Heart attacks: The tipping point

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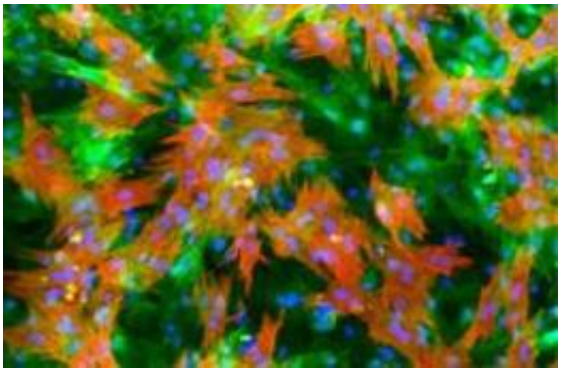

A fluorescent micrograph showing mytocytes (red) and fibroblasts (green). Credit: AFTAU

Twenty percent of American deaths each year are caused by heart attack or angina, sometimes without any warning.

But thanks to new research from Dr. Sharon Zlochiver of the Department of Biomedical Engineering at Tel Aviv University, there's new hope for potential heart attack victims. By looking at the electrical activity coupling two types of heart muscle cells, Dr. Zlochiver has discovered a new way of identifying an impending attack.

Dr. Zlochiver can not only predict when a heart attack will occur, but he can also help doctors — and patients — buy time before a deadly attack takes place. His research was published last year in the *Biophysical Journal*.

Keeping His Eye on the Balance

"Seventy percent of the heart is made up of myocytes, which are contractile muscle cells. The remaining 30% is mostly rigid structural cells called fibroblasts that work to hold the muscle in place," Dr. Zlochiver explains. "As the heart ages and contends with factors such as high blood pressure or genetic disease, this balance begins to change."

Through the course of his research, which was started at the University of Michigan, Dr. Zlochiver developed a mathematic model that shows when the proportion of structural fibroblast cells are at dangerous levels, at approximately 70% of the heart's volume. According to Dr. Zlochiver, this is the "tipping point" where a heart attack is imminent.

The problem has been that these cells are not apparently differentiated from one another, which presented a challenge to Dr. Zlochiver. Though a regular EKG could not give the information he sought, Dr. Zlochiver was determined to see how the cell ratio within the heart could be measured by electrical activity. Studying the electric coupling -- tiny electric signals -- between myocytes and fibroblast cells, he was able to paint a more accurate picture of a heart's health than could be deduced from even an MRI or CT scan.

"This coupling is crucial to the initiation of fibrillation," he says. Indicating how the electrical impulses move in a healthy heart, in a synchronized ordered manner, he compares that to a diseased heart, where electric coupling is scattered and irregular and the impulses break into chaotic local "tornados."

"Abnormal electrical activity causes the heart to contract abnormally," he says. Working with his colleagues at the University of Michigan, Dr. Zlochiver is working to repair hearts in real patients at risk prophylactically, so that electrical coupling signals in diseased hearts

resemble a more organized, "tornado-free" pattern.

Fixing a Broken Heart by Email

Dr. Zlochiver's research will no doubt alter the way cardiac arrest is diagnosed and treated. "If we get an image from an MRI or CT from the inside of the heart, we can build a mathematical model and simulate electrical activity. That way, we can identify the problem point and stop fibrillation," he says.

"We can use the knowledge of the electrical activity and the interaction between cells in order to give ideas on treatment. Physicians will have a better idea on how to treat specific patients. For example, physicians will be able to locally ablate or release drugs in cardiac areas that are especially susceptible to fibrillation."

In the future, Dr. Zlochiver hopes that doctors will be able to send in scans of their patients' hearts and the models he creates from the scans would help guide decisions on treatment.

Dr. Zlochiver, a recipient of a 2007 award from the American Heart Association for his work, is one of 23 bright new faculty recruits to Tel Aviv University.

Source: Tel Aviv University (news : web)