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URINARY INFECTION

Original Article

Using negative pressure therapy for improving skin graft taking on genital area defects following Fournier gangrene

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ABSTRACT

Objective: Fournier's gangrene is an infective necrotizing fasciitis of the perineal, genital and perianal regions. Treatment includes aggressive surgical debridement that often results in extensive loss of genital skin. Skin grafts may be used for reconstruction but skin grafting of the male genitalia is diffucult because the penis and scrotum are mobile and deformable. A variety of methods are used to secure skin graft to recipient beds. We used negative pressure therapy (NPT) to secure skin grafts and improve skin graft taking.

Material and methods: We used negative pressure therapy for graft fixation in 13 male patients who underwent debridements with the indication of Fournier gangrene, and whose defects formed were reconstructed with grafts between January 2009, and January 2014. Information about age of the patients, sessions of negative pressure therapy applied before, and after reconstruction, duration of hospital stay, and graft losses during postoperative period were recorded.

Results: Median age of the patients was 56.15 (46-72) years. NPT was applied to patients for an average of 6.64 sessions (4-12) before and 1 sessions after graft reconstruction. Patients were hospitalized for an average of 26.7 (20-39) days. Any graft loss was not seen after NPT.

Conclusion: Because of the peculiar anatomy of the genital region, anchoring of grafts is difficult so graft losses are often encountered. Use of NPT for ensuring graft fixation on the genital region prevents skin graft shearing.

Keywords: Fournier gangrene; negative pressure therapy; skin graft.

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Introduction

Fournier gangrene was firstly described by Alfred Fournier in the year 1883, and it is an infective necrotising fasciitis of genital and perianal regions.[1] Fournier gangrene is caused by aerobic, and anaerobic bacteria found in gastrointestinal, genitourinary system or skin flora including mainly *escherichia coli, staphylococcus aureus*, and *streptococcus* species.[2] As clinical manifestations, perineal pain, edema, rashes, indurations, crepitation, tense skin, bulla formation, purulent discharge, local symptoms as necrosis of skin, and superficial fascia together with systemic symptoms as fever, septic shock, and multiorgan failure can be seen. Besides, within the spaces between subcutaneous tissue gasses as hydrogen, nitrogen, hydrogen sulfide, and methane can accumulate.[3] Fournier gangrene is seen 10 times more frequently in men than women.[4] Immune deficiency, diabetes, hypertension, alcoholism, malnutrition, obesity, low income level, and smoking are considered among risk factors.[3] General treatment approach consists of removal of necrotic tissues with series of debridements, and parenteral antibiotherapy.[5] Despite appropriate treatment in Fournier gangrene mortality rates up to 20% can be seen.[6]

Aggressive treatment with surgical debridement cause skin, and soft tissue defects which should be reconstructed.[7] For the reconstruction of these defects various alternatives as pri-

mary skin closure local flaps, distant flaps, and partial thickness skin grafts are available.[8]

Reconstruction of defects using skin grafts are relatively easier surgical procedures, and they enable functional, and cosmetic reconstruction of large defects in a single session. Most frequently seen complications when skin grafts were used, include contraction, and graft loss. Subgraft hematoma, skin graft shearing, and infection rank on top among causes of graft loss.[9] In some publications cited in the literature potential use of Negative Pressure Therapy (NPT) so as to prevent skin graft shearing, and graft taking have been indicated.[10]

Negative Pressure Therapy is an active wound closure method used for the treatment of acute, subacute, chronic, and infected wounds. In NPT, negative pressure can be applied on the entire surface of the woıund using a sponge made of polyurethrane foam. With the negative pressure applied excess exudate in and around the wound is absorbed with resultant decrease in turgor pressure of the wound leading to increase in local blood flow, and tissue oxygenation mediated through capillary network around the wound stimulating neovascularization, increasing cellular proliferation at the peripihery of the wound, decreasing bacterial load of the wound, and dimensions of the wound by conttracting the circumference of the wound.[11,12]

In experimental, and clinical studies performed, it has been demonstrated that NPT increases formation of granulation tissue at the wound site for 4 times, decreases bacterial load of the wound, and shortens wound healing time relative to wet dressings with an increase in the wound healing rates. The most effective negative pressure value has been found to be 125 mmHg.[11,12]

In this study, in patients in whom skin grafts were used for the reconstruction of the defects formed as an outcome of Fournier gangrene, we aimed to demonstrate effectiveness of use of negative pressure therapy (NPT) for the prevention of graft shearing, and increasing graft taking.

