolated pathogen was *Escherichia coli* (34.9%) (Table 1). Group I comprised 33 patients and Group II comprised 15 patients. There was no significant difference in age, BMI and number of debridement procedures performed in Groups I and II ($p > 0.05$) (Table 2). The number of dressings, VAS score, and number of analgesics were statistically significantly lower in Group II than in Group I ($p < 0.05$) (Table 2). There was no difference between Groups I and II in terms of comorbidity rate and history of anorectal/scrotal surgery ($p > 0.05$) (Table 2). Wound closure method as well as colostomy and orchiectomy rates were similar between the two groups ($p > 0.05$) (Table 2). The time from the first debridement procedure to wound closure was 13.2 $\pm$ 6.4 days in Group I and 13.3 $\pm$ 2.6 days in Group II. There was no difference between these two groups ($p > 0.05$) (Table 2). The length of hospital stay was 19.2 $\pm$ 8.5 days in Group I and 19.1 $\pm$ 3.9 days in Group II. There was no difference between these two groups ($p > 0.05$) (Table 2), and there was no difference in mortality rates between the two groups either ($p > 0.05$) (Table 2). FGSI was calculated in two groups and did not show significant differences ($p > 0.05$) (Table 2).

JOMH
Journal of Men's Health

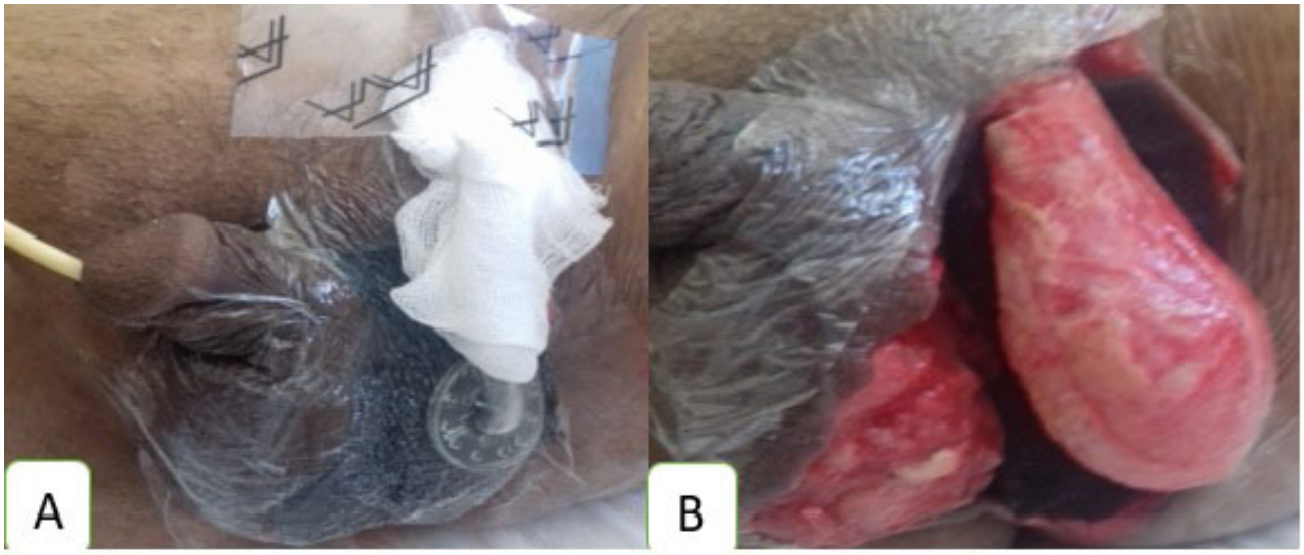

FIG. 1. Case of a patient with Fournier's gangrene. (A) Vacuum-assisted closure therapy on the affected area. (B) Healthy granulation tissue after the third session of vacuum therapy.

TABLE 1. Bacteriological results.

