



**COMBINING NEGATIVE –PRESSURE WOUND THERAPY WITH 10% SOLUTION OF  
SODIUM CHLORIDE IN MANAGING LARGE POSTTRAUMATIC WOUND: A CASE  
REPORT**

Nedim Mujanović<sup>1\*</sup>, Benjamin Kaknjašević<sup>1</sup>, Aldin Šahinović<sup>1</sup>, Mirza Tursum<sup>1</sup> and Mirza Gačanin<sup>2</sup>

<sup>1</sup>Department of Orthopedic and Trauma Surgery, University Medical Centre, Sarajevo, Bosnia and Herzegovina.

<sup>2</sup>Department of Surgery, General Hospital Konjic, Bosnia and Herzegovina.



\*Corresponding Author: Dr. Nedim Mujanović

Department of Orthopedic and Trauma Surgery, University Medical Centre, Sarajevo, Bosnia and Herzegovina.

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**ABSTRACT**

Negative-pressure wound therapy (NPWT) is known for improving a wide range of acute and chronic wounds. NPWT boosts the wound healing process by removing fluid and drawing out the infection from a wound, promoting the growth of new tissue. The treatment aims to prepare wounds for further surgery, reduce the rate of infection, and potentially decrease the time of wound healing. NPWT device works by providing and distributing negative pressure evenly across the wound bed, either through the application of an open cell foam or a gauze dressing. It provides a warm, moist wound bed while removing wound fluid that contains factors that inhibit cell growth, enhances wound oxygenation and improves the flow of blood and nutrients to the wound. For infected wounds, the device can be used to apply antibiotics. Broadly used 0.9% sodium chloride solution, also known as normal saline, is used for a variety of medical purposes, including: rehydration of patients who are dehydrated due to illness or injury, replacing fluids lost during surgery or other medical procedures, diluting medications that will be given intravenously, flushing and cleaning wounds or body cavities, maintaining catheter patency. In this article, a 70-year-old woman sustained a fall on her left knee, following a large defect in her left knee region. A NPWT and a solution of 10% sodium chloride were applied to the wound intermittently during a 10 week-period in the successful management of this patient.

**KEYWORDS:** Negative-pressure wound therapy, NPWT, Sodium chloride, Wound healing.

**INTRODUCTION**

NPWT is a general term used to describe a system that promotes wound healing through the application of sub-atmospheric pressure to help reduce inflammatory exudate and promote granulation tissue. Usage of NPWT is broad, can be used for healing acute and chronic wounds, ranging from open fasciotomy wounds and diabetic foot ulcers to closed surgical incisions.<sup>[1]</sup> The concept evolved since its first use in the 19<sup>th</sup> century.<sup>[2]</sup> In 1997 Argenta and Morykwas described the efficacy of NPWT system in their publication.<sup>[3]</sup> There are a number of systems now available on the market with a similar design. It includes a base unit pump to provide negative pressure, a canister to collect wound drainage, and a tube that connects it to the sealed wound.<sup>[4]</sup> NPWT works at the microscopic level by creating tension that produces cellular proliferation, increased vascularity, mechanical stresses, and changes in cell signaling. All of the above facilitates favorable wound bed characteristics for healing.<sup>[5,6]</sup> Detailed mechanism of action is consisted of : macrodeformation of the wound in which the wound

edges are brought closer together by the suction distributed through the foam sponge. The last reduces the space required to be healed by primary closure or secondary granulation; Microdeformation of the wound surface at the microscopic level. Computer models have shown that NPWT produces 5-20% strain across the healing tissues, that promotes cell division and proliferation, growth factor production and angiogenesis;<sup>[7]</sup> Extraction of oedematous fluid and exudate from the extracellular space, removing inflammatory mediators and cytokines whose prolonged effect can hinder the ability of the microcirculation to support damaged tissue; Warm and moist environment that prevents desiccation of the wound and enhances formation of granulation tissue.<sup>[8]</sup>

Soaking wounds in high concentration of sodium chloride with osmotic salt properties can provide a drying effect on the wound so that the growth of new tissue accelerates skin contact more quickly.

*Streptococcus aureus* is unable to survive on sodium chloride, which has a concentration of 7% or higher.<sup>[9]</sup>

### CASE REPORT

A 70-year old woman weighing 92kg presented to our department 9 days after she had fell on her left knee. On examination her left knee was swollen with a hematoma on her left lower thigh and her left knee, and an area of skin necrosis medial to patella, with a diameter of 12cm. Her left knee ROM was decreased due to pain. X-ray showed no fracture in her left knee area. The patient's past medical history included hypertension, hyperlipidemia and hypothyroidism, and she had no allergy recordings.

