ORIGINAL ARTICLE

Cirujano General
October-December 2019
Vol. 41, no. 4 / p. 270-275

Use of VAC system for the management of patients with Fournier gangrene

Uso del sistema VAC en el manejo de pacientes con gangrena de Fournier

Efrén Flores-Álvarez,* Gerardo Sánchez-Miranda,‡ Ana Karen Fernández-Sánchez§

Keywords:
Fournier's gangrene, vacuum assisted closure, necrotizing fasciitis, surgical debridement.

Palabras clave:
Gangrena de Fournier, sistema de cierre por presión negativa, fascitis necrosante, desbridamiento quirúrgico.

ABSTRACT

Introduction: Fournier's gangrene is a rare and fatal disease that occurs primarily in young adult patients with immune system deficiency. The progression is usually rapid and fulminant and comes to affect and spread through the abdominal fascias. Treatment consists of antibiotics and aggressive surgical debridement. Despite timely and aggressive management, most studies report high mortality. **Material and methods:** The records of 22 patients admitted from January 2007 to December 2015 were retrospectively reviewed. Two groups were formed: group 1, treated with conventional surgical debridements, and; group 2, treated with the VAC (Vacuum-Assisted Closure) system. The variables analyzed were: time of onset of the symptoms, comorbidities, origin of the disease, number of surgical debridements, VAC system placement, primary closure, hospital stay, morbidity, and mortality. **Results:** From the 22 patients, 14 (63.6%) were in group 1, and eight (36.3%) were in group 2. Primary closure was achieved in four (50%) patients in group 2 and two (14.2%) in group 1 (p = 0.07). The median value of hospital stay was 24 days (range, four a 76) in group 1 and 17 days (range, one a 42) in group 2 (p = 0.23). The median value of surgical debridements was 12 (range, one a 49) in group 1 and eight (range, one a 24) in group 2 (p = 0.064). Overall mortality was six (27.2%); four (18.8%) patients of the group 1 and two (9%) of group 2 (p = 0.7). **Conclusions:** Patients treated with VAC system had a higher probability to achieve primary closure, less number of surgical debridements, and shorter hospital stay.

RESUMEN

Introducción: *La gangrena de Fournier es una enfermedad infecciosa del periné, infrecuente y fatal que ocurre en pacientes adultos jóvenes con alguna deficiencia en el sistema inmune. La evolución suele ser rápida y fulminante, y se propaga a través de las fascias. El tratamiento consiste en antibióticos y desbridamiento quirúrgico agresivo.* ***Material y métodos:*** *Estudio retrospectivo de 22 pacientes ingresados entre enero de 2007 y diciembre de 2015. Se formaron dos grupos de estudio: el grupo 1, tratado con desbridamientos quirúrgicos convencionales, y el grupo 2, tratado con el sistema de cierre asistido por vacío, VAC (por sus siglas en inglés, Vacuum Assisted Closure). Las variables analizadas fueron: tiempo de evolución de los síntomas, enfermedades asociadas, origen de la enfermedad, número de ingresos al quirófano, cierre primario, días de hospitalización y mortalidad.* ***Resultados:*** *De los 22 pacientes, 14 (63.6%) correspondieron al grupo 1 y ocho (36.3%) al grupo 2. El cierre primario se logró en cuatro (50%) pacientes del grupo 2 y dos (14.2%) del grupo 1 (p = 0.07). La mediana de estancia hospitalaria fue de 24 días (rango, 4 a 76) en el grupo 1 y de 17 días (rango, 1 a 42) en el grupo 2 (p = 0.23). La mediana de ingresos a quirófano fue de 12 (rango, 1 a 49) en el grupo 1, mientras los pacientes en el grupo 2 fue de ocho (rango, 1 a 24) (p = 0.064). La muerte ocurrió en seis pacientes (27.2%), de los cuales cuatro (18.8%) fueron del grupo 1 y dos (9%) del grupo 2 (p = 0.7).* ***Conclusiones:*** *Los pacientes tratados con el sistema VAC tuvieron mayor probabilidad de cierre primario, menor necesidad de desbridamientos quirúrgicos y menor estancia hospitalaria.*

* MSc, General Surgeon and Oncologist, Graduate Professor Titular in General Surgery. Centenario Hospital "Miguel Hidalgo". Aguascalientes, Ags.
‡ General Surgeon, Department of General Surgery. Centenario Hospital "Miguel Hidalgo". Aguascalientes, Ags.
§ Undergraduate Physician. Universidad Autónoma de Aguascalientes. Aguascalientes, Ags.

