



Stroke

A stroke occurs when a person's brain is not getting enough blood, which in turn means it is not getting enough oxygen. Strokes are caused by blood clots in blood vessels (ischemic stroke), bleeding of blood vessels into tissue (hemorrhagic stroke), and ruptured blood vessels (subarachnoid hemorrhage or ruptured aneurysm). During a stroke, brain damage can happen very quickly, as the cells begin to die without oxygen. For thousands of years, there was no treatment for the most common type of stroke, a blood clot in an artery, until clot-dissolving drugs were developed in the 1980s. The common belief is that a stroke is only treatable if therapy can be delivered within four to five hours of the stroke. This is simply not true. Stroke patients can respond to HBOT at all phases of the injury: acute, subacute (weeks to months), and chronic (greater than 6 months). The key is resupplying oxygen to the stroked tissue and HBOT does this like no other therapy.

A stroke can be disabling and debilitating. After a person has a stroke, there can be long-term symptoms as a result of lost brain tissue and residual injured brain tissue. Some of these symptoms include pain, difficulty walking or balancing, inability or difficulty speaking, memory loss, mood swings, irritability, and difficulty eating or swallowing. A stroke and its aftermath can be very complicated and hard for any person to endure, especially if they were relatively healthy and active before the stroke.

Hyperbaric Oxygen Treatment of Strokes

HBOT is best delivered as soon after a stroke as possible, but this is often difficult to achieve in the hospital due to the lack of emergency HBOT services and lack of reimbursement. When a patient can begin treatment early there is a much higher chance of healing and recovery. However, HBOT can be effective at all stages of recovery after acute stroke. Dr. Harch's extensive experience treating post-stroke patients consists primarily of treating patients in the subacute and chronic phases of the stroke, i.e., when they are discharged from the acute care hospital or from the rehabilitation hospital. Regardless of how long after the stroke patients receive HBOT, the vast majority of patients experience improvement in their stroke symptoms.

Benefits of HBOT for Stroke Treatment

Another important benefit of HBOT for stroke patients is that it is a simple low-risk treatment. Many patients who suffer a stroke are older and may have difficulty with more intense therapies. Hyperbaric oxygen treatment is a very easy and safe treatment. Patients who use HBOT for stroke recovery can experience significant improvement in strength, endurance, balance, memory, and motor skills, depending on the location and size of the stroke. Some patients also feel less pain, begin to speak more clearly, and improve their activities of daily living (ADLs). Even small gains can have a significant impact on quality of life. When coupled with other therapies, HBOT can often have even greater benefits.

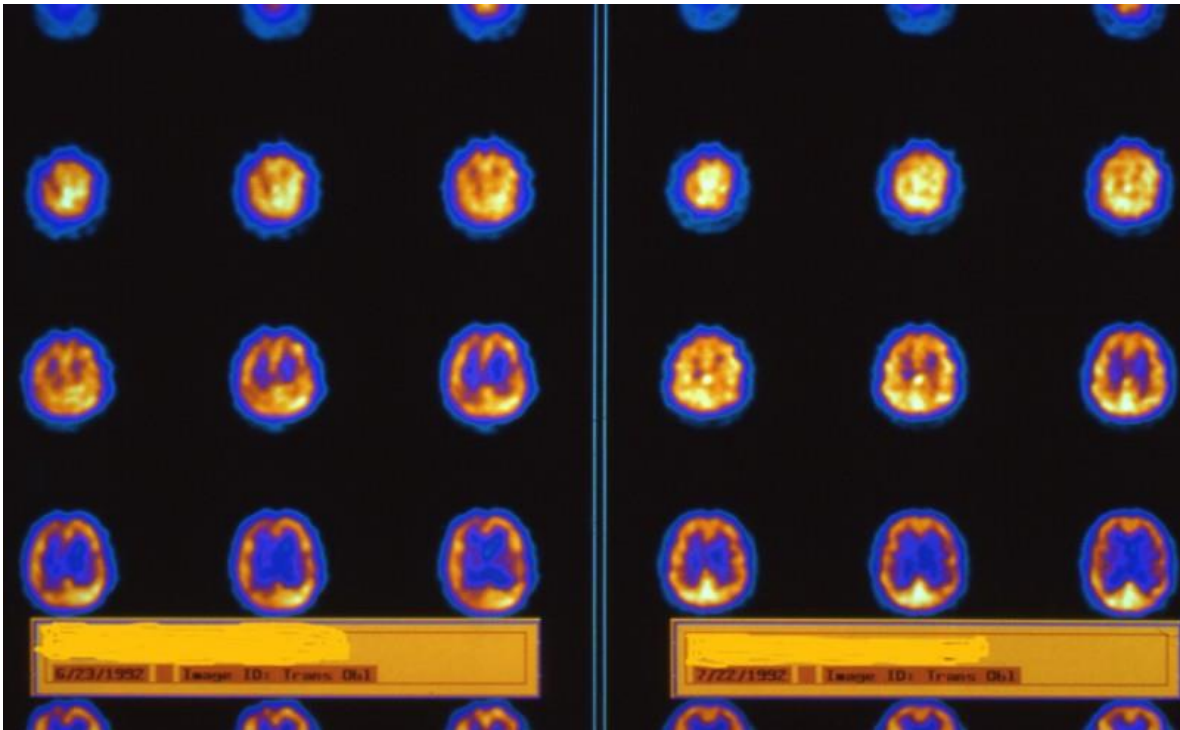
The Importance of Hyperbaric Oxygen Treatments for Strokes

