Effect of Transdermal Continuous Oxygen Therapy on four wounds after treatment with Negative Pressure Wound Therapy

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PURPOSE

The purpose of this case series of 4 patients was to determine the effect of Transdermal Continuous Oxygen Therapy (TCOT) on wounds that became "stuck" and did not close following treatment with Negative Pressure Wound Therapy. (NPWT)

INTRODUCTION

Negative Pressure Wound Therapy (NPWT) has been utilized as an adjunctive therapy in Chronic wound management for various etiologies[1]. The literature has indicated that NPWT can accelerate wound healing by various mechanisms including: removal of exudate, reduction of edema, contraction of wound edges, stimulation of angiogenesis, changes in the wound edges, and the production of granulation tissue[2]. Initially, Negative Pressure Wound Therapy (NPWT) was intended as a means of bringing a recalcitrant wound to a manageable state by increasing granulation[3].

Nonetheless, wounds treated with NPWT can "stall" or get stuck during treatment, i.e., they fail to close after an initial improvement and sometimes another solution may be needed to close the wound[4]. A recent consensus group has listed a number of reasons to discontinue NPWT and they include: a failure to improve, complications – such as excessive bleeding, significant periwound maceration and when patient cannot tolerate pain[4]. One solution that has been shown to be effective is to add oxygen to the wound after wound healing has stalled in the presence of NPWT. The role of oxygen is multifaceted in wound healing and is well documented in the literature[5]. The mechanisms of oxygen in wound healing include: acting as a infection control agent, stimulation of growth factors, assisting collagen synthesis and fibroblast proliferation, stimulation of angiogenesis. Oxygen also plays an essential role in energy metabolism, and is important for polymorphonuclear cell function[6].

Oxygen can be applied to a wound in 3 different ways; via HyperBaric Oxygen Therapy (HBOT) Topical Oxygen and TCOT.

HBOT

HBOT conditions allow blood plasma to transport oxygen to various parts of the body provided that adequate circulation exists. 5 RCTs exist for HBOT and the strongest evidence in favour of HBOT points to its efficacy in healing diabetic foot ulcers[7]. However, HBOT has some significant drawbacks and risks including, claustrophobia, damage to the ears, sinuses and lungs, oxygen poisoning and of course the requirement to be transported to the facility each day to be placed in the chamber[7].

Topical Oxygen Therapy

Topical Oxygen is applied by enclosing the extremity with the wound in a plastic chamber and subjecting the limb to pure oxygen flow at approximately 6 Liters/minute, for up to 90 minutes per day, 3-5 times per week[8]. A research group at Ohio State University has published beneficial outcomes in both humans and animals[9]. In another study 80 patients with refractory non- healing- venous ulcers were treated with Topical Oxygen. After 3 months, 80% of the topical oxygen treated ulcers were completely healed compared to 25% in the control group[10]. However, Topical Oxygen includes some drawbacks and issues including, limb immobility, availability of oxygen for only short periods of time, patient must be stationary during treatment. Also, the wound may be in a location that does not allow it to be placed in the chamber.

TCOT

TCOT is delivered via a small 3 oz. fuel cell based oxygen concentrator. Whereas HBOT can produce vasoconstriction, toxicity and tissue destruction, TCOT may be a viable solution by providing oxygen transdermally and continuously[7]. Said et al have noted, as a potential alternative to systemic HBOT, transdermal oxygen delivery represents an easily applied and inexpensive option that can be incorporated into a wound dressing[11]. Further, every other option for oxygen treatment to date has been intermittent whether applied systemically or topically and although HBOT may have greater impact due to its systemic delivery, the continuous nature of TCOT may offset this benefit[7].

METHOD

In each case a clinical judgment determined that NPWT was no longer assisting the wound towards closure, or there was a contraindication that required a change in therapy modality. In the following 4 cases; at that clinical juncture, TCOT replaced NPWT.

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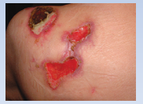
CASE 1

Coumadin Necrosis / Multiple Wounds —NPWT Stopped Due To Contraindication (Pain)

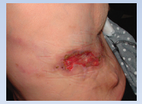
62 year old female, Coumadin treatment for 27 years; renal failure (dialysis), multiple necrotic wounds appearing and enlarging associated with extreme pain. NPWT attempted but stopped due to increased pain with vacuum start.


1 – Prior to EPIFLO® treatment


Week 2 EPIFLO® treatment


Week 3 EPIFLO® treatment


2 – Prior to EPIFLO® treatment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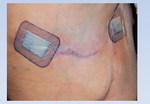

Week 3 EPIFLO® treatment

CASE 2

Neuropathic Heel Pressure Ulcer —NPWT Stopped Due To "Stalled" Healing

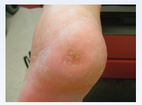
Removed with water jet debridement. Inpatient 1 week NPWT; Outpatient 12 weeks NPWT; ABPI Left 0.49; 59 year old male. Type I Diabetes, neuropathy, previous failed vascular graft on left leg with neuropathic / left heel pressure ulcer. 3.0 cm x 3.0 cm x 11 mm depth – wound bed filled with tenacious spongy slough severe circulatory impairment; NPWT after 13 weeks with initial reduction in size but wound became 'stuck' and would not improve (i.e. no change since Week 10).


Debridement prior to NPWT


NPWT applied


Week 13 NPWT


Week 1 EPIFLO® treatment


Week 5 EPIFLO® treatment

CASE 3

Neuropathic (IDDM) Toe Ulcer —NPWT Stopped Due To "Stalled" Wound + Maceration

55 year old male. Neuropathic Ulcer developed over 2 weeks before examination. NOTE: bone fragments present in original wound [periosteum breach - potential for osteomyelitis; subsequent bone scan = negative]


Neuropathic Ulcer as presented


NPWT treatment applied


Week 1 NPWT treatment


Week 5 NPWT treatment


Week 1 EPIFLO® applied


Week 2 EPIFLO® treatment


Week 3 EPIFLO® treatment

CASE 4

Trauma Injury / Deep Tissue Infection —NPWT Stopped Due To Contraindication (Blood in Tubing)

55 year old male. Smoker; no comorbidities; originated from left foot being broken by a logging accident. On NPWT as inpatient 9 days then outpatient for 2 weeks to reduce size of wound. Patient on anticoagulant with NPWT suction line showing presence of fresh blood - Switched to EpiFLO. Continuous antibiotics (Cipro/Clindamycin to control deep tissue infection).


Week 3 NPWT post treatment


Week 1 EPIFLO® treatment


Week 4 EPIFLO® treatment

CONCLUSIONS

We have reported four stalled and/or contraindicated NPWT-treated cases in this poster which have been successfully treated to closure with the help of TCOT. We also note other advantages based on publications and clinical experience including patient and clinician-friendly nature of the device, reduction or elimination of pain, delivery of pure oxygen at ambient humidity, flexible dressing choices and easy dressing removal. The highly portable unit, weighing only 3 oz. is available commercially and minimal training is required allowing patients and caregivers the convenience of assisting in the treatment of the wound.