Better life support for artificial liver cells

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Researchers at Ohio State University are developing technology for keeping liver cells alive and functioning normally inside bioartificial liver-assist devices (BLADs).

Such devices enable people who are suffering from acute liver failure to survive while their own liver cells regenerate, or until they receive a liver transplant. The person's blood or plasma circulates through the device. Inside, living cells -- usually pig or human liver cells -- perform normal liver functions.

For those liver cells to keep working, they need oxygen. Andre Palmer, an associate professor of chemical and biomolecular engineering at Ohio State, and his team are developing innovative ways to chemically modify and package hemoglobin -- the blood molecule in red blood cells that transports oxygen -- to deliver oxygen to liver cells in just the right way.

Palmer presented the project's preliminary results on August 23, 2007, at the American Chemical Society meeting in Boston .

In the body, liver cells are naturally exposed to a range of oxygen concentrations, called an oxygen gradient. But reproducing that natural gradient inside a BLAD is difficult.

"If you don't recreate that oxygen gradient and the total amount of oxygen normally delivered, the liver cells in the BLAD won't function as well as they do in the body," Palmer said.

His solution has been to create different kinds of hemoglobin. One he seals inside microscopic polymer capsules; oxygen bound to the hemoglobin diffuses through the polymer over time to reach liver cells. Another is a type of hemoglobin-based oxygen carrier, which consists of long chains of hemoglobin molecules wound into balls that can then transport oxygen to liver cells.

The use of this technology with patients would require clinical trials, which Palmer admits are years away. For now, he is working to prove that he can adjust the oxygen gradient and the amount of oxygen his hemoglobins can transport to liver cells housed in a BLAD.

"We've found that by using different types of hemoglobin-based oxygen carriers with different oxygen affinities and tuning the oxygen concentration, we can recreate natural oxygen gradients," Palmer said.

He began developing this technology while at the University of Notre Dame, and since 2006 has been continuing the work at Ohio State.

Though computer simulations had shown Palmer and his team that they could reproduce a natural oxygen gradient in principle, they have now conducted experiments on actual liver cells in the laboratory, and shown that they can do it in reality.

Source: Ohio State University