Medical Xpress

# Researchers use sound and visuals to simulate blood-flow patterns of brain aneurysms

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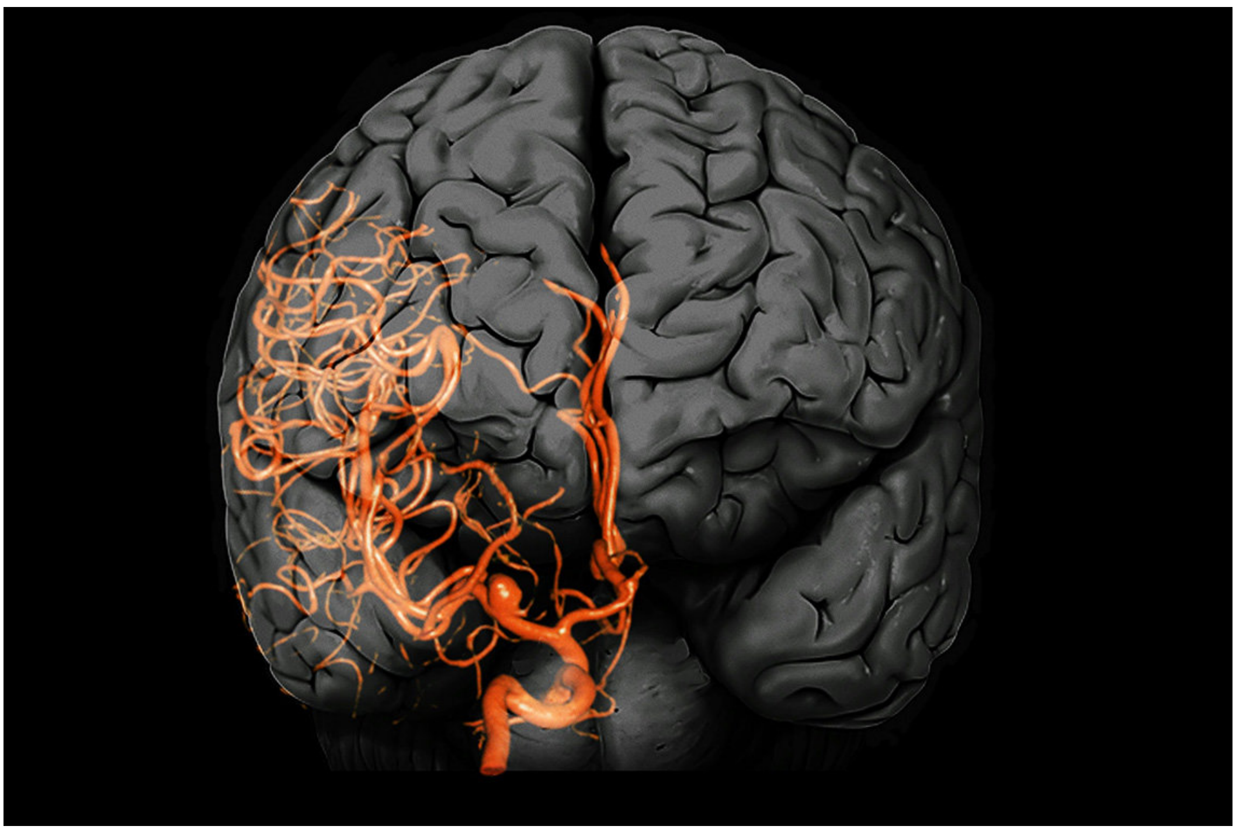


Brain aneurysm: A 3D computed tomography (CT) angiogram coupled with a magnetic resonance imaging (MRI) scan of the brain of a 38-year-old, showing a large aneurysm (bright, lower centre) of the right internal carotid artery. Credit: University of Toronto

Researchers in the University of Toronto's Faculty of Applied Science & Engineering are combining audio and art to provide better, standardized ways of simulating and understanding medical imaging of brain aneurysms.