Material and methods

Graft fixation was applied with the aid of negative pressure therapy in 13 male patients treated for Fournier gangrene between January 2009, and January 2014. The patients who underwent debridements with the indication of Fournier gangrene, and whose defects formed were reconstructed with grafts and negative pressure therapy for the fixation of the graft were retrospectively evaluated. Undersigned, and written informed consent forms prepared in compliance with the principles of Helsinki Declaration were obtained from all patients. Information about age of the patients, comorbid diseases, affected anatomical regions, causative bacterial agents, sessions of negative pressure therapy applied before, and after reconstruction, duration of hospital stay, and graft losses during postoperative period were recorded.

All patients included in the study underwent surgical debridement under general anesthesia in the operating room, and necrotic tissues were removed from the wound. In patients whose adequate debridement could not be achieved at first trial, debridement procedures were repeated at 2 –day intervals. After removing all dead tissues, NPT was initiated. In all patients NPT was applied using vacuum asistant closure (VAC) (Kinetic Concepts, Inc, San Antonio, Texas, USA) system.

Polyurethrane sponge was tailored to the size of the wound, and placed on the wound surface so as to close entire surface of the wound without exceeding the contours of the wound. Then the sponge was covered airtight with transparent film drape. A small hole was opened on the transparent film drape to attach a connecting tube. The free end of the transparent film drape was connected to a vacuum device which would deliver negative pressure ranging between 50, and 200 mmHg. Wound discharge drawn after termination of the NPT was accumulated in the collector of the vacuum device.

For all patients negative pressure therapy was applied at bedside for 3 sessions using a continuous mode under 125 mmHg, and NPT sponges were changed on Mondays, Wednesdays, and Fridays. After formation of granulation tissue, and termination of clinical infection, partial thickness skin graft material was harvested from the femoral region for the reconstruction of the defects. Skin graft was reinforced with a mesh at a rate of 2:1 to reconstruct defects. Immediately after grafting procedure the graft materials were covered with vaseline gauze pads, then polyurethrane sponge, and connected to a NPT system.

Results

Median age of the patients was 56.15 (46-72) years. All patients (100%) had diabetes mellitus, and they were being treated with insulin therapy. In addition to diabetes mellitus, 7 (53.8%) patients had obesity (Body mass index >30 kg/m^2), and 2 (15.4%) of them had renal failure. Starting from the day of their hospitalization, all patients received broad spectrum antibiotherapy, and they were urgently debrided. *Escherichia coli* (n=7; %53,8), *Staphylococcus aureus* (n=6; 46.2%), *Streptococcus* spp. (n=4; 30.8%) *Acinetobacter spp*. (n=1, 7.7%), and *Pseudomonas aeruginosa* (n=1, 7.7 %) were isolated from the wounds of respective number of patients. Following debridements, defects developed on penis, and scrotum (n=9), penis, scrotum, and anterior abdominal wall (n=2), scrotum, and sacral region (n=2). NPT was applied for a median of 6.64 (4-12) sessions before reconstruction, and one session after grafting for a period of 5 days. Median duration of inpatient treatment was 26.7 (20-39) days. Following NPT, any graft loss was not seen after NPT (Table 1) (Figure 1).

