Eye-cyt: Improving our understanding of endocytosis within complex in vitro cell models of the eye.

Supervisory team:
Main supervisor: Dr Peter Watson (Cardiff University)
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Host institution: Cardiff University

Project description:
The cornea, being the transparent front surface of the eye, is crucial for vision. An avascular organ composed of multiple layers of specialized cells and collagen fibers, it acts as a clear window, that assists in refracting light onto the retina. It is a barrier to external threats to the eye, susceptible to injury and disease, but is also an important potential delivery route for therapeutic treatments to the rest of the eye. As such, understanding the way in which cells of the cornea interact with their surroundings, and are able to take up components from the extracellular media via endocytosis , is critical to our understanding of corneal biology. There is a need for gaining a higher level of understanding of how endocytosis regulates corneal cell biology and determining their "endocytic profiles" will give us a better understanding of corneal development, regeneration, disease and for drug delivery.

We have previously successfully developed and deployed a process of endoctytic profiling that enables the uptake of biotherapeutics to be studied in detail within simple 2-dimensional cell models. This project aims to expand and develop this system into a complex in vitro cell model of the cornea so that endocytosis of both endogenous molecules and biotherapeutics can be studied within complex multicellular 3D models. You will design, build, grow and maintain 3D corneal cultures containing cells and extracellular matrix that replicates the conditions seen in the cornea, and then use advanced optical/microscopy approaches to characterise and quantify penetration of biotherapeutics into your model, their cell uptake and endocytic traffic - so developing a "3D-endocytic profiling" toolkit for corneal models. You will be trained in the use of 2D and 3D cell culture, widefield and confocal microscopy, flow cytometry and endocytosis assays using these technical approaches. As the project progresses, you will start to develop and investigate your own novel therapeutic delivery system and test your formulations using the 2D and the 3D tools that you have created Due to the highly complex nature of the cornea, three-dimensional corneal in vitro models are highly useful modalities to study cell-cell interactions, development, and disease pathophysiology. It is hoped that improvements in complex in vitro corneal models will lead to less reliance on live animal models for corneal research and are likely to provide future treatments for corneal disorders and diseases.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.