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Research Article

Is Negative Pressure Wound Therapy an Effective Method for Vascular Site Infection?

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Abstract

Objectives: Wound infection developing after vascular surgery is generally a long-term and difficult process to manage. This study examined the effective, currently preferred, non-pharmacological technique of negative pressure wound therapy for this condition.

Methods: The outcomes of negative pressure therapy applied to treat wound infections that developed after vascular surgery were retrospectively examined. Patients were divided into 2 groups (Szilagyi classification II and III) according to surgical site infection level.

Results: In all, 26 patients were included in the evaluation. Mean patient age was 68.1±6.9 years, and distribution of gender was male/female: 18/8. The most common co-existing disease was diabetes mellitus (65%) and the most frequent anatomical application region was inguinal (65.5%). The mean length of treatment was 26.8±14 days. Blood transfusion was performed for 12 (46.1%) patients. Of all the patients, 57.7% had a Szilagyi II surgical site infection and 42.3% had Szilagyi III. Graft change was observed more in the Szilagyi III group (n=11) than in the Szilagyi II group (n=0) (p=0.01). The length of hospital stay was longer for those classified as Szilagyi III (27±10 days) than those classified as Szilagyi II (20±8 days) (p=0.03).

Conclusion: Although it takes a long time, it was concluded that negative pressure wound therapy is a safe and effective alternative treatment for surgical site infections, including vascular graft infection, because of the low complication rate.

Keywords: Negative pressure wound therapy, surgical site infection, vascular surgery

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Infection of vascular surgery sites generally takes a long time to heal, increases treatment costs and is a process that is difficult to manage. After vascular surgery incisions, 5-10% of patients are observed to have complications like wound dehiscence, lymphatic fistula or infections.[1–3] These wound complications may threaten the extremity or life and results in serious increases in morbidity and mortality.[1]

The initial treatment for wound infection is surgical debridement and antibiotic use. For affected patients with synthetic grafts, treatment involves another level of difficulty. The gold standard treatment for graft infection is graft excision. Following graft excision, extra-anatomic or in situ bypass operations may be performed for revascularization of the extremity.[2] However, as these operations involve high morbidity and mortality attempts have been made to develop a variety of techniques preserving the graft.[4–6] Aggressive debridement, muscle flap transformation, and long term high dose intravenous antibiotic treatment are among com-

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monly used graft preserving techniques. However, these treatment choices may not be appropriate due to conditions such as high perioperative risk, malnutrition or severely scarred wound sites and have a 10–35% re-infection risk.[7] For deep wound site infections, negative wound pressure therapy (NPWT) is an effective and non-pharmacologic technique commonly chosen currently.[2] NPWT is applied with the aid of devices creating continuous or intermittent subatmospheric pressure (VAC® and Versatil®). While VAC® applies pressure from 25-175 mmHg, Versatil® applies lower pressure like 80 mmHg.[2, 6] VAC® therapy is applied 24 hours/day and pain related to therapy may be observed.[2, 3]

In our study, we aimed to present our NPWT results applied after aggressive debridement and clinical experiences of patients developing skin wound site infections after vascular operations.

Materials and Methods

The study included all patients with skin wound infection developing within 90 days of vascular surgery from January 2011 to January 2013 requiring operative debridement that did not affect (Szilagy II) or affected (Szilagy III) the graft with the aim of preserving the graft. The study did not include those developing graft infections after 90 days, with surficial wound site dehiscence developing and those treated with local wound care or cellulitis cases treated with oral antibiotics. Non-infectious seroma cases, and cases with hematoma or other wound site cases were not included in the study.

The demographic characteristics of patients, indications for surgery, co-existing diseases, graft properties, time to first complaint of wound site infections, duration to NPWT application, anatomical region, hospital stay, duration until NPWT use, duration to full resolution, white blood cell (WBC), albumin level, blood transfusion, surgical site infection classification (Szilagy) and data relating to patient follow-up were recorded.

