Case Report

De Novo cataract development following a standard course of Hyperbaric Oxygen Therapy.

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Gesell LB, Trott A. De Novo cataract development following a standard course of Hyperbaric Oxygen Therapy. Undersea Hyperb Med 2007; 34(6):389-392. A 49 y/o female under went 48 hyperbaric oxygen (HBO_2) treatments at 2.5 ATA (atmospheres absolute) (253 kPa) for 90 minutes for chronic refractory osteomyelitis of the sacrum and recurrent failure of a sacral myocutaneous flap. Prior to HBO_2 therapy, formal ophthalmic exams revealed myopia but no evidence of cataract formation. Eight weeks following the completion of HBO_2 therapy, on repeat ophthalmic exam, the patient was discovered to have worsening myopia. Changes of the crystalline lens, consistent with nuclear cataract development, were identified in each eye. Other common causes of cataract formation including diabetes, corticosteroid use, and excessive exposure to ultraviolet light, were excluded. While transient visual changes are known to occur during HBO_2 therapy, cataract formation has only rarely been reported and only after prolonged courses of treatment (150 or more treatments). This case identifies the need to further investigate the ocular effects of HBO_2 therapy, especially with regard to cataract development and progression.

INTRODUCTION

Hyperbaric Oxygen (HBO_2) delivered under standard protocols is known to cause visual changes most commonly in the form of transient myopia (1,2). Refractive changes can be measured by as early as 4 weeks, or 20 treatments (1,3). Following treatment, myopia resolves but may take up to 4 months or longer (4). More serious complications, cataracts, can be induced under experimental HBO_2 conditions, but have rarely been reported in humans (5,6). In the reported human cases, cataracts developed only after prolonged HBO_2, 150 treatments or more (7). With the maximum number of individual HBO_2 treatments in the United States ranging from 60 to 75, *de novo* cataracts have not been reported (8). We report the first case of a patient with documented clear lenses on an exam prior to HBO_2 who developed bilateral nuclear cataracts 8 weeks after undergoing 48 treatments.

CASE REPORT

A 49 year old female with sacral osteomyelitis and recurrent failure of a myocutaneous flap was treated with a course of HBO_2 therapy. Medical history was significant for hypertension, asthma, and scleroderma with minor manifestations. Other causes of cataracts including diabetes, corticosteroid use, and excessive exposure to ultraviolet light were excluded. Two ophthalmic exams carried out two and a half years and one year prior to HBO_2 therapy revealed myopia but no lenticular abnormalities consistent with cataract formation. Each exam included formal refraction and biomicroscopy with lens evaluation. During an 11 week period, the patient underwent HBO_2 therapy at 2.5 ATA (253 kPa) for 90 minutes with two five minute air breaks. She received a total of 48 treatments. Prior to HBO_2, the patient's visual acuity at 6 meters was 20/100 (-1.00 diopter) in the right eye and 20/80 (-0.75 diopter) in the left eye. She improved to 20/20 with corrective lenses, and her lenses were observed to be clear by exam performed by an optometrist. Eight weeks following HBO_2 therapy, the patient's ophthalmic exams were significant for increased myopia. Visual acuity was 20/200 (-2.50 diopters) in both eyes. Changes consistent with grade 0-1 nuclear cataract formation, (with haze), in the crystalline lens of each eye, were identified. In follow-up examinations, the patient continued to complain of visual changes. Subsequent ophthalmic examinations demonstrated that there was no reversal of her myopia, in fact, in continued to progress. Her visual acuity in both eyes at 11 months was 20/600 (-4.25 diopters). Her cataracts stabilized at grade 1-2 with increased haze and showed no evidence of reversal. All of the ophthalmic exams, before and after the HBO_2 therapy, were carried out by the same optometrist.

DISCUSSION

Cataracts are the leading cause of blindness in the world and mostly commonly occur after the age of 65 (9). Risk factors include advancing age, female sex, smoking, diabetes, ethanol use, corticosteroids. There are three types of cataracts including cortical, subcapsular, and nuclear—the most common (10). In addition to visual changes noted by the patient, cataracts can be identified by a hazy appearance and yellow-brown discoloration within the lens. While the mechanism of cataract formation is not completely understood, oxidation of lens components plays a central role (11). Reduced glutathione in the lens stroma is critical to maintaining the transparency of lens crystallin proteins (12). Oxidation of the glutathione can lead to abnormal protein cross linking, increase of insoluble proteins, and abnormal colorization. The net affect is nuclear light scattering (NLS), an early finding in cataract formation, with eventual development of refractive changes.

