

Traumatic Brain Injury and Hyperbaric Oxygen Therapy

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ABSTRACT

The modern age of hyperbaric medicine began in 1937, when Behnke and Shaw used a hyperbaric chamber to treat decompression sickness. However, even today, few know about hyperbaric oxygen's effects on the body and medical conditions outside of diving medicine and wound care centers. This is now a serious ethical issue as there are 20+ US military veterans committing suicide every day directly related to Traumatic Brain Injury/Post Traumatic Stress Disorder while underutilized is hyperbaric oxygen therapy, which has more "on-label" indications for brain injury than any other drug or therapy in medicine. The issue at hand is not whether hyperbaric oxygen is effective for treating brain injuries - the real issue is why the interference in offering this therapy to those who need it.

Up against black-boxed anti-depressants that are not efficacious, it should be a "no-brainer" to use a safe, off-label drug, but in the case of military veterans, every suicide might be seen as a tremendous cost saving to certain technocrats. The unspoken rationale is that if the military were to embrace hyperbaric oxygen as the efficacious therapy that it is then current active troops that have suffered injuries will come forward and seek treatment and benefits for their Traumatic Brain Injuries now that they know there is a viable therapy and in so doing troop strength will

be decimated. So, to attempt to delay the acceptance of hyperbaric oxygen the Department of Defense has funded faux-studies claiming low pressure room air to be a placebo or sham, and then proclaiming there is no statistical difference between treatment arms and sham or placebo treatment arms. With few who understand hyperbaric medicine there is almost no one to call them on this subterfuge and prevarication. The possibility that if this therapy came to the fore it would interfere with well funded dark projects it might explain the reason for this scientific malfeasance. Warriors have always been considered expendable assets even retired warriors. Many peer-reviewed articles have been published in the last decade that demonstrate hyperbaric oxygen is effective in repairing an injured brain even long after that injury took place. One of the most notable showed that blast-induced brain injured war veterans experienced a 15 point IQ increase ($p < 0.001$), 39% reduction in post concussion symptoms, 30% reduction in post traumatic stress disorder symptoms and a 51% decrease in depression.

Hyperbaric oxygen is an efficacious, benign and humanitarian way to affect brain repair but it has not been adopted because it lacks patent protection and has no large corporate sponsors. It has also met interference because other agendas are present be they the protection of the status quo, myopic budgetary constraints, perceived liability issues or interference with protected dark projects.

Keywords: Football, TBI, Brain Injury, HBOT, Hyperbaric Oxygen, CTE, Encephalopathy,

Hyperbaric Oxygen Therapy (**HBOT**) saturates the body's tissues with oxygen using a pressure vessel. HBOT is most often recognized as the treatment for Decompression Sickness (**DCS**) or "the bends." DCS causes significant neurological injury and post initial injury. The dysfunctional changes are virtually identical to those caused by trauma. Thus oxygen under pressure has been used to treat neurological injuries since 1937, almost eighty years. No one has found a replacement or substitute treatment for the bends that works as well as oxygen. HBOT results in a 95 percent acute treatment cure rate for DCS in all of the navies of the world. Combining HBOT with other therapies that help brain-injured patients enhances the effect of those treatments and makes these other therapies less costly, while creating additional recovery in any given patient.



Figure 1: A Seachrist monoplace hyperbaric oxygen chamber.

An increase of one-half atmosphere will raise the oxygen levels in plasma seven times to twelve time's normal (700 percent to 1,200 percent). Under this increased pressure, oxygen acts like a drug- and DNA-signaling agent. This treatment's mechanisms of action simply follow the general gas laws for saturating liquids with a gas, similar to the way Sodastream® saturates water with carbon dioxide. No one yet has found a substitute for oxygen in human physiological processes, and any injury caused by a lack of oxygen can be expected to benefit from HBOT with the right oxygen dosage. Saturating with oxygen is a safe procedure when all of the correct protocols are followed, and significant side effects are extremely rare.



Figure 2: A Perry model monoplace hyperbaric oxygen chamber.

