High-speed photography provides first direct evidence of how microbubbles dissolve killer blood clots

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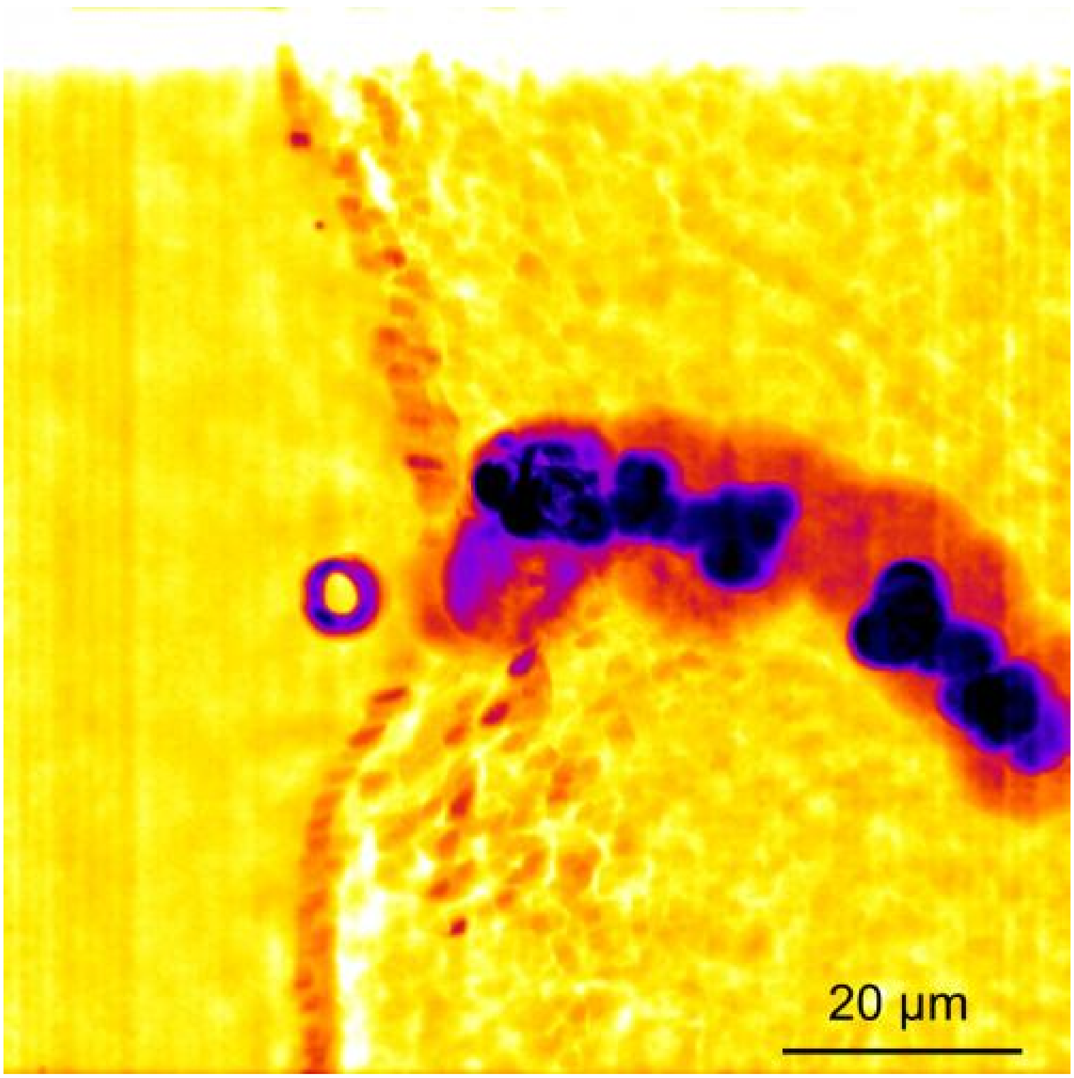
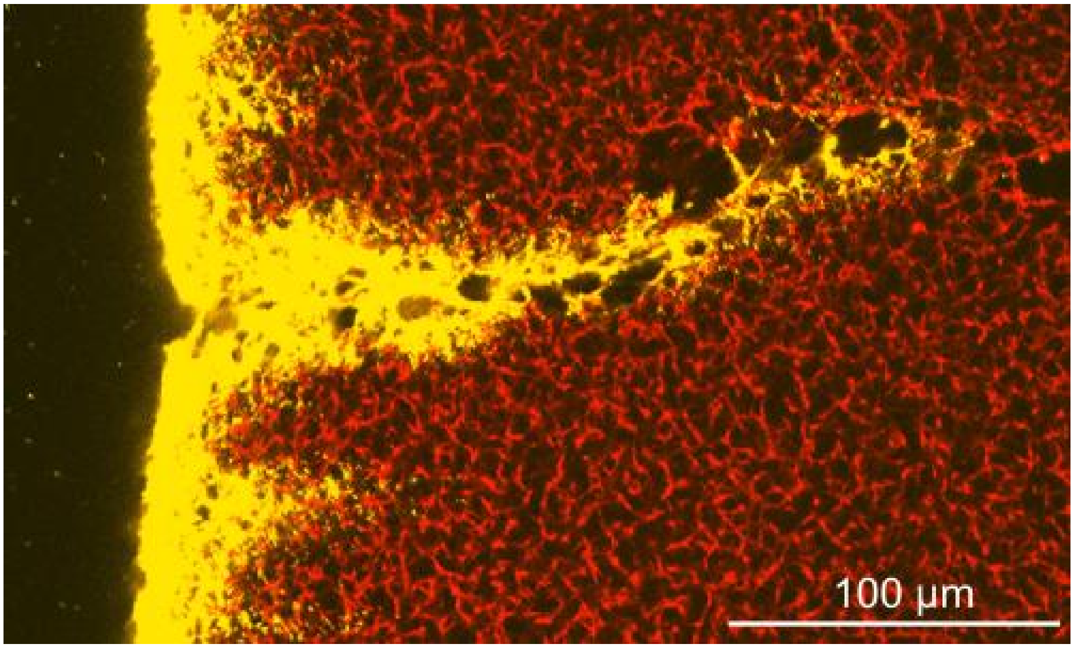


