

Lab-engineered proteins: a promising treatment for liver disease

The team led by Aitziber L. Cortajarena has succeeded in reducing liver fibrosis and hepatocellular carcinoma in mice

This CIC biomaGUNE study paves the way for developing therapeutic and diagnostic agents based on engineered proteins

Donostia. 23 June, 2026. The research group led by CIC biomaGUNE's Ikerbasque Research Professor [Aitziber L. Cortajarena](#) has developed an innovative anti-fibrotic and anti-tumor treatment by binding a synthetic protein to gold nanoclusters (small aggregates of approximately 6 atoms of gold). Conducted in collaboration with the group led by Dr Ana Beloqui at the Catholic University of Louvain (Belgium), the study has demonstrated that this hybrid formulation displays strong hepatic specificity and minimal side effects in mice.

Liver diseases can progress from reversible inflammation to chronic conditions, such as liver fibrosis and liver cancer. Fibrosis is characterized by the progressive build-up of scarred tissue in the early stages, eventually leading to the development of tumors and liver failure in advanced stages. According to the WHO, 830,000 deaths due to hepatocellular carcinoma were recorded worldwide in 2020. Furthermore, it is estimated that around 3.3 per cent of the global population suffers from advanced liver fibrosis.

In recent years, considerable effort has gone into developing therapeutic strategies aimed at blocking the function of the Hsp90 protein, because of its central role in fibrosis and cancer progression. Synthetic protein molecules have emerged as an attractive alternative as they can be rationally engineered to recognize specific targets, and their therapeutic activity can be optimized.

In this respect, the hybrid material developed by CIC biomaGUNE's [Biomolecular Nanotechnology](#) group, in collaboration with the Advanced Drug Delivery and Biomaterials group at the Louvain Drug Research Institute, is engineered to bind to the Hsp90 protein, in much the same way as a key fits into a lock: "That way, the processes that trigger the disease are blocked as excessive amounts of this protein are found in diseased livers," explained Dr Cortajarena, scientific director of CIC biomaGUNE. "The results of the study show that the compound developed is a promising, state-of-the-art therapy that elicits a low immune response and offers high therapeutic potential."

In the case of liver fibrosis, the treatment developed reduces liver damage. The team were able to verify that there was a reduced presence of molecules that trigger the disease, as well as a reduction in the accumulated collagen fibers. In other words, it applies a brake to the mechanism that causes scarring while removing the tissue that has already been damaged.

In the case of liver cancer, the results are equally promising: blocking the Hsp90 protein leads to a reduction in the proteins that allow cancer cells to divide uncontrollably. Thanks to this biological “braking” mechanism, the research team managed to significantly reduce both the number and size of the tumors, a breakthrough they were able to confirm using various imaging and molecular analysis techniques.

For therapy, monitoring and diagnosis

Meanwhile, the presence of the gold nanocluster enabled “the distribution of the drug in the mouse to be detected, thus making it possible to investigate the organs in which it had built up; this is key information when it comes to understanding its behavior in the body and, therefore, to developing effective drugs”, said Gabriela Guedes, one of the researchers participating in the study.

“It is important to highlight the fact that the versatility of these engineered proteins opens up the possibility of adapting the metal component to the desired imaging technique modality,” said Cortajarena. The protein structure can be engineered so that, aside from gold, it can bind in a stable way to other metals, such as gadolinium or iron, which gives the therapeutic system the ability to be tracked using a range of imaging and diagnostic techniques. For example, “the binding of iron-based nanostructures to the engineered protein would allow treatment to be monitored in real time using magnetic resonance imaging without the need to administer an additional contrast agent,” added the Ikerbasque Research Professor.

The researchers concluded that this study provides evidence not only for the potential of the engineered protein as an antifibrotic and anti-tumor agent, but also for its versatility in developing it as a theranostic agent, in other words, one that fulfils both therapeutic and diagnostic functions. These results open up countless opportunities for improving patient treatment and outcomes: “Our findings offer new possibilities for developing therapies based on proteins of this type.”

About CIC biomaGUNE

The Center for Cooperative Research in Biomaterials [CIC biomaGUNE](#), member of the Basque Research and Technology Alliance ([BRTA](#)), is a not-for-profit research center located in Donostia that conducts state-of-the-art research at the interface between Chemistry, Biology and Physics, devoting particular attention to studying the properties of biological nanostructures at the molecular scale, and their biomedical applications. It was recognized in 2018 as a “María de Maeztu” Unit of Excellence for meeting requirements of excellence, which are characterized by a high impact and degree of competitiveness in its field of activity on the global scientific stage.

Bibliographic reference

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Engineered protein nanoclusters reduce liver fibrosis and hepatocellular carcinoma in mice models

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Photo captions

Photo 1: Purification of the protein-metal hybrid material. (CIC biomaGUNE).

Photo 2: Andrea García Esnaola, research technician at CIC biomaGUNE, analyzes the structure of the synthetic protein (CIC biomaGUNE).