Magnets Keep Blood Flowing

By Jon Cartwright | 9 June 2011 3:30 pm | Comments

Two physicists searching for a novel way to prevent heart attacks and strokes have discovered that strong magnetic fields can dramatically reduce the thickness, or viscosity, of blood flowing through a tube. The pair speculate that if this effect holds for blood in veins and arteries, scientists might someday develop a magnetic alternative to medicines designed to keep blood flowing in humans.

Strokes and heart attacks, the leading causes of death in the industrialized world, are often linked to high blood viscosity. Thicker blood damages blood vessels, and in repairing the damage, the vessels build up fatty deposits, which make strokes and heart attacks more likely. Currently, the only way to reduce blood viscosity is with drugs like aspirin, which inhibit the tendency of blood to clot. But aspirin has side effects: in high doses, it can lead to stomach bleeding, ulcers, and even tinnitus, or ringing of the ears.

Physicist Rongjia Tao of Temple University in Philadelphia, Pennsylvania, and medical physicist Ke Huang of the University of Michigan, Ann Arbor, wondered whether magnetic fields offered a potentially safer solution. After all, high-strength magnets of 1 to 3 tesla are already used in hospitals during magnetic resonance imaging (MRI) and have been shown to have no harmful effects on the body. Tao and Huang let blood flow inside a tool for measuring blood viscosity, which itself was inside an electromagnet producing a field of about 1.3 tesla. They arranged the components so the blood flowed in the same direction as the magnetic field lines.

The researchers discovered that just 1 minute inside the field was enough to reduce the blood viscosity by 20% to 30%. After exposure, the viscosity went back up to its original value after about 2 hours, but they could repeat the process to take it down again. The results are described in a forthcoming paper in *Physical Review E*.

The magnetic effect, the researchers say, all comes down to hemoglobin, the iron-based protein inside red blood cells. In the same way that iron filings align themselves along the field lines around a bar magnet, so the red blood cells align themselves along the straight field lines of Tao and Huang's electromagnet. This reduces viscosity in several ways. For one, the cells become streamlined with the direction of flow. The alignment also encourages the cells to stick together, forming clumps of various sizes. Although one might think clumps would increase viscosity, they actually have a lower total surface area compared with single cells, and this cuts down on friction. What's more, the mixture of clump sizes allows more cells to pack into the same volume, with small cells fitting around the big clumps and allowing more room for movement.

One catch with the technique is that the blood flow must be in the same direction as the magnetic field. The effect wouldn't be the same when an entire body is in an MRI machine, for example, because blood vessels travel in all different directions. But Tao doesn't think this would be a problem. "There's no need to apply the magnetic field to the whole body," he explains. "In fact, we just need to apply the magnetic field locally—for example, apply the magnetic field parallel to one artery." By putting one artery in the field for a few minutes, he says, blood circulation would transmit the effect to the whole body. Tao hopes that, with refinement, the technique will allow patients who are not hospital-bound to check into a clinic only twice a day for treatment, to keep their blood viscosity down permanently.

Mehmet Toner, a medical engineer at Harvard Medical School in Boston, calls the results "very intriguing," and thinks they could be important if they are repeated inside the body. The researchers need to do "a lot more work to prove that the magnetic field can reduce blood viscosity under physiological conditions, and do so in a manner useful for clinical applications," he says.

Tao and Huang are currently designing a magnet into which patients could insert an arm or a leg easily. They are also developing technology to measure blood viscosity at several locations inside an artery. "Afterwards, we will work with some doctors in our medical school to have clinical trials," Tao says.

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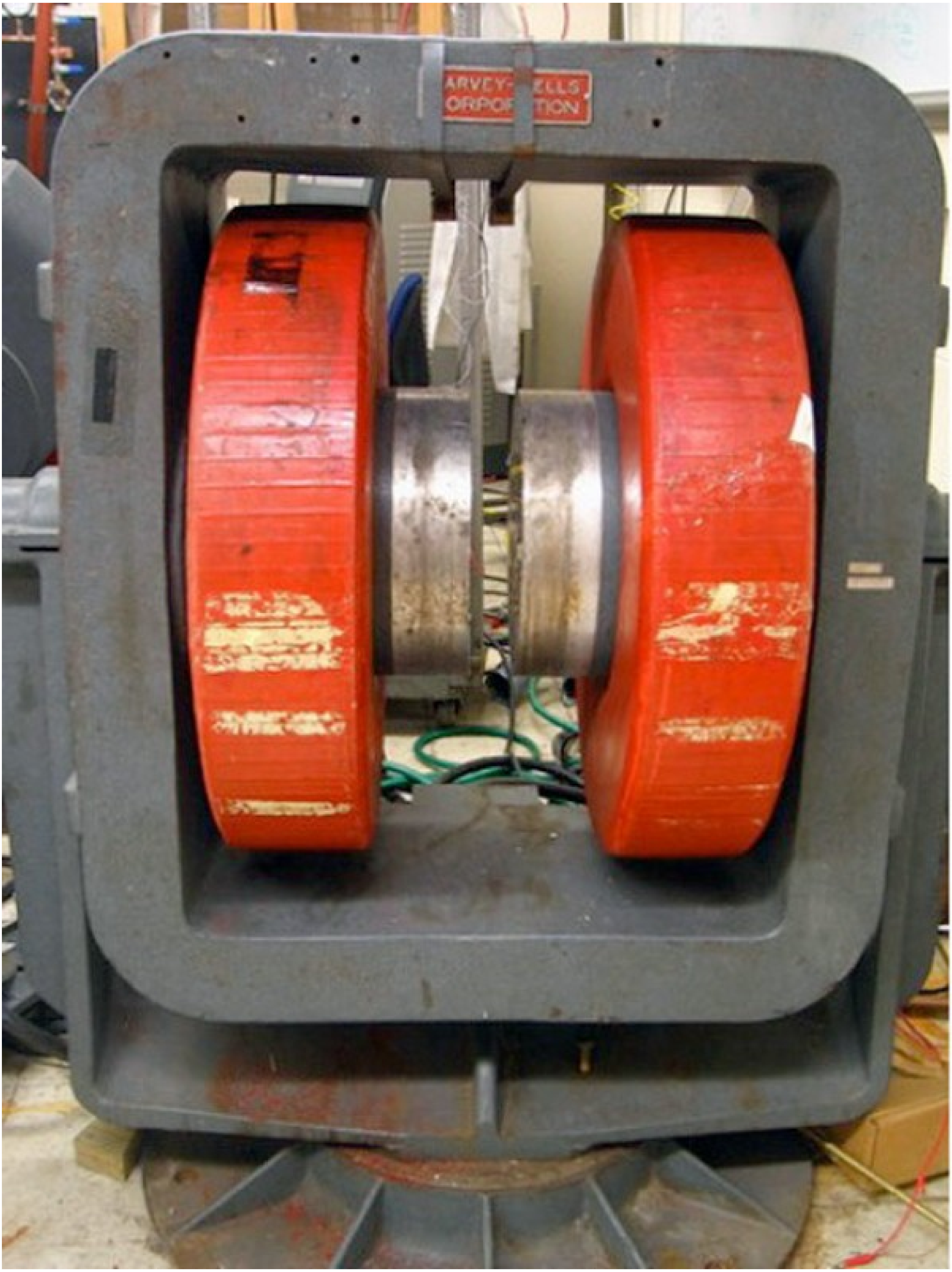

RONGJIA TAO

Smooth running. Could very strong magnetic fields, like the ones produced by this magnet in the current study, improve blood flow?