Hyperbaric oxygen treatment increases oxygen levels in the blood and in the tissues, improves circulation, and helps heal damaged tissues quickly. The area of dead and dying brain tissue can vary in size and location. When the tissue in the brain has died, this is called an infarct. HBOT has no known effect on dead brain tissue. It is the area surrounding the dead brain tissue, consisting of living damaged tissue, that HBOT treats. If left untreated much of this injured brain tissue will die. When subjected to hyperbaric oxygen this injured brain tissue can be salvaged, healing occurs, and patients recover function. Hyperbaric oxygen will stimulate new blood vessel growth which contributes to further return of function. Once the brain has begun to heal, the patient can be more responsive to physical, occupational, and speech therapy. Hyperbaric oxygen treatment of stroke, when administered early in the healing process, can help the patient take tremendous strides in healing and long-term wellness.

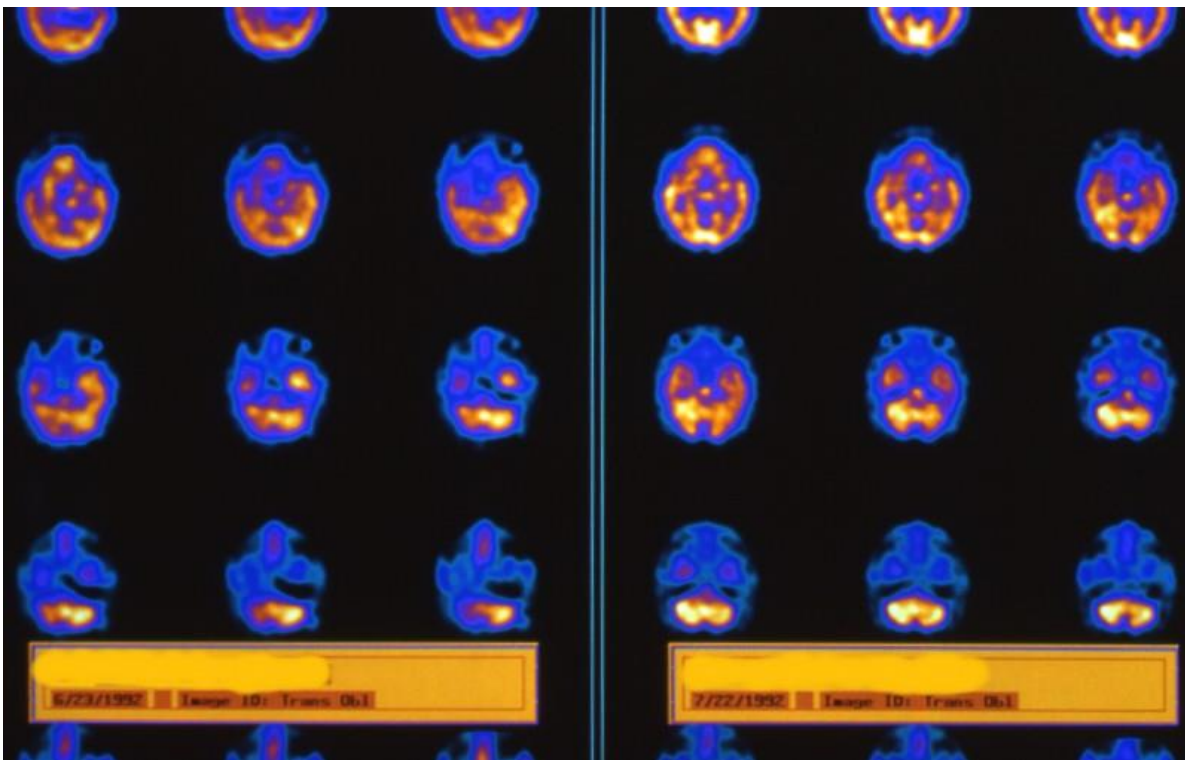
Case Study

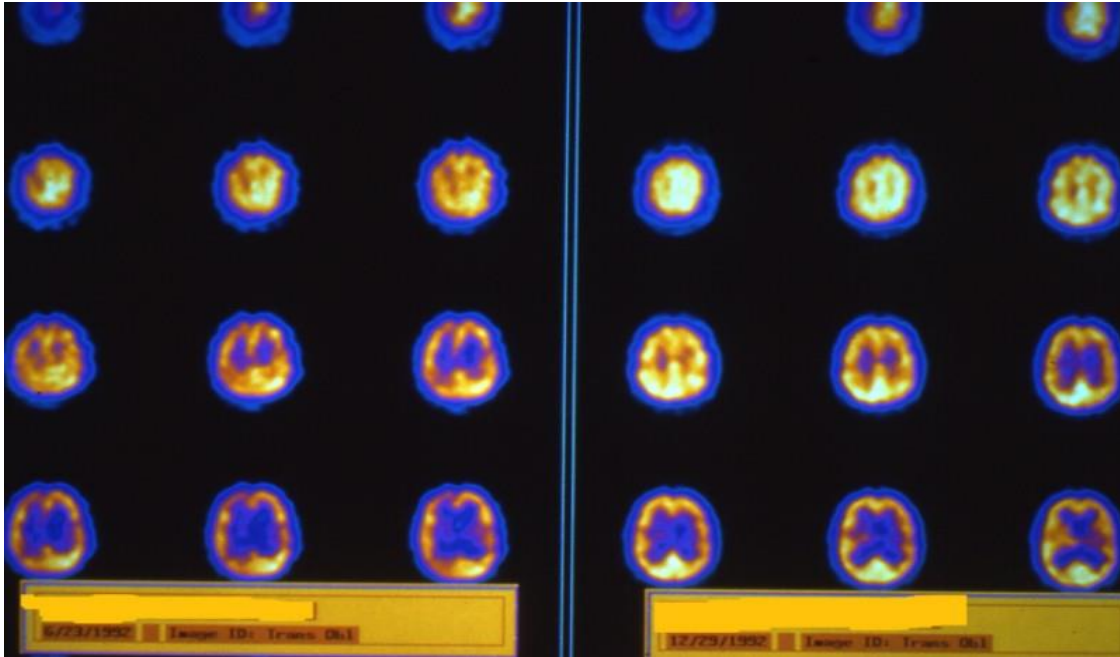
Mr. Bennett was a 68 year old man who had experienced multiple small strokes over his lifetime, with the last stroke occurring 2.5 years before his referral for HBOT. The last stroke was the most serious. After this stroke, Mr. Bennett had intractable dizziness, poor balance, right body incoordination, poor motor control, and was walking-cane dependent. He was now housebound, afraid that he would fall in public if he ventured out with his cane and knee brace. The constellation of these symptoms caused a severe depression where he voiced suicidal thoughts, saying that he was only staying alive for his grandchildren.

Mr. Bennett underwent a SPECT scan, and the next day received a single HBOT dose followed by a repeat SPECT scan. Over the course of the next 5 months he received 80 HBOTs in two blocks, with a break in between each set of 40. During this time and after treatment, he experienced a marked decrease in his dizziness, improved balance, improved right body coordination, and better control of his left knee, such that he needed neither a cane nor knee brace. With these improvements, he resumed his previously active lifestyle, was no longer housebound, and had a marked improvement in his depression. His SPECT brain imaging showed a remarkable improvement and was responsible for his clinical improvement.



