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https://www.gesundheitsindustrie-bw.de/en/article/press-release/after-heart-attack-inflammation-weakens-hearts-energy-production

After a Heart Attack: Inflammation Weakens the Heart's Energy Production

Why does heart function often continue to deteriorate after a heart attack, even though blood flow has been restored? A research team from the DZHK sites Heidelberg and North has now identified an important mechanism: an inflammatory switch in cardiomyocytes can impair cellular energy production and thereby drive the development of heart failure. The results were published in Nature Communications.

After a heart attack, the immune system responds. This response is initially necessary to remove damaged tissue. However, if it persists or becomes too strong, it can harm the heart.

A multi-site research team, led by Dr. Manju Kumari and Prof. Dr. Norbert Frey from Heidelberg University Hospital in collaboration with Prof. Dr. Joerg Heeren from University Medical Center Hamburg-Eppendorf, showed that a transcription factor called IRF3 is particularly active in cardiomyocytes during heart failure. Controlled regulation of IRF3 normally plays a role in the defense against viral infections, whereas excessive activation can lead to autoimmune diseases. In the diseased heart, however, excessive IRF3 interferes with the regulation of energy supply.

When the heart lacks energy

Cardiomyocytes are largely responsible for the heart's energy supply and generate this energy with the help of their mitochondria, the cell's powerhouses. The authors show, however, that cardiomyocytes do more than produce energy: they also play an active role in regulating inflammatory processes in the heart.

If IRF3 is persistently activated in cardiomyocytes, these powerhouses function less efficiently. Metabolism becomes imbalanced, key energy processes are downregulated, and the heart's pumping function declines.

In mouse models, targeted activation of IRF3 specifically in cardiomyocytes alone led to a marked deterioration in heart function. Conversely, when IRF3 was specifically switched off in cardiomyocytes, the heart remained more functional after an infarction.

Energy production as a therapeutic approach

The researchers went one step further. They moderately increased the production of another protein, PGC-1α, in cardiomyocytes, which plays a central role in energy generation. This intervention improved mitochondrial function, reduced inflammatory processes, and markedly stabilized cardiac performance.

First author Manju Kumari says: "Our results identify a molecular network and a specific point of intervention where inflammatory processes and energy metabolism in the heart muscle intersect. If we succeed in targeting this mechanism, we may be able to slow the progression of heart failure, particularly after a heart attack."

These findings open up perspectives for therapies that specifically target the link between cardiac inflammation and energy metabolism.

Original publication:
Kumari M, Evangelakos I, Deshpande A, et al. Activation of IRF3 in cardiomyocytes impairs mitochondrial oxidative function through PGC-1α inhibition and drives heart failure. *Nat Commun.* 2026;17(1):2051. Published 2026 Feb 27.

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Further information

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