Currently, if a patient comes into a medical clinic with an unruptured brain aneurysm, a clinician's decision to operate or leave it depends on risk factors related to the patient's medical history, as well as the aneurysm's shape, size and location in the brain.

Aneurysms in the back of the brain, for example, are more likely to rupture than those at the front. "This is what the epidemiology has told us," says David Steinman, a professor of mechanical engineering. However, many large aneurysms don't ever rupture, and many small aneurysms that are normally left alone, do rupture.

So the question is: How does one treat only the aneurysms that are risky?

Steinman's approach to finding a solution is a unique one – he's melding biomedical engineering and the art world. Collaborating with Toronto Western Hospital's Aneurysm Clinic, which is Canada's largest, as well as Peter Coppin, an assistant professor in the Faculty of Design at OCAD University, his lab is taking fresh insights from visual artists and sound designers to improve visual and audio communication in medical imaging, starting with aneurysms.

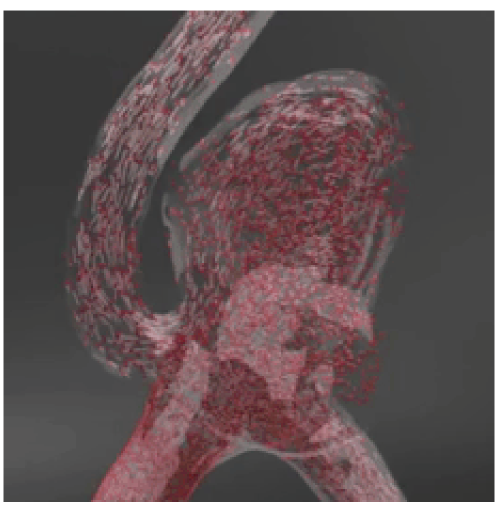
"Visualizations of computational fluid dynamics (CFD) are typically presented to clinicians as 'canned' animations, which tend to rely on dense engineering representations that unselectively portray both relevant and irrelevant details," says Steinman.

Using graphics and sound to amplify key features, while suppressing irrelevant information, "would allow a user to visually concentrate on one field, while listening to the other. Certain aspects of complexity can be heard better than it can be seen," he says.

A clinician can then more easily and efficiently decide whether to operate on an aneurysm.

If the simulated blood flow of the aneurysm were to show a very strong and unstable 'jet' coming into the aneurysm and against the aneurysm wall, "that might be a hint that that wall is more likely to be aggravated," explains Steinman.

He hopes this innovative approach can help reduce the number of unnecessary treatments and the number of accidental ruptures. "Imagine I'm a patient with what I feel is a ticking time bomb in my head. What do I do about it? And a clinician tells me, 'Well, we're not sure,'" says Steinman. "I want to provide more information for the clinician. It's a new piece of the puzzle to give to them."



A computer simulation of blood-flow patterns within an aneurysm, created by Professor David Steinman's Biomedical Simulation Laboratory. Credit: University of Toronto

To work alongside Coppin's team at OCAD University, he has recruited post-doctoral researcher Thangam Natarajan to translate CFD visually, and master's student Dan MacDonald to translate CFD into sounds. Both Natarajan and MacDonald are in the department of mechanical and industrial engineering.

MacDonald is a trained classical pianist, a skill that has helped elevate his project. "Piano led me to synthesizers and sound design," he says. "So taking the data and turning them into sound, has a lot to do with knowing fundamentally how to create sound from the bottom up."

In the future, Steinman hopes his work will lead to a standardized, new way of representing and understanding how to treat aneurysms in medical clinics.

"The way I see it, you'd build a tool where the CFD data could be displayed on a simple interface," Steinman says. "Then, you'd either put on headphones or turn on the speakers, just like a Doppler ultrasound exam. We're maybe five years away from that."

Provided by University of Toronto