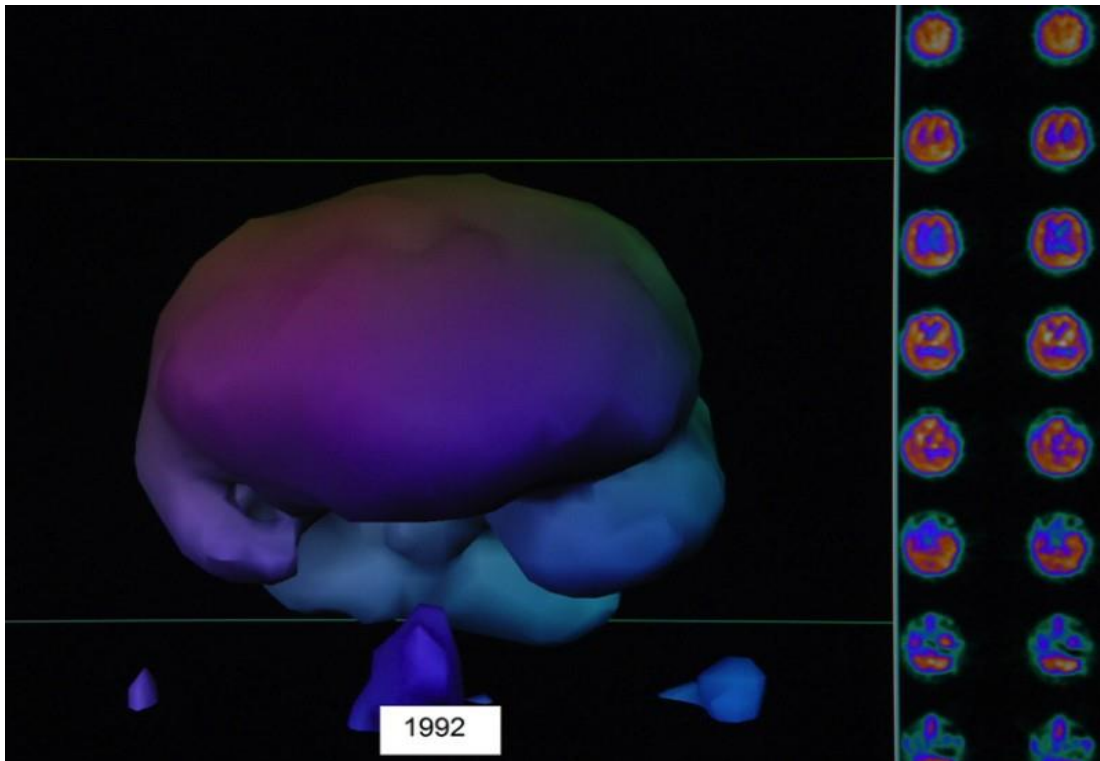
Mr. Bennet's SPECT scans before and after a single HBOT: The pre-HBOT scan is on the left and the after-1 HBOT scan on the right. The first picture is the top half of the brain and the second picture is the lower half. Note the global increase in brain blood flow after just 1 HBOT.



