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STORY BY

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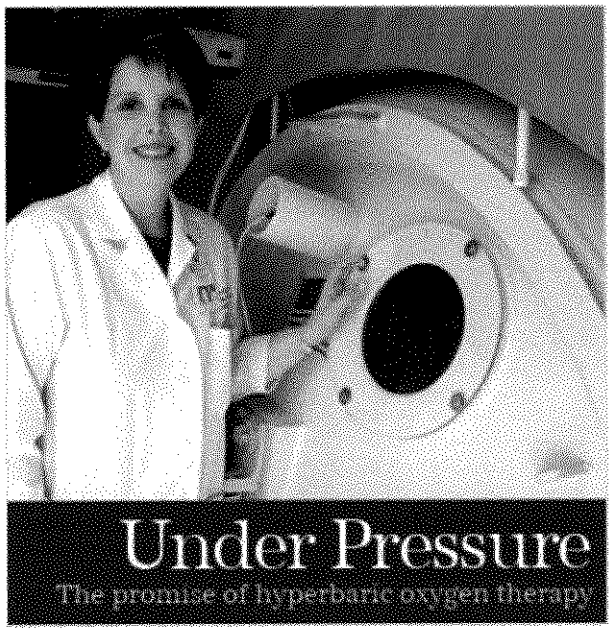


Breathe oxygen in. Exhale. Add pressure. Repeat.

That's the deceptively simple philosophy behind hyperbaric oxygen therapy, a medical treatment that uses a special chamber to increase the amount of oxygen in the blood.

But the simplicity that makes hyperbaric oxygen therapy such an elegant and effective treatment also fuels misconceptions. Hyperbaric oxygen therapy is regarded warily by some members of the medical community who feel not enough evidence supports its use to treat some conditions, and is embraced as a cure-all by persons desperately searching for medical miracles.

"It is really frustrating seeing negative perceptions about hyperbaric oxygen therapy overshadow the many exciting discoveries that are coming out about it," says Caroline E. Fife, an associate professor of medicine at The University of Texas at Houston Medical School and director of Clinical Research in Hyperbaric Medicine for Memorial Hermann–Texas Medical Center.

In fact, Fife says, research shows hyperbaric oxygen therapy helps heal a spectrum of conditions from decompression sickness caused by diving to diabetic foot ulcers. It also may hold promise for a serious condition that occurs when blood flow is *restored* to the body, called ischemia reperfusion injury.

Got oxygen?

In a healthy person, hemoglobin picks up oxygen from the lungs and delivers it to the bloodstream, which circulates the oxygen throughout the body. Persons with chronic medical conditions or injuries can't get enough oxygen to their hemoglobin, starving the body's organs and tissues of oxygen.

Simply breathing in extra oxygen at sea level helps, but only to a point. That's where hyperbaric oxygen therapy comes in. Increasing pressure using a hyperbaric chamber—2.5 or more times the normal atmospheric pressure is considered optimum—allows the oxygen to dissolve into the body's plasma, dispersing it throughout the body.

Certified Hyperbaric Technicians David Baylor (left) and Bob Agan demonstrate how oxygen is delivered in the hyperbaric chamber.

"The (body's circulatory) system is so beautifully designed that just by sitting here now at sea level, your hemoglobin is carrying all the oxygen it can handle," says Fife, who is conducting research on which patients benefit most from hyperbaric oxygen therapy. "Using hyperbaric oxygen therapy, we can dissolve a lot of extra oxygen into the plasma, the fluid part of the blood. That plasma-dissolved oxygen can go places that blood may not be traveling normally, for example, to tissues damaged in a crush injury."

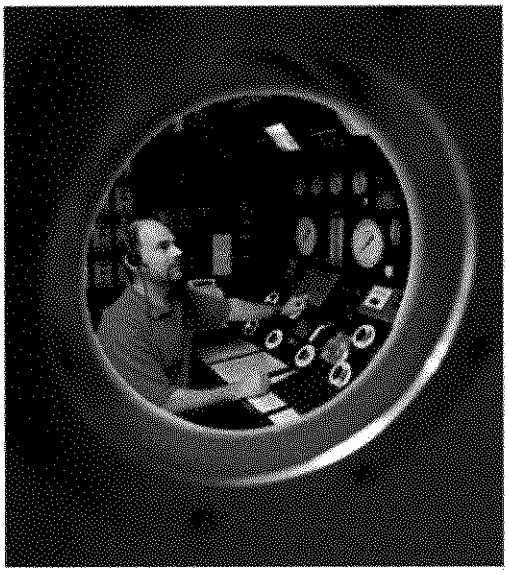
Raising oxygen levels keeps the body's cells alive, fights off deadly infection and boosts the effectiveness of certain types of antibiotics that need normal oxygen levels to work.

