Introduction

Oxygen is fundamental to cellular life, and its absence causes cell senescence and death. It has been recognised for many years that without it, effective wound healing is not possible. The metabolic requirements of healthy skin are relatively low, but following the development of a wound, overall body metabolism must increase energy production by around 20% to heal a clean wound and 50% for infected wounds. Local cellular metabolism at the wound bed must increase by around 500% with the need to fight infection, generate new collagen, support cell division and enable epithelial cell migration. All of these vital processes are significantly impaired when wound oxygen concentrations are low. The presence of underlying morbidities such as arterial disease, diabetes, venous insufficiency and oedema mean that the majority of chronic wounds exhibit levels of hypoxia and therefore do not heal well.

The recognition of oxygen’s pivotal role in wound healing has led to the development of several therapies aimed at increasing wound oxygen levels. Whilst some of these have been effective at this, they have often failed to gain widespread utilisation because of issues relating to cost or patient acceptability. Continuous Oxygen Ambulatory Therapy (COAT) delivers a steady flow of sterile, humidified oxygen to the wound surface. The ambulatory topical oxygen device used in this study delivers continuous oxygen to the wound bed through a dressing, and employs a small battery-powered electrochemical oxygen generator to concentrate atmospheric oxygen.

The pure and moist oxygen is delivered at a rate of around 15 mL per hour through a fine soft tube to a dressing-like oxygen distribution system that is placed over the wound and held in place by an overlying conventional dressing. The oxygen generator is worn by the patient in a holster on the waist or above the calf, or can be placed in a trouser pocket, thereby enabling the patient to enjoy normal mobility whilst receiving continuous oxygen treatment.

This study was conducted at a specialist wound and trauma clinic run by Maccabi Healthcare Services in Israel and evaluated the use of the device in chronic and hard-to-heal wounds in several aetiologies.

Method

Ten patients were recruited from a specialist wound and trauma clinic that provides advice and treatment for complex non-healing wounds. All patients were treated in a primary care setting and the recruitment criteria required patients or carers to be able to manage the oxygen generator device and dressing changes unaided.

The basic exclusion criteria were as follows:

- Presence of infection
- Wound size greater than 10 cm by 10 cm
- Presence of malignancy.

The wounds were of various aetiology and included 4 venous ulcers, 2 post-radiotherapy skin reaction wounds, 2 pressure ulcers, 1 diabetic foot ulcer, and 1 mixed aetiology leg ulcer.

The overlying dressing was standardised across the patient group, with a hydropolymer dressing used in all cases.

Patients were reviewed in the clinic at least weekly during the treatment period and data concerning wound size measurement, pain, and patient satisfaction with the treatment were collected.

Results

Prior to treatment with the ambulatory topical oxygen delivery device, the median duration of ulceration was 12 months (mean 17.5), confirming that these were chronic non-healing wounds. Treatment periods ranged from 17 to 46 days.

Of the 10 ulcers treated in this study, 2 (20%) healed completely and one venous ulcer that had been present for 8 months and which measured almost 6 cm$^2$ healed completely within 5 weeks of treatment. A further venous ulcer measuring 3.5 cm$^2$ also healed completely within 5 weeks.

An improvement in wound healing was noted in a further 6 patients (60%), with a reduction in wound size of between 28 and 99%, and evidence of granulation tissue increased from between 0 and 25% to 75 to 100% during the treatment period.

In 2 patients, treatment was discontinued by 10 days as no significant healing was noted; both of these patients had post-radiotherapy site wounds.

All patients and caregivers rated the device as being very comfortable to use and wound pain was reported to be improved in all cases.

In summary, the treatment was beneficial in 8 of 10 wound treated, with those that did not heal completely showing evidence of improvement nevertheless.

Conclusion

In an era when chronic wounds are increasing in prevalence and are associated with significant morbidity, reduced quality of life, and escalating healthcare costs, it is important to seek novel therapies that can accelerate healing and which will be acceptable to patients.

The ambulatory topical oxygen delivery device studied showed a significant beneficial effect on wound size in 80% of patients, and was associated with reduced pain in all wounds. It was tolerated extremely well by patients and caregivers, with all reporting it to be comfortable to use.

The treatment has practical advantages over other oxygen based wound therapies such as hyperbaric oxygen therapy in that it delivers oxygen continuously, it is very easy to use, and it is accessible. Its suitability for use in the community and primary care settings could prove cost effective; its application is very straightforward, no complicated training is required, and patients can remain mobile throughout the treatment period.

References

3. NATROX™ Continuous Oxygen Ambulatory Therapy. Inotec AMD Ltd.

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The NATROX™ Device