

Rosenthal Group

Research in the Rosenthal group concentrates on the biology of regeneration by focussing on heart and skeletal muscle development, aging, and degenerative disorders. The team studies mouse biology as the premier model for human development and response to disease. Their collaborative work at ARMI has expanded to include comparative studies of regeneration in vertebrate species using a combination of evolutionary, developmental and stem cell biology. By investigating the fundamental principles of regeneration, the Rosenthal group aims to discover the mechanisms controlling the more regenerative vertebrates such as salamanders or fish, and explore this machinery in the mammalian context. Defining the molecular signaling pathways in these animal models will help address the lack of regeneration we suffer as adults, despite our remarkably robust regenerative properties as embryos. At the cellular level, the team is seeking to improve effective regeneration by controlling inflammation and promoting repair using blood and tissue stem cells.

Prof Nadia Rosenthal

Professor Rosenthal is internationally renowned for her work to enhance the prospects for muscle regeneration and heart repair. Her research focuses on embryonic heart development, ageing mechanisms, and the stem cell-driven regeneration of neuromuscular and cardiac tissue. Prof Rosenthal also heads a laboratory in the mouse biology program at the European Molecular Biology Laboratory (EMBL) Outstation in Monterotondo, Italy, and holds a Chair of Cardiovascular Science in the Heart Science Centre at Imperial College London. Nadia has also recently accepted the role of Scientific Head for EMBL Australia.





Research Themes

Growth factor signalling in muscle regeneration

Delivery of Insulin-like growth factor propeptides to various mouse models can attenuate muscle atrophy and improve regeneration in ageing and muscular dystrophy, promoting recruitment of stem cells to sites of tissue damage. Discovering the signalling pathways and cellular responses activated by IGF-1 propeptides will provide new avenues for therapeutic intervention in muscle wasting, dystrophies and ALS.

Improving heart repair

Studies in the repair of cardiovascular injury have implicated FGF, NFkB and Notch-mediated signalling in the intervention of damage and disease. New avenues of research are investigating regulatory networks through which combinations of supplemental growth factors can improve regeneration and mobilize stem cell pools, providing new targets for clinical intervention.

Immune cells in regeneration

Improvement of mammalian regeneration can be achieved by modulation of the innate immune system. Macrophages, which orchestrate the initial inflammatory response to injury, also play important roles in muscle tissue homeostasis and repair, by secreting key factors that promote a regenerating environment and contributing directly to tissue reconstruction. Similar roles played by related immune cells are currently being explored in the adult heart.

Characterisation of the Axolotl immune response

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Very little is known about the immunological response in salamanders. A detailed characterisation of the important immunological circuits using novel transgenic approaches will reveal the specific cell types and regulatory switches that promote regeneration after wounding.

Salamanders have a remarkable ability to regenerate or replace an array of damaged body parts as an adult such as, spinal cord, intestines, some parts of the brain, sections of the heart, parts of the eye, and even whole limbs. By comparison, the regenerative ability of mammals appears distinctly curtailed. Humans are subject to many diseases or environmental stresses that can damage organs or remove body parts. A great deal is known about the human immune system and how we deal with injury in many different situations. Mammalian healing usually results in formation of abnormal tissue (scar tissue) that can impair function. The salamander immune system can repair injuries without the scarring observed in mammals and very little is known about how this is achieved. Understanding how amphibians such as the salamanders can perform the perfect repair of damaged tissue (regeneration) that results in an identical copy of the original tissue, is of great interest to us. We aim to understand the healing pathways in salamanders and find the molecules that direct the cells at a site of injury to regenerate a perfect copy. This has important implications for extending the regenerative capacity in mammals in a wide variety of clinical contexts.