Received: 20/08/2018
Accepted: 22/07/2019

INTRODUCTION

Fournier's gangrene was described in 1883 by French venereal disease specialist Jean Alfred Fournier. It is defined as a polymicrobial infection of the perineum, the genitals or the perianal region, characterized by a fulminant evolution originating in the anorectal and genitourinary region and may affect the inguinal region, the pelvic extremities, the abdominal wall, and even the thorax, given its ascending progression through Buck's fascia, the *tunica*

How to cite: Flores-Álvarez E, Sánchez-Miranda G, Fernández-Sánchez AK. Use of VAC system for the management of patients with Fournier gangrene. Cir Gen. 2019; 41(4): 270-275.

dartos, and the fascia of Scarpa, respectively.[1] It preferentially affects young adults who have systemic underlying diseases that compromise immunity. Diabetes mellitus is the most common comorbidity, occurring in up to 60% of patients.[2] Most affected patients are between 50 and 79 years of age. The male to female ratio is 10:1.[3]

The diagnosis is essentially clinical; however, imaging may be useful in atypical cases or in establishing a wide extension of necrosis. At a clinical level, there is a need for differential diagnosis with some entities such as balanitis, epididymitis, orchitis, testicular torsion, strangulated hernia, hydrocele, cellulitis, scrotal abscess, pyoderma gangrenosum, polyarteritis nodosa, allergic vasculitis, among others.[4]

Immediate aggressive surgical debridement of necrotic tissue and systemic administration of antibiotics is the basis of treatment. Despite early and advanced management, mortality remains high, with figures ranging from 20 to 40%.[5]

One of the current treatment options is a technique to improve the cleaning and granulation of the crude area, the Vacuum-Assisted Closure (VAC). It consists of a foam sponge, a fluid collection system, an adhesive cover, and a continuous or intermittent suction pump.[6] This paper aims to demonstrate the advantages of using the VAC system concerning the conventional system in the management of patients with Fournier's gangrene.

Table 1: General characteristics of the patients.

	n	%
Age		
< 40 years	4	18.1
40-60 years	10	45.4
> 60 years	8	36.3
Sex		
Female	1	4.6
Male	21	95.4
Smoking	12	50
Alcoholism	12	50
Diabetes mellitus	13	59
High blood pressure	1	4.6
Obesity	3	13.6

MATERIAL AND METHODS

The files of patients diagnosed with Fournier's gangrene admitted from January 2007 to December 2015 to the General Surgery Service of the Centennial Hospital "Miguel Hidalgo" were reviewed. Out of a total of 28 patients with a diagnosis of Fournier's gangrene, 22 were included, 6 had incomplete files. Two study groups were formed: group 1, treated with conventional surgical debridement, and group 2, treated with the VAC system; assigned according to the availability of resources and arbitrary criteria of the surgeon in charge of the patient. In both groups a double antimicrobial scheme was used, starting with ceftriaxone and metronidazole, which was changed according to the result of the culture and antibiogram at the surgeon's discretion. All patients underwent a joint medical treatment for metabolic and hydroelectrolytic stabilization. Some of them required management in the Intensive Care Unit.

The variables analyzed were: age, sex, the existence of associated diseases such as type 2 diabetes mellitus, systemic arterial hypertension, and obesity, place of origin of the disease, number of interventions in the operating theatre, placement of the VAC system, type of closure of the denuded area, days of hospital stay, morbidity and mortality.

Statistical analysis was carried out with the SPSS program version 21.0. A descriptive analysis of each of the variables was performed. Absolute frequencies and percentages were calculated for qualitative variables. For quantitative variables, the mean and standard deviation or median and ranges were estimated, depending on the type of data distribution. The differences between the groups were measured with the χ^2 test for the qualitative variables and with the Mann-Whitney U test for the quantitative variables. A $p < 0.05$ was considered to be statistically significant.

RESULTS

A total of 22 patients were included in the study, one woman (4.5%) and 21 men (95.5%), with a median age of 56 years (range 18-82 years) for group 1 and 61 years (range 44-79 years) for group 2 patients. Of the 22 patients, 14 received conventional treatment with surgical debridement on demand (group 1) and eight used the VAC system (group 2).

