MedicalXpress

Scientists show function of helical band in heart

December 1 2008

Scientists from the California Institute of Technology (Caltech) have created images of the heart's muscular layer that show, for the first time, the connection between the configuration of those muscles and the way the human heart contracts.

More precisely, they showed that the muscular band--which wraps around the inner chambers of the heart in a helix--is actually a sort of twisting highway along which each contraction of the heart travels.

Their findings were published in the December issue of the American Physiological Society journal, *Heart and Circulatory Physiology*.

Since the days of Leonardo da Vinci, observers of the human body have known that the heart's beat is not a simple in-and-out movement--that it has more than a little bit of a twist to it. "The heart twists to push blood out the same way you twist a wet towel to wring water out of it," explains Morteza Gharib, the principal investigator on the study, and the Hans W. Liepmann Professor of Aeronautics and professor of bioengineering in the Division of Engineering and Applied Science at Caltech.

Some 50 years ago, anatomist Francisco Torrent-Guasp was the first to show the helical configuration of the heart's myocardium--its muscular middle layer, the one that contracts with each heart beat.

But what he and subsequent generations of scientists were unable to do was to connect that myocardial band to the heart's function--to prove

that the helical shape is important to the effective beating of the heart. Without that connection, physicians and scientists have tended to look at the heart as "just a piece of meat," says Gharib.

Until now, that is. Using a technique pioneered by Han Wen and his team at the National Institutes of Health, Gharib and his colleague Abbas Nasiraei Moghaddam, a Caltech graduate and visitor in bioengineering, were able to create some of the first dynamic images of normal myocardium in action at the tissue level. "We tagged and traced small tissue elements in the heart, and looked at them in space, so we could see how they moved when the heart contracts," Gharib explains. "In this way, we were able to see where the maximum physical contraction occurs in the heart and when--and to show that it follows this intriguing helical loop."

With each beat of the heart, a wave of contraction starts at the heart's apex--which, despite its name, is actually at the very bottom of the heart--and then travels up through the myocardium. "The only time the whole helix shows up in the images is at the end of systole, which is when the heart is contracting," says Gharib. "This simple band structure is akin to an engine behind the heart pumping action."

In addition to going a long way toward settling the decades-long structure/function debate surrounding Torrent-Guasp's work, this finding also has major implications for the surgical treatment of heart disease, Gharib says. "It's going to change the way we repair the heart," he explains. Knowing that the contractile wave travels along the helical pathway--instead of occurring throughout the heart all at once--has implications for which parts of the heart will be most vulnerable to a surgeon's scalpel, for instance. "Seventy-five percent of the function of the heart depends on this muscle," Gharib says. "Surgeons now know what to cut and what not to cut. This will help them to come up with new and more effective surgical procedures."

Source: California Institute of Technology

Citation: Scientists show function of helical band in heart (2008, December 1) retrieved 23 April 2024 from https://medicalxpress.com/news/2008-12-scientists-function-helical-band-heart.html

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