Biomedical breakthrough: Blood vessels for lab-grown tissues (w/ Video)

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Researchers from Rice University and Baylor College of Medicine (BCM) have broken one of the major roadblocks on the path to growing transplantable tissue in the lab: They've found a way to grow the blood vessels and capillaries needed to keep tissues alive.

The new research is available online and due to appear in the January issue of the journal Acta Biomaterialia.

"The inability to grow blood-vessel networks -- or vasculature -- in lab-grown tissues is the leading problem in regenerative medicine today," said lead co-author Jennifer West, department chair and the Isabel C. Cameron Professor of Bioengineering at Rice. "If you don't have blood supply, you cannot make a tissue structure that is thicker than a couple hundred microns."

As its base material, a team of researchers led by West and BCM molecular physiologist Mary Dickinson chose polyethylene glycol (PEG), a nontoxic plastic that's widely used in medical devices and food. Building on 10 years of research in West's lab, the scientists modified the PEG to mimic the body's extracellular matrix -- the network of proteins and polysaccharides that make up a substantial portion of most tissues.

West, Dickinson, Rice graduate student Jennifer Saik, Rice undergraduate Emily Watkins and Rice-BCM graduate student Daniel Gould combined the modified PEG with two kinds of cells -- both of

which are needed for blood-vessel formation. Using light that locks the PEG polymer strands into a solid gel, they created soft hydrogels that contained living cells and growth factors. After that, they filmed the hydrogels for 72 hours. By tagging each type of cell with a different colored fluorescent marker, the team was able to watch as the cells gradually formed capillaries throughout the soft, plastic gel.

To test these new vascular networks, the team implanted the hydrogels into the corneas of mice, where no natural vasculature exists. After injecting a dye into the mice's bloodstream, the researchers confirmed normal blood flow in the newly grown capillaries.

Another key advance, published by West and graduate student Joseph Hoffmann in November, involved the creation of a new technique called "two-photon lithography," an ultrasensitive way of using light to create intricate three-dimensional patterns within the soft PEG hydrogels. West said the patterning technique allows the engineers to exert a fine level of control over where cells move and grow. In follow-up experiments, also in collaboration with the Dickinson lab at BCM, West and her team plan to use the technique to grow blood vessels in predetermined patterns.

More information: Paper online: dx.doi.org/10.1016/j.actbio.2010.08.018

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