Regarding associated diseases in our patients, four (18.1%) of group 2 had diabetes mellitus and three (13.6%) were obese. Nine (40.9%) patients in group 1 with type 2 diabetes mellitus and one patient (4.5%) with systemic hypertension. Twelve patients (54.5%) had a history of smoking and alcoholism, of which eight (66.6%) belonged to group 1 and four (33.3%) to group 2 *(Table 1)*.

The origin of the disease in both groups is shown in detail in *Table 2*. Among the adjuvant urological surgical procedures, the performance of unilateral orchiectomy on two patients and cystostomy on five patients, all belonging to group 1, stand out. In addition, two group 1 patients and four group 2 patients underwent colostomy.

Of the 22 patients, four (18.1%) required management in the Intensive Care Unit, one in group 1 and three in group 2. All four required support with vasoactive amines due to septic shock. Three patients required assisted mechanical ventilation, two from group 1 and one from group 2. Disease severity was measured using the APACHE II scale: the median score in group 1 patients was nine (range 0 to 18) and six (range 2 to 18) in group 2 ($p = 0.34$).

Primary closure was achieved in four (50%) group 2 patients and two (14.2%) group 1 patients ($p = 0.07$). Patients who could not achieve primary closure were managed by the Plastic and Reconstructive Surgery Service and skin flaps were rotated in two patients (25%) in group 2 and three (21.4%) in group 1. Three patients (21.4%) in group 1 required skin grafts *(Table 3)*.

The hospital stay was longer in group 1, with a median of 24 days (range 4 to 76 days), while group 2 had a median of 17 days (range 1 to 42 days) ($p = 0.23$). The number of OR admissions was higher in group 1 with a median of 12 surgical debridements (range 1 to 49), whereas in group 2 it was only eight (range 1 to 24) ($p = 0.064$). Overall mortality was 27.2% ($n = 6$), of which four (18.8%) were in group 1 and two (9%) in group 2 ($p = 0.7$) *(Table 4)*.

During follow-up, the two patients (100%) in group 2 with colostomy had their intestines reconnected, while in group 1 this was done in only two (50%) of the four patients.

Table 2: Origin of disease.

	Group VAC		Conventional group	
Origin	n	%	n	%
Anorrectal	4	50.0	1	7.1
Genital	1	12.5	8	57.0
Genital, perineal y anorrectal	2	25.0	4	28.5
Abdominal	1	12.5	1	7.1
Total	8	100	14	100

DISCUSSION

Fournier's gangrene is an infectious disease that affects the soft tissues of the perineum. It is characterized by local tissue necrosis, with a rapid progression up to 1.5 cm/hour through the regional fascia of Colles, the *tunica dartos*, and the fascia of Scarpa, associated with significant systemic toxicity. Anaerobic bacteria produce gases that cause the area to crackle, a sign present in the majority of cases.[7] Fournier's gangrene manifests itself in a wide spectrum of diseases or conditions that have as a common denominator the alteration of the immune response. It is associated with risk factors such as alcoholism, diabetes, malnutrition, advanced age, and immunosuppression.[8] In our environment, it occurs frequently and represents a real challenge for the surgeon, particularly when the infectious process is advanced due to mismanagement or delay in initial care. We face patients with multiple comorbidities associated with the disease

Table 3: Association of variables with the two study groups.

Variable	VAC group n	Conventional group n	p
Primary closure	4	2	0.07
Skin flaps	2	3	0.66
Hospital stay	17.3	26.7	0.23
Surgical lavages	8	12	0.06
Mortality	2	4	0.7

such as high blood pressure, diabetes mellitus, obesity, smoking, and alcoholism.

Fournier's gangrene requires multimodal treatment including intensive care for hemodynamic stabilization and metabolic and hydroelectrolytic management, administration of broad-spectrum antibiotics, nutritional support, and first aggressive surgical debridement. It should be noted that early surgical debridement is the main key to successful treatment; delaying it will harm prognosis.[9-12] The initial approach in our department is surgery as early as possible, once hemodynamic and metabolic stabilization has been initiated, in addition to broad-spectrum antimicrobial management. All non-viable and necrotic tissue should be resected until well-vascularized viable tissue is reached. The limit of infectious infiltration may not be evident from areas of skin disease, which is usually smaller than the subcutaneous disease. Debridement should be vigorous but careful not to accidentally open deeper fascial planes not affected.[13]

Urinary or fecal diversion may be necessary depending on the source of the disease.[14,15] In our series, six patients underwent a colostomy, four of whom were in the conventional treatment group and two in the VAC treatment group. Five patients in the conventional group underwent cystostomy. Of the patients with fecal diversion, the two (100%) from the VAC group could be reconnected and only two of the four (50%) belonging to the conventional group.

