Hyperbaric Oxygen Therapy and Alzheimer's Disease

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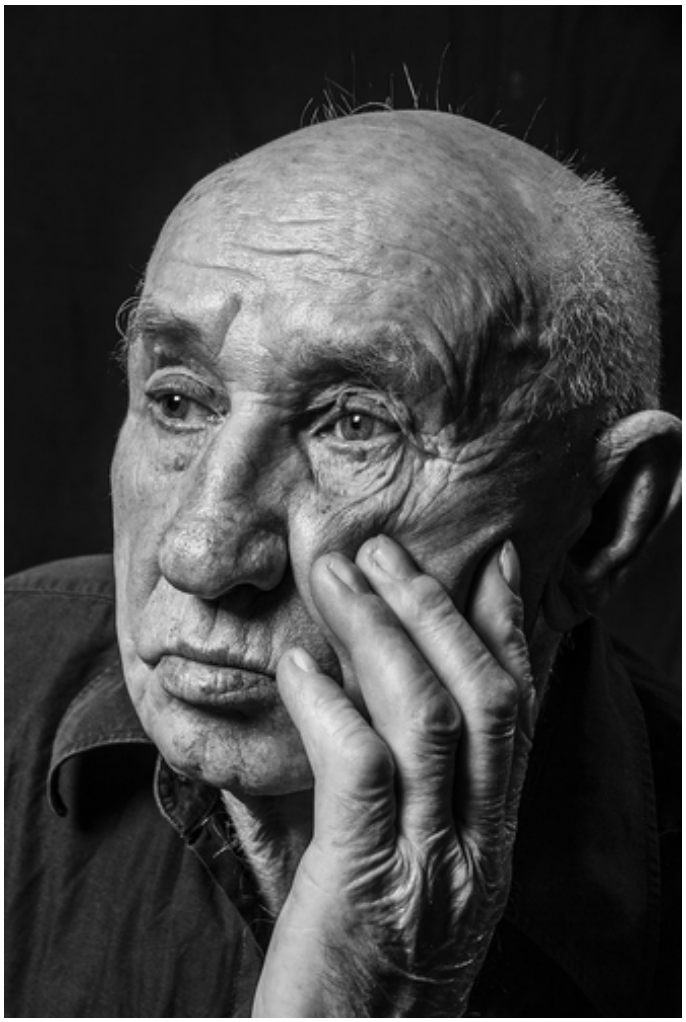
"You know, people get frustrated because their loved ones who have Alzheimer's, oh, he doesn't recognize me anymore, how can I recognize this person, if they don't recognize me? They're not the same person. " "Well, they are the same person, but they've got a brain disease. And it's not their fault they've got this disease." –Ron Reagan—

The disease that bears the name of Aloysius Alzheimer was first described in Munich, 1906. Prior to this discovery by Dr. Alzheimer, the loss of memory, forgetfulness, and the decline in mental acuity and competence were ascribed to old age. Since that time, the clinical symptoms and the changes that occur in the brain are known as a neurological disease and not the inevitable decline of the aging process.



These changes are well documented, with a variety of different types of dementia now understood to be part of a spectrum of disease. In the last 105 years, the biological mechanisms that kill the neurons of the brain have become defined (1-3), but the ultimate cause remains elusive. Recently, the role of the amyloid plaques (4-7) and neurofibrillary tangles (8-13), a hallmark of Alzheimer 's disease (AD), have been redefined. Previous work assumed that plaques and tangles were the cause of AD, but it appears that these proteins are the brain's response to the actual damaging agent of the disease: oxygen radical formation (14-18).

Fight Oxygen With…Oxygen!?

Hyperbaric oxygen therapy (HBOT) has been in use for over 100 years, safely treating a variety of medical conditions (19-21). HBOT is a treatment in which the entire body is exposed to 100% oxygen under increased pressure. By augmenting total gas pressure, oxygen levels in all body organs can be increased dramatically (19, 21), sparing and maintaining organs that are oxygen deprived, removing obstructions in blood flow caused by gas bubbles, and inhibiting certain types of bacteria (22-24).

