G Chir Vol. 40 - n. 5 - pp. 445-449
September-October 2019

NPWTid in the treatment of infected diabetic foot

G. CESTARO[1], F. FASOLINI[2], L. REGUSCI[2], A. TORRE[2], M. DE MONTI[2]

SUMMARY: **NPWTid in the treatment of infected diabetic foot.**

G. CESTARO, F. FASOLINI, L. REGUSCI, A. TORRE, M. DE MONTI

Negative Pressure Wound Therapy with instillation therapy and dwelling time (NPWTid) represents a good tool to treat severely infected non-healing wounds. This topical treatment consists of negative pressure and retrograde instillation of antiseptic/antibiotic solutions into the wound surface, to promote cleansing and consequently the healing process. We reported our initial experience (five cases) in the treatment of severely infected diabetic foot, that can be considered a life-threatening condition. In our case reports, patients presented with clinical signs and symptoms of severe sepsis. Our treatment based on multidisciplinary approach (surgical, NPWTid, interventional radiology, skin grafts) had satisfying results. NPWT represented an important support to treatment of these diabetic patients.

KEY WORDS: NPWTid - Diabetic foot - Non healing wounds.

Introduction

Negative Pressure Wound Therapy with Instillation therapy and Dwelling time (NPWTid) is a modification of conventional NPWT. It is revealed useful in the treatment of acute and chronic wounds after initial surgical debridement (1). This modified topical treatment consists of the retrograde instillation of an antiseptic / antibiotic substance or saline solution and then the dwelling period (interruption of negative pressure), i.e. the time the solution needs to be effective, usually 4-20 minutes. The first publications about NPWT with instillation appeared in the year 1998 (2). Since initial experience, several improvements of method occurred. Nowadays it is possible to obtain a computer-controlled therapy, characterized by an automatic control of the instillation therapy, including the amount of solution, instillation and dwelling times, frequency of cycles (1. instillation - 2. solution action - 3. suction and wash -out). During the vacuum phase (i.e. suction and wash out), the therapeutical solution is removed together with the wound exudate and detritus by negative pressure, that is most often set from - 75 to - 125 mmHg (Figure 1). NPWTid is usually 7-14 days long (3). Specific application of NPWTid can be represented by diabetic ulcers' treatment. Indeed, diabetes is related to severe complicated lesions of the limbs: ulcers, neuropathic foot, neuro-ischaemic foot, skin anomalies (4). First guidelines for the use of NPWT in diabetic lesions were published in the year 2004 (5). NPWT improved management of this kind of patients: time-consuming and painful dressing changes are reduced by this approach. Moreover, several randomized controlled trials showed an increased wound healing rate, a shortening of wound healing time and a reduction of minor and major amputations in diabetic foot ulcers treated by NPWT when it is compared to traditional dressings (6). Actually, NPWT determinates a stimulation of granulation tissue formation, wound exudate control and then secondary intention healing of these difficult-to-treat ulcers. Introduction of instillation represents an important adjunctive tool in the

[1] Unit of General Surgery, ASL Caserta, PO "Moscati", Aversa (CE), Italy
[2] Department of Surgery, "Ente Ospedaliero Cantonale", Regional Hospital "Beata Vergine", Mendrisio, Svizzera

Corresponding author: Giovanni Cestaro, e-mail: giovacestaro@gmail.com

Figure 1 - NPWTid treatment.

management of diabetic foot. NPWTid can be very useful to support the multidimensional treatment strategy of diabetic foot lesions, also in severely complicated cases. Some reports about instillation therapy also based on insulin solution in diabetic lesions are in literature (7). We report 5 examples of infected diabetic foot successfully treated by extensive surgical debridement and prolonged NPWTid.

Case report

Patients and methods

All patients presented at our Department with clinical signs and symptoms of severe sepsis: laboratory data were characterized by hyper-serum creatinine concentration (acute renal failure), elevation of hepatic enzymes (hepatic failure), impairment of coagulation activity (reduced PT, increased PTT and INR) and elevation of WBC (White Blood Cell) and CRP (C-reaction protein) because of a Systemic Inflammatory Response Syndrome (SIRS). At physical examination all the patients presented severely compromised diabetic foot, with wide necrotic areas and radiological aspects of osteomyelitis. Two patients presented all features typical of Multiple Organ Failure (MOF). The therapeutic approach was based on aggressive surgical debridement with removal of necrotic and infected tissue, application of NPWTid with Octenidine instillation for a period from 6 to 8 days and then traditional NPWT cycles. During this therapy, 3 patients was submitted to percutaneous angioplasty (PTA) finalized to revascularization of stenotic arterial tracts localized by Doppler-US scan of the limbs. After that a planned reconstructive surgery was performed: 4 split-thickness skin grafts, with previous dermal matrix implantation in 2 patients, and direct suture of wound in 1 patient, resulting in a 4-fingers foot.

Ozono-therapy was performed during postoperative period (7 to 43 instillations) in 3 patients. Recovery time to walk was variable from 21 to 90 days for all patients, with a specific Talus shoe characterized by posterior pressure point. Overall healing time of the wounds was variable from 3 to 9 months.

Results

Results are showed in the following synopsis scheme:

Case 1 (Figures 2, 3, 4)

M.Z., 62 years old: plantar abscess secondary to infected cutaneous lesion depending on burn injury:

NPWTid for 8 days (50 ml Octenidine for 3 min every hour)
NPWT for 55 days
Percutaneous angioplasty performed
Split-thickness skin graft with about 85% healing
Walking recovery with Talus shoe 90 days after the first surgical procedure
Complete healing of the wounds after 9 months.