The history of hyperbaric medicine reaches back to the year 1620 when Drebbel developed a one-atmosphere diving bell, and forty years later Boyle joined forces with Gay-Lussac to develop the general gas law. Moving the sands of time to the near present day, the modern age of hyperbaric medicine began in 1937 when Behnke and Shaw used a hyperbaric chamber to treat DCS. However, it was not until 1955 that there was major interest in using Hyperbaric Oxygenation (**HBO**) outside of treating DCS. That year, Churchill-Davidson began to use oxygen therapy in a hyperbaric chamber to treat the damage induced by radiotherapy in cancer patients. In 1956, Boerema (Holland) performed the first reported heart surgery on “blue babies” in a hyperbaric chamber. He became the “Father of Hyperbaric Medicine” when he treated a woman who had been badly beaten, was unconscious, and was about to lose her leg. This became the first recorded prevention of an amputation with HBOT, and the woman did well. The next year his famous “Life without Blood” study was published. He referred to the treatment as “oxygen drenching” [1].



Figure 3: A Seachrist model monoplace hyperbaric oxygen chamber

In 1962, Sharp and Smith (Scotland) were first to use HBOT to treat carbon monoxide poisoning; in 1963, Hitchcock testified before the House Labor Health, Education and Welfare Committee on the need for hyperbaric chambers in surgery, and congress appropriated money for building a score of them [2]. In 1965, Perrins (United Kingdom) showed the effectiveness of HBOT in osteomyelitis, and in 1965, Japanese researchers treated the first burn patients.

In 1966, Saltzman et al. (United States) showed the effectiveness of HBOT in stroke patients; in 1970, Boschetty and Cernoch (Czechoslovakia) used HBOT to treat multiple sclerosis (MS). In 1971 Lamm (France) used HBOT for treatment of sudden deafness, and in 1973, Thurston showed that HBOT reduces mortality in myocardial infarction.

In 1976, Hollbach and Wasserman determined that 1.5 ATA (atmospheres absolute) maximizes oxygen content and glucose metabolism in the brain; in 1983, the first double-blind RCT was conducted using HBOT to treat MS. In 1987, Jain (Swiss) treated paralysis of stroke with HBOT. In 1989, the US Navy discovered that bubbles are gone within five minutes, so while DCS is caused by bubbles initially, the secondary injury cascade is the same as in all brain insults.

In 1992, Harch treated the first delayed decompression sickness, which led to the treating of “dementia pugilistica” in boxers, children with cerebral palsy or autism, and nearly 700 patients with fifty various neurological conditions. In 1992, Rockswold (United States) conducted the first double-blind Randomized Control Trial (**RCT**) showing that HBOT reduces mortality in acute

Traumatic Brain Injury (**TBI**) by 59 percent, the largest single reduction in mortality since the invention of the ambulance.

In 2002, a US Army study confirmed Harch's finding that HBOT repairs white matter damage in children with Cerebral Palsy (**CP**), and a Canadian group showed hyperbaric air (the original treatment for DCS and Mountain Sickness) and HBOT to be 1.75 effective in treating CP in double-blind randomized trial.



Figure 4: A Perry monoplace hyperbaric oxygen chamber

In 2005, I treated for the first time a child with fetal alcohol syndrome [3] and Thom (United States) found that HBO causes stem cell mobilization. In 2007, Harch et al. (United States) treated chronic TBI in animal models, and in 2009 in military veterans [4]; in 2010, Godman discovered that HBOT activates 8,101 genes, reducing inflammation and increasing growth and repair hormones. In 2011, I treated the first retired National Football League (**NFL**) player treated for Chronic Traumatic Encephalopathy (**CTE**); [5] in 2012; Harch demonstrated use of HBOT to treat blast-induced, post concussion syndrome and post-traumatic stress disorder

The above is not meant to be a comprehensive timeline, a meta-analysis of HBOT for various conditions, but rather an opportunity to understand why a benign yet beneficial therapy has been

ignored and even treated with great disdain. Bureaucratic concerns have repeatedly trumped medical and scientific evidence. For someone with training in decision theory and bureaucratic behavior, the problems are very clear. Each time in history when a decision was made about the deployment of hyperbaric oxygen therapy (starting with Behnke's discovery of oxygen improving the outcomes for DCS), bureaucratic concerns over budget constraints trumped science; to the detriment of the persons those bureaucracies were intended to serve. Sometimes it was concerns about costs. Other times it was incorrect assumptions about the impact of the new science on the healthcare system. The latest concern is that the military feared that if HBOT was acknowledged as an official treatment for TBI/PTSD, then hordes of troops that were just bearing their injuries, because there was no viable alternative but to grin and bear it, would come out of the closet and reveal that they too had TBI/PTSD and in so doing decimate the military as a fighting force.



