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Stem cells make new heart valves

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Virna Sales hopes to produce valves that grow along with the hearts of children suffering from heart defects and thus avoid numerous surgeries. Photo courtesy of Boston Children's Hospital

Researchers have coaxed adult stem cells into forming artificial heart valves that could one day mean fewer surgeries for children suffering from heart defects.

The scientists, at Harvard-affiliated Boston Children's Hospital, grew the valves from a type of stem cell that normally gives rise to the inner lining of blood vessels. They used a biodegradable scaffold to give the cells

shape and a mix of proteins and growth factors to stimulate the cells to grow into the proper tissue type.

Instructor in Medicine Virna Sales, a researcher in Boston Children's Department of Cardiac Surgery, said the work, which used the tissue of laboratory animals, builds on research conducted over the past decade by Professor of Surgery John Mayer.

Mayer, also in Boston Children's Department of Cardiac Surgery, was the senior investigator of the study. His research over the past 10 years has focused on helping the 25,000 to 30,000 children born each year with heart defects.

Today, Sales said, the defects are corrected using prosthetics made from artificial materials and tissue from pigs. The problem with those materials, she said, is that they don't grow. Depending on the defect type and the age of the child at the time of surgery, the child may (and often does) need additional surgeries as his or her heart gets larger.

Researchers hope to be able to screen the blood-vessel stem cells, called endothelial progenitor cells, from a child's blood and use them to make valves out of a child's own tissue. Since the valves would be made from living tissue, they would grow, sparing the child additional surgery.

The research, published in the journal *Circulation*, is still five to 10 years away from being used in humans, Sales said.

The body has two major types of stem cells. Embryonic stem cells are present at the very early stages of life and have the ability to change into any type of cell in the body. More limited are adult stem cells, which give rise to different cells within a particular tissue type. Blood stem cells, for example, are found in the bone marrow and are constantly growing and differentiating, replacing cells in the bloodstream as they

are needed.

Prior research has sought both the right cells to start with and the proper mix of proteins and growth factors to coax the cells to differentiate into the right kind of tissue.

The body uses these growth factors and proteins to signal stem cells to divide, grow, and change into the type of tissue needed.

Though the natural process may seem straightforward, the mix of factors, including dosage, and timing, are delicately balanced in nature and provide researchers a significant challenge to reproduce.

As researchers learn to fine-tune the process, Sales said, they can use multiple coatings on the scaffold to expose the tissues to different factors at different times. That way, she said, it may be possible to "customize" one's heart valve.

Now that they've successfully grown the valves from animal tissue, researchers are working to refine the technology. They're testing the mechanical properties of the engineered valves in a bioreactor, a device designed to mimic the never-ending motion of the heart. They're also experimenting with a different mix of the growth factors and proteins to see if they can get the valves to grow more naturally, without the supporting scaffold.

"I'm going back to the basics," Sales said, "[We're] going to mimic mother nature."

Source: Harvard University