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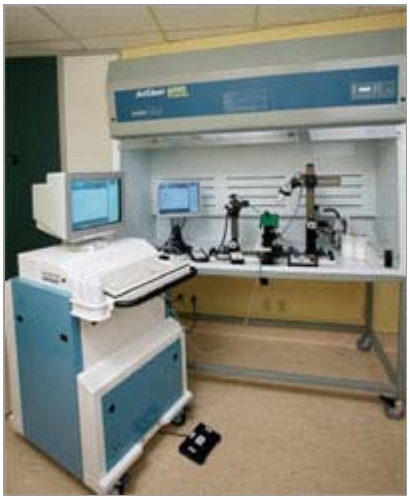
Sound and Vision

Micro-ultrasound provides real-time, high-resolution imaging of small animals

By **Aileen Constans**

Courtesy of VisualSonics



The same technology that reveals to expectant parents the sex of their developing fetus is now being used for noninvasive, real-time imaging of small, live animals such as mice, rats, chick embryos, and zebrafish. Toronto-based VisualSonics' [http://www.visualsonics.com] Vevo 770 imaging system uses micro-ultrasound to generate high-resolution (down to 30 micrometers) images, allowing researchers to study embryonic and neonatal cardiovascular and neurological development as well as tumor development.

The system's main advantage over competing imaging technologies such as magnetic resonance imaging (MRI) and positron emission tomography (PET) imaging is that ultrasound data can be collected within minutes rather than over the course of hours, which is critical for obtaining clear pictures from a living, breathing mouse. "For

structures that are rapidly moving, things like the heart for example, it's very important to be able ... to look at the dynamics of the myocardium or the valves opening and closing or the blood flow in real time," says chief technical officer Stuart Foster.

The system's Doppler capabilities allow Daniel Turnbull, professor of radiology and pathology at New York University Medical Center, to measure blood flow in developing mouse embryos. He notes that, to his knowledge, the Vevo 770 is the only high-resolution system with this capability. "Optical imaging methods really don't penetrate far enough for us to do true in utero imaging, noninvasively, the way that we've been doing with ultrasound," he adds. Turnbull is a member of the company's Scientific Advisory Board.

Foster points out that ultrasound is not inherently a three-dimensional imaging technique for the whole animal. Instead, it does real-time imaging of 1–2-cm fields of view. In contrast, "in a technique such as MRI or PET imaging, you put in the mouse, and you come back and you've got a 3-D data set that you can look through and study. So [ultrasound] is much more hands-on, much more immediate in terms of its use," he explains.

Foster also notes that ultrasound currently has limited capabilities for cellular tracking, unlike MRI, which employs contrast agents to monitor cellular events. VisualSonics currently is working with cardiologist Jonathan Lindner of the University of Virginia to develop targeted contrast agents to detect and monitor molecular events.

Ultrasound is less costly than MRI or PET imaging. According to Foster, the Vevo 770 costs between $150,000 and $200,000 (US), while a typical MRI instrument would cost more than $1 million. PET scanners cost around $750,000.

Lee Adamson, principal investigator of the Samuel Lunenfeld Research Institute of Mount Sinai Hospital, Toronto (and also a member of Visual-Sonics' Scientific Advisory Board), adds that ultrasound allows the animals to remain fully accessible during the experiment, so that researchers can perform ultrasound-guided microinjections to infuse drugs, for example. Further, the system can be used to visualize adult mice as well, says Adamson. "I can use the same piece of equipment from the day the embryo implants, right through to when that embryo becomes an adult. So you don't have to worry about systematic errors caused by switching instrumentation partway through."

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