Figure 5: A Perry monoplace hyperbaric oxygen chamber

There is no evidence of a pharmaceutical company running interference, although such interference could be inferred after a 1983 study was published in the *New England Journal of Medicine* showing HBOT to benefit patients with multiple sclerosis. B. H. Fischer, MD, a tenured professor at New York University, became the principal investigator of a study funded by the National Multiple Sclerosis (**MS**) Society (which is directly funded by pharmaceutical companies).

Apparently, this society had great difficulty accepting the results of the work Dr. Fischer had completed, and multiple revisions were made to weaken the conclusions sufficiently to satisfy the editors of the New England Journal of Medicine. In this double-blind controlled study of patients with advanced chronic disabilities, Fischer found significant improvement in objective measurements, and the treatment effect persisted for at least one year [6].

Today, HBOT is the primary treatment in the United Kingdom for MS patients by MS patients.

The study was never followed up, despite the positive results, for all the usual reasons. Clinical trials are expensive so where does one get funding to do a study from which no entity with money will profit? So, the treatment languished for lack of financial support and sponsorship. Indeed, Fischer lost his position, and his chamber was destroyed.

The reports about HBOT's impact on patients have never changed. What has changed is we now understand the mechanisms of action and how vital oxygen is to healthy functioning human metabolism.

For example, a 2002 Canadian study [7] found that even room air under relatively low pressure (1.3 atmospheres) improved the clinical outcomes of the children in this double-blind, randomized study. Ten times more progress was made in Gross Motor Function (**GMF**) during the two months of hyperbaric therapy (while all other therapies were ceased) than during the three months of follow-up with OT/PT restarted. The editorial in the Lancet, where the article was published, pointed out that "both groups of children improved substantially with respect to GMF, speech, attention, memory and functional skills." The Canadian government, which financed the study after being pressured by parents of children with cerebral palsy, falsely claimed the pressurized room air was a placebo and therefore there was no difference between the placebo group and the group of children receiving 100 percent oxygen. While this is sadly amusing, it kept HBOT from becoming standard of care for children with CP in Canada and in the United States. This is a gross tragedy and disservice, and not using hyperbaric oxygen therapy to treat these children when their brains are plastic and recovery can be dramatic leaves them as adults with continued high care costs and lost productivity.

HBOT has truly been the Cinderella of conventional medicine, which means it has been an attractive therapy that has shown it to be efficacious in treating many conditions and yet is treated with derision or ignored at best. Because no patent is possible on oxygen (or any other element), there is no profit to spark a large pharmaceutical company's interest to prove or promote it. Few know about HBOT's effects on the body and medical conditions outside of diving medicine and wound care centers. But this has become much more than an issue of lack of marketing and poor public relations. With over twenty US military veterans committing suicide every day directly related to TBI/PTSD, the lack of access to HBOT and military sponsorship of studies that deliberately set out to disprove its effectiveness pushes this into the realm of criminality.

Suicide losses exceed combat casualties, and even National Football League (**NFL**) veterans are committing suicide. The clinical trial called the National Brain Injury Rescue and Rehabilitation project [8] showed HBOT can virtually eliminate suicidality in this population once they are treated with HBOT, while reducing depression by 51 percent. That is a larger and broader effect on depression than anything advertised on television. Yet even on the basis of compassionate use, it is not possible to get HBOT paid for to treat TBI even though HBOT has more “on-label” indications for brain injury than any other drug or therapy in medicine. The issue at hand is not whether HBOT is effective for treating TBI/PTSD. HBOT is an effective treatment; the real issue is why the interference, for the time is upon us to expose the obfuscation of this humanitarian therapy—literally people are dying because they are not getting into hyperbaric chambers to breathe oxygen.



