CLINICAL OUTCOMES OF COLD ATMOSPHERIC PLASMA THERAPY FOR CHRONIC DIABETIC FOOT ULCERS, VENOUS LEG ULCERS, AND PRESSURE ULCERS

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INTRODUCTION

- Chronic wounds such as diabetic foot ulcers (DFUs), venous leg ulcers (VLUs), and pressure ulcers (PUs) are slow to resolve and impose significant clinical and economic burdens.
- Their prolonged course is frequently driven by impaired perfusion, chronic inflammation, microbial load, and patient comorbidities, which collectively limit responsiveness to standard care.
- Cold atmospheric plasma (CAP) has emerged as an adjunctive modality capable of generating reactive oxygen and nitrogen species that exert broad-spectrum antimicrobial activity while stimulating pathways involved in cellular repair, angiogenesis, and immune modulation.
- This study evaluated the early therapeutic effect and safety profile of CAP in individuals with long-standing, treatment-resistant ulcers.

METHODS

- A prospective 4-week case series enrolled 12 adults presenting with chronic DFUs, VLUs, or a pressure ulcer.
- Participants received twice-weekly CAP treatment delivered via portable device in addition to standard wound management.
- Wound area was digitally quantified at each weekly visit, and qualitative changes in bacterial burden were assessed using fluorescence imaging.
- The primary endpoint was percent area reduction (PAR), defined as >40% reduction for DFUs and VLUs and >10% for pressure ulcers.
- Safety was evaluated through monitoring of adverse events..

Table 1: Key Inclusion and Exclusion Criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
• At least 18 years of age • Presence of a DFU, Wagner 1 or 2 grade, extending at least through the dermis or subcutaneous tissue and may involve the tendon or muscle provided it is below the medial aspect of the malleolus. • Presence of a full-thickness VLU or PU without exposure of underlying tissues and free of non-viable tissue. • Surface area between 0.75cm^2 and 5.0cm^2 (DFU) • Surface area between 2.0cm^2 and 20.0cm^2 (VLU, PU) • Present for minimum of 4 weeks, treated with SOC • Has adequate perfusion	• Ulcer caused by a medical condition other than diabetes or venous disease or related to a pressure injury • Ulcer has a history of cancer or, in the opinion of the investigator, is suspicious for cancer. • History of more than 2 weeks of treatment with immunosuppressants, cytotoxic chemotherapy, or application of topical steroids to the ulcer surface • History of radiation at ulcer site • Active treatment of infection with IV antibiotics • Suspected or confirmed gangrene in affected limb • Previous treatment with HBOT, biologic treatment, or CTP within 30 days of enrollment • Known or suspected allergy to products

RESULTS

Table 2: Percent area reduction by wound type. Count (Percent)

WOUND TYPE	PAR >40%	PAR <40%
Diabetic Foot Ulcer	3 (50%)	3 (50%)
Venous Leg Ulcer	3 (60%)	2 (40%
	PAR >10%	**PAR <10%**
Pressure Ulcer	0	1 (100%)

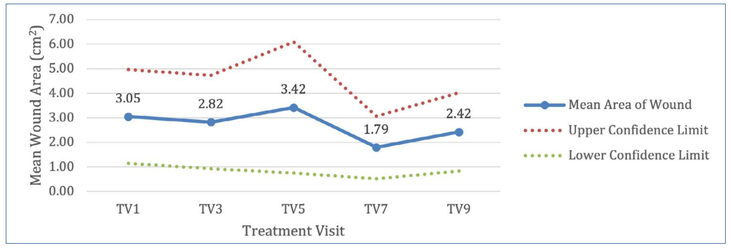

Figure 1. 95% Confidence interval of mean wound area (cm^2)

Across all ulcer types, the mean PAR was 21%. Among DFUs, 50% of subjects achieved >40% reduction, including one ulcer that fully closed before week 4. VLUs demonstrated similar responsiveness, with 60% meeting the >40% threshold. The single pressure ulcer did not reach the ≥10% PAR criterion but showed qualitative improvement in granulation tissue. Fluorescence imaging indicated decreased bacterial signal intensity in eight of twelve ulcers. CAP was well tolerated, with only one instance of transient periwound erythema reported.

Figure 2: DFU Case, SV vs TV-9/EOS
Baseline photo (left), fifth-week follow-up photo (right)

Figure 3: Pressure Ulcer TV-1(left) and EOS (right).

CONCLUSIONS

CAP administered with the portable device was safe and demonstrated early signals of clinical benefit when used alongside standard of care. The observed reductions in wound area and bacterial fluorescence support CAP's potential role as an adjunctive therapy for chronic, refractory ulcers. Larger, controlled studies are needed to determine optimal treatment parameters and confirm long-term efficacy.

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