Afer admitting the patient to our department, we made a preoperative assessment and put the patient on clindamycin and ciprofloxacin. Detailed necrectomy was done in the operating room. A necrectomy revealed a defect of skin and subcutaneous tissue 12cm in diameter with 3cm in depth, and no damage to left knee joint (Fig.1a). Intraoperative wound swab for culture and sensitivity showed growth of *Staphylococcus epidermidis*, with no etiological significance. Postoperatively we applied NPWT to the wound. NPWT system is made of several components which include a vacuum system, a connecting tube, a semi-permeable

dressing to isolate the wound environment and allow the vacuum system to transmit sub-atmospheric pressure to the wound surface, and a sponge made of the polyurethane black hydrophobic foam compiled of many cells that are highly interconnected and have an average pore size of 400 to 600  $\mu\text{m}$ . A sponge is placed into the wound and it allows extensive fluid drainage and stimulates granulation tissue formation. This permits the vacuum to be distributed evenly throughout the foam and improves drainage. Pressure applied through NPWT system was -120 mmHg, and the mode was continuous. On the recommendation of an infectious disease specialist, we excluded dual antibiotic treatment and put the patient on trimethoprim-sulfamethoxazole orally. The NPWT system was changed every three to four days, with a one day break in between, which has been used to apply a solution of 10% sodium chloride to the wound. The 10% sodium chloride solution in this study was made in a liquid to wash the wound, which provides wound drying and anti-bacterial properties, so the wound healing process becomes faster. Wound swabs for culture and sensitivity in between the NPWT changes showed no growth. Healthy and clean granulation tissue was formed after 7 cycles of NPWT (approximately 4 weeks), which was then excluded. We continued to apply a solution of 10% sodium chloride to the wound during the next 6 weeks until complete healing. (Fig.1)



**Fig. 1: Wound after: a. 4 days of treatment; b. 2 weeks.; c. 4 weeks; d. 7 weeks; e. 8 weeks; f. 10 weeks.**

### DISCUSSION

NPWT system is used routinely for open wounds, such as open fractures, fasciotomies, ulcers, and infected wounds. Often addressed as VAC (Vacuum-Assisted Closure), this system is only effective if applied correctly by trained individuals. It is usually performed in the operating room, given the fact that the wounds usually require debridement and a washout in a sterile environment.

A number of studies have compared NPWT with WTD (wet to dry) dressings. Stannard *et al.*<sup>[9]</sup> studied 62 severe high-energy open fractures, all receiving an initial irrigation and debridement and returning to theatre every 48-72 hours until wound closure. 37 fractures were randomised to interval NPWT and 25 had standard fine mesh gauze dressing. The NPWT group showed significantly less infections than the control (0 acute and 2 delayed versus 2 acute and 5 delayed,  $p=0.024$ ). Of the entire study group of 58 patients, 21 had either a

rotational, free flap or skin graft; but the infection rate in this group was not separately analysed.

The effect of NPWT on bacterial load remains controversial. Some studies have shown a reduced bacterial load in response to NPWT, and some studies have shown comparable levels between treatment and control groups, comparing foam dressings with and without suction, respectively.<sup>[10]</sup>

A meta-analysis by Semsarzadeh *et al.*<sup>[11]</sup> examining 14 manuscripts utilizing NPWT and incidence of infection found that the use of NPWT decreased the rate of surgical site infections.

While evaluating chronic diabetic, arterial, and venous ulcers in high-risk patients, in a retrospective cohort study, Huang *et al.*<sup>[12]</sup> found that treatment with NPWT increased closure incidence. In this study he also found that high bacterial levels have been measured in sonicated foams, and that porous polyurethane ether

foam on high suction pressure had fewer bacteria than polyvinyl alcohol foams on lower suction pressure. Hasan *et al.*<sup>[13]</sup> found that NPWT may protect the amputation of digits in the treatment of scleroderma ulcers.

There are few studies that talk about impact of high concentrations of sodium chloride solution on wound healing. In a study conducted by Samidah *et al.*<sup>[14]</sup> they revealed that a higher concentration of sodium chloride soaking could increase the effectiveness of wound healing.<sup>[9]</sup>

The decision to use any new medical technology must include a cost assessment. NPWT management of a wound requires some higher costs for the materials that include the sponges, occlusive drapes, and the vacuum machine. Two recent studies found the cost effectiveness to be comparable to traditional wound therapy with clinical benefits.<sup>[15,16]</sup>

## CONCLUSION

NPWT has proven to be a revolutionary breakthrough in wound management. Wounds that previously were hard to deal with or were in a chronic, nonhealing state have become manageable. Wounds with exposed bone, tendon, or hardware also have been managed successfully. There appears to be a reduction in the rate of infection, but whether this is due to a decrease in nosocomial infection or due to the environment created by the NPWT is unclear and there may be a difference in effectiveness across types of bacteria. Further research should demonstrate whether NPWT can improve wound healing or reduce the impact of a postsurgical wound complication. Not least, there is open space for studies to explain impact of high concentrations of sodium chloride in wound healing. In conclusion, NPWT combined with solution of 10% sodium chloride should be considered an important part of the wound healing process for any surgeon dealing with wounds.

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