The ability of HBOT to help in the healing process is mediated by a number of different mechanisms in the body. Each of these mechanisms helps us understand why HBOT can accelerate wound healing and help in combating a variety of neurological diseases. In animal and human clinical studies, HBOT has shown a beneficial effect in reducing inflammation (25-28) in stroke and headtrauma. This anti-

inflammatory effect helps to reduce swelling and increase healthy blood flow to the brain. At the same time, HBOT promotes the growth of new blood vessels, increases the number of circulating stem cells that are involved in new blood vessel growth and wound healing (29-31), and induces the production of new neurons in the brain (32-34).

As the section title implies, the idea of using oxygen to fight oxygen radicals seems like a bad idea. Why give more of the same material that produces the damaging oxygen radicals? Studies looking into this question reveal that HBOT exposure increases the activity and number of oxygen radical-fighting enzymes (35-39). By giving more oxygen, oxygen radicals are suppressed and a number of healing and rejuvenating pathways are stimulated.

What Can HBOT Do in Alzheimer's Disease?

Inflammation is a hallmark of AD and plays an important role in the damage caused by this disease. For three decades, non-steroidal anti-inflammatory drugs (NSAIDs: aspirin, acetaminophen, ibuprofen) have been known to reduce the severity of AD (40-45). Research studies of brain trauma have found that inflammation can be further reduced and controlled by use of HBOT (25, 26, 46). The hyperbaric oxygen effect on inflammation could help reduce and reverse the damage seen in AD.

Since the early 1990s, the idea of insufficient blood flow in the brain was a major impetus for developing therapies that could stimulate new blood vessel growth in the brain of AD sufferers. This new blood vessel growth, called angiogenesis, has been shown to be effective as a critical component for fighting the ravages of AD.

A tissue known for its angiogenesis-inducing capabilities is the omentum, a lining of the intestine that is routinely used with compromised surgical sections (47). Reports of omentum transplantation into the brains of AD patients (48-53) demonstrated a reversal of symptoms associated with AD, and reduction in senile plaques was observed (49, 54, 55) where the omentum was transplanted onto the brain. The major limitation with this surgical procedure is its severity and the lack of long-term effectiveness (54). The surgery is highly invasive (the skull and the abdomen are opened) and risky, given the age and poor health condition of many AD sufferers. Yet, many are willing to risk it due to the lack of options and the positive outcomes that do arise from it. Even short-term benefits do provide a reprieve from the ravages of AD.

In HBOT, the induction of blood vessel regrowth is observed in the brain (43) and has successfully helped to treat traumatic brain injury (56-60). It is not unreasonable to think that with HBOT, the effects seen with omental transplantation could be replicated with AD sufferers. The approach of inducing angiogenesis with HBOT obviates the risky surgical approach and the required recovery after surgery. Testing for functional cognitive recovery can be done continuously, without the need to wait for recovery, as well.

At the same time, inflammation can be readily reduced in the brain via HBOT (25-28, 46, 61), providing another healing effect. The work done with NSAIDS clearly shows that inflammation plays an important role in AD. By reducing the level of inflammation, blood vessels and new neurons may grow faster in the brain and promote a quicker recovery.

Finally, since AD is a disease caused by oxygen radicals (15, 17, 42), the increase in anti-oxidant enzyme activity by HBOT treatments could provide a third healing effect (37, 62). The role of oxygen radicals in producing the damage in the brain may be countered by improving mitochondrial function. HBOT has shown the ability to return "idling" mitochondria to full function, hopefully reducing the number of mitochondria that are over producing oxygen radicals.

Why Isn't HBOT Used On AD?

The use of hyperbaric oxygen for neurological diseases is a relatively new experimental application. For decades, the medical community has been overly concerned about the production of oxygen radicals due to HBOT (63). Recent studies have demonstrated that this concern is minor (64-66), and the increase in oxygen radical-fighting enzymes more than compensates for the extra oxygen in the body. Most of the work in AD has been centered on increasing blood flow to the brain, controlling inflammation, removing the amyloid plaques from the brain, and sparing brain function of the affected individuals. An evolution in the way that researchers think about AD is bringing about a major change in treatment of this disease. The observation that HBOT can have a regenerative effect on the brain, restore

blood supply, decrease inflammation, and increase anti-oxygen radical activity is a compelling case for using HBOT for AD patients. This may be an effective therapy to halt the ravages of AD and help reverse the damage. At a minimum, we hope that HBOT may help slow down the progression of the disease.

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