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Blood vessel builders

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Futuristic plans to grow replacement organs, bones or muscles for soldiers maimed on the battlefield or patients suffering from debilitating disease or injury won't be anything but science fiction unless new blood vessels can grow into that tissue.

Without blood vessels delivering oxygen and nutrients and clearing out waste, any replacement parts would starve.

Holding out stimulus money as an incentive, the National Institutes of Health challenged investigators across the country to come up with formulas to build vascular networks in engineered tissues.

A team of Case Western Reserve University researchers was awarded a $1 million "Challenge Grant" for their proposal to combine custom-designed synthetic molecules with the best-suited stem cells for the job. Leading the project are Roger Marchant and Horst von Recum, professors of biomedical engineering at the Case School of Engineering.

The researchers are developing their approach in a mouse, as a model for technology that could be used to improve human lives. The goal is to produce vascular networks that grow and maintain themselves like those that grow naturally.

"We're bringing together unique skills that alone wouldn't address the problem," said Marchant, who's had a long, distinguished career in biomimicry, imitating designs and processes found in nature.

Marchant has built complex synthetic molecules that assemble on vascular grafts and lay a foundation for a coating of sugar-rich molecules that prevent blood clots. He's developed synthetic proteins that latch onto bacteria and can prevent colonization on surfaces or act as a direct drug delivery site.

Over the next two years, Marchant will try to build molecules that assemble into the scaffolding of an entire network of blood vessels and attach stem cells onto the surface. "We're no longer working in two dimensions," he said. "We have to come up with techniques to build in three dimensions."

The project requires embryonic stem cells because adult vascular cells fail to regenerate quickly enough to build blood vessels, von Recum explained.

Recently, von Recum helped discover a way to identify which stem cells will successfully differentiate into endothelial cells - the cells that line blood vessels - and to remove other, unwanted cell types.

Von Recum's group will genetically modify the select stem cells to home in on and attach to Marchant's scaffolding and even break down and remodel the scaffolding as needed.

"In the body, our tissues are constantly regenerating and remodeling," von Recum said. "Osteoporosis is an example of what can go wrong: the cells that break down bone are working faster than cells that rebuild bone.

"A synthetic scaffold can't regenerate and remodel, but we can introduce new DNA in the stem cells so they can remodel the scaffolding, break down pieces of scaffolding in the way."

Source: Case Western Reserve University (news : web)