Case 2 (Figures 5, 6, 7)

P.R., 78 years old: dorsal abscess in patients affected by diabetes, atherosclerotic vascular disease and multiple gouty tophi:

NPWTid for 7 days (16 ml Octenidine for 5 min every 2 hours)

Figures 2, 3, 4 - Case 1.

Figures 5, 6, 7 - Case 2.

NPWT for 33 days
Percutaneous angioplasty performed
Dermal matrix implantation (two times) and then split-thickness skin graft with about 60% healing

NPWT portable for 100 days
Walking recovery with Talus shoe 130 days after the first surgical procedure
Complete healing of the wounds after 8 months,

Case 3

T.E., 81 years old: plantar abscess (5th metatarsal region) depending on bedsore in patient affected by diabetes and atherosclerotic vascular disease:

NPWTid for 6 days (12 ml Octenidine for 3 min every 5 hours)
NPWT for 26 days
Percutaneous angioplasty performed
Dermal matrix implantation and then split-thickness skin graft with about 60% healing
Walking recovery with Talus shoe 30 days after the first surgical procedure
Ozono-therapy 43 instillations
Complete healing of the wounds after 7 months.

Case 4

E.G., 37 years old: left forefoot completely necrotized in patient affected by severe diabetes:

NPWTid for 8 days (10 ml Octenidine for 4 min every 5 hours)
NPWT for 19 days
Split-thickness skin graft with about 80% healing
Walking recovery with Talus shoe 45 days after the first surgical procedure
Ozono-therapy 7 instillations
Complete healing of the wounds after 4 months.

Case 5

M.M., 63 years old: septic forefoot secondary to plantar mal perforans in patient with severe diabetes:

NPWTid for 5 days (18 ml Octenidine for 4 min every 5 hours)
NPWT for 5 days
Direct suture of the wounds
Walking recovery with Talus shoe 21 days after the first surgical procedure
Ozono-therapy 10 instillations
Complete healing of the wounds after 3 months.

Discussion

Infected diabetic foot can be a threatening-life condition that must be treated in emergency surgical setting. Large infected ulcers, plantar abscesses and / or foot osteomyelitis represent pathological conditions that can promote septic shock onset (8). Consequently, a complicated diabetic lesion is properly treated by prompt and aggressive surgical approach. After the debridement, wound management is based on local and systemic antibiotic therapy, exudate removal and an accurate perilesional skin care (9). In our opinion, contrarily to traditional NPWT that is not indicated in case of infected wounds, NPWTid improve diabetic wound management because the regulated instillation of antiseptic/antibiotic solution and wash out guarantees a continuous and appropriate wound cleansing. Moreover, it is important to remember that several scientific data demonstrated reduction of minor and major amputation rate by NPWTid in diabetic foot (10). Surgical debridement is fundamental because it has a role to remove adequately necrotic tissue, fibrin edges, slough, pus, biofilm. Indeed, these non-healing wounds features represent contraindications to start a negative pressure therapy. Diabetic foot treatment must be based on the multidisciplinary approach. For this reason, in adjunct of surgical debridement and NPWTid, an accurate vascular assessment (by Doppler- Guided US and/or angiography), a precise bone study (by radiography/TC and/or MR) and a rigorous glucosemetabolismregulation are necessary tools to obtain a correct management of diabetic foot and significantly improve diabetic wound healing rates (11).

References

1. Aycart MA, Eble DJ, Ross KM, Orgill DP. Mechanisms of Action of Instillation and Dwell Negative Pressure Wound Therapy with Case Reports of Clinical Applications. Cureus. 2018 Sep 27;10(9):e3377.
2. Fleischmann W, Russ M, Westhauser A, Stampehl M. Vacuum sealing as carrier system for controlled local drug administration in wound infection. Unfallchirurg. 1998;101(8):649-54.
3. Peinemann F, Labeit A. Negative pressure wound therapy: a systematic review of randomized controlled trials from 2000 to 2017. J Evid Based Med. 2018 Nov 20.
4. Liu S, He CZ, Cai YT, Xing QP, Guo YZ, Chen ZL, Su JL, Yang LP. Evaluation of negative-pressure wound therapy for patients with diabetic foot ulcers: systematic review and meta-analysis. Ther Clin Risk Manag. 2017 Apr 18; 13:533-44.
5. Armstrong DG, Attinger CE, Boulton AJ, Frykberg RG, Kirsner RS, Lavery LA, Mills JL. Guidelines regarding negative wound therapy (NPWT) in the diabetic foot. Ostomy Wound Manage. 2004 Apr;50(4B Suppl):3S-27S.

6. Liu Z, Dumville JC, Hinchliffe RJ, Cullum N, Game F, Stubbs N, Sweeting M, Peinemann F. Negative pressure wound therapy for treating foot wounds in people with diabetes mellitus. Cochrane Database Syst Rev. 2018 Oct 17;10:CD010318.
7. Scimeca CL, Bharara M, Fisher TK, Kimbriel H, Mills JL, Armstrong DG. Novel use of insulin in continuous-instillation negative pressure wound therapy as "wound chemotherapy". J Diabetes Sci Technol. 2010 Jul 1;4(4):820-4.
8. Mishra SC, Chhatbar KC, Kashikar A, Mehndiratta A. Diabetic foot. BMJ. 2017 Nov 16;359: j5064.
9. Sinwar PD. The diabetic foot management - recent advance. Int J Surg. 2015 Mar; 15:27-30.
10. Khamaisi M, Balanson S. Dysregulation of wound healing mechanisms in diabetes and the importance of negative pressure wound therapy (NPWT). Diabetes Metab Res Rev. 2017 Oct;33(7).
11. Blume P, Wu S. Updating the Diabetic Foot Treatment Algorithm: Recommendations on Treatment Using Advanced Medicine and Therapies. Wounds. 2018 Feb;30(2):29-35.