Bacterial organism		n	%
Data missing		5	10.40%
Bacterial growth	(–)	7	14.6%
	(+)	36	75.0%
Escherichia coli		15	34.9%
Staphylococcus aureus		5	11.6%
Streptococcus Milleri Group		4	9.3%
Acinetobacter baumannii		3	7.0%
Klebsiella pneumoniae		3	7.0%
Enterococcus faecalis		2	4.7%
Pseudomonas aeruginosa		2	4.7%
Corynebacterium		1	2.3%
Streptococcus agalactiae		1	2.3%

5. Discussion

Fournier gangrene is rare, but it can be extremely fatal. It accounts for <0.5% of the annual hospital presentations in the world [4]. It is 10 times more common in males than in females [2], and its prevalence increases after the fifth decade of life [11]. The most important risk factor for FG is DM [11, 12]. Hyperglycaemia and microangiopathy decrease neutrophil adhesion, chemotaxis and cellular immunity in uncontrolled DM. Therefore, the progression of infection may be accelerated and wound healing may be delayed [13]. The present study reported uncontrolled DM in 65.6% of the patients, and this condition could be induced the development of FG in patients.

FG is accepted as a polymicrobial infection, and the most commonly reported bacteria are *Escherichia coli*, *Streptococcus* and *Staphylococcus* [14]. In this study, the most commonly isolated bacteria were *Escherichia coli* (34.9%), *Streptococcus* (11.6%) and *Staphylococcus* (11.6%).

The cornerstones of managing this life-threatening condition are urgent patient resuscitation, broad-spectrum antibiotic therapy and surgical debridement [8]. The early and radical removal of necrotic tissue is the crucial step in impeding the progression of infection [15]. The mortality rate of patients who underwent early intervention was much lower (risk ratio: 0.38) than that of patients in whom intervention was delayed for ≥3 days [16]. After the patients were admitted to our clinic, broad-spectrum antibiotics were initiated and aggressive debridement was performed on the same day.

Wound care is very important in the period after the first debridement in FG. In most cases, wounds are treated with conventional dressings containing various active agents such as saline, povidone iodine and potassium permanganate [17]. In wound care, there are options such as raw honey, hyperbaric oxygen and VAC therapy as well as conventional dressings [3, 9, 17]. VAC therapy contributes to wound healing by increasing fibroblast migration and cell proliferation [18]. It offers advantages such as lesser dressing changes, less pain, more mobility and a shorter duration of treatment for the clinician [19]. Rosser *et al.* [20] reported a faster discharge by using VAC for managing large perineal soft tissue defects. Furthermore, Aslam *et al.* [21] compared VAC and conventional dressing in treating diabetic foot ulcers and demonstrated that the recovery time was shorter and morbidity and hospital costs were lower in those who received VAC therapy. However, in a study by Czymek *et al.* [10] comparing conventional dressing and VAC therapy, no difference was reported in terms of wound healing. In another study comparing conventional dressing and VAC therapy, the superiority of VAC therapy in terms of clinical results was not demonstrated [17]. Similarly, there was no difference between the clinical results in both groups in the present study.

Conventional dressings are performed twice daily and are quite painful. Therefore, its application negatively affects the quality of life [9]. In a study by Yanaral *et al.* [17], it

TABLE 2. Comparison of the demographic characteristics and clinical course of the patients.

