British Society for Cell Biology
Dispatches from the Frontiers of Cell Biology

Wound Healing

Lessons from embryos

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Further reading

Martin, P. (1997). Wound healing: aiming for perfect skin regeneration. Science 276, 75-81.

Grose, R. and Martin, P. (1999). Parallels between wound repair and morphogenesis in the embryo. Sem. Cell Dev. Biol. 10, 395-404.

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Wound healing

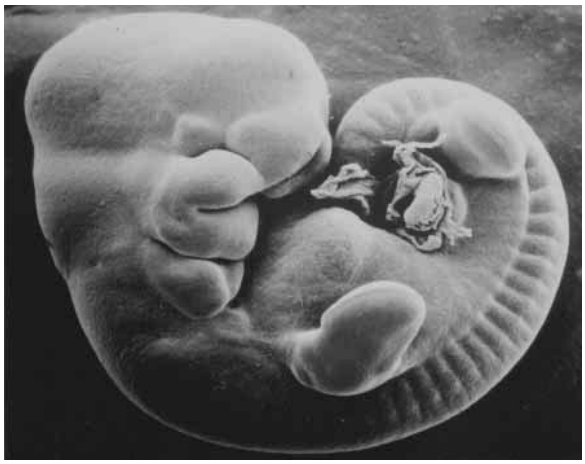
Skin is the largest organ in the body, acting as a barrier to protect our internal organs from the hazards of the outside world. If the barrier is broken and the skin is wounded – whether by an accident or from an operation – a complex repair process begins, sealing up the wound and leaving a scar.

Although this process is extremely efficient, there are always risks of infection and, if the wound is large, the scarring can be severe. So, researchers are searching for ways to make wound healing better and faster in the clinic. One of the best ways will be to look at how embryos do it – remarkably, even though they seldom need to call upon repair machinery, they seem superbly adapted to healing wounds.

In the embryo

Throughout development, the embryo is busy shaping and remodelling its tissues as it converts a single fertilized egg cell into a miniature model of the adult organism – made up of millions of cells. Surprisingly, until relatively late stages of development, all organisms are exceptionally good at healing wounds; they repair any tissue damage rapidly and efficiently and do not leave a scar.

We have analysed the 'start' and 'stop' signals that regulate the cell shape changes and other cell behaviours that underly this 'perfect' repair process, with the hope that these studies will tell us something about how the natural tissue movements of embryogenesis are regulated as well as suggesting ways in which we might make adult tissues repair more efficiently.



Above: This mouse embryo has grown from a single fertilized egg into a miniature model of the adult organism.

Watching cells move in 4D

For the first time, we can watch cell and tissue movements in 4D as they occur in transparent zebrafish embryos or in *Drosophila* (fruitfly) embryos expressing fluorescent proteins. This has allowed us to compare the artificially triggered tissue movements of wound healing with the natural tissue movements of morphogenesis…and we find many similarities. The same genes are switched on, and the same contractile machinery appears to be used to tug and bend the epithelia during normal development as is used to close a wound.

Above: A *Drosophila* embryo

These observations suggest that embryos are so good at healing wounds because they are using the same portfolio of tools they normally use to shape their bodies during development – perhaps repair simply recapitulates embryogenesis.

Inflammation

One major and significant difference between wound healing in the embryo and adult is the inflammatory response. Whenever an adult tissue is injured, a massive inflammatory response is raised, with white blood cells recruited from the bloodstream to the site of the wound. In the embryo no such inflammatory response occurs. Using a transgenic 'knock-out' mouse that has no inflammatory cells, we are able to test the requirement of the inflammatory reponse during adult tissue repair. These studies strongly suggest that repair is better off without inflammation – just as it is in the embryo.

The future

The study of wound healing in the embryo is 'basic research', but it could have far-reaching implications for the clinic. From new dressings and treatments for wounds caused by accidents and those longstanding sores and ulcers suffered by diabetics and the elderly, to therapies that allow plastic surgeons to operate without fear of scarring their patients, the field is immense and the future looks bright for healing.