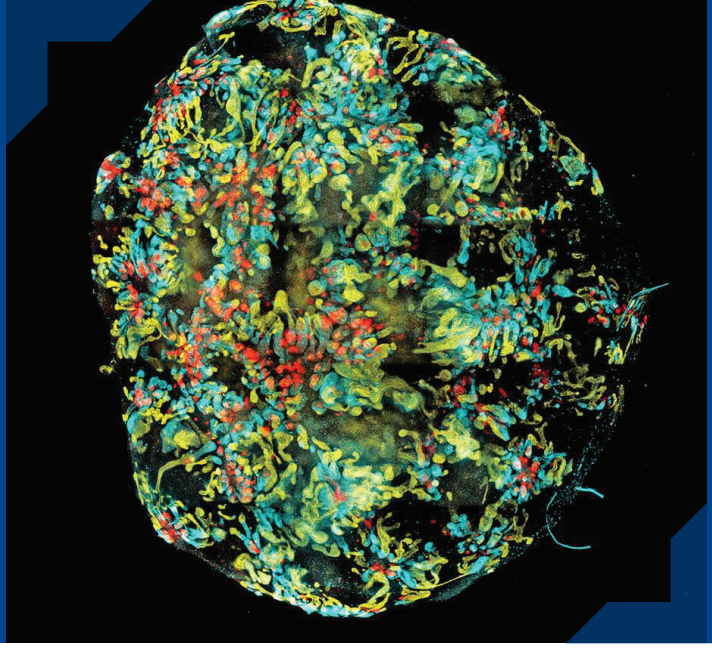
THE UNIVERSITY OF MELBOURNE

Centre for Stem Cell Systems

Stem Cell Stories



Mini-kidneys in a dish

Professor Melissa Little is at the forefront of research to find new therapies for kidney disease, thanks to her tiny, lab grown organoids.

The need

More than 4,000 Australians are diagnosed with chronic kidney disease each year, a number that is increasing about 6% annually. The costs of healthcare and lost productivity exceed $1 billion each year. No new treatments have become available in the past 60 years, making this an urgent healthcare issue. The kidney's main function is to filter waste from the blood, making urine. Nephrons are the kidney's filtration unit, and while the kidneys can partially repair damaged nephrons, this is inadequate and ultimately leads to kidney failure. While stem cells capable of making new nephrons are present during early development, they are lost before birth. This leaves the kidneys vulnerable to long term injury. Finding ways to regenerate nephrons could provide better options for the growing number of renal failure patients.

The projects

In 2015, Professor Melissa Little and her team at Murdoch Children's Research Institute produced the world's first kidney in a dish. No larger than the tip of your finger, her lab-grown mini-kidneys have the hallmarks of a regular-sized kidney, including the tiny tubes and blood vessels that form nephrons, the organ's filtering structures. This achievement, published in the prestigious journal Nature, was at the forefront of what is now more commonly called organoid development – referring to the process of coaxing stem cells in the lab to mimic organs. To create the kidney organoids, Little and her team first used cell reprogramming technology, taking adult skin cells and reverting them back into a type of pluripotent stem cell. From there, they were able to direct the stem cells to begin forming kidney tissue, similar to what occurs in early development. Currently, the mini-kidneys are not functional, as they lack a constant flow of blood through the nephrons as well as a channel for any urine produced to leave the organ. However, even in their current state, the mini-kidneys are extremely valuable for research and are being usedto better understand how kidneys develop and what happens in disease.

The impact

The Little lab's unique approach has already yielded important insights into kidney development and disease. Their kidney organoids are being used in the lab to screen promising new drug candidates, thereby identifying drugs that may cause kidney damage and avoiding potential side-effects for patients. The next challenge will be to produce larger more complex structures that could one day be a source of healthy cells for transplantation or entire replacement organs. To that end, in 2017, Little partnered with Organovo, a US-based company that specialises in bioprinting, to develop a more accurate 3D model of the kidney. These efforts are bringing research a step closer to a regenerative medicine solution for kidney disease.

Professor Melissa Little is the 'Kidney Development, Disease and Regeneration' Group leader at the Murdoch Children's Research Institute.

Visit her web page to find out more.