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Cosmetic effect of hyperbaric oxygen

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There are some romantic notions about the various uses of hyperbaric oxygen (HBO). For example, students have used HBO exposure to improve their levels of achievement (Le et al. 2005) and it has also been reported that HBO can exert a cosmetic effect. What is more, some individuals use HBO as a drug to treat almost all diseases. However, its effectiveness remains to be confirmed in many diseases.

What are the reasons that HBO can be used to treat diseases? As we all know, oxygen is indispensible for humans. However, it has low solubility in water, and the oxygen supply to tissues in humans depends on its transportation by hemoglobin. Under normobaric conditions, more than 98 % of hemoglobin is saturated by oxygen. Thus, it is hard to increase the blood oxygen content significantly by oxygen inhalation. However, under hyperbaric conditions, the dissolved oxygen in the blood significantly increases proportionally, further increasing the oxygen supply to the hypoxic tissues. Theoretically, HBO can be applied as long as hypoxia is present in tissues. In clinical practice, many hypoxia/ischemia diseases such as carbon monoxide poisoning and diabetic gangrene have been treated with HBO, achieving favorable outcomes (Gill and Bell 2004; Abidia et al. 2003; Kessler et al. 2003; Duzgun et al. 2008).

Oxygen has a toxic as well as therapeutic effect, however. Oxygen is a free radical and has potent toxicity, which often occurs under hyperbaric conditions. When HBO exposure overwhelms the tolerance of tissues (especially the lung and brain (Jenkinson 1993)), further HBO exposure may eventually result in toxicity or, more precisely, in oxidative injury (Simsek et al. 2011). The presence of oxygen toxicity occurs after extended periods of HBO exposure and/or at high pressure. In routine HBO treatments, time and pressure in HBO exposure are strictly controlled to avoid oxygen toxicity (safe oxygen exposure). Under these conditions, hypoxia is corrected, and oxygen toxicity is avoided. Based on long-term experience and comprehensive studies, intermittent inhalation of oxygen at certain pressures is recommended in clinical practice although the specific regimens vary among settings. For example, HBO exposure is usually done once or twice daily, at a pressure not higher than 2.5 ATA, and the duration of HBO exposure ranges from 1 to 2 h (Germain et al. 2003; Muzzi et al. 2010).

In numerous diseases, ischemia or hypoxia is present in the tissues. In the light of mechanisms underlying the therapeutic effect of HBO on hypoxia, HBO holds promise for the treatment of a variety of diseases. Unfortunately, the effectiveness of HBO exposure has not been confirmed in some ischemia/hypoxia-related diseases. Indeed, it has been found to be detrimental under some conditions, which places the application of HBO treatment in a dilemma (Michalski et al. 2011).

As a complex system, the human body has an innate ability to adapt to harmful external stimulations, which is used to combat or prevent disease. For example, repeated hypoxia exposure that takes advantage of hypoxia adaptability has been used as preconditioning to prevent subsequently fatal attacks (Burtscher et al. 2008). Most mountaineers use this method to improve their levels of achievement and reach higher altitudes. Clinically, transient ischemia and high environmental temperature are also used as strategies for preconditioning to protect tissues against injury (Churchill et al. 2010; Du et al. 2011). In recent years, some researchers have proposed that the mechanisms involved in the therapeutic effect of HBO are more extensive than just an improvement in hypoxia. The mild toxicity of oxygen has been regarded as a noxious stimulation that may protect against subsequent injuries (Kim et al. 2001).

The safety of HBO treatment has been widely confirmed in clinical practice, but its effectiveness is controversial. Understanding the therapeutic effect of HBO from the point of view of HBO preconditioning may be helpful in explaining some unexpected events in HBO treatment. Thus, a hypothesis is proposed that preconditioning with oxygen as a mildly detrimental stimulation may protect against injuries, which is increasingly accepted and approved clinically. This is also used as a common explanation of therapeutic effects of HBO treatment (Nie et al. 2006).

Ultraviolet (UV) exposure is a major cause of skin aging and skin malignancies. Although some physical and/or chemical measures have been developed for protection against UV exposure, complete protection is impractical. Thus, numerous investigators have attempted to identify more effective strategies for protection against UV exposure (Studer et al. 2012; Bodekær et al. 2012).

Most recently, a study by Fuller et al. from the University of Connecticut showed that HBO preconditioning could exert protective effect on a direct oxidative challenge of UV-A to skin tissue (Fuller et al. 2012). The hairless SKH1-E mice were divided into three groups and exposed to UV-A (3 days per week) for 22 weeks. Mice in two groups received an HBO (2.4 ATA) pretreatment (either two or four times per week). At the end of the study, the skin and liver were collected for examinations. The expressed proliferating cell nuclear antigen was measured by immunohistochemistry to evaluate the cell proliferation; TUNEL staining was done to detect apoptosis; the skin elasticity and wrinkles depth were measured aiming to evaluate skin photo-aging. Their results demonstrated that pretreatment with HBO significantly reduced UV-A-induced apoptosis and proliferation, and resulted in an improvement in skin elasticity and wrinkles depth.

Interestingly, Fuller et al. also observed that UV exposure could induce oxidative stress in the liver, which was significantly attenuated by HBO pretreatment. The oxidative stress in the liver was attributed to UV-induced systemic stress. That is, UV exposure not only leads to skin injury but may also result in systemic oxidative stress.

The authors attributed these effects to the consequence of HBO preconditioning. Of note, in this study, UV exposure was intersected with HBO exposure, which may not exclude the direct (therapeutic) effect of HBO. Thus, we postulate that the “cosmetic effect” (protection against UV-induced skin injury) of HBO may involve both preventive and therapeutic effects of HBO.

Evidence from animal studies is not enough to conclude that this strategy is also effective in humans, and let alone to recommend HBO as a strategy for cosmetic purposes. In light of the safety and economy of HBO, preconditioning is feasible and promising for patients with excessive UV exposure. Both the protective effect of HBO on UV-induced skin injury and the cosmetic effect of HBO require confirmation by evidence from clinical practice.

Go to:

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