Summary – Hyperbaric Oxygen Therapy in Mito Patients
Dr. Bruce Cohen

The first slide demonstrates the energy flow through the electron transport chain from complex I to complex V. Protons derived from the breakdown of food particles are pumped into the intermembrane space of the mitochondria to create a positive charge in this area. NADH is the high-energy compound that drives these pumps. At complex IV you can see a reaction where the oxygen is combined with hydrogen to form water and with electron transport, ATP now becomes a "charged battery" in the mitochondria (ie, it is full of energy).

Slide 2 is another depiction of the electron transport chain. O_2 (oxygen) is turned into water at complex IV. When a muscle biopsy is conducted in the lab in order to diagnosis mitochondrial disease, the mitochondria are observed as they are fed molecules such as NADH, and the speed of the electron transport chain is measured. Like a car engine, the mitochondria can only burn fuel at a certain rate; it cannot go any faster once it reaches a certain point. It has been discovered that no matter how much oxygen is provided for the mitochondria, the electron transport chain has a maximum speed at which point it can run no faster. Increasing the amount of oxygen above that which is in the atmosphere does not speed up the reaction.
Slide 3 reiterates how oxygen in the mitochondria is combined with hydrogen at complex IV to produce water.

Slide 4 (not shown) introduces the concept of free radicals. Free radical oxygen molecules (called superoxide free radicals) are mainly produced after complex I when electrons attach themselves to an oxygen molecule. Free radicals can appear in other places along the electron transport chain as well, and the body has some mechanisms to get rid of these free radicals (enzymes that convert them back into oxygen and water).

Slide 5 shows where free radicals are produced in the mitochondria. This occurs in healthy people - we need some free radicals, and they are produced in the natural aging process.

Slide 6 shows how free radicals can, however, damage the body. These "extra" electrons on the O_2 can damage nuclear DNA, mitochondrial DNA, and can rip apart other molecules and create a whole list of problems for the human body.

As demonstrated on Slide 7, external toxins can produce free radicals that assault our bodies: ultraviolet light, radiation (used to kill cancer cells to die but can damage healthy cells as well), smoking, air pollution, and inflammation (from a viral infection, for example).

Slides 8 & 9 humorously demonstrate the importance of eating fruits and vegetables to help eliminate free radicals; some say blueberries are the best free radical fighter of all.

Hyperbaric Oxygen Therapy (HBOT) Hyperbaric Oxygen Therapy is a method of delivering more oxygen to the body than is available in the atmosphere. The percent of

oxygen in the atmosphere is normally about 20%. Patients with cardiac or pulmonary disease sometimes receive 100% O_2 through a face mask or nasal tube as a treatment because their organs (heart and lungs) are not functioning properly. HBOT is used in people who have suffered diving injuries and also for those with gangrene because it provides more oxygen for the tissues. In some patients who develop radiation necrosis years after radiation treatment for cancer, HBOT can be used to slow down or reverse this necrotic process. These uses of HBOT have all been proven useful through rigorous controlled research studies.

Scientific Method The last two Wikipedia references are articles about scientific research and clinical trials. The first article discusses the scientific method; that is, the objective of scientific research is to prove something using a rigorous controlled trial. The objective of using the scientific process is for a scientist to prove that something works, not to prove it doesn't work. For example, it is the obligation of the person who says that HBOT works as a treatment to prove that it works using thorough scientific methods.

Clinical Trials In medicine, clinical trials have several phases and are designed to establish efficacy (ie, does the treatment/drug/procedure work). In Phase 1 trials, the maximum tolerated dose is established. These trials begin by using the smallest possible dose and then increasing it in small increments to see at which point harmful side effects begin to appear. The trial is stopped and the maximum tolerated dose is established. Once the safety factor is established through Phase 1 trials, Phase 2 trials establish effectiveness - does the treatment work? Finally, Phase 3 trials set about establishing whether this new treatment is in fact better than any other treatment. This phase can be difficult to complete because we don't want to deny anyone a known treatment in favor of a new unproven one. This is why sometimes clinical trials cannot always be undertaken safely. If the "new" treatment is NOT toxic and fairly inexpensive, then it may be worth trying. About 20 - 30 years ago Aspirin was given to women with the idea that it would decrease heart attacks. The scientific results were not that it decreased incidence of heart attacks, but that it did decrease the incidence of strokes. Also, some patients show that taking CoQ10 supplements can be of great help. However, for other patients, there is no change in their condition. Since CoQ10 has few if any side effects and is fairly inexpensive, it is often recommended to patients even though its use has not been subjected to rigorous scientific research.
Scientific research has shown that HBOT cannot speed up electron transport. It is also known that adding oxygen to systems that do not need it can result in an increase in free radicals which can damage the body. For example, newborns in the 1950's who were placed in high oxygen environments became blind because of free radical damage to their retinas. In patients with mitochondrial disease, there appears to be a risk associated with the use of HBOT due to the risk of free radical damage, and Dr. Cohen cannot support its use. "I am not enthusiastic about it [Hyperbaric Oxygen Therapy] as a treatment for mitochondrial disease." Dr. Cohen would be interested in clinical trials that could prove that HBOT was an effective treatment for Mito: there are none to date.

Summary Though there is personal testimony that HBOT has worked for some patients

with certain Mito conditions, there is no scientific evidence to date that would positively indicate the use of HBOT as a treatment for mitochondrial disease. Dr. Cohen recommends further study in this area. Sometimes there are treatments that work for certain patients that are at the time unexplainable. Until these can be explained by science, however, he cannot recommend them as treatments.

QUESTIONS

Several people called to say that they (or family members) had been treated with HBOT and had great relief from Mito symptoms. Dr. Cohen felt that these phenomenon were still unexplainable and encouraged the callers to seek sources who might study these phenomenon in a rigorous scientific manner.

Why does regular O_2 treatment work? Patients with cardiac disease or lung disease can be aided by O_2 administration because these organs need O_2 to function and if diseased, more O_2 can ease their workload. An example for Mito patients might be someone with low O_2 saturation levels who develops sleep apnea. Instead of a normal O_2 level of 96-99%, it drops to 85% or lower during sleep which is not good. Having extra oxygen supplied at night can keep their O_2 saturation level near normal during these apneac spells. This oxygen is not treating or helping the mitochondrial disease *per se,* but rather other body organs that may be compromised due to mitochondrial disease.

Summary compiled by Joanne M. Turco, RN, MS, Danielle D'Ambrada, and Cristy Balcells RN MSN