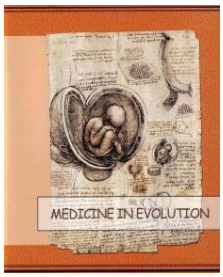
Negative pressure wound therapy in orthopaedic surgery



Hogea B.G.[1,2], Voiculescu M.A.[1], Sandesc M.A.[1,2], Misca L.C.[1], Patrascu J.M.[1,2], Patrascu R.[2], Ilie C.A.[2], Patrascu Jr. J. M.[1,2]

[1]*Department of Orthopedics and Trauma SCJUPBT*
[2]*Victor Babes University of Medicine and Pharmacy, Eftimie Murgu Sq., 300041 Timisoara, Romania*

Correspondence to:
Name: Mihai Alexandru Sandesc
Address: Street Orhideea 12A,Town Giroc, County Timis, Country Romania
Phone: +40 744300745
E-mail address: sandesc.mihai@umft.ro

Abstract

Negative wound pressure therapy (NPWT) is a popular method used for the management of acute and chronic wounds. Its use is widespread in surgical specialties that use NPWT to varying degrees as part of their arsenal against high-risk wound injuries. The use of this method in orthopedics is diverse and includes: management of acute traumatic wounds, wounds resulting from surgical therapy, management of bedsores, management of infected or dehiscent wounds.

This paper is based on a retrospective study in order to provide current information related to the use of negative pressure therapy in orthopedic pathology, to report the effectiveness of this method of treatment depending on the duration of wound healing, the success rate of surgery and reducing complications.

Keywords: Negative pressure therapy, orthopedic pathology, support in wound treatment

INTRODUCTION

NPWT was originally promoted in 1989 by Charker et al. [8] which described a suction drainage system used in the management of skin incisions and fistulas. The system described by them was different from the devices used today, because it used as an absorbent material for filling the wound, cotton gauze, connected to a vacuum that sucks at pressures of 60-80 mmHg. Charker et al. considered that their system is effective in promoting fluid drainage, helping to form granular tissue and reduce skin lesions.

Despite the growing popularity of NPWT in the last two decades, there are a small number of studies proving the superiority of this method. Also, wound healing is a complex process, affected by both local and systemic factors, related to the general condition of the patient, so the results after using NPWT vary from one patient to another.

Aim and objectives

The aim of this study is to highlight the effectiveness of NPWT negative pressure wound therapy as a therapeutic aid, a viable solution in the modern treatment of complicated wounds in orthopedic surgery.

The main objective of this study is to use NPWT for the curative purpose of complicated wounds. Although the exact mechanism of NPT's action on wound healing is still an active area of research, evidence suggests that it is achieved by removing edema, increasing blood circulation, reducing bacterial bio-load, ensuring a moist wound healing environment and increasing granulation and tissue formation.

MATERIAL AND METHODS

This study was performed at the Orthopedics - Traumatology Clinic II of SCJUPBT and is a retrospective observational study. The study aims at the use of NPWT in orthopedic pathology performed on hospitalized and treated cases, for a period of 2 years, between January 1, 2017 and January 1, 2019, in the Orthopedics-Traumatology II clinic within the County Emergency Clinical Hospital "Pius Brânzeu" Timisoara, the studied group being represented by 28 patients. The study includes patients belonging to both sexes, with both urban and rural backgrounds, and ages between 18 and 82 years, who underwent surgery. In carrying out the paper, a series of correlations were followed, the most important being the following:

- Personal data of patients (sex, environment of origin)
- The type of trauma suffered and the anatomical location;
- NPWT and open fractures;
- NPWT and arthroplasties complicated by infections;
- The degree of complications and the duration of treatment

RESULTS

Regarding the distribution of cases by sex and environment of origin, we can see a predominance of male patients(16 out of a total of 28) from urban areas. In this category are included both cases of implants / prostheses complicated with infections, as well as patients who suffered soft tissue injuries with a lack of substance or open fractures.