Figure 6: Beijing Yanhua Hospital

In 2009, and again in 2010, Paul Harch, MD, Director of the LSU Hyperbaric Medicine Department, delivered testimony to both the House and Senate Armed Services Committees reminding them that the epidemic of suicides among military veterans was most likely due to cocktail of “off-label” antidepressants they were being prescribed—black-boxed antidepressants, none of which are approved for treating TBI. Others have delivered this warning as well. The exact FDA warning states: “Antidepressants increased the risk compared to placebo of suicidal thinking and behavior (suicidality) in children, adolescents, and young adults in short-term studies of Major Depressive Disorder (**MDD**) and other psychiatric disorders. Anyone considering the use of (insert name of antidepressant) or any other antidepressant in a child, adolescent, or young adult must balance this risk with the clinical need.”

While antidepressants are modestly effective in reducing the symptoms of severe depression, they increase the brain's susceptibility to future episodes after they have been discontinued. This fact contradicts pharmaceutical company-sponsored research, as antidepressants cause neuronal damage and cause mature neurons to revert to an immature state, both of which may explain why antidepressants also cause neurons to undergo apoptosis (programmed death) [9].

If antidepressants cause death on a micro level, then it is much easier to understand why certain patients commit suicide given that the human body (macro level) is made up of these cells. So, not only are black-boxed, off-label Selective Serotonin Reuptake Inhibitors (**SSRIs**) prescribed to a vulnerable population, but they are done so without any regard to an ability to metabolize this class of drugs [10], which further exacerbates suicidal behaviors. And then it seems SSRIs actually deplete both catecholamine and serotonin, which is exactly what isn't in a depressed individual's interest.



Figure 7: Duke University's multiplace chamber

Up against black-boxed antidepressants that are not efficacious, it should be a no-brainer to use a safe, off-label drug—that is, oxygen at hyperbaric doses—to treat those who have received a TBI now with two decades of use treating various neurological conditions. (The double-blind RCT by Rockswold [11], showing HBOT effective in treating acute severe TBI, was published in 1992; it showed decreasing mortality in the acute treatment on severe TBI by 59 percent, the largest reduction in mortality since the invention of the ambulance, the use of helicopters in Vietnam for battle casualties, and penicillin for infection.) So, what is the problem? What does it take to become “standard-of-care”?

As already pointed out, HBOT is non-patentable. Research on non-patentable or off-patent drugs or with those with insufficient marketing prospects (orphan drugs) is funded by governmental organizations, nonprofit or charitable organizations only. Drugs for which a patent cannot be granted are not being developed and/or marketed, even when they respond to a public health need. Patients, physicians, and other caregivers consequently cannot take advantage of potentially effective treatments—they can't even find out about them.

But while HBOT won't make any entity large profits, it does have other monetary incentives. For each active-duty brain-injured soldier returned to duty, the lifetime savings to the government is \$2.6 million and \$2 million for each injured service member returned to work or school. Between 60 percent and 80 percent of the veterans participating in the National Brain Injury Rescue and Rehabilitation (**NBIRR**) project are returning to work, duty, or school after receiving HBOT. One would think that would move the powers-that-be to action, but it have not. And the reason for that has already been pointed out . . . the Department of Defense (**DOD**) doesn't want to acknowledge there is a safe and efficacious therapy for TBI/PTSD, because they fear so many troops would want to receive this therapy as to decimate an impractical number of troops.

Paradoxically, the DOD reports that mental illness ranks as the leading cause of hospitalization for active-duty troops. At one end you have hundreds of thousands of diagnosed and undiagnosed TBI/PTSD cases, disproportionate numbers of veteran homelessness, joblessness and incarcerations; bad-paper-discharges; and spousal abuse and secondary PTSD among caregivers. At the other end, running interference is this profitable prescription drug epidemic blocking, to a greater or lesser degree, an efficacious intervention come to the fore.

The DOD and VA medicine are unfaltering – they insist that there is no treatment for TBI, while billions of dollars continue to be expended on black-boxed drugs and long-term care of treatable TBIs. Meanwhile, female military veterans commit suicide at nearly six times the rate of other women; for female veterans between 17 and 25, the rate is twelve times the national rate.

After ten years and over \$9B+ spent on research, the Army and military medicine are no closer to an answer to the challenge of fielding an effective treatment while the DOD and VA contend with hundreds of thousands of backlogged cases.

Carolyn M. Clancy, MD, the Interim Under Secretary for Health in the Department of Veteran Affairs has written:

“We are committed to providing the best proven treatments and technologies to assist in the care of our Nation's Veterans.”

