



Fixing hearts by finding out what makes them tick

You can learn a lot about hearts by trying to build one from scratch. A pair of scientists have grown 'beating' human heart muscle tissue from stem cells and are exploring cardiac regeneration.

Developmental biologist Associate Professor Enzo Porrello became interested in how newborn mammal hearts can regenerate while working in Dallas, Texas at one of the leading labs researching heart development.

Heart disease is Australia's leading cause of death. Each year, about 54,000 Australians suffer a heart attack, with an average of 23 deaths per day. "We're trying to understand how the heart works in order to fix it, the same way a car mechanic needs to understand how a car engine works in order to fix it." – James Hudson

Associate Professor James Hudson has a background in chemical and biological engineering. In Germany, he developed bioengineering techniques to make force-generating human heart tissue at the University Medical Center in Göttingen.

Enzo and James met when they both returned to Australia to work at the University of Queensland. It was a match made in scientific heaven.

They've brought their skills together to create beating human heart tissue for cardiac research in the lab and developed patented technology to do it at scale.

They're investigating the development of the human heart in detail, including the short-lived self-healing ability of newborn babies' hearts.

"There are a small number of case reports of human newborns recovering from heart attacks, which is very intriguing," says Enzo.

Their previous research with newborn mice shows that heart muscle cells lose their regenerative potential at the same time as they massively increase their force production. They identified the thousands of genetic changes that happen during this process. Then they identified the equivalent pathways in humans.

"We want to understand what happens in this window in time, firstly to engineer better tissues and secondly to come up with better therapeutic drugs for heart failure and regeneration," explains James.

Their work building functional heart tissue from stem cells is also revealing how the cells work together. Enzo and James are making heart tissue with the right ratio of muscle and supporting cells, and that are integrated so they can contract in synchrony.

"Other cell types have a huge impact on the heart muscle cells, which was previously under-appreciated," says James. "This is increasingly important as we get closer to creating tissues for drug discovery or transplantation into patients."

Enzo now leads the Cardiac Regeneration group at Murdoch Children's Research Institute and the University of Melbourne. James has moved to QIMR Berghofer. However, their research collaboration continues, with projects making tissues for drug screening, making 'artificial heart pumps' for children with congenital heart conditions, developing drugs to simulate heart repair or improve function, and broadly improving our understanding of the heart and how it works.