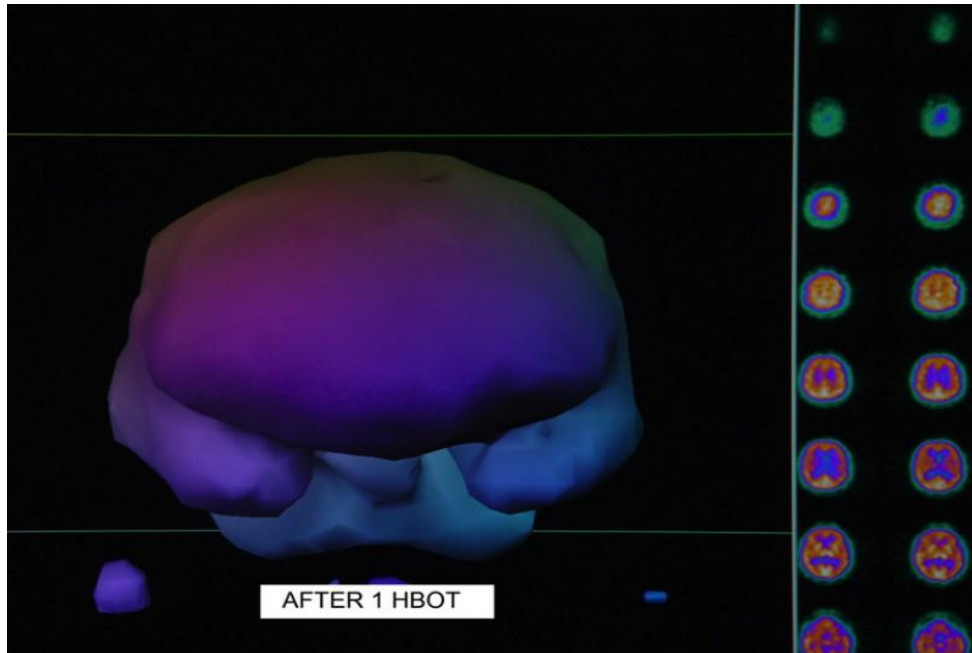


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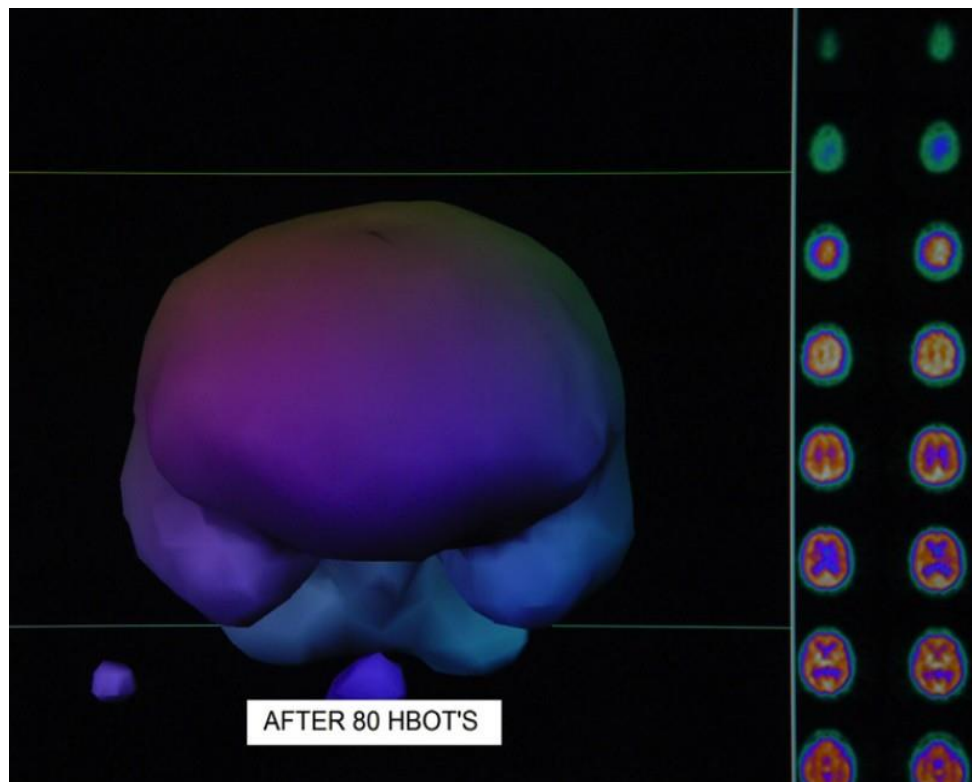
Bennet's SPECT scans before HBOT and after 80 HBOTs: The before HBOT scan is on the left and the after 80 HBOTs' SPECT on the right. Again, note the global improvement in brain blood flow which is now more permanent and responsible for the clinical improvements Mr. Bennett experienced.



3D surface reconstruction of Mr. Bennett's scan before HBOT: while the slices capture global abnormalities, the surface reconstruction mainly shows reduced blood flow to the right temporal lobe (on the left side of the image), and the right cerebellum (in the back at the bottom of the image).



3D surface reconstruction of Mr. Bennett's SPECT scan after 1 HBOT: note the smoother appearance of the surface of the brain and marked improvement in right temporal lobe and cerebellum. Note: A SPECT scan is often performed before HBOT and again after one HBOT to display recoverable brain tissue. In order for increased blood flow to be more permanent, at least approximately 40 treatments are completed.



3D surface reconstruction of Mr. Bennett's SPECT scan after 80 HBOTs: note the improvements seen on the pre-HBOT scan which are now more permanent and responsible for Mr. Bennett's clinical improvement.

Supportive Research and Information

K.K. Jain, Role of Hyperbaric Oxygenation in the Management of Stroke, Textbook Of Hyperbaric Medicine, 6th Edition, Editor: K.K. Jain, Springer Publisher, Cham, Switzerland, 2017. (can purchase individual chapter at: <https://www.springer.com/us/book/9783319471389#>)

<https://www.ncbi.nlm.nih.gov.ezproxy.lsuhsu.edu/pubmed/1968553> (One of the most dramatic cases of HBOT in chronic stroke that suggested the concept that injured (stroked) brain tissue could exist in an idling state for 14 years and was able to be re-activated. Published by Dr. Richard Neubauer, Dr. Harch's mentor).

<https://www.ncbi.nlm.nih.gov.ezproxy.lsuhsu.edu/pubmed/7394869> (An early review of 122 stroke cases treated by Dr. Neubauer).