The surgery aims to eliminate all non-viable tissues, control the progression of local infection, and alleviate systemic toxicity. Surgical debridement should be extended until the tissues are well perfused and viable tissue is identified. Tissue that is easily separated from the fascial plane must be completely removed.[16] Multiple surgical debridements are the rule, with an average of 3.5 procedures required per patient.[17] In our series, patients managed with the VAC system required fewer surgical procedures than those in the conventional group, a clinically relevant advantage. Although the testicles are usually preserved, testicular orchiectomy is eventually necessary for up to 21% of patients. Two of our patients underwent unilateral orchiectomy, both from the conventional group.

With the introduction of the VAC system to the market, the concept of wound management has been revolutionized and consequently, the evolution of wounds. A VAC device consists of a sterile foam sponge that is placed on the wound and covered with a transparent adhesive dressing that creates an airtight environment, a non-collapsible tube is used to connect it to a portable pump that provides continuous or intermittent negative pressure. An environment is created, which in theory, promotes rapid wound healing; it promotes wound closure by facilitating perfusion, fibroblast migration, mitosis, and cell proliferation. It also facilitates the removal of infected material and excess exudates, reduces local edema, and delineates wound edges by promoting resolution of the infectious process and the initiation of healing.[18,19]

Some studies have shown improved wound healing and a significant reduction in wound surface area in patients with full-thickness wounds treated with the VAC system, compared with conventional therapy.[20-23] Those patients in the VAC system group achieved primary closure in half of the cases. In contrast, those managed with conventional therapy achieved it in only 14%. A quick resolution of the infectious process and the granulation of the

affected surfaces can reduce the size of the denuded area and the inflammation of the adjacent tissues allowing to plan an easier reconstruction, so that our patients treated with the VAC system could be managed by the Plastic and Reconstructive Surgery Service in the same hospitalization by means of flap and graft rotation with good results.

Traditional w dressing changes require several operations in a day, which is painful for the patient and laborious for the staff. The VAC system, on the other hand, is changed every 48 to 72 hours, which reduces the number of dressing changes, reducing discomfort, handling, and cost to the patient.[24] In our series, patients treated with the VAC system required eight procedures in the operating room, while the group treated conventionally required almost twice as many cleanings and surgical debridements.

There are few published studies evaluating the efficacy of the VAC system in the treatment of Fournier's gangrene. In our study, favorable results were observed. This invites to its use as a first option. Although statistical significance was not achieved in the parameters evaluated, better results were obtained in patients in whom the VAC system was used.

Table 4: Surgical procedures performed.

Surgical procedure	n	Range	%	p
Surgical lavage	20			
VAC group	8	1-24		0.06
Conventional group	12	1-49		
Colostomy	6		27.2	
VAC group	2		9.0	0.45
Conventional group	4		18.1	
Cystostomy	5		22.7	
VAC group	0		0	0.08
Conventional group	5		35.7	
Reconstruction				
Primary closure	6		27.2	0.07
VAC group	4		50.0	0.08
Conventional group	2		14.2	
Flap rotation	5			
VAC group	2		25.0	0.08
Conventional group	3		21.4	
Skin graft	3		13.6	0.12
VAC group	0		0	
Conventional group	3		25.0	

Total VAC group n = 8
Total conventional group n = 14

CONCLUSION

Patients with Fournier's gangrene who were treated with the VAC system had a greater tendency to primary closure of the denuded area, less need for dressings and surgical debridement as well as a shorter hospital stay, compared to patients managed in a conventional way, although the values did not reach statistical significance due to the small sample size of our series.

We consider that the VAC system a useful and safe alternative in the treatment of patients with Fournier's gangrene. It could become the management of choice.

