STROKE

Every 40 seconds, someone in the United States suffers a stroke, what some medical professionals now refer to as a "brain attack." That frequency adds up to nearly 800,000 cases per year. Every three-and-a-half minutes, someone dies from a stroke. Neuroplasticity can be activated and operative, long after a stroke event.

An episode of malignant hypertension is a medical emergency that can trigger cell death in any part of the body—the brain, the heart, the kidney, and more. It most often afflicts people with high blood pressure, but it can happen to other people as well. It is more common in young adults, especially among Black people.

Kidneys are such important organs in orchestrating the blood pressure, electrolytes, and biochemistry for how well the body functions or does not function. Nephrology is a specialty in how kidneys function, renal-related disease, electrolyte balance, fluid-volume balance, and blood pressure; each is a dynamic element of homeostasis—the self-regulating process by which biological systems tend to maintain stability while adjusting to conditions that are optimal for survival.

If homeostasis is successful, life continues; if unsuccessful, disaster or death ensues. Accordingly, nephrologists are expected to acquire an encyclopedic understanding of human physiology. When the kidney stops functioning, nephrologists take full control to preserve the human homeostasis.

Spontaneous natural recovery of some weakened capacities can happen up to three months. After six months, there is little chance any stoke sufferer will experience a significant spontaneous recovery. However, a surge of oxygen and energy delivered through hyperbaric oxygen therapy can stimulate growth of neurons, repair damaged ones, and restore brain and motor functions lost after a stroke.

Groups of people who had suffered a stroke between six months and three years prior, with some type of motor problem that could be visually assessed, (unable to move a hand, leg, or finger or take care of routine daily living tasks such as cooking, eating, and toileting) **had forty ninety-minute sessions, five days a week over two months to generate the *hyperoxic-hypoxic paradox*** (HHP)**. The control continued with their standard rehabilitation.**

Patients in the treatment group had "statistically significant improvements from their debilitating impacts after stroke. They now could better raise a hand or lift an arm of leg. There was no significant improvement in the control group. Later, after the study finished, the same treatment was offered to the control group. Their results matched those of the initial treatment group.

THE DISABILITY, SYMPTOMS, AND SCIENCE OF STROKE

Strokes can be disabling in many ways, with varying degrees of severity. Difficulty with speech or reading, loss of vision, loss of hand, fingers, arm or leg movement on one side of the body, and diminished memory and other cognitive functions are common.

Medical evaluations for assessing a stroke's severity cover all these functions: bathing, dressing, grooming, oral care, toileting, walking, climbing stairs, eating, shopping, cooking, managing medications, using a phone, housework, doing laundry, driving, and managing finances.

Patients become despondent often when the effects of a stroke make it impossible for them to handle simple daily habits such as bathing, dressing, and using the toilet. They lose independence.
There are two types of strokes. One is ischemic, a condition in which blood clots or some other blockage (occlusion) **in an artery restricts or prevents oxygen flows in some area of the brain and disrupts the functions, such as memory or motor movement, controlled in that area. Ischemic stroke is by far the more common type, totaling about 87% of all strokes in the United States.**

The other type is hemorrhagic, a rupture somewhere in the wall of an artery that causes blood to leak into adjacent areas of the brain. For an ischemic stroke, we want to remove the blockage, which most often is a blood clot, as soon as possible, either with drugs to break up the clot (thrombolytic therapy)**, or by inserting a tiny tube into the arteries, maneuvering the tube to the precise location of the blockage, and removing the clot. The major danger from brain hemorrhage arises as leaking blood seeps into places it does not belong.**

The pressure building inside the skull—a closed box with the brain inside—can damage neurons and other tissue. Blood flows through the arteries according to a pressure gradient, meaning from areas of high pressure toward lower pressure. When a hemorrhage causes pressure in the closed box to increase, the gradient decreases and the blood and oxygen supply falls. Mental or motor functions controlled in that section of the brain can break down.

How can we reduce rising pressure caused by blood leaking from the ruptured vein or artery? One method is opening a section of the skull by removing part of the scalp. A second is drilling a hole in the skull. Anotjher is inserting a stent into a leaking artery and inflating its tiny balloon to fit the artery wall and prevent blood from leaking.

Primary reasons for stroke include high blood pressure, high cholesterol, obesity and diabetes, and smoking. For stroke patients, physical therapy, fitness training, and cognitive training with mental exercises are vital elements that we need to "teach" healthy tissues in the brain to take on diminished functions of damaged tissues.

Hyperbaric oxygen therapy cannot revive dead tissue in the brain; dead tissue is replaced with cerebral spinal fluid, leaving no space for angiogenesis and the restorative benefits that could be delivered by migration of higher levels of stem cells.

