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RESEARCH

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Aortic aneurysms: under scrutiny

When abdominal aortic aneurysms rupture, the outcome is usually severe disability or death. Aneurysms identified as being likely to burst can be repaired by open surgery or, increasingly, by endovascular aneurysm repair (EVAR). The main problem with this minimally invasive strategy is that repairs may not be long-lasting. If blood starts leaking into the aneurysm (a phenomenon known as an endoleak) then the risk of rupture returns.

Patients who undergo EVAR of an abdominal aortic aneurysm with a stent-graft must have regular, lifelong checks to exclude post-procedural failure and endoleaks. Although CT is regarded as the most reliable method of detecting these leaks, the examination involves injection with an iodinated contrast agent and exposure to ionizing radiation. This is far from ideal for an annual or biannual follow-up scan. Other options include grey-scale B-mode and Doppler ultrasound, though neither is as sensitive as CT.

Canadian researchers have now shown that elasticity imaging could improve the overall reliability of ultrasound-only EVAR follow-up. Initial studies on animals have confirmed the potential value of ultrasound elastography as an adjunct to grey-scale and Doppler imaging methods (*Phys. Med. Biol.* **53** 6475). Patient trials are now planned.

The elasticity imaging method proposed for endoleak detection was originally developed by medical physicists at the University of Montreal Hospital Research Centre (CRCHUM), Québec, to characterize the properties of arterial plaques. Researchers also realized, however, that the same strain-mapping technique could be used to identify blood clots forming in the aneurysm sac and deformation to the aneurysm wall caused by endoleaks.

The feasibility of this idea was first tested by imaging the elastic properties of surgically constructed aneurysms in six dogs. The bilateral aneurysms were made by stitching a portion of jugular vein into the animals' left and right iliac arteries. Strains were measured in portions of artery above the "aneurysm" and in the inserted piece of venous tissue. In each case, ultrasound elastography was able to differentiate between the "healthy wall" (native artery) and the "pathological region" (venous patch).

A second imaging study was then conducted on 17 dogs, also with two surgically constructed aneurysms apiece. This time the animals had been fitted with stent grafts during EVAR, but the repairs had been deliberately sabotaged to create leaks. The "aneurysms" were examined using ultrasound elastography, and the combination of colour Doppler ultrasound and X-ray angiography as a reference standard.

"We were able to detect all endoleaks and thrombosed areas from measurements of wall elasticity. That is pretty good news," said Gilles Soulez, co-author of the study and professor of radiology at the University of Montreal Hospital. "Now we need to move to clinical validation."

The spatial resolution of images acquired in patients may not be as good as those from the animal studies because the frequency of the ultrasound probe will need to be lowered, said Guy Cloutier, director of the CRCHUM Laboratory for Biorheology and Medical Ultrasonics. "Vascular aneurysms are so big, especially in the abdomen, that the image may be a little impaired, but I don't think that the difference in resolution will affect clinical decisions," he said. "Of course, this still needs to be proven in humans that it will work."

In a parallel research programme, scientists at the CRCHUM are testing a new biomaterial that could help prevent endoleaks from forming. Ultrasound elastography will be used to assess the performance of these new materials in animal models.

About the author

Paula Gould is a contributing editor on *medicalphysicsweb*.