This is a time lapse image of a bubble (purple) burrowing into the network of a clot. The bubble is initially at rest in the fluid next to the clot. Exposure to ultrasound causes the bubble to shoot from left to right, penetrating the clot and causing damage to it in the process. Credit: Christopher Acconcia

Ultrasound-stimulated microbubbles have been showing promise in recent years as a non-invasive way to break up dangerous blood clots. But though many researchers have studied the effectiveness of this technique, not much was understood about why it works. Now a team of researchers in Toronto has collected the first direct evidence showing how these wiggling microbubbles cause a blood clot's demise. The team's findings are featured in the AIP Publishing journal *Applied Physics Letters*.

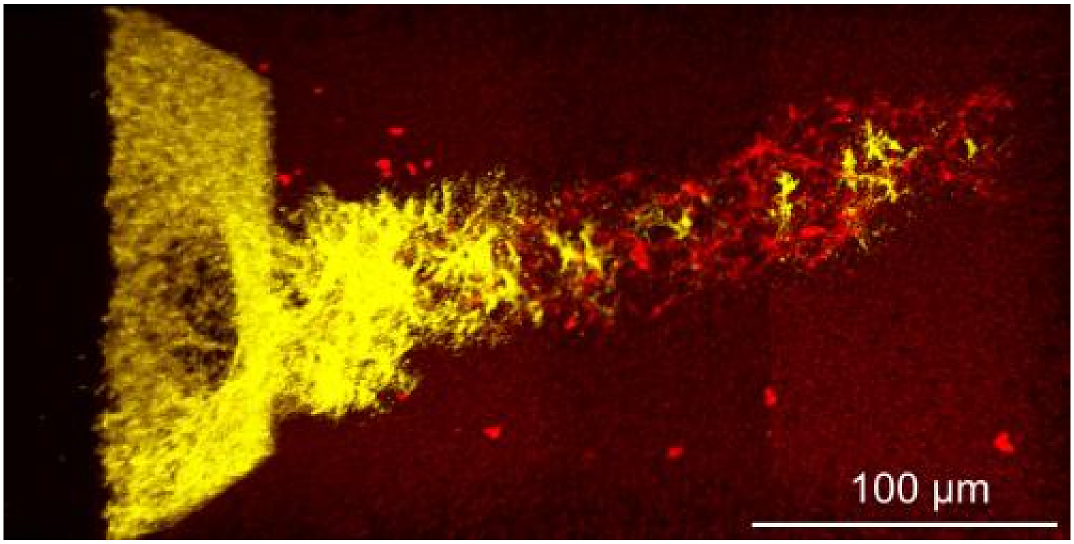
Previous work on this technique, which is called sonothrombolysis, has focused on indirect indications of its effectiveness, including how much a blood clot shrinks or how well blood flow is restored following the procedure. The Toronto team, which included researchers from the University of Toronto and the Sunnybrook Research Institute, tried to catch the clot-killing process in action. Using high-speed photography and a 3-D microscopy technique, researchers discovered that stimulating the microbubbles with ultrasonic pulses pushes the bubbles toward the clots. The bubbles deform the clots' boundaries then begin to burrow into them, creating fluid-filled tunnels that break the clots up from the inside out.

These improvements in the understanding of how sonothrombolysis works will help researchers develop more sophisticated methods of breaking up blood clots, said lead author Christopher Acconcia.



This is a fluorescence imaging of a clot network (red) after sustaining damage from an ultrasound stimulated bubble. The bubble violently penetrated the clot leaving behind a path of damaged clot fibers in its wake. Also shown here is evidence of fluid from outside the clot being transported within (yellow), along the bubble's path. This implies that if clot busting drugs were present, penetrating bubbles could aid in destroying the clot from the inside out. Credit: Acconcia et. al., 2013

Efforts so far "may only be scratching the surface with respect to effectiveness," said Acconcia. "Our findings provide a tool that can be used to develop more sophisticated sonothrombolysis techniques, which may lead to new tools to safely and efficiently dissolve clots in a clinical setting."



This is a 3D rendering of a clot network (red) after sustaining damage from an ultrasound stimulated bubble. The bubble violently penetrated the clot and this fluorescence imaging technique shows the path of damaged clot fibers left in its wake. Also shown here is evidence of fluid from outside the clot being transported within (yellow), along the bubble's path. This implies that if clot busting drugs were present, penetrating bubbles could aid in destroying the clot from the inside out. Credit: Credit: Christopher Acconcia

More information: The article, "Interactions between ultrasound stimulated microbubbles and fibrin clots" by Christopher Acconcia, Ben Y. C. Leung, Kullervo Hynynen and David E. Goertz appears in the journal *Applied Physics Letters*: dx.doi.org/10.1063/1.4816750

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