Stem cells aid heart regeneration in salamanders

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Marbled Salamander, Ambystoma opacum. Location: Durham County, North Carolina, United States. Photograph by Patrick Coin, via Wikipedia.

Imagine filling a hole in your heart by regrowing the tissue. While that possibility is still being explored in people, it is a reality in salamanders. A recent discovery that newt hearts can regenerate may pave the way to new therapies in people who need to have damaged tissue replaced with healthy tissue.

Heart disease is the leading cause of deaths in the United States. Preventative measures like healthful diets and lifestyles help ward off heart problems, but if heart damage does occur, sophisticated treatments and surgical procedures often are necessary. Unfortunately, heart damage is typically irreversible, which is why researchers are seeking regenerative therapies that restore a damaged heart to its original capacity.

We have known for hundreds of years that newts and other types of salamanders regenerate limbs. If you cut off a leg or tail, it will grow back within a few weeks. Stanley Sessions, a researcher at Hartwich College in Oneonta, N.Y., wondered if this external phenomenon also took place internally. To find out, he surgically removed a piece of heart in more than two dozen newts.

"To our surprise, if you surgically remove part of the heart, (the creature) will regenerate a new heart within just six weeks or so," Sessions said. "In fact, you can remove up to half of the heart, and it will still regenerate completely!"

Before the research team dove deeper into this finding, Sessions and his three undergraduate students, Grace Mele, Jessica Rodriquez and Kayla Murphy, had to determine how a salamander could even live with a partial heart. It turns out that a clot forms at the surgical site, acting much like the cork in a wine bottle, to prevent the amphibian from bleeding to death.

What is the cork made of? In part, stem cells. Stem cells have unlimited potential for growth and can develop into cells with a specialized fate or function. Embryonic stem cells, for example, can give rise to all of the cells in the body and, thus, have promising potential for therapeutics.

As it turns out, stem cells play an important role in regeneration in newts. "We discovered that at least some of the stem cells for heart regeneration come from the blood, including the clot," Sessions explained.

This finding could have exciting implications for therapies in humans with heart damage. By finding the genes responsible for regeneration in the newt, researchers may be able to identify pathways that are similar in newts and people and could be used to induce regeneration in the human

heart. In fact, a clinical trial performed just last year was the first to use stem-cell therapy to regenerate healthy tissue and repair a patient's heart.

Combining advances in medical and surgical technologies with the basic pathways of heart regeneration in newts could lead to better therapies for humans. Sessions posed this hopeful question: "Wouldn't it be great if we could find a way to activate heart stem cells to bioengineer new heart tissue so that we can actually repair damaged hearts in humans?"

More information: Grace Mele will present the team's findings at the Experimental Biology 2014 meeting at 1:15 p.m. Tuesday, April 29, during the Cell Proliferation poster session (Poster #D370) in Exhibit Hall A-D, San Diego Convention Center.

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