"One of the primary ways the body kills bacteria is by making peroxide," Fife says. "In order to make peroxide, your white cells need 10 to 20 times more oxygen available to them."

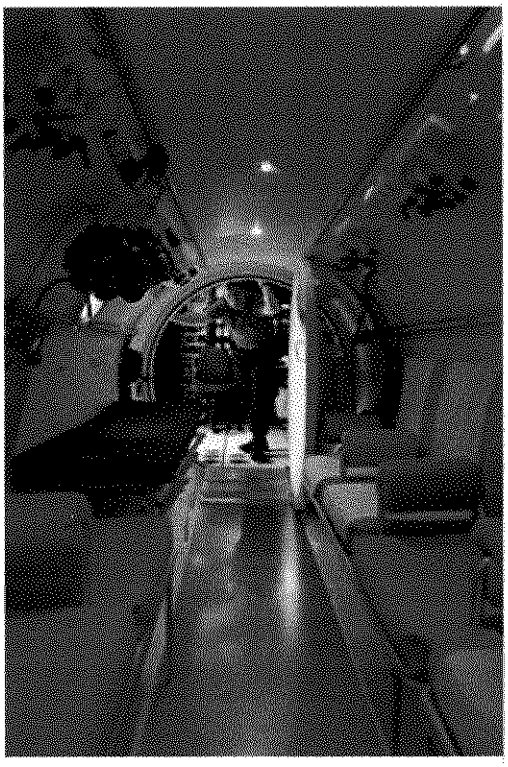
Hyperbaric oxygen therapy typically uses two kinds of hyperbaric chambers: acrylic chambers, which hold one person, or metal room-like chambers that can hold multiple people, like the chamber used at Memorial Hermann. Devices that resemble bread bags and blow oxygen on the skin or around the wound are not hyperbaric, contrary to companies claiming to sell "topical hyperbaric oxygen therapy," Fife says."Your tissues only get oxygen delivered to them when you breathe it," she adds.

Patients undergoing treatment enter the chamber, take a seat and don a hood that resembles an astronaut's helmet. After the door closes, the room is pressurized with air at least two and a half times that of sea level. Then the patient breathes oxygen in through the hood.

Treatments may last from minutes to hours depending on the type and severity of the patient's medical condition.



Control center of the hyperbaric chamber.



A look inside the hyperbaric chamber.

Proven uses

Hyperbaric oxygen therapy is probably best known as a treatment for decompression sickness ("the bends") in deep-sea divers. Decompression sickness occurs when divers rise to the surface too suddenly, not allowing the gas bubbles to escape gradually. The gas bubbles can clog small blood vessels, killing the body's tissues. Severe cases of decompression sickness can cause death.

Increasing pressure during hyperbaric therapy crushes the nitrogen bubbles, restoring blood flow. Hyperbaric oxygen therapy also dissolves more oxygen into the bloodstream, reducing swelling and helping restore damage. Most cases of decompression sickness require only one hyperbaric oxygen therapy treatment, but divers with more serious cases may need multiple treatments.

Treating diabetic foot ulcers—a condition that often leads to amputation—is another common use of hyperbaric oxygen therapy. An estimated 85 percent of all diabetes-related amputations are preceded by a diabetic foot ulcer, according to the International Diabetes Federation.

Diabetes causes poor circulation, which prevents oxygen from getting to the wound to fight the infection. Once a diabetic has a below or above the knee amputation, the likelihood that he or she will have the other leg cut off increases by 10 percent a year. Even more startling, a high percentage of persons with diabetes who have their feet or legs amputated will die within five years.

"A major amputation tends to be a death sentence in a diabetic patient," Fife says. "The survival rate is worse than most cancers. They (amputations) also are expensive, not just because of the cost of the amputation but because many patients have to go to a nursing home to be cared for afterwards."

A recent review of research literature by the Cochrane Collaboration concluded that hyperbaric oxygen therapy decreases the likelihood of a major amputation among diabetics, Fife adds.

Average treatment takes two hours, five days a week. The typical diabetic requires an estimated 30 treatments to heal a wound, or make enough progress toward healing to go home.