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Discussion

Following debridement performed for the treatment of Fournier gangrene, defects may be formed on genital region, and especially penis and scrotum.[9] Reconstruction of these defects is necessary not only for cosmetic reasons, but also for functional, and physiologic reasons. Scrotum has a thermoregulatory function required for normal spermatogenesis. Testicles should be enclosed in a scrotum for the achievement of spermatogenesis, and hormone production from testicles. Scrotal defects up to 50% can be closed primarily, and defects occupying more than 50% of the scrotal skin require reconstruction. Skin layer to be used for the scrotal reconstruction should be adequately thin, resilient, foldable, and allow testis to dangle loosely from the body.[13] For the reconstruction of scrotal defects alternatives such as grafts or flaps are available.[9]

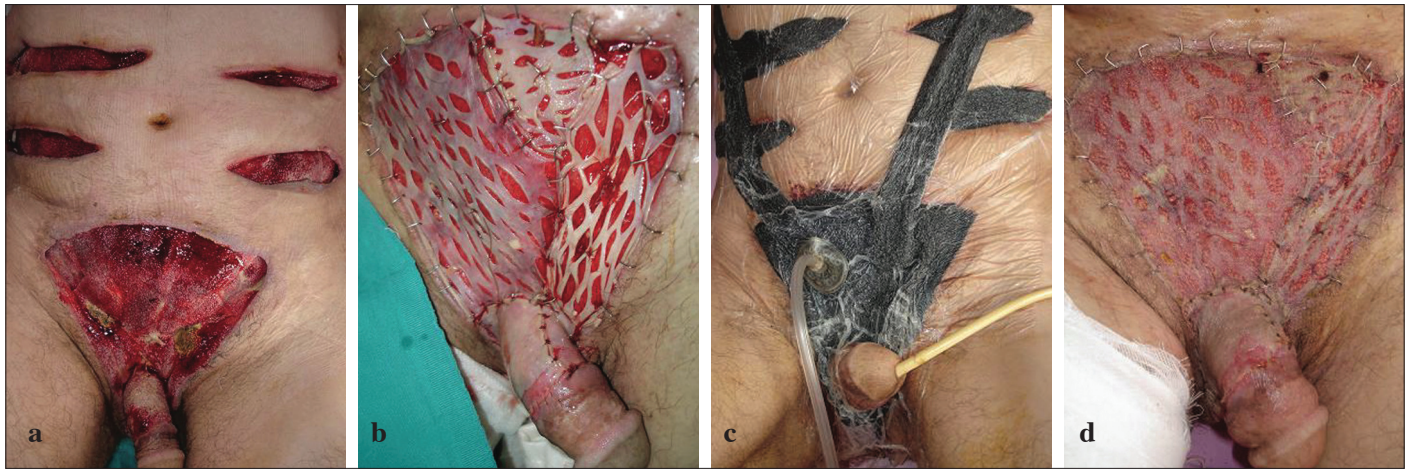
Multiple number of flaps have been described for the closure of scrotal defects. However thickness of the flap is the most important disadvantage of ther reconstruction with a flap. Adipose and muscle tissues contained in flaps increase testicular temperature which may lead to inhibition of spermatogenesis.[14] As another alternative for reconstruction, skin grafts liken normal scrotal and penile skin as for skin thickness, colour, and shape, since they are thin, and ensure a cooler environment for the testes for the achievement of testicular functions. Therefore skin grafts seem to be more suitable alternatives for scrotal reconstruction.[9] However in only 10% of the patients with Fournier gangrene reconstruction with skin graft has been preferred.[15] Graft loss is the most frequently seen complication of reconstruction of the defect using skin graft. Graft shearing ranks on top of the reasons for graft loss.[16] Application of skin grafts for male genitalia is very challenging when compared with other parts of the body. Since penis, and scrotum have mobile, variable structures with certain contours, and occupy a narrow area between both legs, fixation of the graft on penis, and scrotum is a difficult procedure. Therefore skin grafts are not frequently preferred for genital defects.[15]

For the fixation of skin graft on genital region especially on penis, and scrotum classically various methods including tie-over pillow, sponge pillow, plastic splint, splitting with a syringe, and reinforcement with an ureteral catheter have