But the VA's contention that they are using “the best proven treatments and technologies” doesn't jive with their faux research approach to solving an epidemic, and there is no sense of urgency about the suicide epidemic.

The nation faces an unprecedented suicide epidemic in the military community. At least twenty- two successful and forty-four failed suicide attempts per day attest to the failure of the DOD/VA to comprehend, much less successfully address over 24,000 acts of desperation every year. DOD has reported that mental illness ranks as the leading cause of hospitalization for active-duty troops, but not one of the seventy therapies, countless computer applications, and over a hundred different drugs prescribed in DOD/VA/Army medicine has been approved by the FDA for TBI. All are used off-label for TBI. All are controversial on some level.

The number of patients treated by VA is up 29 percent, but narcotics prescriptions are up 259 percent. According to a CBS study in 2012, Veterans are dying of accidental narcotic overdoses at a 33 percent higher rate than non-veterans.

The Institute of Medicine recently issued a report that highlights the plethora of ineffective off-label treatments being used across the military, and their negative utility. The report and a summary notes: “The Defense and Veterans Affairs departments spent \$9.3 billion to treat post-traumatic stress disorder from 2010 through 2012, but neither knows whether this staggering sum resulted in effective or adequate care. . . .”

Since 2006, not one of the hundreds of veteran service members treated with HBOT has died of oxygen or any other drug overdose during or after treatment. A 2008 DOD Consensus Conference on Hyperbaric Oxygen Therapy in Traumatic Brain Injury attended by hundreds of researchers and practitioners from across the USG, DOD, VA and civilian medicine recorded the group’s consensus that HBOT at 1.5 ATA 100% O₂ was completely safe. HBOT is so safe that it has been deregulated in the United Kingdom by an Act of Parliament in 2008.

The Samueli Institute, hired by the Army to “provide an independent, objective, and transparent analysis of the research conducted to date on HBO₂ for TBI” stated that “HBOT is a healing environment.” They also noted in Summary Conclusions that “improvements in outcomes Cannot be ignored....HBO₂ may be of value and could benefit these patients [moderate-severe TBI] as a relatively safe adjunctive therapy if feasible.”

It is well noticed that there is at least one common denominator to all repair/regeneration mechanisms: they are all energy/oxygen dependent.

- HBOT increases stem cell mobilization providing regeneration and repair of injured and low performing organs.
- HBOT returns cell, organ and brain metabolism to optimal levels
- HBOT stimulates the growth of new blood vessels to locations in the body with reduced circulation
- HBOT reduces swelling, decreases inflammation, strengthens the immune system, and stimulates the release of stem cells

- HBOT creates an adaptive increase in superoxide dismutase, one of the body's antioxidants and free radical scavengers, promoting the ability of white blood cells to fight disease and infection.

The DOD collusion with the VA sponsored three controlled studies was done purposely to scuttle HBOT for treating TBIs. They were designed to fail from the beginning.

The authors of these studies characterize the DOD studies as sham-placebo controlled clinical investigations. A sham group “omits a key therapeutic element of the treatment or procedure under investigation” and a placebo must be inert. The key therapeutic elements in hyperbaric therapy are pressure and hyperoxia, neither of which is inert. All subject groups in these disinformation studies had groups receiving increased pressure, hyperoxia, or both. Therefore, they were neither sham, placebo, nor controlled.

A 20% increase in ambient air pressure cannot be regarded as a “sham” treatment because the concentration of the respired oxygen increases from 158 to 190 mm Hg (at a barometric pressure of 760 mm Hg). But that is science, and the DOD/VA/Army studies were never to be about science – only pseudo-science to justify an agenda to not embrace HBOT.

All high altitude climbers know that a modest increase in air pressure will improve both pulmonary and neurological symptoms. During WW2 a pressure bag was used to great effect in treating altitude sickness in experiments conducted in a B24 Liberator - the forerunner of the portable hyperbaric chambers now used by high altitude climbers and the US Army Special Operations Command. As a small increase in air pressure can resolve a mountaineer's life-threatening pulmonary and cerebral edema, the subtle residual problems that follow concussion will surely benefit from hyperbaric air treatment.

So, what is the problem behind the problem?

