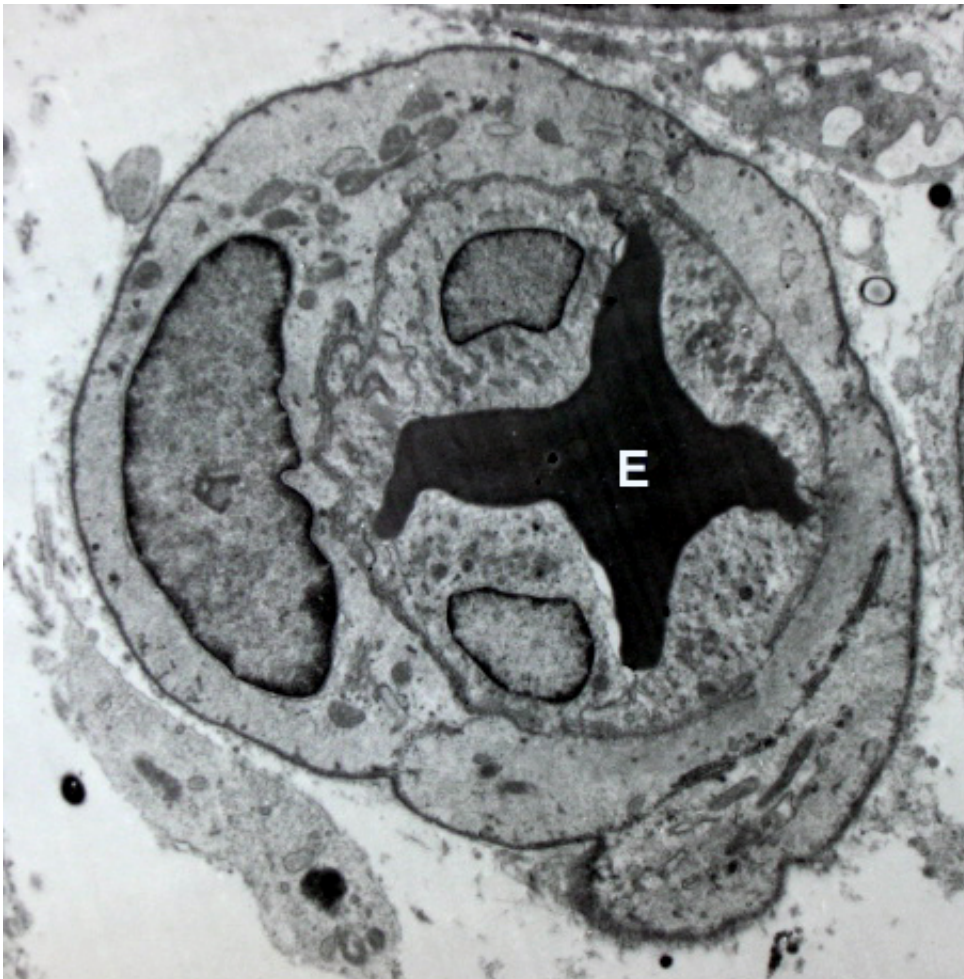


Scientists grow perfect human blood vessels in a petri dish

January 16 2019



Blood vessel with an erythrocyte (red blood cell, E) within its lumen, endothelial cells forming its tunica intima (inner layer), and pericytes forming its tunica adventitia (outer layer) Credit: Robert M. Hunt/Wikipedia/CC BY 3.0

Scientists have managed to grow perfect human blood vessels as organoids in a petri dish for the first time.

The breakthrough engineering technology, outlined in a new study published today in *Nature*, dramatically advances research of vascular diseases like [diabetes](#), identifying a key pathway to potentially prevent changes to [blood](#) vessels—a major cause of death and morbidity among those with diabetes.

An organoid is a three-dimensional structure grown from [stem cells](#) that mimics an organ and can be used to study aspects of that organ in a petri dish.

"Being able to build human blood vessels as organoids from stem cells is a game changer," said the study's senior author Josef Penninger, the Canada 150 Research Chair in Functional Genetics, director of the Life Sciences Institute at UBC and founding director of the Institute for Molecular Biotechnology of the Austrian Academy of Sciences (IMBA).

"Every single organ in our body is linked with the circulatory system. This could potentially allow researchers to unravel the causes and treatments for a variety of vascular diseases, from Alzheimer's disease, cardiovascular diseases, wound healing problems, stroke, cancer and, of course, diabetes."

Diabetes affects an estimated 420 million people worldwide. Many diabetic symptoms are the result of changes in blood vessels that result in impaired [blood circulation](#) and oxygen supply of tissues. Despite its prevalence, very little is known about the vascular changes arising from diabetes. This limitation has slowed the development of much-needed treatment.

To tackle this problem, Penninger and his colleagues developed a

groundbreaking model: three-dimensional human blood [vessel](#) organoids grown in a petri dish. These so-called "vascular organoids" can be cultivated using stem cells in the lab, strikingly mimicking the structure and function of real human blood vessels.

When researchers transplanted the blood vessel organoids into mice, they found that they developed into perfectly functional human blood vessels including arteries and capillaries. The discovery illustrates that it is possible to not only engineer blood vessel organoids from human stem cells in a dish, but also to grow a functional human vascular system in another species.

"What is so exciting about our work is that we were successful in making real human blood vessels out of stem cells," said Reiner Wimmer, the study's first author and a postdoctoral research fellow at IMBA. "Our organoids resemble human capillaries to a great extent, even on a molecular level, and we can now use them to study blood vessel diseases directly on human tissue."

One feature of diabetes is that [blood vessels](#) show an abnormal thickening of the basement membrane. As a result, the delivery of oxygen and nutrients to cells and tissues is strongly impaired, causing a multitude of health problems, such as kidney failure, heart attacks, strokes, blindness and peripheral artery disease, leading to amputations.

The researchers then exposed the blood vessel organoids to a "diabetic" environment in a petri dish.

"Surprisingly, we could observe a massive expansion of the basement membrane in the vascular organoids," said Wimmer. "This typical thickening of the basement membrane is strikingly similar to the vascular damage seen in diabetic patients."

The researchers then searched for chemical compounds that could block thickening of the blood vessel walls. They found none of the current anti-diabetic medications had any positive effects on these blood vessel defects. However, they discovered that an inhibitor of γ -secretase, a type of enzyme in the body, prevented the thickening of the blood vessel walls, suggesting, at least in animal models, that blocking γ -secretase could be helpful in treating diabetes.

The researchers say the findings could allow them to identify underlying causes of vascular disease, and to potentially develop and test new treatments for patients with diabetes.

More information: Human blood vessel organoids as a model of diabetic vasculopathy, *Nature* (2019). DOI: [10.1038/s41586-018-0858-8](https://doi.org/10.1038/s41586-018-0858-8), www.nature.com/articles/s41586-018-0858-8

Provided by University of British Columbia

Citation: Scientists grow perfect human blood vessels in a petri dish (2019, January 16) retrieved 20 March 2024 from <https://medicalxpress.com/news/2019-01-scientists-human-blood-vessels-petri.html>

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