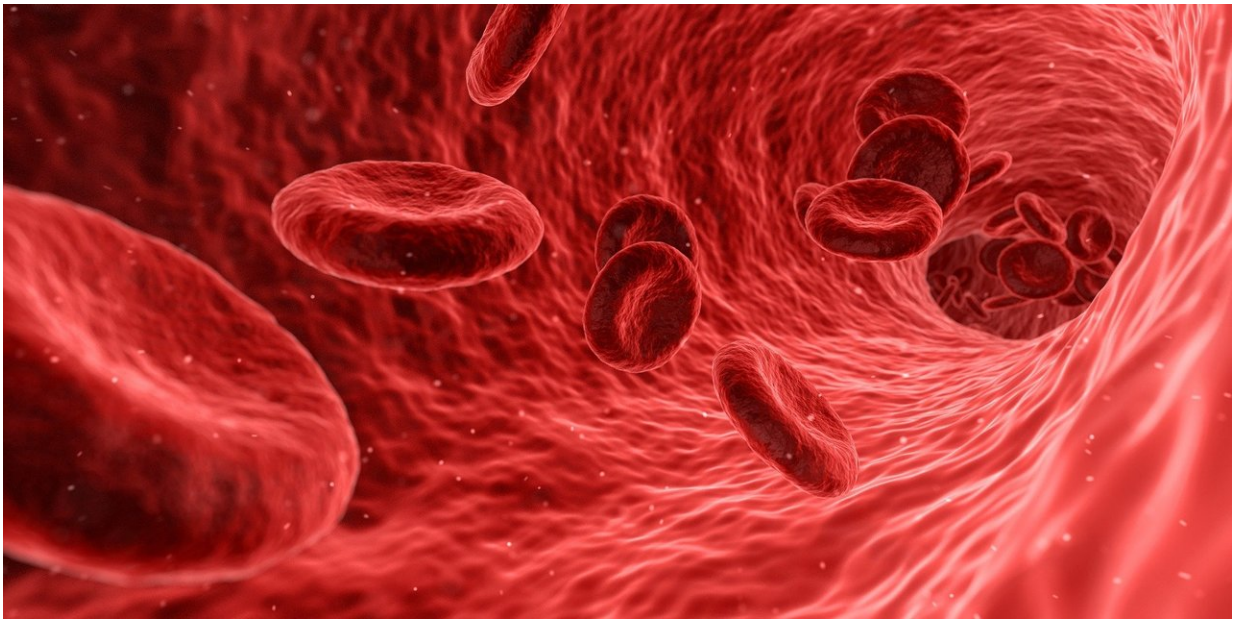
Miniature version of human vein allows study of deep vein thrombosis

May 5 2020



Credit: CC0 Public Domain

The Vein-Chip device, a miniaturized version of a large human vein, allowed scientists to study changes in vein wall cells, blood flow and other functions that lead to deep vein thrombosis (DVT) in humans, according to preliminary research presented at the American Heart Association's Vascular Discovery: From Genes to Medicine Scientific Sessions 2020. The meeting is a virtual event in 2020, to be held May 5-7.

The Vein-Chip is a translucent hollow chamber which serves as a miniature version of a human vein with similar architecture and cellular function. The chip allows researchers to test various human endothelial cells to differentiate various factors—gender, race, ethnicity and more—revealing which populations may have more or less DVT risk. In the end, the technology might allow for more personalized therapies for vein diseases.

"Within the Vein-Chip, we cultured endothelial cells retrieved from human veins that line all sides of the chamber and form a venous vessel. Blood drawn from participants was perfused via a syringe pump under the same physical conditions one would expect in a patient," said Abhishek Jain, Ph.D., lead study author and assistant professor of biomedical engineering at Texas A&M University's College of Engineering in College Station, Texas. "With this micro-chip, we simulated various functions, - and we could introduce toxins and medications to make the vein diseased and cured over time. We can also observe these processes to understand changes in gene and protein expression of the cells."

Three discoveries were made in this study of the Vein-Chip. Researchers found:

- Under a normal healthy state, if a DVT risk factor like slowing blood flow occurs, the body might try to adapt by releasing anti-clotting factors. This adaptation happens within the vein pocket only and suggests that medications should be locally delivered at the site most affected by the disease.
- Clot dissolving medications delivered through the vein do not always easily reach the clot in the vein pocket. This suggests new strategies are needed that could enhance the local transport of drugs to the vein pockets.
- Human veins have pockets of different shapes, resulting in

different extents of clotting, or thrombosis. As a result, venous architecture is an important DVT contributor.

- Human veins consist of pockets that are one-way, pumping valves transporting blood from the legs to the heart. "It is in these pockets where blood flow can become unstable. The living cells, that line the walls, called endothelial cells, can switch from being normal to inflammatory. The inflammation results in clots that can then break apart, reach the small vessels of the lungs and brain and block the organ's blood supply, causing death from stroke," Jain said. "Venous pockets have been largely overlooked in venous thrombosis research, even though they are the primary sites of blood clot formation."

One of the challenges of research to develop technologies such as this is human trials can be conducted only after successful animal studies, according to Jain. "This is considered by many funding agencies to be a high-risk concept. Seeing a technology like this through to human studies requires a leap of faith among basic scientists, physicians, pharmaceutical companies, the FDA and funding agencies," he said.

Navaneeth K.R. Pandian is the study's co-author. Author disclosures are in the abstract. The National Institute of Biomedical Imaging and Bioengineering of the National Institutes of Health and the Texas A&M University funded the study.

Provided by American Heart Association