		Group I (n: 33)			Group II (n: 15)			p
		Mean ± sd/n-%		Median	Mean ± sd/n-%		Median	
Age		57.2 ± 14.6		59.0	51 ± 13.9		47.0	0.174^{t}
BMI (kg/m²)		27.5 ± 3.7		27.3	25.6 ± 3.9		25.4	0.122^{t}
Duration of operation (minutes)		65.9 ± 23.7		60.0	77.5 ± 23.4		70.0	0.121^{t}
Number of debridement		2 ± 0.7		2.0	2.2 ± 0.7		2.0	0.281^{m}
Number of dressings (per day)		2.2 ± 0.4		2.0	0.5 ± 0.1		0.5	***0.000***^{m}
VAS		8.5 ± 1.2		9.0	5.7 ± 1.4		5.0	***0.000***^{m}
Number of analgesics (per day)		2.4 ± 0.5		2.0	1.6 ± 0.8		1.0	***0.001***^{m}
FGSI		3.52 ± 1.9		2.0	3.94 ± 3.54		2.0	0.750^{m}
Nartcotic analgesics	(–)	22	66.7%		12	80.0%		0.346$^{X^2}$
	(+)	11	33.3%		3	20.0%		
CRP (mg/L)		19.4 ± 6.6		18.0	19.7 ± 13.6		23.0	0.936^{t}
Predisposing factor	(–)	12	36.4%		4	26.7%		0.509$^{X^2}$
	(+)	21	63.6%		11	73.3%		
Diabetes mellitus		12	57.1%		7	63.6%		
Hypertension		10	47.6%		4	36.4%		
Chronic obstructive pulmonary disease		1	4.8%		1	9.1%		
Malignancy		2	9.5%		0	0.0%		
Ulcerative colitis		1	4.8%		0	0.0%		
Paraplegia		1	4.8%		0	0.0%		
Penile cancer		0	0.0%		1	9.1%		
Chronic renal failure		0	0.0%		1	9.1%		
History of anorectal/scrotal surgery	(–)	29	87.9%		11	73.3%		0.210$^{X^2}$
	(+)	4	12.1%		4	26.7%		
Wound closure technique	Greft/flap	10	30.3%		5	33.3%		0.834$^{X^2}$
	Tertiary	23	69.7%		10	66.7%		
Bacterial growth	(–)	7	25.0%		0	0.0%		0.092$^{X^2}$
	(+)	21	75.0%		15	100.0%		
Colostomy	(–)	30	90.9%		13	86.7%		0.642$^{X^2}$
	(+)	3	9.1%		2	13.3%		
Orchiectomy	(–)	24	72.7%		14	93.3%		0.103$^{X^2}$
	(+)	9	27.3%		1	6.7%		
Duration of wound closure (days)		13.2 ± 6.4		10.0	13.3 ± 2.6		14.0	0.119^{m}
Duration of hospitilasition (days)		19.2 ± 8.5		16.0	19.1 ± 3.9		20.0	0.163^{m}
Mortality	(–)	31	93.9%		14	93.3%		1.000$^{X^2}$
	(+)	2	6.1%		1	6.7%		

^{t} t test / ^{m} Mann-whitney u test / $^{X^2}$ Chi-square test, Statistically significant results are in bold italics ($p < 0.05$).

BMI, Body Mass Index; VAS, Visual Analog Scale; WBC, White Blood Cell; CRP,C-reactive protein; FGSI, Fournier Gangrene Severity Index.

was reported that patients who underwent VAC therapy had less analgesic requirement, more patient mobilization, and less dressing requirement. In the same study, the severity of pain during dressing was compared, and the VAS score was reported to be statistically significantly lower in the VAC group. A recently published systematic review reported that VAC therapy requires fewer dressing changes, less pain, and less analgesic [22]. In our study, daily analgesic requirement, number of dressings and VAS score during dressing were reported to be statistically significantly lower in the VAC therapy group than in the conventional dressing group. Patient satisfaction and comfort was higher in the VAC therapy group. Moreover, the wound remained cleaner without exudate in patients who received VAC therapy.

In FG, repeated debridement procedures are recommended for infection control in cases in which necrotic tissue is observed during wound care [3]. In a study conducted by Chawla *et al.* [23], it was reported that an average of 3.5 debridement procedures per patient was required for infection control. In the present study, the mean number of debridement procedures was reported to be 2. There was no difference in the number of debridement procedures performed in both the groups.

Length of hospital stay is prolonged in FG because large tissue defects and complications occur, and repeated debridement procedures and wound care are required. Hospitalisation periods of up to 278 days have been reported in the literature [24]. Horsanali *et al.* [25] demonstrated that the duration of hospitalisation was shorter in patients who received VAC therapy than in those who did not receive VAC therapy. In another study conducted by Kızılay *et al.* [26], the length of hospital stay was reported to be shorter in patients who received VAC therapy than in those who received conventional dressing. In the study by Yanaral *et al.*

[17], the length of hospital stay was reported to be similar in the VAC therapy and conventional dressing groups. In the present study, the mean length of hospital stay was reported to be 18 days. The length of hospital stay and the time from first debridement to wound closure did not differ between the two groups.

