Delivery of Oxygen to a Liquid Medium by a Novel Oxygen Delivery Device

Suleman, L., Moug, M., Westgate, S J.

Introduction

Intact skin supplies 5% of the body's oxygen requirements and oxygen is essential to all phases of wound healing. Without adequate oxygen levels, the required energy for healing damaged tissue and preventing infection cannot be generated. Novel technologies are being developed to facilitate oxygen delivery through external surfaces of the body. These devices are primarily aimed at chronic wounds which can have high levels of exudate, therefore determining to what extent oxygen can pass into liquid can determine whether supplementary oxygen is capable of entering the wound.

Aim

To determine the levels of oxygen produced by a novel Oxygen Delivery Device* and to assess the device's ability to deliver oxygen into a liquid medium.

Method

Oxygen Delivery Devices*(Figure 1) were connected to sealed, empty vessels and vessels containing tissue culture media. The level of oxygen produced by the device and the level transferred into liquid was measured over 24-hours and 72-hours respectively using a Mettler Toledo Seven2Go oxygen-sensing monitor then compared to zero hour readings. Testing was performed in triplicate.

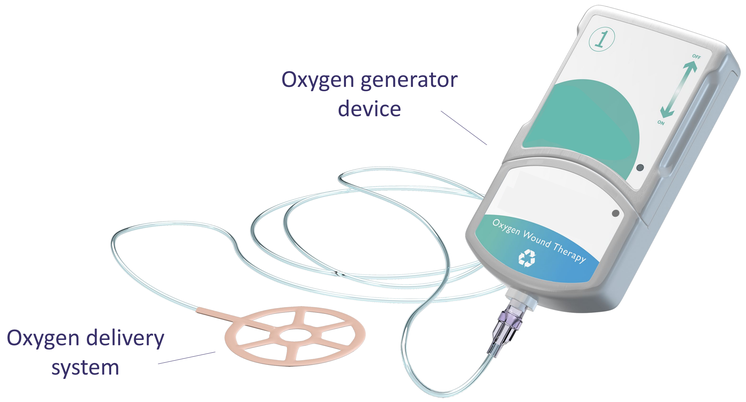

Figure 1. Oxygen Delivery System with Oxygen Generator.

Results

Following 1-, 3-, 5- and 24-hours treatment with the device, oxygen levels in the empty vessel increased by 11.56%, 36.58%, 59.97% and 198.32% respectively (Table 1, Figure 2). Following 24-, 48- and 72-hours treatment with the device, oxygen levels in the liquid media increased by 200.85%, 259.50% and 291.47%, respectively (Table 2, Figure 3).

Time (Hours)	Average oxygen increase within the flask (% ± SD)
0	0 ± 0.00
1	11.56 ± 0.14
3	36.58 ± 0.18
5	59.97 ± 0.10
24	198.32 ± 0.05

Table 1. Average increase in oxygen production in a T75 tissue culture flask, compared to zero-hour. SD = standard deviation. Measurements were taken in triplicate.

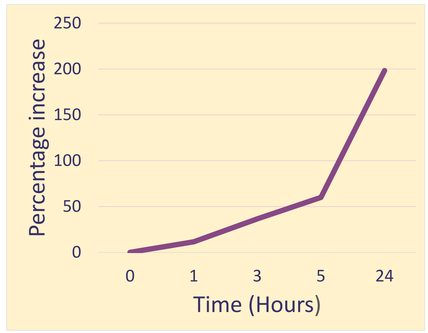

Figure 2. Average percentage increase in oxygen from the Oxygen Delivery Device* in a T75 tissue culture flask, compared to zero-hour. Measurements were taken in triplicate.

Time (Hours)	Average oxygen within liquid media (% ± SD)
0	0 ± 0.00
24	200.85 ± 0.70
48	259.50 ± 1.37
72	291.47 ± 0.27

Table 2. Average increase in oxygen in the liquid culture medium, compared to zero-hour (37°C ± 2°C and 5% CO_2). SD = standard deviation. Measurements were taken in triplicate.

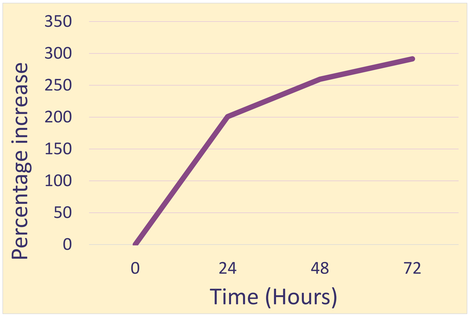

Figure 3. Average increase in oxygen production from the Oxygen Delivery Device* in the liquid culture medium, compared to zero-hour (37°C ± 2°C and 5% CO_2). Measurements were performed in triplicate.

Discussion & Conclusion

Restoration of macro- and micro-circulation to tissue surrounding a wound is essential for wound healing and the reconstruction of new vessels and connective tissues. Sustained oxygen at the wound site is vital to achieve this in patients' non-healing wounds. In this test model, the Oxygen Delivery Device* demonstrated consistent delivery of oxygen in the atmosphere and liquid medium. This suggested that the oxygen delivery device could deliver oxygen to the primary, exudate-rich layer of complicated wounds. Throughout the two experiments, triplicate data was highly reproducible with all standard deviation values below 1.37. The *in vivo* impact of this would need to be confirmed using further *in vitro* studies or clinical assessments.

References

Gottrup. F. 2017. Oxygen therapies for wound healing: EWMA findings and recommendations. Wounds International. Vol 8 Issue 4.

Ladizinsky, D. and Roe, D. 2010. New insights into oxygen therapy for wound healing. Wounds. Volume 22 Issue 12: 294-300.

Stücker, M. 2002. The cutaneous uptake of atmospheric oxygen contributes significantly to oxygen supply of human dermis and epidermis. Journal of Physiology. Volume 538 Issue 3: 985-94.

This project was carried out by Perfectus Biomed Ltd and funded by Inotec AMD Ltd.

Perfectus Biomed is an independent testing laboratory. Techspace one, Keckwick Lane, Cheshire, WA4 4AB Tel +441925 737 237,
E-mail info@perfectusbiomed.com

*NATROX® Oxygen Delivery Device