Table 1. Evaluation parametres of the cases

Case	Age (Year)	Comorbidity	Affected anatomic region	Bacterial agent	Number of NPT sessions applied before reconstruction with a graft	Number of NPT sessions applied after reconstruction with a graft	Hospital stay (days)	Graft taking
1	52	Diabetes mellitus	Abdominal wall, Penis and scrotum	*Escherichia coli*	4	1	20	100%
2	46	Diabetes mellitus	Penis and scrotum	*Staphylococcus aureus*	7	1	28	100%
3	57	Diabetes mellitus, obesity	Penis and scrotum	*Streptococcus* types	7	1	30	100%
4	51	Diabetes mellitus, obesity	Penis and scrotum	*Staphylococcus aureus*	6	1	28	100%
5	48	Diabetes melitus, obesity,	Penis and scrotum	*Pseudomonas aeruginosa*	4	1	22	100%
6	60	Diabetes mellitus, renal failure, obesity	Gluteal region and scrotum	*Escherichia coli, Staphylococus aureus Streptococus* spp.	12	1	39	100%
7	54	Diabetes mellitus, obesity	Anterior abdominal wall, penis and scrotum	*Escherichia coli*	8	1	30	100%
8	61	Diabetes mellitus, obesity	Penis and scrotum	*Escherichia coli, Staphilococus aureus*	6	1	23	100%
9	70	Diabetes mellitus, renal failure	Penis and scrotum	*Escherichia coli, Staphilococus aureus*	5	1	21	100%
10	66	Diabetes melitus, obesity	Gluteal region, penis and scrotum	*Escherichia coli, Streptococcus* spp.	7	1	25	100%
11	52	Diabetes mellitus	Penis and scrotum	*Staphylococcus*	8	1	32	100%
12	55	Diabetes mellitus	Penis and scrotum	*Escherichia coli*	6	1	26	100%
13	58	Diabetes mellitus	Penis and scrotum	*Streptococcus* spp. *Acinetobacter*	6	1	24	100%

NPT: negative pressure therapy



Figures 1. a-d. Necrotic tissues on penile, scrotal, and anterior abdominal wall of a 49-year –old patient with the diagnosis of Fournier gangrene were debrided , and bilateral orchidectomy was performed. (a) Macroscopic appearance of the graft before grafting. (b) After 6 sessions of NPT reconstruction with grafting was performed. (c) NPT was applied on the graft. (d) Macroscopic appearance of ther graft on perineal region, and penis after NPT

NPT: negative pressure therapy

been tried.[17] For the fixation of skin graft on this region NPT can be also used. In a clinical study by Moisidis et al.[18] the authors determined that NPT significantly increased graft taking when compared with conventional methods. Increases in graft taking rates using NPT were demonstrated for the reconstruction of penile, and scrotal defects developed after traumatic events, and abscess (Weinfeld et al.[17]), and penoscrotal elephanthiasis (Stokes et al.[19]). Also in our study, increase in the rates of skin graft taking has been demonstrated using NPT for the repair of penile, and scrotal defects developed as an outcome of the treatment applied for Fournier gangrene, and graft loss was not encountered in all of our patients. The main mechanism underlying increased incidence of the skin taking related to the use of NPT. Indeed thanks to negative pressure created during NPT, closer contact of the skin graft with wound bed prevent graft shearing. Besides, absorption of the exudate accumulated beneath the graft, and decreasing the bacterial load of the environment contribute to improved graft taking.[18]

In our study, in all patients NPT was used both for stabilization of graft, and also for tailoring wounds for reconstruction after debridement. In the literature to this end application of NPT for the patients with Fournier gangrene for 3-22 sessions has been reported in various publications.[20] In our study, after application of NPT for an average of 6.64 sessions, all defects became suitable for reconstruction using grafts, and none of our patients needed reconstruction with a flap. In one patient with large defects occupying gluteal region, penis, and scrotum, application of 12 sessions of NPT were required, and for the remaining 12 patients 4-8 sessions of NPT sufficed. Median hospital stay of Fournier gangrene patients who are followed up with conventional dressing methods ranges between 23.97, and 27.8 days.[15,21] In our study median hospital stay was 26.7 days. NPT did not shorten duration of hospitalization, however in 100% of the patients reconstruction of the genital region was fascilitated using more suitable graft material.

In conclusion, reconstruction of the defects developing as an outcome of Fournier gangrene is challenging because of their anatomic location. Even if repair of the defect with a graft is possible fixation of the grafts is difficult so frequently graft losses are encountered. Use of NPT ensures stabilization of the graft and prevents graft loss.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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