The Robert M. Lombard Hyperbaric Oxygenation Medical Center, Inc.

Lyme Disease and Treatment with HBOT

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LYME DISEASE

PATHOLOGY: The Borrelia burgdorferi (Bb) spirochetes, which are the cause of Lyme disease, are commonly transmitted by deer tick bites. They are anaerobic or microaerophilic (intolerant of oxygen or elevated levels of oxygen). The Bb spirochetes burrow deeply into muscle and nervous tissue and cause a variety of symptoms. Primary symptoms are an infection localized to the site of the bite, which may be seen as a red, progressively expanding circular lesion, and which may be accompanied by flu-like symptoms. Secondary symptoms include joint and muscle pain, sore throat, fever, chills, headaches, weakness, intolerance to light, secondary skin rashes, difficulty in mentation (thinking), muscle and nervous tissue fatigue, and heart palpitations. Advanced symptoms include arthritis, irregular heartbeat, severe headaches, loss of sensation, carditis, meningitis, cranial neuritis, radiculoneuropathy, and migratory pain in joints, tendons, bursae, muscles or bones. In stage 3, the spirochetes may cause arthritis of large joints, especially in the knees, encephalopathy, and advanced atrophy of the skin of the upper or lower limbs known as Acrodermatitis Chronica Atrophicans (ACA). In the end stage of ACA, the skin becomes so atrophic that the superficial veins and subcutaneous tissue become prominent and are easily lifted and pushed into folds. If left untreated or not treated promptly, Lyme disease symptoms may become chronic; the disease may cause permanent disability and, rarely, death.

Lyme disease is often misdiagnosed as another type of illness based on the presentation of symptoms.

The Bb organism is capable of encapsulating itself in the body's protein, and thus the immune system fails to react to the Bb organism as a foreign organism that should be destroyed. The spirochetes typically burrow deeply into the fatty muscle and nervous tissue where they are not detected by immune system antibodies. Hidden in a cloak of protein and in areas of low oxygen concentration (low pO_2 levels), they release neurotoxins which circulate through the body's fat storage systems triggering classic Lyme symptoms.[1] Spirochetes can hide *within* the body's cells and may enter a dormant state that will not be affected by antibiotics. Chronic Lyme has increased distribution of spirochetes in non-perfused tissues.

When the disease is discovered during the first six months of infection and is treated in its early stages, the patient generally responds well to oral antibiotics and the spirochetes are killed. However, spirochetes replicate slowly and have the capacity to lie dormant for as long as 10 months. The only time the spirochete is vulnerable to antibiotics is during a growth/reproduction stage. Further complicating matters, some enzymes produced by the spirochetes confer resistance to some kinds of antibiotics, making treatment of this disease, once a person has been infected for longer than six months, challenging.[2]

TREATMENTS

ANTIBIOTIC THERAPIES

ORAL ROUTE

Penicillins and Cephalosporins

This antibiotic therapy is the first line defense in the treatment of Lyme disease. It circulates mainly in the body's fluids but has difficulty penetrating into muscle tissues to eradicate Bb bacteria and is incapable of entering cells where Bb organisms can reside. If treated with the penicillins or the cephalosporins in the primary stage, the person usually responds well. If the symptoms have entered stage II or later, where the Bb spirochete has entered muscle tissue, a second form of antibiotic therapy is often necessary and may be used in combination with the primary therapy.

Macrolides (azithromycin)

This antibiotic family can attack Bb organisms that may be established in the body's cells as well as killing Lyme bacteria residing outside the cells in deep tissue areas of the body. Macrolides may not be able to penetrate the full depth of muscle tissue. Macrolide antibiotics are not recommended as first-line therapy for early Lyme disease (E-I). When used, they should be reserved for patients who are intolerant of amoxicillin, doxycycline, and cefuroxime axetil.[3]

If the person does not respond well to oral antibiotics, IV therapy may be used and may involve different antibiotics. Oral therapy is easier to administer than IV antibiotics and is considerably less expensive. It also is associated with fewer serious complications. Its disadvantage is that some patients treated with oral agents have subsequently manifested nervous system involvement, which may require IV therapy for successful treatment.

IV THERAPY

Ceftriaxone (Rocephin) and Vancomycins

IV therapy is useful in that it provides antibiotics "ready to use," that do not have to be absorbed through the digestive system as with oral antibiotics. IV drugs are often prescribed because of the failure or intolerance of oral therapy and may be other classes of antibiotics. Rocephin is still the most used IV antibiotic, often delivered via a peripheral IV line and may well be given with a macrolide to increase the overall effectiveness. There are several IV antibiotics that may affect the Bb organism, such as doxycycline and vancomycin.

Long term antibiotic use can be problematical to a person's overall health and the spirochetes may become drug resistant. Persons who don't respond well to conventional drug therapy or who have drug sensitivities or allergies, or become sensitive or allergic, may respond well with complementary therapies.

