Regeneration/Cell Therapy

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Goals and Projects

The primary goal of Dr. Alex Yuan's laboratory is to characterize the wound healing response of the retina and to develop novel methods to repair damaged retina. The retina is comprised of a multi-layered, complex network of neurons that receive light stimuli and transmit that information to the brain. In response to mechanical, chemical, or photic damage, the retina forms scar tissue, which interrupts the normal connections between neurons. This disruption is permanent and once vision has been compromised, it cannot be restored. However, there are some organisms such as teleost fish that are capable of retinal repair following injury. Our lab is studying the retina repair process following laser induced retinal injury in fish. We hypothesize that there are molecular pathways that are modified or lost in mammals which, if restored, may allow the mammalian retina to regenerate.

Studies:

1. **A comparison of the retinal microglial cell response to injury in mice and zebrafish**. Using a laser induced injury model, we are comparing the response to injury in mice and in zebrafish. We will characterize the cellular and the molecular determinants of scar formation in mice and compare those with determinants of regeneration in fish. In mice, early mobilization of microglia are seen following laser injury. We hypothesize a similar early response is seen in zebrafish. Our lab is currently working on constructing a transgenic fish with GFP labeled microglia. In mice, Muller glia are mobilized following injury and a glial scar is formed. In fish, Muller glia are also activated but they may serve a different role and may initiate a regenerative program instead of scar formation.
2. **Develop novel techniques for targeted delivery to the retina.** Our lab is also interested in developing cell based therapies to deliver molecular to the retina. We are working on a non-invasive method to target peripheral immune cells to specific locations within the retina. These immune cells may be modified to deliver molecules to the retina.
3. **Cellular response to subthreshold laser lesions.** We are characterizing the response of microglia and macrophages to subthreshold laser lesions that do not cause any structural damage to the retina and do not initiate scar formation. We will specifically look for changes in the expression of proteins that may have an effect on vascular permeability.

Innovations:

1. **Developed a novel laser induced injury model in zebrafish.** In collaboration with the Yuankai Tao lab, we have developed an OCT-guided laser injury model in the zebrafish retina. The zebrafish retina is capable of regeneration and the technique is non-invasive, making this a great model for studying regeneration in a vertebrate *in vivo*.

Lab Staff members

- Alex Yuan, Principal Investigator
- Rose DiCicco, Laboratory Manager and Lead Technician
- Zippy, Laboratory Zebrafish Mascot