REFERENCES

1. Águila-Gómez MV, Salas-Villanueva W, Barbosa N, Werle R. Gangrena de Fournier, nuevas estrategias para un viejo mal: presentación de un caso y revisión de literatura. Rev Méd La Paz. 2016; 22: 50-55.
2. Marchesi A, Marcelli S, Parodi PC, Perrotta RE, Riccio M, Vaienti L. Necrotizing Fasciitis in aesthetic surgery: a review of the literature. Aesthetic Plast Surg. 2017; 41: 352-358.
3. Hagedorn JC, Wessells H. A contemporary update on Fournier's gangrene. Nat Rev Urol. 2017; 14: 205-214.
4. Somville F, Swerts S, Vandamme S, Monsieurs K. Fournier's gangrene: a fulminant subcutaneous infection. Acta Chir Belg. 2016; 116: 178-183.
5. Pawłowski W, Wroński M, Krasnodebski IW. Fournier's gangrene. Pol Merkur Lekarski. 2004; 17: 85-87.
6. Smith GL, Bunker CB, Dinneen MD. Fournier's gangrene. Br J Urol. 1998; 81: 347-355.
7. Bannura G. Enfermedad de Fournier. Rev Med Chile. 1992; 120: 304-310.
8. Sedano-Basilio JE, Cornejo-Dávila V, Trujillo-Ortiz L, Cantellano-Orozco M, Fernández-Noyola G, Martínez-Arroyo C, et al. Experiencia y revisión de la literatura en el manejo de gangrena de Fournier en una institución, 2008-2015. Rev Mex Urol. 2016; 76: 29-35.
9. Oktar SO, Yucel C, Ercan NT, Çaplan D, Ozdemir H. Fournier's gangrene: U.S. and M.R.I. imaging findings. Eur J Radiol Extra. 2004; 4: 81-87.
10. Encycl Méd Chir. Nephrologie-Urologie. 2001; 18-642-A10.
11. Elliott D, Kufera JA, Myers RA. The microbiology of necrotizing soft tissue infections. Am J Surg. 2000; 179: 361-366.

12. 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 Int. 2012; 110: E1096-E1100.
13. Chernyadyev SA, Ufimtseva MA, Vishnevskaya IF, Bochkarev YM, Ushakov AA, Beresneva TA, et al. Fournier's gangrene: literature review and clinical cases. Urol Int. 2018; 101: 91-97.
14. Paty R, Smith AD. Gangrene and Fournier's gangrene. Urol Clin North Am. 1992; 19: 149-162.
15. Li YD, Zhu WF, Qiao JJ, Lin JJ. Enterostomy can decrease the mortality of patients with Fournier gangrene. World J Gastroenterol. 2014; 20: 7950-7954.
16. Cancino BC, Avendaño HR, Poblete-Andrade C, Guerra HK. Gangrena de Fournier. Cuad Cir. 2010; 24: 28-33.
17. Chawla SN, Gallop C, Mydlo JH. Fournier's gangrene: an analysis of repeated surgical debridement. Eur Urol. 2003; 43: 572-575.
18. Singh A, Ahmed K, Aydin A, Khan MS, Dasgupta P. Fournier's gangrene. A clinical review. Arch Ital Urol Androl. 2016; 88: 157-164.
19. Whelan C, Stewart J, Schwartz BF. Mechanics of wound healing and importance of Vacuum Assisted Closure in urology. J Urol. 2005; 173: 1463-1470.
20. Mouës CM, van den Bemd GJ, Heule F, Hovius SE. Comparing conventional gauze therapy to vacuum-assisted closure wound therapy: a prospective randomised trial. J Plast Reconstr Aesthet Surg. 2007; 60: 672-681.
21. Czymek R, Schmidt A, Eckmann C, Bouchard R, Wulff B, Laubert T, et al. Fournier's gangrene: vacuum-assisted closure versus conventional dressings. Am J Surg. 2009; 197: 168-176.
22. 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. Arch Ital Urol Androl. 2017; 89: 208-211.
23. Hong KS, Yi HJ, Lee RA, Kim KH, Chung SS. Prognostic factors and treatment outcomes for patients with Fournier's gangrene: a retrospective study. Int Wound J. 2017; 14: 1352-1358.
24. Silberstein J, Grabowski J, Parsons JK. Use of a vacuum-assisted device for Fournier's gangrene: a new paradigm. Rev Urol. 2008; 10: 76-80.

Ethical considerations and responsibility: Data privacy. According to the protocols established in the authors' workplace, they declare to have followed the protocols on the privacy of patient data while preserving their anonymity. The informed consent of the patient referred to in the article is held by the author.

Funding: No financial support was received for this work.

Conflict of interest: The authors declare that there is no conflict of interest in carrying out this work.

Correspondence:
Dr. Efrén Flores Álvarez
Paseo del Lago Núm. 141,
Residencial Jardines del Lago, 20218,
Aguascalientes, Aguascalientes.
Phone: 52 44 9196-28 57
E-mail: efflorez@hotmail.com