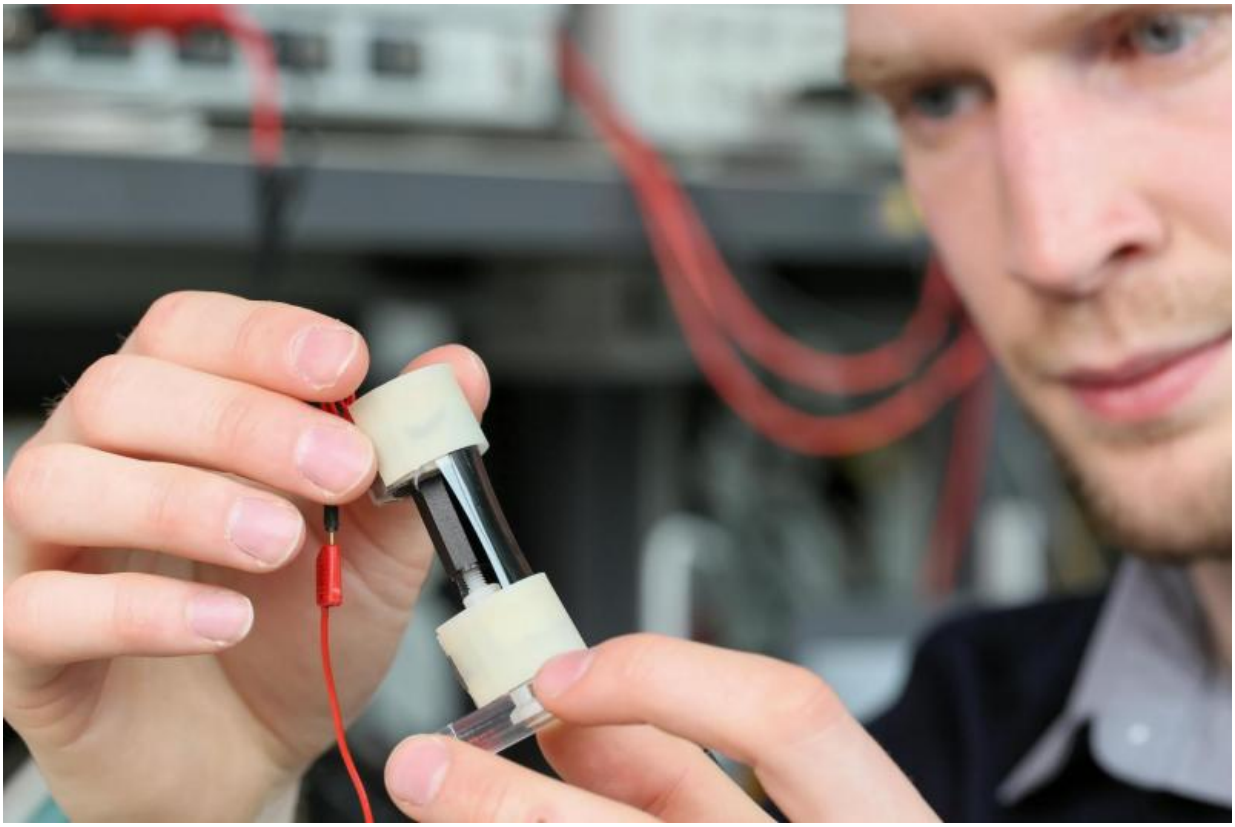
A tiny pump comes to the aid of weakened hearts

June 20 2016, by Sarah Perrin



Credit: EPFL/ A.Herzog

EPFL researchers have developed an innovative cardiac support system in the form of a small ring placed on the aorta. This device is less invasive than traditional methods and avoids problems of hemolysis and

the need for regular transfusions because it does not come into direct contact with the blood.

The heart is sometimes in a weakened state when recovering from certain diseases or while waiting for a transplant. To help the tired heart pump blood, researchers at EPFL's Integrated Actuators Laboratory (LAI) came up with a clever solution. Their device is made up of three tiny rings made out of a material with special electrical properties. The device, called a Dielectric Electro Active polymer (DEAP), dilates when a current is applied and contracts when it is switched off. Because the reactions are immediate, the back-and-forth movement can be controlled in real time.