Table I. Distribution of cases according to the type of lesions

	Cases	Value
Dehiscent wounds	5	17,8%
Open fractures	6	21,4%
Infected wounds	7	25%

	Cases	Value
Post-arthroplasty hip infection	3	10,7%
Post-knee arthroplasty infection	3	10,7%
Wounds with a great lack of substance	4	14,2%

With reference to the distribution of cases according to the type of lesions (fig. IV) for which NPWT was used, an approximately uniform distribution could be observed, most cases being cases complicated by infections or cases with an increased risk of complication by infections; we can observe a slight predominance of NPWT use in postoperatively infected wounds and in the case of open fractures. Arthroplasties complicated by infections can also be classified as infected wounds.

Table II. Correlation between the type of lesion and the anatomical location

Location	Arm	Forearm	Hip	Thigh	Knee	Calf	Ankle	Total
Wound with great lack of substance	0	1	0	0	0	3	1	5
Open fractures	1	0	0	2	0	2	2	7
Infected wounds	1	0	1	2	1	0	1	6
Dehiscent wounds	0	0	1	1	2	0	0	4
Post-arthroplasty hip infection	0	0	3	0	0	0	0	3
Post-knee arthroplasty infection	0	0	0	0	3	0	0	3
Total	2	1	5	5	6	4	4	28

Table III. Distribution of horses for which NPWT was used and location

Location	Number of cases	Value
Upper limb	3	10,7 %
Lower limb	25	89,2 %

In terms of anatomical location, most cases for which NPWT was used were located in the lower limb, totaling 25 cases out of the 28 studied. Most cases were located in the knee (6 cases) and hip (5 cases) and included both arthroplasties complicated by infections, dehiscent wounds or infected wounds. At the level of the leg, the wounds with a great lack of substance predominated, and at the level of the ankle, most of the cases were of open fractures for which NPWT was used. It should be noted that the indication for the use of secondary suture or grafting as a complementary technique in the management of these lesions is based on several factors. For the management of lesions with large defects of substance, with the exposure of bone or ligaments or for the management of open fractures, grafting was mainly used as a complementary technique. Also for some cases of complicated arthroplasties due to infection, grafting was used because after extensive debridement, the resulting defect was too large to allow secondary suturing, especially at the knee where the skin tensions are very high. In most infected wounds and for all cases of dehiscent wounds, the secondary suture was used as the final procedure in the management of these patients.

Table IV. The relationship between the complementary procedure used and the severity of the injuries

		Secondary suture	Skin graft/Flap	Total
Type of Wound	Wounds with a great lack of substance	0	3	3
	Open fractures	2	4	6
	Infected wounds	6	1	7

		Secondary suture	Skin graft/Flap	Total
	Post-arthroplasty hip infection	2	1	3
	Post-knee atroplasty infection	2	2	4
	Dehiscent wounds	5	0	5
Total		17	11	28

The duration of use of NPWT in orthopedic practice in the present study was between 7 and 28 days, depending on the type of lesions and their size. The lesions for which NPWT was used for a longer period were arthroplasties complicated by infections and lesions with residual infections. For the rest of the cases of open fractures, dehiscent wounds or wounds with severe lack of substance, the duration of use of NPWT did not exceed 14 days. The average duration of use of NPWT in orthopedic practice was about 17 days.

Table V. Duration of use of NPWT depending on the type of lesions

		Duration of NPWT use					
		7 days	10 days	14 days	21 days	28 days	Total
Type of Wound	Wounds with a great lack of substance	2	1	1	0	0	4
	Open fractures	0	4	2	0	0	6
	Infected wounds	0	1	0	4	2	7
	Post-arthroplasty hip infection	0	0	0	1	2	3
	Post-knee atroplasty infection	0	0	0	1	3	4
	Dehiscent wounds	2	1	1	0	0	4
Total		4	5	4	5	6	28

Frequency of complications

Of the 28 cases included in this study and for the management of which NPWT was used, only 3 cases presented complications, the complications being of a septic nature. The 3 complicated cases were represented by a case with open fracture and a case with a wound with a lack of large substance, in both cases being present bone exposure and massive contamination. Following antibiotic therapy and prolonged use of NPWT, the evolution of the 3 cases was favorable.