Three months of hyperbaric oxygen therapy treatments cost an estimated $3600. In contrast, the cost of a major amputation ranges between $30,000 and $60,000.

Another major use of hyperbaric oxygen therapy is to treat tooth sockets that won't heal—a common problem for patients with head or

neck cancer who have had radiation. These sockets fail to heal because of poor circulation after radiation and later can become infected. Some patients may lose their jaw as a result—a disfiguring and painful consequence that leads to other health problems. Hyperbaric oxygen therapy helps heal the socket and prevent bone infection.

Patients usually require 20 to 30 treatments depending on the stage of their teeth pulling and radiation treatments.

Doctors also use hyperbaric oxygen therapy to treat patients with emergency conditions, such as carbon monoxide poisoning or arterial gas embolism after surgery (when air gets into the arteries during surgery).

"We are always busy with carbon monoxide poisoning," says Fife, adding that she and her colleagues see many emergency cases because the hyperbaric chamber at Memorial Hermann is the only emergency hyperbaric chamber in Houston open 24 hours a day. "When there is a cold snap, people bring space heaters in their homes. During the hurricanes—Katrina, Ike and Rita—we treated people with carbon monoxide poisoning who used their generators inside. More than 30 people were seen in our emergency room who had their generator in the house during Hurricane Ike."

Hyperbaric oxygen therapy is reserved for patients who have severe carbon monoxide poisoning. To prevent brain damage, patients need to be treated as soon as possible.

Promising research also shows that hyperbaric oxygen therapy may help stop tissue damage caused when blood flow is restored to the body, a condition called ischemia reperfusion injury.

The jury's still out

Hyperbaric oxygen therapy's success as a treatment for ischemia reperfusion injury has created overwhelming enthusiasm for the therapy as a potential treatment for other medical conditions—particularly for brain disorders such as cerebral palsy.

"A lot of people have problems for which there aren't any good treatments available and pin their hopes on this modality," Fife says, adding that an increasing number of individuals and business are willing to meet the demand for hyperbaric oxygen therapy. "If you Google hyperbaric oxygen for cerebral palsy, you will find thousands of Web sites. There are people who will buy a chamber and set it up in their garage. It is really the wild west out there."

Fife cautions that current research shows no conclusive evidence that hyperbaric oxygen therapy helps treat cerebral palsy. To determine which uses are legitimate, she advises using the Web site, HBOEvidence (hboevidence.com), a database of randomized controlled trials in hyperbaric medicine. The site lists all human randomized controlled studies in diving and hyperbaric medicine.

"It (hyperbaric oxygen therapy) is the ultimate 'natural treatment,' at a time when natural interventions are a sort of craze," Fife says. "While it acts like a drug, oxygen is not made by a drug company. The problem is, it is drug companies who fund research."

Despite lack of funding, research continues to reveal more information about the benefits and risks of hyperbaric medicine. In the future, hyperbaric oxygen therapy also may be useful as an adjunctive treatment in many conditions, which involve poor circulation from acute stroke to retinal occlusion, Fife adds.

Share your thoughts:

Send us your questions for the experts, comments or suggestions.

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Dr. Fife received her medical degree at Texas A&M University College of Medicine and completed a Fellowship in Undersea and Hyperbaric Medicine at Duke University in North Carolina. In 1990, she was recruited to the University of Texas to direct the Memorial Hermann Center for Hyperbaric Medicine where she initiated a center for wound care, and in 1998, in response to the needs of the community, a Lymphedema Treatment Center.

Dr. Fife has received many awards and honors and has served on several national boards including the Association for the Advancement of Wound Care (AAWC) and the American Academy of Wound Management (AAWM) which provides the Certified Wound Specialty examination (CWS). She is a past president of the Undersea and Hyperbaric Medical Society.

She is a reviewer for many journals including *Circulation*, *Aviation, Space and Environmental Medicine*, and *Undersea and Hyperbaric Medicine*. She is on the editorial board for *Advances in Skin and Wound Care* and is co-editor of *Today's Wound Clinic*. She is a member of the National Quality Forum (NQF) Pressure Ulcer Framework, funded by AHRQ. She is a Special Consultant to NASA's Neutral Buoyancy Laboratory at the Johnson Space Center and serves on the Divers Alert Network (DAN) Advisory Panel.

She is the co-editor of the popular textbook, *Wound Care Practice*, and the author of numerous other book chapters, papers and review articles. Her current area of research interest is lymphatic imaging, in conjunction with Dr. Eva Sevick, using NIR fluorescence.

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