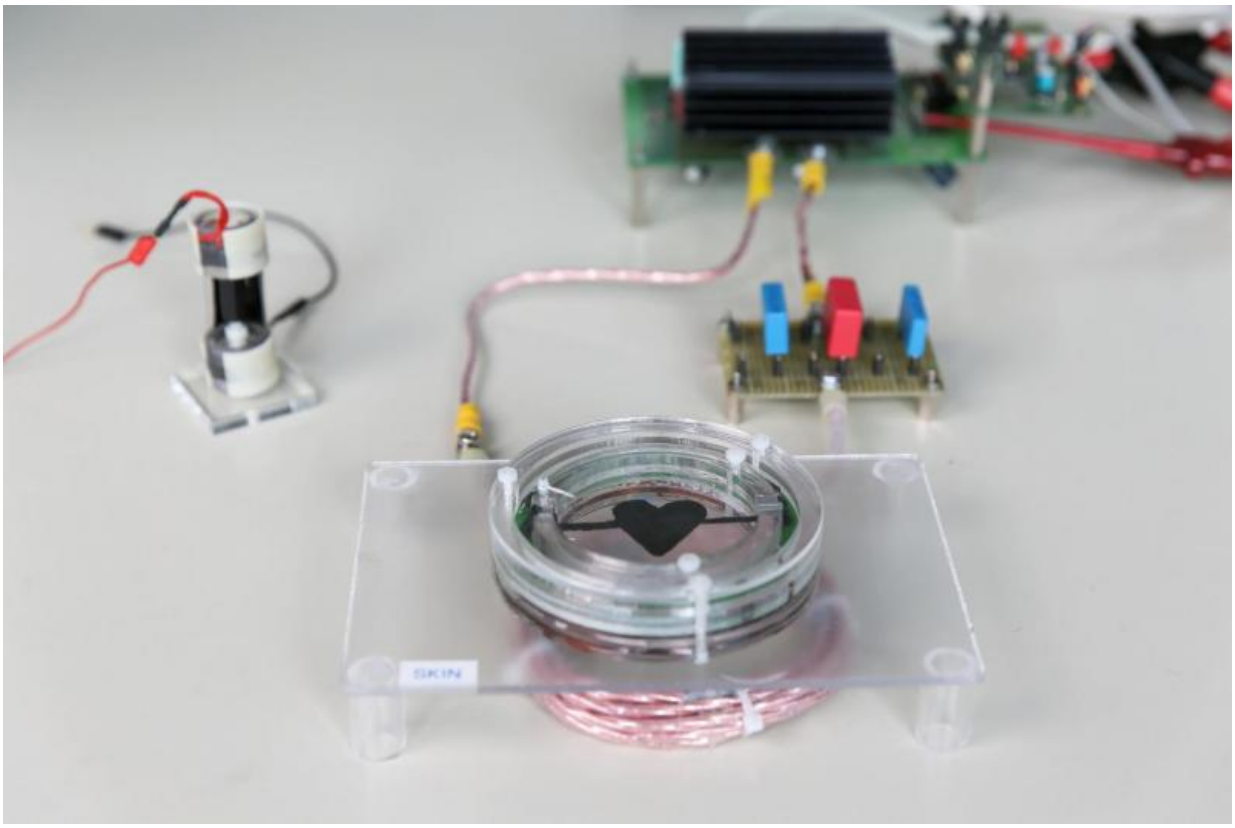
The researchers' innovation was to place these rings around the aorta – the body's main artery – at the exact spot where it exits the left ventricle. Each ring has two electrodes that are drawn together by an electrostatic force whenever the electric field is activated. "The electrodes squeeze the polymer as they come together," said Jonathan Chavanne, a PhD student at the LAI. "Yet because this material is incompressible, its volume remains constant. So its surface area increases and stores up elastic energy."

The electrical pulse is provided to the device by magnetic induction. Each of the three rings contracts in turn, in a movement reminiscent of an earthworm. This series of contractions, called peristalsis, creates a wave that moves the liquid inside the artery. This double action – simultaneously vertical and horizontal – helps the heart pump and transport blood.