Table VI. Frequency of complications following the use of NPWT

	Cases	Value
Without complications	25	89,2%
Septic complication	3	10,8%
Total	28	100%

Table VII. Distribution of complications depending on the type of lesions

		Without complications	Septic complication	
Tipul plăgii	Wounds with a great lack of substance	2	1	3
	Open fractures	4	1	5
	Infected wounds	6	0	6
	Post-arthroplasty hip infection	3	0	3
	Post-knee atroplasty infection	3	0	3
	Dehiscent wounds	4	0	4
Total		22	2	24

DISCUSSIONS

Limb wounds are usually associated with significant loss of soft tissue, exposure of the implant, bones, tendons and are difficult to treat, the risk of complications being high. Favoring local vascularization and rapid formation of granulation tissue are essential for the uncomplicated healing of these lesions. In fact, lesions in the lower limbs often require the use of skin grafts or flaps to cover defects, and in order to use these complementary methods of treatment we need the presence of granulation tissue, the use of NPWT speeding up this process.

Use of NPWT in infected wounds - According to the study by Stannard et al. [8] the risk of complications from infections in patients treated with NPWT is 5 times lower than the risk of infection in patients who have used conventional dressings. Sinha et al [1] also reported a significant reduction in positive bacterial cultures in patients receiving NPWT. Although these results are encouraging, there are divided opinions regarding the ability of NPWT to reduce the bacterial load on the lesions.

Use of NPWT in open fractures - In the case of open fractures, there is a very high risk of complications due to infections or of not consolidating, which causes a high morbidity. According to the literature, in the case of open tibial fractures there is an 8-12% risk of complications from infections.

Blum et al. [2] conducted a retrospective study comprising 229 cases of open tibial fractures, of which 72% of cases benefited from NPWT and 28% of cases of conventional dressings. They found a significantly lower infection rate in the NPWT group (8.4%) compared to the conventional bandage group (20.6%). They also noted that NPWT reduces the risk of deep infections by 80%.

In the present paper we recorded the use of NPWT in 6 cases of open fractures, of which only 2 cases had complications. In a study published by Stannard et al. [8] performed on 62 patients with open fractures and who aimed to compare the results after management with NPWT (37 patients) or with classic sterile dressings (25 patients), the following results were obtained: - incidence rate of complications in patients receiving conventional dressings was much higher than the rate of complications in patients receiving NPWT; - in the group of patients who benefited from conventional dressings, 2 cases of acute infections and 5 cases of infections with delayed evolution were reported; - in the group of patients who benefited from NPWT, 2 cases of infections with delayed evolution and no case of acute infections were reported.

Use of NPWT in complicated arthroplasties - Intraarticular septic foci continue to be a serious problem in orthopedic surgery and are extremely difficult to treat due to the poor penetration of antibiotics at this level.

Kelm et al. [5] reported the eradication of infections that complicated arthroplasties in 9 of the 10 cases included in the published study. Also, Kirr et al. [4] reported favorable results in 3 cases of infected hip arthroplasties benefiting from NPWT. In another study published by Ludeman et al. [3] involving 17 patients who received NPWT, persistence of infection or reinfection was reported in 8 of the 17 cases (47%).

Clinical Case

Use of NPWT 14 days associated with soft tissue coating as a complementary technique; 23-year-old patient; the victim of a road accident; open fracture Gustilo Anderson III A left ankle; in the following images (fig. X, XI, XII, XIII) the evolution of the case is presented.

Figure 1. The appearance of the lesion after the physico-chemical wound therapy

Figure 2. Application of NPWT

Figure 3. Appearance at 21 days of NPWT use

Figure 4. The final result after complementary surgical treatment

CONCLUSIONS

- Wound healing is a complex process, affected by both local and systemic factors, related to the general condition of the patient, so the results after using NPWT vary from one patient to another;
- To identify the independent effect of NPWT, a large number of cases are needed to reduce the effect of patient-dependent factors;
- There are a small number of studies proving the superiority of NPWT in terms of efficacy compared to the use of conventional dressings;
- The main mechanisms by which NPWT acts are: -macrodeformation; -microdeformarea; -removal of fluids (drainage); -modifying the healing environment;
- Side effects of NPWT use are: -hemostasis; - modulation of inflammation; -stimulating cell division, differentiation and migration; - stimulation of angiogenesis; -stimulating the formation of granulation tissue; - changes in microbiosis
- The general interpretation of the various studies is that NPWT can promote healing by modulating inflammation and cell migration, while inhibiting epidermal development and maturation;
- Following the use of NPWT, it was observed the reduction of the wound dimensions and the acceleration of the granulation tissue formation, thus being possible to cover with grafts or flaps the defects as early as possible

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