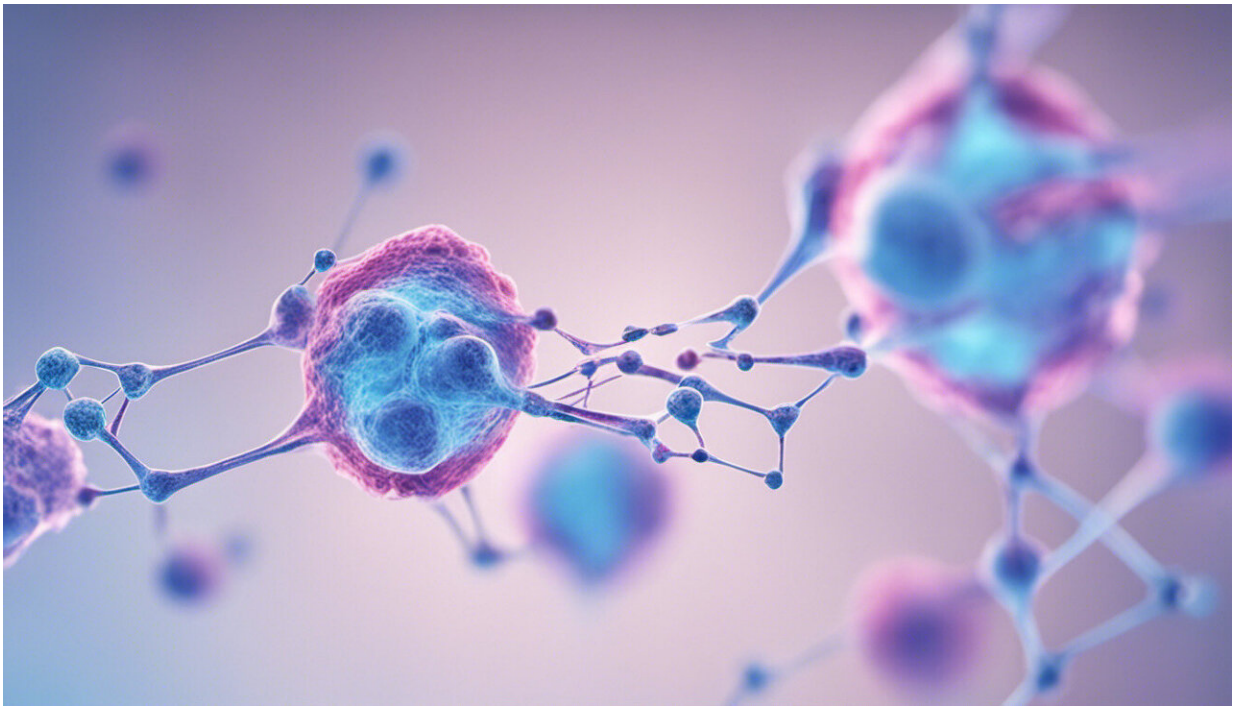
Synthetic 'mini' receptors block atherosclerosis

February 12 2021



Credit: AI-generated image (disclaimer)

Atherosclerosis, a lipid-triggered chronic inflammatory disease of the arteries, is the main cause of strokes and heart attacks. An international team of researchers led by the Technical University of Munich (TUM) and the LMU University Hospital has developed novel synthetic peptides that can help to prevent atherosclerosis in vitro, that is in the test tube, as

well as in animal models.

Research over the last 20 years has shown that atherosclerosis is a chronic inflammatory condition of the arterial blood vessel wall. Soluble mediators such as cytokines and chemokines are pivotal players in this disease, promoting vascular inflammation. However, the development of anti-inflammatory therapeutics directed against such mediators that could prevent atherosclerosis has proven difficult, despite promising clinical studies in the recent past.

Previous anti-inflammatory therapeutic strategies to prevent atherosclerosis, heart attacks, strokes, rheumatoid arthritis and other inflammatory diseases have mainly been based on antibodies and small-molecule drugs. The Munich-based research team has now designed and chemically synthesized short chains of amino acids—i.e., peptides—that function like a minimized soluble chemokine receptor. In animal models, these peptides can block atherosclerosis.

Researchers design a new class of peptides against atherosclerosis

Chemokines orchestrate the migration of immune cells in our bodies. They are key players in inflammatory diseases, including atherosclerosis; and this is why they are of great interest to biomedical researchers.

The peptides designed and synthesized by the Munich researchers mimic certain chemokine receptors and are able to specifically inhibit chemokine mechanisms that promote atherosclerosis, whereas chemokine mechanisms that control important physiological processes in the body are not affected—one could say they are "spared."

Previous studies have shown the effectiveness of therapeutics related to

cytokines and chemokines. However, these drugs, not only interfered with the effect of these mediators on atherosclerosis, but also suppressed their beneficial effects, for example those related to the host defense against infections.

"The mini-CXCR4 mimics we have developed are able to selectively differentiate between two different chemokines that target the same receptor—in this case between the atypical chemokine MIF and the classical chemokine CXCL12. This enables them to specifically block pathways underlying atherosclerosis," explained Aphrodite Kapurniotu, Professor for Peptide Biochemistry at TUM.

Peptide therapeutics are suitable and inexpensive

"Peptide-based therapeutics are often considered less stable, as peptides may get rapidly degraded in the body by enzymes called proteases. However, we can apply various state-of-the-art approaches of peptide chemistry to improve the stability of peptides, for example by introducing unnatural amino acids into the peptide sequence," Prof. Kapurniotu added.

"So far, our approach was validated only in an animal model of atherosclerosis, but future clinical applications seem possible, in particular also due to the fact that peptide-based therapeutics are substantially less expensive than antibodies," said Prof. Jürgen Bernhagen from the Institute for Stroke and Dementia Research (ISD) at the LMU University Hospital.

Therapeutic potential for inflammation diseases

The Munich researchers view these results as a "proof-of-principle" of their approach. In fact, their findings show that concepts based on

mini-chemokine-receptor mimics are feasible and suggest that this kind of concept could potentially be applied to other chemokines as well.

Thus, the new molecular concept could bear therapeutic potential for atherosclerosis and other inflammatory diseases.

More information: Christos Kontos et al, Designed CXCR4 mimic acts as a soluble chemokine receptor that blocks atherogenic inflammation by agonist-specific targeting, *Nature Communications* (2020). DOI: 10.1038/s41467-020-19764-z

Provided by Technical University Munich