Hyperbaric oxygen therapy improves outcomes of umbilical cord blood transplant patients

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For the past 27 years, cord blood transplants have been a life-saving treatment option for thousands of people with leukemia, non-Hodgkins lymphoma, Hodgkins disease and myelodysplastic disorders. Cord blood helps replace cancerous blood cells and replenish a patient's own bone marrow and immune system. Even with its success, researchers are continually looking for ways to improve the transplant process and increase cure rates.

Omar Aljitawi, M.D., member of the Cancer Biology Program at The University of Kansas Cancer Center and associate professor of hematology/oncology at The University of Kansas Medical Center, has just completed a pilot clinical trial that tested the use of hyperbaric oxygen therapy to improve the outcomes of umbilical cord blood transplant patients. The preliminary data from a small first trial showed positive results and could pave the way towards a simple and safe way of making umbilical cord blood transplants more effective.

In 2008, Dr. Aljitawi was at a meeting where the recipient of the first cord blood transplant spoke, and he was inspired. Previously a physician who strictly saw patients in the clinic, Dr. Aljitawi saw an opportunity to venture into the laboratory and nurture this newfound interest.

"After doing more research into umbilical cord blood transplants, I noticed that a big problem with the transplant process was engraftment," he said. Engraftment is when the transplanted stem cells make their way to the bone marrow and start making new, healthy blood cells. "I wanted to figure out a way to improve that process and make the transplants more successful."

Rebecca Hertzog, a participant in Dr. Aljitawi's hyperbaric oxygen treatment trial for blood cancers, is shown inside a hyperbaric chamber. (Courtesy Omar Aljitawi)

One inherent problem with cord blood transplants is the lack of stem cells due to the small sample size. Most researchers in the field focused their energy on artificially manipulating and multiplying the number of stem cells in a sample. Dr. Aljitawi, however, turned his energy elsewhere after reading a paper that discussed the drastic drop in stem cells in a baby's bloodstream right after birth. This drop was caused by clearance of the stem cells from the blood as they made their way to the bone marrow, a process called homing.

The research also noted that erythropoietin (EPO), a hormone secreted by the kidney that increases the rate of red blood cell production as oxygen levels in the blood go down, was also decreased right after birth.

Armed with this new information, Dr. Aljitawi hypothesized that EPO had something to do with the homing process. The lower the EPO levels, the more blood cells are gravitating to the bone marrow. Since EPO levels seemed to fluctuate based on the levels of oxygen, he knew he had to discover a way to increase oxygen levels in people.

The answer was in a treatment that is already easily available and safe: hyperbaric oxygen therapy. Interestingly, increased oxygen levels alone did not lower EPO, only hyperbaric conditions did as some research suggested.

"Through the initial animal testing - and then in human testing - we've found improvement in the engraftment process and in lowering the EPO level," said Dr. Aljitawi. " The treatment was also tolerated very well and there were few side effects."

The trial was able to move from animal to human testing so quickly because hyperbaric oxygen therapy is already an approved treatment for a number of diseases such as carbon monoxide poisoning, and severe skin infections.

During hyperbaric oxygen treatment, the patient is placed in a tube where the air pressure is two and a half times higher than normal; increasing the amount of oxygen the blood can carry.

For patients with blood cancers, they're first given a round of chemotherapy and radiation to rid the body of the mutated blood cells. In the morning, they'll receive a 2-hour hyperbaric treatment and, in the afternoon, are infused with the umbilical cord stem cells. In the days that follow, patients are given transfusions until their blood cell and platelet counts are back to normal.

Dr. Aljitawi's pilot study had 15 patients. In a preliminary analysis of the first twelve patients, all were weaned off transfusions within 100 days of their umbilical cord blood transplant. This means the new stem cells latched onto the bone marrow quickly and started producing new, healthy blood cells. Engraftment occurred soon after the transplant.

"In a group of cord blood transplant patients without hyperbaric treatment, only around 70% of them were off transfusions within 100 days," said Dr. Aljitawi. "This shows an effective way to improve the process without manipulating the actual stem cells."

Currently Dr. Aljitawi is gathering data he collected on how the hyperbaric oxygen treatment also affected the levels of the EPO hormone, and how that could also aide in better stem cell homing right after transplant. He's looking to start a phase II trial with more participants soon.

"We're hoping to include patients with more types of blood cancer and expand it even further," said Dr. Aljitawi. "But it's exciting to know we have something here that has shown it betters the process, is cost-effective and safe for people.

Source:
University of Kansas Cancer Center
