Regulating Podocyte Redifferentiation Using Mechanical and Geometrical Constrains

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Over 25 million Americans alone live with some form of renal complication, resulting in hundreds of thousands of deaths every year. Increased development in the kidney research field could result in treatments and even cures for these often fatal conditions. One key issue with performing kidney research involves culturing podocytes, one of the most fundamental cell types of the kidney. If podocytes can be cultured so that they resemble their in vivo state, research into and treatments for renal diseases that are directly caused by malfunctioning podocytes would become more feasible. The ability to properly culture podocytes in vitro is also the first fundamental step in developing lab grown kidneys, bio-printed kidneys, or a kidney-on-a-chip. Podocytes reside on the glomerular basement membrane and filter the bloodstream with their crucially localized proteins and highly specialized morphology consisting of interdigitating foot processes. When cultured with traditional techniques, on substrates such as glass or plastic, podocytes are not differentiated. They have a large round shape and proteins expression such as that of nephrin, F-actin, and vimentin is uncharacteristically low with nephrin and F-actin being dispersed evenly throughout the cell instead of localized. When podocytes were cultured with two novel approaches including microfabricated channel-shaped indentations in glass as well as two crosslinked gelatin gels, notable changes were observed. Podocytes were smaller and spread less randomly, they formed elongated processes, proteins such as nephrin, F-actin, and vimentin were expressed with high intensities, and nephrin and F-actin were also localized. These changes indicated a higher degree of podocyte differentiation in vitro than with previous techniques.

Awards Won:

Third Award of $1,000