Imagine there is an agency that works under the umbrella of the Pentagon but is independent of the Pentagon – pretty much doesn't account to anyone and reports only to very senior Defense management types in a kind of closed loop system. Imagine this agency has vast sums of money – billions of dollars a year that it has invested along certain lines of research, for example, using implanted electrodes to stimulate areas of the brain to deal with the vagaries of TBI/PTSD.

Perfecting this cybernetic therapy with the wounded first, using the wounded as justification for very invasive procedures, but then in the hopes of using their perfected intervention for TBI, perhaps, later on for mind control – soldiers that just do and feel what their handlers want them to do or feel. Remember, we are just imagining all this for the sack of argument. Well, if suddenly HBOT came to the fore and it was clear that no fancy cybernetic interventions were required to heal the brain of a TBI/PTSD service member, then it would be hard to justify an invasive procedure and the justification or cover for doing this research is gone.

I submit that a lot of money may be tied up by Defense Advanced Research Projects Agency (**DARPA**) in just such an activity and they may be, in part, behind the interference in allowing

HBOT to come to the fore. Just something to think about, because even in madness, there are reasons why people do certain things and it is madness to not support the use of such a benign, non invasive therapy to help TBI/PTSD victims.

The NFL provides an example of this on a smaller scale...

For many decades, evidence has linked repetitive traumatic brain injury to long-term neurological problems in many sports. The NFL as the organizer, marketer, and face of the most popular sport in the United States, in which head trauma is a regular occurrence, was aware of the evidence and the risks associated with repetitive traumatic brain injuries and concussions for decades, but it apparently ignored and worse actively concealed the information from those who participated in organized football at all levels.

So, what seems to have taken place was that the NFL inserted itself into the scientific research and discussion concerning the relationship between concussions and short-term and long-term impairment of the brain. After doing so, the NFL then intentionally and fraudulently misled present and former players, and all people who reasonably rely upon the NFL's expertise about its own sport, regarding the short-term and long-term risks posed by concussions and head trauma.

Rather than warn players that they risked permanent brain injury if they returned to play too soon after sustaining a concussion, the NFL actively deceived players by misrepresenting to them that concussions did not present serious, life-altering risks.

The NFL created the Mild Traumatic Brain Injury Committee (the MTBI Committee) in 1994 to research and ameliorate the impact of concussions on NFL players. Notwithstanding the purported purpose of the MTBI Committee, and despite clear medical evidence that on-field concussions led directly to brain injuries with tragic results for players at every level of the sport, the NFL failed to inform its current and former players of the true risks associated with such head trauma and purposefully misrepresented and/or concealed medical evidence on that issue. The NFL also stonewalled on an intervention and therapy that could be helping injured players, regardless of whether those injuries were acute or chronic. The author has firsthand experience dealing with the NFL's 88 Plan in an attempt to get veteran NFL players with dementia HBOT.

The 88 Plan is designed to assist players who are vested under the Bert Bell/Pete Rozelle NFL Player Retirement Plan and who are diagnosed as having dementia. But if a plan member tries to get HBOT using the plan because they have been diagnosed with CTE, they will be told CTE does not cause dementia, and therefore HBOT, which treats CTE, will not be a covered benefit. Obviously, that is irrational, but there is often madness behind the reason for not allowing an effective treatment to be utilized by those who need it. In the case of military veterans, avoiding twenty suicides every day might be seen as a tremendous cost savings to certain decision makers. Be that as it may, the DOD can't have an unknown throng of troops suddenly declare they have TBI/PTSD too should HBOT be embraced.

Now, this is truly misanthropic, but no more so than what tobacco corporations do, and we still tolerate their malfeasance. In the case of the NFL, the reason for prevaricating about TBI and potential treatments is just a business decision. The exposure of the “hit squad” of the New Orleans’s Saints, where there was a bounty put on players from opposing teams (to cause injury on the field), is a clear example of what kind of business this is about.

A great deal of time has been lost by those who believe hyperbaric oxygen either is a placebo or should be subjected to placebo-controlled studies, or want others to believe so. But oxygen can never be a placebo. HBOT is an FDA-approved drug that affects nonspecific biological repair; in fact, it is the only non hormonal FDA-approved treatment known to repair and regenerate human tissue. It does so at a DNA level by activating growth factors and reviving mitochondrial function [13]. The beneficial effects of HBOT apply no matter where a wound or injury is located in the body.