Animal models to measure HBO_2 effect on the eye have shed light on oxidation and the formation of cataracts. A study of older guinea pigs treated with HBO_2 at 2.5 ATA for 2-2.5 hours for three times a week for up to 100 treatments revealed lenticular nuclear oxidative stress including loss of soluble protein, increase in insoluble protein and elevated levels of oxidized thiols (5). In addition, there were slight decreases in the low molecular weight antioxidants glutathione and ascorbate. Noteworthy is that nuclear light scattering was noticed in some guinea pigs after as few as 19 treatments. Morphological changes were similar in those seen in immature nuclear cataracts, although no distinct nuclear cataracts were observed during this study. Another study of older guinea pigs treated with HBO_2 at 2.5 ATA three times a week for

2.5 hours demonstrated acceleration of loss of nuclear cytoskeletal proteins (13). Finally, in a mouse model, 100 mice were treated with HBO at 3 ATA for 2 hour twice a week for six weeks (14). Only 50 percent of these mice survived; however, of the surviving mice, 50 percent developed cataracts.

In spite of evidence that HBO_2 can cause cataracts in animals, there has been only one report of cataracts occurring in humans as a result of HBO_2 therapy (7). In this case series, 25 patients, mean age 65, with peripheral ischemic ulcers, were treated at 2 – 2.5 ATA, 7 days a week for between 150 – 850 exposures. Total time per treatment under pressure at 100% oxygen was 100 minutes. Twenty four of the twenty five patients developed myopia of between negative 1 to negative 3 diopters. Of special note, although unexplained, is that the myopia tended to reverse when the patients were still under treatment. Fifteen of the 25 patients had no changes consistent with cataracts prior to HBO_2 treatment. Following treatment, 7 of the 15 patients developed nuclear cataracts evidenced by increased turbidity of the nucleus. All of the cataracts developed between 6 months to a year following treatment. Of the ten patients with pre-existing cataracts, 8 progressed as a result of the treatments. Finally, two patients without pre-existing cataracts showed some signs of cataract reversal.

The case of cataract formation reported here is significant in two respects. First, this is only the second report of cataract formation in a patient after treatment with HBO_2, and second, the cataract development required only 48 treatments. That this is only the second report of HBO_2-associated cataracts in humans could be due to under reporting. In the only other report of cataracts from HBO_2, they did not manifest until several months following termination of treatment (7). The cataracts reported here were discovered 2 months following treatment. Because this patient was seen by the same optometrist before and after therapy, this continuity of care allowed the cataracts to be discovered in the context of the HBO_2 therapy. Additionally, many patients treated with HBO_2 are over age 65 or have other risk factors for cataract formation. The association with HBO_2 may not be made in other circumstances where the care is more fragmented.

The appearance of these cataracts after 48 treatments is consistent with animal data in which lens changes and NLS could be observed by 20 treatments (5). Myopia, which has been clearly associated with HBO_2 treatment, is also an early sign of cataract formation (15). The timing of myopia progressing to cataract formation is unknown but it is reasonable to speculate that oxidative effects of HBO_2 could accelerate the process.

Finally, it is possible that the cataracts could have occurred coincidentally to the HBO_2 therapy. Age is a major factor associated with cataracts, but the incidence peaks over the age of 65. While cataracts can occur in women under age 50, they are uncommon and more likely to be subcapsular (15). Although this patient was known to have a mild form of scleroderma, cataracts are not known to be associated with this disorder (16). Search of the literature however revealed one report in 1985 of a cataract in a patient possibly associated with advanced scleroderma (17). Because of the timing and formation of this patient's cataract within two to three months following her HBO_2 treatment, it seems likely that this abnormality was caused by the treatment. This case identifies the need to further investigate the ocular effects of HBO_2 therapy especially with regard to cataract formation and progression.

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