Remarkable new images show a 4-D view of the heart

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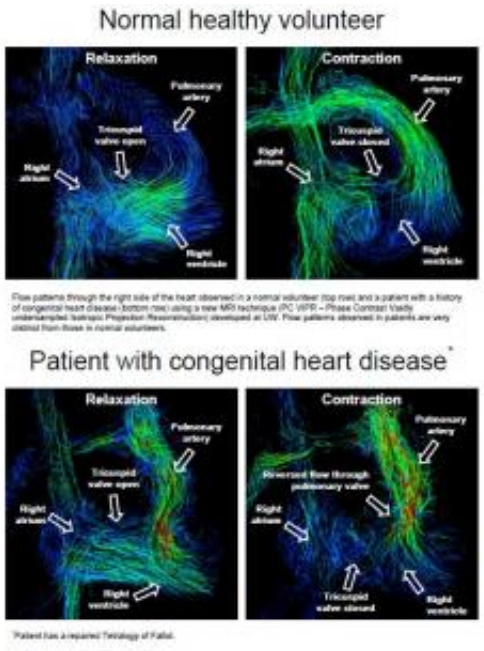

Four-dimensional images of the heart show the rate of blood flow.

(PhysOrg.com) -- What does the racing heart of someone in love - or on a fast treadmill - really look like? Researchers at the University of Wisconsin School of Medicine and Public Health (SMPH) now have pictures that are better than anything that's come before. With the new technology they've developed, the scientists produce remarkable images to measure how fast blood is flowing through various places in the heart and the major arteries around it.

Physicians given a preview are wowed by what they see, according to Dr. Oliver Wieben, a School of Medicine and Public Health medical physicist who has been working on the technology for several years, and Dr. Christopher Francois, a radiologist at the medical school who specializes in heart imaging.

Even lay people can appreciate the revealing colorful pictures.

In the images, blood flowing through the heart is seen as a bundle of long threads or filaments, color-coded to indicate the speed of the flow at various locations in the heart. Blue threads represent the relatively slow flow that occurs throughout the heart when it is relaxed, while green threads indicate blood flowing faster during contraction.

In patients with heart problems making blood flow abnormally fast, the threads appear red or yellow. In addition to flow velocity at various spots, the images show the direction the blood is flowing and the effect of any obstructions or deviations on blood flow, such as in patients with Tetralogy of Fallot, the condition snow boarder Shaun White had repaired as a child.

A 10-minute session in an MRI scanner is all it takes. Patients don't need to hold their breath, the procedure is completely non-invasive and it requires no contrast agent or general anesthesia. Squirmy children may need sedation to keep them still.

Physicians have measured blood velocity with standard MRIs for about 20 years, but it hasn't been optimal. To acquire the 20 to 30 slices that are usually needed to scan the entire heart with an MRI, it can take between 45 and 90 minutes. Since patients must not move during the procedure, younger patients often require general anesthesia, which isn't always desirable, especially for children with heart problems.

Ultrasound is another common technique used to look at blood flow in the heart, but the chest bone and other anatomy can make it hard to see some portions of the heart and vessels surrounding it.

What's more, ultrasound and MRI images are typically two-dimensional representations, at times 3-D. But the new technique supplies 4-D information-three spatial dimensions plus time as the fourth dimension.

The new technique is known as PC VIPR (Phase Contrast Vastly undersampled Isotropic Projection Reconstruction).

"In designing this, we threw out all the old rules of radiology and came up with a new way to acquire data that allows us to do the imaging much faster while still getting excellent quality," Wieben says. "We're also developing new ways to display the complex flow data on a 2-D monitor."

The Wisconsin scientists are excited about extending the technology to analyzing blood vessel walls as well. PC VIPR can be used to identify areas of weakening in the vessel wall or areas under increased stress, which can lead to aneurysms or build-up of damaging plaque.

The new technology will be particularly useful for adults and children with congenital heart disease, the most common birth defect.

"This is a new paradigm in cardiac imaging," says Francois. "It will allow physicians to see things they haven't seen before in all their complexity."

The technology is still in the research stage, but it has been tested on hundreds of volunteers and patients. Wieben and Francois hope it will be available for use in hospitals in three or four years.

Provided by University of Wisconsin-Madison