In our clinic, after diagnosis of wound site infection, and taking of blood and wound site cultures, empirical intravenous broad spectrum antibiotic therapy is begun. After debridement of patients, the spread of infection is determined with diagnostic imaging methods. The wound site is cleared of all necrotic or infected tissue and after hemostasis is ensured (after operative debridement), NPWT is applied. Depending on the proximity of the NPWT infection area to vascular anastomosis, negative pressure is set in the interval 50-125 mmHg. NPWT sponges are changed every third day and if necessary during sponge changes, minor debridement is applied. Intravenous antibiotic therapy appropriate to culture results is continued for 2 to 10 weeks. No wound site treatment required skin graft. After treatment ended patients are followed-up in the 3rd and 6th months. All patients has clinical investigation and routine follow-up accompanied by Doppler ultrasonography for vascular graft and soft tissue.

Data was analysized with the SPSS (Statistical Package for Social Sciences) for Windows 21.0 statistical analysis program. The Fisher's exact test and t test were used to compare demographic data. Data are presented as mean ±standard deviation, number and percentage.

Table 1. Cormorbid risk factors and indications for vascular surgery

	Mean±SD	n	%
Classification of surgical site infection			
Szilagy II		15	57.7
Szilagy III		11	42.3
Age (year)	68.1±6.9		
Sex			
Male		18	69
Female		8	31
Emergency surgery		13	50
DM		17	65
Hypertension		16	61.5
COPD		4	15
Chronic renal failure		4	15

SD: Standard deviation; DM: Diabetes mellitus; COPD: Chronic obstructive pulmonary disease.

Table 2. Surgical procedures performed and regions treated

	n	%
Infection region		
Inguinal	17	65.5
Femoral	7	26.9
Abdominal	2	7.6
Surgical procedures		
Femoral popliteal/distal bypass	9	34.6
Femorofemoral bypass	8	30.7
Femoral endarterectomy and patch repair	7	26.9
Aortobifemoral bypass	2	7.7

Results

A total of twenty-six patients, fifteen with Szilagy II and eleven with Szilagy III had wound site infection. The mean age of patients was 68.1±6.9 (55-79) years. Male patients were observed to be in the majority [male/female: 18/8 (69/31%)]. The comorbid risk factors and indications for vascular surgery of patients are given in Table 1. The majority of vascular surgery interventions were related to critical leg ischemia (76.9%) and the surgical interventions performed are listed in Table 2. Twenty patients had polytet-

Table 3. Data related to negative pressure wound therapy applications

	Szilagy II (n=15)	Szilagy III (n=11)	p
Graft change	0	11	0.01
Fever (≥38 ºC)	7	7	1.0
Leukocyte (/mm^3)	12.4±6.8	13.1±7.0	0.35
Albumin (g.dL^{-1})	2.6±0.6	2.8±0.6	0.63
Duration until application (day)	2.4±1.6	2.0±1.1	0.23
Application duration (day)	18±12	23±10	0.72
Length of hospital stay (day)	20±8	27±10	0.03

rafluoroethylene (PTFE) graft, with six patients given autologous saphenous vein graft. In the Szilagy III group, eight patients had PTFE graft and three had autologous vein graft. In the postoperative period, NPWT was applied to the inguinal (n=16; 61.5%), femoral (n=7; 26.9%) and abdominal (n=2; 7.6%) regions due to disrupted wound healing. The duration for development of findings related to infection was 12 to 65 days (mean 25±11 days). In patients with deep wound site infections, four had lymphorrea symptoms. In 12 patients (46.1%) blood transfusion was performed. The mean follow-up duration for patients was 25.7±14.5 months and no late period infection was observed during follow-up. After wound debridement, no patient in the Szilagy II group reached the graft level. Of the 11 patients in Szilagy III group, eight had at least partial anastomosis revealed after debridement ($p<0.05$). Before debridement, non-invasive imaging methods identified that 11 patients with Szilagy III had fluid (n=6) or air (n=5) around the graft. Data related to the applications are summarized in Table 3.

Fourteen patients, seven from each group, had fever on application (≥38 °C). WBC count was 12.4±6.8/mm3 in Szilagy II group and 13.1±7.0/mm3 in Szilagy III group (p=0.35). The serum albumin levels in both groups varied from 2.0 to 3.6 g.dL-1 with mean levels of 2.6±0.6 g.dL-1 in Szilagy II group and 2.8±0.6 g.dL-1 in Szilagy III group (p=0.63). A total of 16 patients (61.5%) had hypoalbuminemia. The infection source was polymicrobial for the majority of cases. The time to application of NPWT was 2.4±1.6 days for Szilagy II group and 2.0±1.1 days for Szilagy III grop (p=0.23). The NPWT application lasted 9-45 days. The duration was 18±12 days for Szilagy II and 23±10 days for Szilagy III (p=0.72). The hospital stay was clearly longer in the Szilagy III group (Szilagy II 20±8 days; Szilagy III 27±10 days, p=0.03). Wound healing was ensured in mean of 16±13 days (9-43 days) and there was no significant difference between the groups (p=0.69). After treatment all patients had wound sites primarily closed.