The DOD/VA/Army-funded HBOT studies used pressurized air as their placebos, knowing that pressurized air is not a placebo and has been shown to be therapeutic. But it was their hopeful delusion that since so few knows anything about HBOT; they could get away with this piece of fraud. So, all DoD-funded studies seem to come out with equivocal results, whereas all civilian studies all come out with positive results.

In the last decade, many peer-reviewed articles have been published that demonstrate HBOT is effective at repairing an injured brain even long after that injury took place. One of the most notable used only one-half of the NBIRR protocol (forty 60-minute treatments at 1.5 atmospheres). The blast-induced TBI war veterans experienced a 15-point IQ increase ($p < 0.001$), a 39 percent reduction in post concussion symptoms, a 30 percent reduction in PTSD symptoms, and a 51 percent decrease in depression. This is all consistent with past-published reports of HBOT in chronic brain injury, including research by the US Army on brain-injured children [14].

The first battle casualty to be treated with HBOT (at 1.5 atmospheres), and one of the few to be treated, was General Patt Maney (retired) for his blast-induced brain injury in Afghanistan. His treatment was ordered after nine months of therapy at Walter Reed had shown minimal improvement. As a result of his injuries, he was nonfunctional and unable to return to his job, let alone redeploy to Afghanistan. After HBOT treatment he was discharged from Walter Reed and returned to his civilian job as a Florida state judge.

He received treatment from George Washington University Medical Center at the Tricare Reimbursement rate of \$250 per treatment. Counting lost time and hospital costs, and his months at Walter Reed making no progress; the DOD spent \$400,950, with a permanent disability loss to the service of \$1.3 million. Had he received HBOT (at 1.5 atmospheres) earlier, he would have been able to remain on active duty, a savings of \$1.3 million, but more importantly, the five months of recovery once he began receiving HBOT at 1.5 cost \$133,650, a savings to the government of \$287,300. No other patients were treated at the Walter Reed’s brain injury center,

despite the general's remarkable recovery that everyone on the staff witnessed. The \$20,000 for his hyperbaric medical treatment was \$12,000 less than what a RAND report states the annual ongoing costs per year of the current treatments for mild-TBI is [15]and that is a lot of SSRIs.

Since every working person represents \$1 million in tax revenue over their working life to the government, that government should be interested in, and foster payment for, biological repair of brain injury. Thus every brain-injured veteran, all 700,000+ of them, at a cost of \$60,000 per year to the economy every year in increased costs and lost productivity, is a \$42 billion drain on the economy. Treated, they immediately set about doing what young people do: they begin to form families and create the next American generation. Injured, they are unable to do so, and it is highly likely that these untreated brain injuries are a major cause of our nation's economic challenges. But bureaucracies do not think logically—their ability to think laterally is limited. When Medicare approved HBOT to treat diabetic foot ulcers at the end of 2002, they made it available only for Wagner III and IV lesions (osteomyelitis and gangrene), so afraid they were of budgetary constraints.

HBOT prevents 75 percent of major limb amputations in Wagner III and IV ulcers, but if they had included Wagner II lesions, HBOT would be preventing 88 percent of amputations. So, the result is there are a lot of unnecessary amputations not because of bad science but because technocrats were afraid of having a short-term budget problem.

HBOT is an efficacious, benign, and humanitarian way to affect brain repair, but it has not been adopted because it lacks patent protection and has no large corporate sponsors. It has also met interference because other agendas are present, be they the protection of the status quo, myopic budgetary constraints, or perceived liability issues. After all, when you treat TBI directly the way that HBOT does, the problems creating those TBIs in the first place are harder to ignore, and the unconscious way those problems have been dealt with are harder to deny. It brings the true cost and repercussions of war to the fore, and football, after all, is just a form of organized war. This perspective, should it be adopted by the general public, will be a catalyst for change. So, whether that means changing the way football is played to not allowing our “leaders” to guide us into unending military forays for the sack of war-profiting run amuck—all of these subterrain issues come into play when a very straightforward and effective therapy tries to assert itself: hence the resistance both on a conscious and a subconscious level.