ALTERNATE AND COMPLEMENTARY THERAPIES

These therapies have been shown to have a positive influence to some degree on symptoms for persons with Lyme disease[2]:

- Vitamins
- Diet
- Exercise
- Immune modulation
- Reishi spore extract, transfer factor
- Acupuncture
- **Hyperbaric Oxygenation**

In pursuing hyperbaric oxygen (HBO) therapy to treat Lyme disease, it has been shown in studies by both Charles Pavia, PhD, and William P. Fife, PhD, that ***spirochetes exposed to an increased partial pressure of oxygen could not survive.*** Bb organisms do

not thrive in elevated pO_2 levels above 70-80 torr. Hyperbaric oxygen therapy involves delivering 100% oxygen to a patient at a greater-than-sea-level atmospheric pressure. Normal pO_2 levels of tissues increases from a typical 35-40 torr to 999+ torr when measured by transcutaneous oximetry at 2-3 ATA (atmospheres absolute). Arterial saturation of oxygen rises to about 22 mL/dL, of which nearly 25 percent is dissolved in the plasma[4]. The cerebral-spinal fluid is also supersaturated with molecular oxygen. Life could be sustained without hemoglobin at this level.

Because plasma seeps into areas between cells, this increase in the amount of oxygen carried by the plasma allows oxygen to be distributed at very high levels deep within muscle and body tissues, and to areas where normal blood flow is compromised. This causes accessible Borrelia burgdorferi spirochetes to be destroyed, interrupts the reproductive cycle or forces them into spore (inactive) form.

In addition to the increased pO_2 level, hyperbaric oxygen therapy also stimulates the immune system response which increases the production of phagocytes, the white blood cells that ingest and destroy foreign matter, and the production of leucocytes, the white blood cells that defend the body against infective organisms. It is bacteriostatic—it interferes with the ability of the organism to reproduce, and is bactericidal and directly attacks the cell wall of the bacterium, causing it to rupture, then die.

Hyperbaric oxygen therapy produces natural free-radicals that are believed to have an antibiotic-like effect.[5] The Bb organisms can be killed by oxygen free-radicals.

Over a series of treatments, HBO therapy causes angiogenesis, the formation of new capillaries. This is important for the distribution of the Penicillin and Cephalosporin families of antibiotics which travel via blood flow. The new blood vessels allow the antibiotics to reach tissue that was poorly perfused, and the combination of HBO therapy and antibiotics is greater than the effect of either one alone. Antibiotics may be more readily incorporated into the cell wall of the bacteria in the presence of elevated oxygen tension.

JARISCH-HERXHEIMER RESPONSE

The Jarisch-Herxheimer response (Herxheimer) occurs when symptoms recur, flare up or become exaggerated and is an increase in the severity of symptoms a person suffers. It is an indication of the death of spirochetes. Dead and dying spirochetes release endotoxins as their cell walls break down. These endotoxins exacerbate symptoms and can be fat soluble which slows elimination from the body, extending the symptoms. In the normal 28 to 32 day life-cycle of a spirochete, as adult bacteria reproduce and die, a person experiences a Herxheimer usually during this same period. Outside of this normal reproductive die-off, a Herxheimer is used as a clinical diagnostic tool to confirm the effectiveness of antibiotics and other treatments such as HBO therapy.

Under hyperbaric oxygen therapy, a Herxheimer response usually occurs within days to weeks of starting therapy. Improvements from hyperbaric oxygenation may not be observed until 3 weeks to 3 months post therapy due to the effect of endotoxins trapped in fat soluble tissues.

Hyperbaric oxygen is tolerated by most patients and is a complement to traditional antibiotic therapy. It also provides relief for those patients who cannot tolerate antibiotics or who have become stagnant in their antibiotic response.

TREATMENT PROTOCOL

The hyperbaric oxygen treatment protocol for Lyme disease is 1.8 to 2.4 atmospheres absolute (ATA) for an initial series of 40 treatments. This time frame covers the typical

reproductive cycle of the Bb organism. A repeat series is recommended after 6-8 weeks if symptoms recur and single or dual treatments may help to stem the spirochete reproductive cycle before a second full series is deemed necessary. If tolerated, antibiotic therapy is recommended to be continued as this will help to eliminate remaining bacteria.

1. ***http://www.chronicneurotoxins.com/learnmore/lymedisease***
2. ***Burruscano, Joseph J., Jr., M.D. Managing Lyme Disease***
3. ***Practice Guidelines for the Treatment of Lyme Disease; Gary P. Wormser et al. CID 2000;31***
4. ***Hyperbaric Oxygen Therapy Gains Respect in Medical Circles, Deborah S. Cowder, As, RRT. Issue Date: 7/29/2002***
5. ***An Overview of Lyme Disease and Hyperbaric Oxygen Therapy; Mitchell L. Hoggard and L. James Johnson***