Mortality rates associated with FG vary between 4% and 80% [6, 7]. The mortality rate was 16% in a comprehensive study in which 1726 patients were evaluated [2], 8% in a study by Garg *et al.* [27] and 4.7% in a compilation covering the years 2004 and 2012 [28]. In this study, the mortality rate was 6.3%. The deaths of these three patients resulted from multiple organ failure because of sepsis. Mortality rates were similar in both groups.

6. Limitations

This study has limitations such as the retrospective study design and a lack of cost analysis of the two methods. There is a requirement for prospective randomized studies comparing these two methods.

7. Conclusions

In this study, although no superiority of VAC therapy over conventional dressing could be demonstrated in terms of clinical results, it had advantages such as less number of dressing and a less painful procedure, less analgesic requirement, and higher patient satisfaction. In addition, it had advantages such as shortening the time spent by the clinician on wound care, prevention of loss of work force and cleaner wound healing without exudate. Further prospective randomized multicenter studies may be required to validate our results.

Abbreviations

VAC, vacuum-assisted closure; FG, Fournier gangrene; DM, diabetes mellitus; HIV, Human Immunodeficiency Virus; BMI, Body Mass İndex; WBC, white blood cell; CRP, C-reactive protein; VAS, Visual Analog Scale; FGSI, Fournier Gangrene Severity Index.

Author contributions

MD: Data acquisition, interpretation, drafting, and final approval, İY: Analysis, critical revision. BK: Conception and design. ESP: Analysis and interpretation. AT: Data acquisition. HÇ: Final approval.

Ethics approval and consent to participate

This retrospective study involving human participants was in accordance with the ethical standards of the Institutional and National Research Committee; and with 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Harran Universıty Clinical Studies Ethics Committee approved this study (Decision No. HRU/21.02.06).

Acknowledgment

Thanks to all the peer reviewers for their opinions and suggestions.

Funding

This research received no external funding.

Conflict of interest

The authors declare no conflict of interest.

References

[1] Fournier JA. Gangrène foudroyante de la verge (overwhelming gangrene). Sem Med 1883. Diseases of the Colon & Rectum. 1988; 31: 984–988.
[2] Eke N. Fournier's gangrene: a review of 1726 cases. British Journal of Surgery. 2000; 87: 718–728.
[3] Hong KS, Yi HJ, Lee R, Kim KH, Chung SS. Prognostic factors and treatment outcomes for patients with Fournier's gangrene: a retrospective study. International Wound Journal. 2017; 14: 1352–1358.
[4] Sorensen MD, Krieger JN, Rivara FP, Broghammer JA, Klein MB, Mack CD, *et al.* Fournier's Gangrene: Population Based Epidemiology and Outcomes. Journal of Urology. 2009; 181: 2120–2126.
[5] Oguz A, Gümüş M, Turkoglu A, Bozdağ Z, Ülger BV, Agaçayak E, *et al.* Fournier's Gangrene: a Summary of 10 Years of Clinical Experience. International Surgery. 2015; 100: 934–941.
[6] Jeong HJ, Park SC, Seo IY, Rim JS. Prognostic factors in Fournier gangrene. International Journal of Urology. 2005; 12: 1041–1044.
[7] Stephens BJ, Lathrop JC, Rice WT, Gruenberg JC. Fournier's gangrene: historic (1764-1978) versus contemporary (1979-1988) differences in etiology and clinical importance. The American Surgeon. 1993; 59: 149–154.
[8] Singh A, Ahmed K, Aydin A, Khan MS, Dasgupta P. Fournier's gangrene. A clinical review. Archivio Italiano di Urologia e Andrologial. 2016; 88: 157–164.
[9] Tucci G, Amabile D, Cadeddu F, Milito G. Fournier's gangrene wound therapy: our experience using VAC device. Langenbeck'S Archives of Surgery. 2009; 394: 759–760.
[10] Czymek R, Frank P, Limmer S, Schmidt A, Jungbluth T, Roblick U, *et al.* Fournier's gangrene: is the female gender a risk factor? Langenbeck'S Archives of Surgery. 2010; 395: 173–180.
[11] Cuccia G, Mucciardi G, Morgia G, Stagno d'Alcontres F, Galì A, Cotrufo S, *et al.* Vacuum-Assisted Closure for the Treatment of Fournier's Gangrene. Urologia Internationalis. 2009; 82: 426–431.
[12] Morpurgo E, Galandiuk S. Fournier's gangrene. Surgical Clinics of North America. 2002; 82: 1213–1224.
[13] Nisbet AA, Thompson IM. Impact of diabetes mellitus on the presentation and outcomes of Fournier's gangrene. Urology. 2002; 60: 775–779.
[14] Uluğ M, Gedik E, Girgin S, Çelen MK, Ayaz C. The evaluation of microbiology and Fournier's gangrene severity index in 27 patients. International Journal of Infectious Diseases. 2009; 13: e424–e430.
[15] Thwaini A, Khan A, Malik A, Cherian J, Barua J, Shergill I, *et al.* Fournier's gangrene and its emergency management. Postgraduate Medical Journal. 2006; 82: 516–519.
[16] Sugihara T, Yasunaga H, Horiguchi H, Fujimura T, Ohe K, Matsuda S, *et al.* Impact of surgical intervention timing on the case fatality rate for Fournier's gangrene: an analysis of 379 cases. BJU International. 2012; 110: E1096–E1100.
[17] Yanaral F, Balci C, Ozgor F, Simsek A, Onuk O, Aydin M, *et al.* Comparison of conventional dressings and vacuum-assisted closure

