Do salamanders hold the solution to regeneration?

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

Salamanders' immune systems are key to their remarkable ability to regrow limbs, and could also underpin their ability to regenerate spinal cords, brain tissue and even parts of their hearts, scientists have found.

In research published today in the *Proceedings of the National Academy of Sciences* researchers from the Australian Regenerative Medicine Institute (ARMI) at Monash University found that when immune cells known as macrophages were systemically removed, salamanders lost their ability to regenerate a limb and instead formed scar tissue.

Lead researcher, Dr James Godwin said the findings brought researchers a step closer to understanding what conditions were needed for regeneration.

"Previously, we thought that macrophages were negative for regeneration, and this research shows that that's not the case - if the macrophages are not present in the early phases of healing, regeneration does not occur," Dr Godwin said.

"Now, we need to find out exactly how these macrophages are contributing to regeneration. Down the road, this could lead to therapies that tweak the human immune system down a more regenerative pathway."

Salamanders deal with injury in a remarkable way. The end result is the complete functional restoration of any tissue, on any part of the body including organs. The regenerated tissue is scar free and almost perfectly replicates the injury site before damage occurred.

"We can look to salamanders as a template of what perfect regeneration looks like," Dr Godwin said.

Aside from "holy grail" applications, such as healing spinal cord and brain injuries, Dr Godwin believes that studying the healing processes of salamanders could lead to new treatments for a number of common conditions, such as heart and liver diseases, which are linked to fibrosis or scarring. Promotion of scar-free healing would also dramatically improve patients' recovery following surgery.

There are indications that there is the capacity for regeneration in a range of animal species, but it has, in most cases been turned off by evolution.

"Some of these regenerative pathways may still be open to us. We may be able to turn up the volume on some of these processes," Dr Godwin said.

"We need to know exactly what salamanders do and how they do it well, so we can reverse-engineer that into human therapies."

More information: Macrophages are required for adult salamander limb regeneration, www.pnas.org/cgi/doi/10.1073/pnas.1300290110

Provided by Monash University