Veterans are considered a threat by the security apparatus in the United States. They are considered a threat because many know what is really going on; that is, our troops are being used to feed conflict so others can profit. So, is someone thinking that it is better to let twenty potential threats kill themselves every day? This is a dark rabbit hole to go down, but the human cost of war is a deep rabbit hole and one that many want to keep hidden. Someone is making money when someone else bleeds to death from a cluster bomb. It is that black and white—someone is making money giving dangerous SSRIs to treat TBI.

Technocrats rotating between corporation and state are the last people you want making medical decisions, but that is exactly who has been making medical decisions. These are all things to be looked at when asking the question, Why is a therapy like HBOT being suppressed? If the man on the street understood why certain medical therapies are not available while other dangerous and non-efficacious therapies are favored, then change would be demanded.

Right now the man on the street is being kept in the dark about how money drives medical decisions to the extent it is today, or about what lengths will be taken should something come forward that could interfere with the flow of that money.

References

1. Vance Trimble. *The Uncertain Miracle: The little-known maverick medical treatment which has saved the lives of thousands of people*. New York: Doubleday. 1974; 83-84.
2. Hearing before the House Labor Health, Education and Welfare Committee, House of Representatives, Labor-HEW Public Witness Testimony. Statement of Hitchcock. 1963.
3. KP Stoller. Quantification of Neurocognitive Changes Before, During and After Hyperbaric Oxygen Therapy in a Case of Fetal Alcohol Syndrome. *Pediatrics*. 2005; 116: 586-591.
4. Paul G Harch, Edward F Fogarty, Paul K Staab, Keith Van Meter. Low pressure hyperbaric oxygen therapy and SPECT brain imaging in the treatment of blast-induced chronic traumatic brain injury (post-concussion syndrome) and post traumatic stress disorder: a case report. *Cases Journal* 2. 2009:6538.
5. Stoller KP. Hyperbaric oxygen therapy (1.5 ATA) in treating sports related TBI/CTE: two case reports. *Med Gas Res*. 2011; 1: 17.
6. Boguslav H, Fischer, Morton Marks and Theodore Reich. Hyperbaric-oxygen treatment of multiple sclerosis: a randomized placebo-controlled, double-blind study. *New England Journal of Medicine*. 1983; 308: 181-186.
7. Carole Sénéchal et al. Hyperbaric Oxygenation Therapy in the Treatment of Cerebral Palsy: A Review and Comparison to Currently Accepted Therapies. *Journal of American Physicians and Surgeons* 12. 2007.
8. Fischer BH, Marks M, Reich T. Hyperbaric-oxygen treatment of multiple sclerosis. A randomized, placebo-controlled, double-blind study. *N Engl J Med*. 1983; 308: 181-186.
9. Andrews PW, Thomson JA Jr, Amstadter A, Neale MC. Primum non nocere: an evolutionary analysis of whether antidepressants do more harm than good. *Front Psychol*. 2012; 3: 117.
10. Y Lucire, C Crotty. Antidepressant-induced akathisia-related homicides associated with diminishing mutations in metabolizing genes of the CYP450 family. *Pharmacogenomics and Personalized Medicine* 2011: 65 – 81.
11. Delgado PL, Moreno FA, Onate L, Gelenberg AJ. Sequential catecholamine and serotonin depletion in mirtazapine-treated depressed patients. *Int J Neuropsychopharmacol*. 2002; 5: 63-66.
12. Rockswold GL, Ford SE, Anderson DC, Bergman TA, Sherman RE. Results of a prospective randomized trial for treatment of severely brain-injured patients with hyperbaric oxygen. *J Neurosurg*. 1992; 76: 929-934.
13. Gutsaeva DR, Suliman HB, Carraway MS, Demchenko IT, Piantadosi CA. Oxygen-induced mitochondrial biogenesis in the rat hippocampus. *Neuroscience*. 2006; 137: 493-504.
14. Philip Waalkes, Daniel T Fitzpatrick, Seth Stankus, Richard Topolski. Adjunctive HBO treatment of children with cerebral anoxic injury. *Army Medical Department Journal*. 2002.
15. Terri Tanielian and Lisa Jaycox. *Invisible Wounds of War: Psychological and Cognitive Injuries, Consequences, and Services to Assist Recovery*. California: RAND Corporation. 2008.