in the wound therapy of Fournier's gangrene. Archivio Italiano Di Urologia, Andrologia. 2017; 89: 208–211.

[18] Marathe US, Sniezek JC. Use of the Vacuum-Assisted Closure Device in Enhancing Closure of a Massive Skull Defect. Laryngoscope. 2004; 114: 961–964.

[19] Syllaios A, Davakis S, Karydakis L, Vailas M, Garmpis N, Mpaili E, *et al.* Treatment of Fournier's Gangrene with Vacuum-assisted Closure Therapy as Enhanced Recovery Treatment Modality. In Vivo. 2020; 34: 1499–1502.

[20] Rosser CJ, Morykwas MJ, Argenta LC. A new technique to manage perineal wounds. Urology Infection. 2000; 13: 45–55.

[21] Aslam R, Rehman B, Nasir II. Comparison of vacuum assisted closure versus conventional dressings in treatment of diabetic foot ulcers. The Kaohsiung Journal of Medical Sciences. 2015; 8: 226.

[22] Franco-Buenaventura D, García-Perdomo HA. Vacuum-assisted closure device in the postoperative wound care for Fournier's gangrene: a systematic review. International Urology and Nephrology. 2021; 53: 641–653.

[23] Chawla SN, Gallop C, Mydlo JH. Fournier's gangrene: an analysis of repeated surgical debridement. European Urology. 2003; 43: 572–575.

[24] Barkel DC, Villalba MR. A reappraisal of surgical management in necrotizing perineal infections. American Surgeon. 1986; 52: 395–397.

[25] Horsanali MO, Eser U, Horsanali BO, Altaş O, Eren H. Comparison of vacuum-assisted closure therapy and debridement with primary surgical closure for fournier's gangrene treatment: 10 years' experience of a single center. International Brazilian Journal of Urology. 2017; 43.

[26] Kızılay F, Akıncıoğlu E, Semerci B. Comparison of Vacuum Assisted Closure and Conventional Dressing in Fournier Gangrene Treatment. The New Journal of Urology 2019; 14: 13–20.

[27] Garg G, Singh V, Sinha RJ, Sharma A, Pandey S, Aggarwal A. Outcomes of patients with Fournier's Gangrene: 12-year experience from a tertiary care referral center. Turkish Journal of Urology. 2019; 45: S111–S116.

[28] Furr J, Watts T, Street R, Cross B, Slobodov G, Patel S. Contemporary Trends in the Inpatient Management of Fournier's Gangrene: Predictors of Length of Stay and Mortality Based on Population-based Sample. Urology. 2017; 102: 79–84.