Hyperbaric Oxygen Therapy and Flammability of Topical Skin Care Products

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Abstract

Product selection may determine whether or not proper skin care can be safely provided during hyperbaric oxygen therapy. Independent studies were conducted comparing the oxygen compatiblity for six leading skin care products currently on the market. Oxygen compatibility was deter- mined using an oxygen ignition temperature (AIT) test, oxygen index (OI) testing and heat of combustion (HoC) testing. AIT is a relative indi- cation of a material’s propensity for ignition. OI is a relative indication of a material’s flam- mability, and HoC is the absolute value of a material’s energy release upon burning. Products with a high AIT, a high OI and a high HoC are recognized as being more compatible for application in oxygen-enriched environments. Furthermore, a Material Compatibility Index is calculated based on the above factors to determine which products could provide proper skin protection and healing during hyperbaric oxygen therapy while maintaining strict fire safety standards.

Background

Hyperbaric oxygen therapy has been found useful in the treatment of wounds and wound infections10. The therapy consists of 60–120 minute periods of breathing 100% oxygen in a chamber pressurized between 2.0–2.4 ATA. Over- birthing of high oxygen concentrations increases the transmission of oxygen into the wound. The arrival of oxygen stimulates the production of such substances as hydrogen peroxide. Oxidant production leads to in- creased growth factor levels, increased platelet aggregation, and wound closure.2

Recent clinical studies indicate that hyperbaric oxygen therapy is used to treat various medical conditions including peripheral vascular disease, diabetic foot wounds, and burn wounds.3

Oxygen compatibility testing is a means of evaluating the compatibility of skin care products with oxygen-enriched environments. It is an important concern; therefore appropriate testing of skin care products has been conducted during the past few years in order to determine which products can be safely used during hyperbaric oxygen therapy.

Oxygen compatibility testing is performed using AIT, OI, and HoC testing. AIT testing is a measure of a material’s propensity for ignition. OI testing measures the oxygen index (OI) and compares the oxygen compatibility of various materials. The HoC is a measure of a material’s energy release on burning.4

It should be noted that the skin care products evaluated in this study were not the only products available on the market. Commercial skin care products are used by millions of consumers every day. The selection of these particular skin care products was based on availability and consumer demand.

Methods

Materials and Methods

The six skin care products evaluated in this study included: Healing Ointment® from Beiersdorf AG, Aloe Vesta 2-in-1 Protective Ointment Skin Protectant® from Coloplast, Inc., Critic Aid Clear Moisture Barrier Ointment® from Critic Aid, Inc., Aloe Vesta 2-in-1 Protective Ointment from Medline Industries, Inc., Critic Aid Clear Moisture Barrier Ointment® from Critic Aid, Inc., and Securea Protective Ointment from Medline Industries, Inc. A total of 20 skin care products were evaluated; 6 were positive for oxygen compatibility and 14 were not.

Table I. AIT indicates a material’s propensity for ignition, OI is an absolute value of a material’s energy release upon burning, and HoC indicates a material’s flammability. Oxygen compatible materials maintain high AIT, high OI, and low HoC values.

Material |
| AIT (˚C) |
| OI (calories/gram) |
| HoC (calories/gram) |
| Aloe Vesta 2-in-1 Protective Ointment Skin Protectant® | 146 | 10849 | 25 |
| Healing Ointment® | 186 | 10849 | 25 |
| Critic Aid Clear Moisture Barrier Ointment® | 193 | 8879 | 21 |
| NaturalAloe Cream® | 221 | 2117 | 53 |

Table II. Figure II. HoC values result from the following sources of ignition carried inside the hyperbaric chamber. Occluded sources of ignition on the hyperbaric devices and the treated wound are responsible for the corresponding decrease in oxygen compatibility.

Figure III. Figure III. HoC values result from the following sources of ignition carried inside the hyperbaric chamber. Occluded sources of ignition on the hyperbaric devices and the treated wound are responsible for the corresponding decrease in oxygen compatibility.

Conclusions

The results reported a wide range of AIT, OI, and HoC values, corresponding to significantly different oxygen compatibilities. In order to protect against the overproduction of reactive oxygen species, certain skin care products should be removed.5

The water and silicone base of Skin Repair Cream® is most likely responsible for the product’s self-extinguishing behavior. In contrast, the petrolatum and silicones used in the remaining products contain significant amounts of hydrocarbon liquids.6

References