Discussion

In vascular surgery, site infections are the most common cause of morbidity with frequency of 5-10%. Vascular site infections may cause lengthened hospital stays, extremity loss, and sepsis and as a result increased mortality related to the use of synthetic grafts in this region. For patients with postoperative wound site complications, methods preserving the vascular graft are mainly chosen. Preserving the vascular graft is a choice for situations where the anastomosis is intact, the infection does not affect the whole graft, the patient has no systemic symptoms of sepsis, the graft is patented and the microorganism involved is not Pseudomonas aeruginosa.[8]

After NPWT was described for wound site treatment, NPWT began to be used by vascular surgeons. The first use was for cases with lymphorrea and surficial wound site infection. Pinocy et al. reported NPWT for 24 patients with Szilagy II wound site infection after vascular operations.[9] Success was ensured for all these patients, with no complications encountered during twelve months of follow-up. Svensson et al. applied NPWT for twenty patients with Szilagy III affecting the graft, and after using a non-adhesive cover on the graft they applied 125 mmHg negative pressure.[10] Success was ensured for 71% of patients, with 2 patients observed to have non-fatal anastomosis-sourced hemorrhage. Treatment guidelines recommend that NPWT not be applied directly to veins or anastomosis lines.[11] If it is applied, complications resulting in fatal hemorrhage, such as erosion of vein walls and separation of the anastomosis line, may occur. And also, the veins or anastomosis line should be covered with natural tissue or a biological mesh. Additionally, Berger et al. recommended that for continuous negative pressure during NPWT, the Szilagy III patient group with infection affecting the graft should have 50 mmHg used instead of 125 mmHg.[11]

After appropriate antibiotic treatment and sufficient debridement of deep wound site infections after vascular operations, we applied NPWT with different pressures to the wound site depending on the proximity of the infection to the vascular anastomosis line. In situations where purulent fluid ceased and sufficient granulation tissue formed, NPWT was ended. In cases where the vascular graft was affected, the hospital stay was observed to be longer. No problems related to hemorrhage or wound healing were encountered. During 6 months follow-up, re-infection was not observed in patients. Based on our clinical observations, we think it is necessary for cases treated with NPWT to remain in the hospital environment until full healing is ensured due to conditions in our country. Other factors affecting this consideration include the need for antibiotic

treatment to be maintained regularly and for regular nutrition.[12–15]

In series reported in the literature, it is noteworthy that nearly all patients chosen for NPWT application have clear graft infection and are not well selected for graft preservation.[16, 17] Patients with history of site hemorrhage like infected pseudoaneurysm or without intact vascular graft do not comprise the patient group appropriate for graft preserving techniques. In our patient group, when organizing the operation technique and treatment plan for patients, we considered the results of non-invasive investigations before the operation and the results of previous debridement before beginning NPWT. For cases we did not consider appropriate for graft preserving, the graft was removed and then in-situ or extra-anatomic bypass applications were chosen. There are studies in the literature showing early period graft infections can be treated ensuring full graft preservation.[16–19] Though Dosoglu et al. reported a case with unsuccessful treatment using the early period graft preservation technique, they emphasized the need for careful investigation of wound site during treatment and that no focus of residual infection should remain.[3] NPWT does not provide successful results alone for eradication of late period chronic graft infections, therefore successful results can be obtained for early period graft infections with correct patient selection.

For deep wound site infections developing after vascular surgery, NPWT application after radical debridement and appropriate antibiotic treatment for culture results may be a reliable choice. In situations where the infection affects the graft or anastomosis line, if there is a high risk from graft excision and extra-anatomic bypass, we believe that long term NPWT is a reliable and effective treatment choice due to low complication rates.

Disclosures

Ethics Committee Approval: Retrospective study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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