Saving red blood cells

"This method does not require us to enter the heart," said Yves Perriard, the director of the LAI. "This means it is significantly less invasive than

other cardiac support systems, which work by implanting valves or screw pumps inside the ventricle."

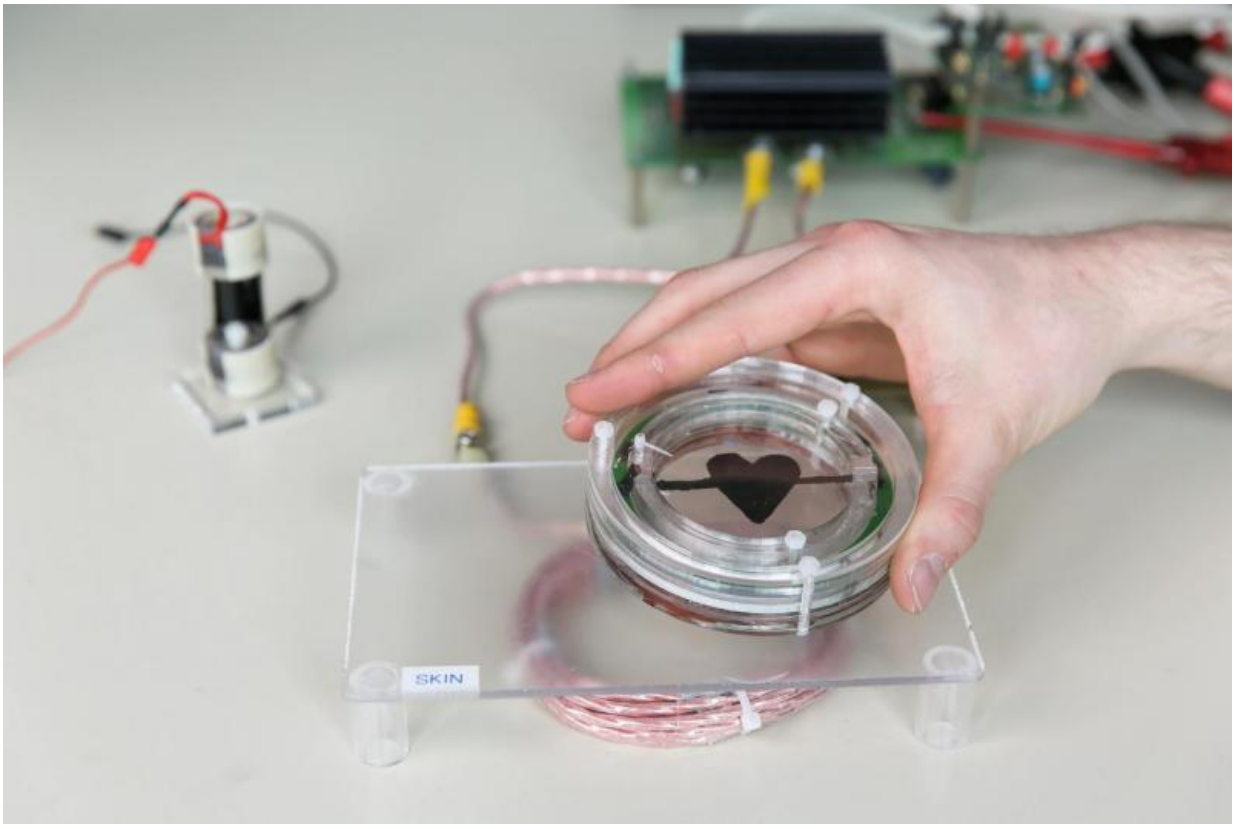


Credit: EPFL/ A.Herzog

In addition, by avoiding direct contact with the blood, this new solution eliminates the risk of excessive hemolysis, in which enough red blood cells are destroyed that regular transfusions may be required. And because the system is powered by magnetic induction, there are no wires coming out of the body.

The invention is currently in the prototype stage and has several more

hurdles to overcome. The researchers plan to improve the device's performance before testing it on a liquid with similar fluidic properties to those of the blood, such as glycerol. The team has been in contact with the University Hospital of Bern, where clinical trials could be conducted.



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