Triggering HHP can be like putting a cast on your broken leg. A cast will help heal the broken leg. But if you have had to have an amputation, and the full leg is no longer there, a cast won't help heal the leg. It's the same with dead tissue in the brain. HHP cannot help heal dead tissue in the brain. Our natural biochemistry, in effect, has amputated that dead tissue. That dead tissue cannot function.

Physicians need to approach the brain as a tissue as they would with any other tissue. We need to evaluate wounds in the brain just as we do for wounds in any other part of the body. Any clinical improvement that resolves a dysfunction in some tissue happens because its metabolism, the life-sustaining chemical reactions in that tissue, has been restored. If the tissue is damaged, we can recover it. If the tissue is dead, it's lost.

STROKE WARNING SIGNS

1. **Sudden numbness or weakness in the face, arm, or leg, especially on one side of the body.**
2. **Sudden confusion, trouble speaking, or difficulty understanding speech.**
3. **Sudden trouble seeing in one or both eyes.**
4. **Sudden trouble walking, dizziness, loss of balance, or lack of coordination.**

5. Sudden, severe headache with no known cause.

If you think you or someone near you may be having a stroke, take these actions as quickly as possible.

- F—Face: Ask the person to smile. Does one side of the face droop?
- A—Arms: Ask the person to raise both arms. Does one arm drift downward?
- S—Speech: Ask the person to repeat a simple phrase, is the speech slurred or strange?
- T—Times: If you see any of these signs, call 9-1-1 right away.

A stroke can leave the patient with two degrees of brain injuries. The most severe is necrosis, or fully dead tissue, which cannot be recovered even with HBOT. However, in some areas the injury may be less severe and a chronic *penumbra*, or “stunned” brain tissue, is formed.

Cells in these stunned areas do have the minimal amount of energy necessary to survive, but they cannot generate enough energy required for normal function in the injured area of the brain. Those cells have metabolic dysfunction. The stunned area usually surrounds the initial core of the necrotic tissue. It happens that, unlike what we thought in the past, this stagnated state can persist for years, hence the adjective chronic.

By improving oxygenation as HBOT treatments generate the hyperoxic-hypoxic paradox within these “border zones” of necrotic tissue, we can rejuvenate neurons previously regarded as nonfunctional. For stroke patients in particular, when selected appropriately, HBOT has been proven to induce neuroplasticity—the brain’s ability to reorganize the synaptic connections of neurons—even years after the acute stroke. With brain imaging, we can observe this improvement during three months of HBOT treatments as more oxygen and stem cells reach the areas with metabolic dysfunction.

Brain imaging at different phases of HHP treatments will demonstrate improved metabolism in stroke patients as it occurs in areas of the brain that control both motor and speech functions and that correlate with the patient’s recovering physical capabilities.

Although the main focus in post-stroke patients is usually on motor function, up to 50% of stroke survivors suffer from cognitive deficits. The HBOT HHP protocol can significantly improve the cognitive functions of post-stroke patients. Moreover, the full spectrum of cognitive activity—memory, executive function, attention, information processing, and speed—significantly increased regardless of the stroke origin, type, or location. These findings reinforce that the main factor for cognitive improvement is patients’ selection based on metabolic dysfunction on brain imaging.

The biochemical responses to HBOT can repair some of the stroke damage and HHP is a medical breakthrough potentially for treating many types of neurological brain injuries. Newer imaging technology enables us to see and assess the integrity of nerve fibers, the microstructure of the brain. The techniques illuminate pathways as multicolored fibers. In perfusion MRI, we can use whatever array of colors we choose to illustrate varying blood flows and oxygen delivery in different areas of the brain. The perfusion MRI correlates with metabolic activity, while the MRI-DTI (*magnetic resonance imaging* and *diffusion tensor tractography*) correlates with the microstructure of nerve fibers.

These technologies made it possible to demonstrate that the brain is a tissue and can be treated as a tissue. You can see the condition inside the brain just as if you were looking at a wound on the body. Advanced brain imaging continues to confirm this approach: the four basic things we need to repair and heal a visible wound on the body are the same basic things we need to heal wounds inside our head.

1. **We need energy.**
2. **We need a trigger to start our biological repair cascade.**
3. **We need stem cells.**
4. **We need new blood vessels** (angiogenesis)**.**

For the first time, there are convincing results demonstrating that HBOT can induce significant neurological improvement in post-stroke patients. The neurological improvements in a chronic late stage demonstrate that neuroplasticity can be operative and activated by HBOT, even long after acute brain insult. HBOT may serve as a valuable therapeutic practice in other neurological disorders exhibiting discrepancy between the anatomical and functional evaluation of the brain.