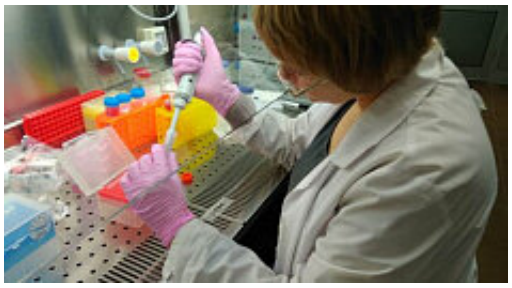
Magnetic nanomaterials become an effective treatment against liver fibrosis

21 January 2020



Magnetic nanomaterials become an effective treatment against liver fibrosis. Credit: Immanuel Kant Baltic Federal University

A team of scientists from Immanuel Kant Baltic Federal University together with their colleagues from NUST MISiS and RWTH Aachen University (Germany) compared different treatments against liver fibrosis and published the results of their study in the *Cells* journal. In the course of this disease liver tissue is replaced with connective (cicatricial) tissue preventing the organ from its normal functioning. According to the scientists, magnetic nanomaterials may become a basis for a completely new approach to anti-fibrosis treatment and help avoid the issues associated with traditional therapeutic methods.

Fibrosis may affect different body organs. It develops as a reaction to long-time inflammation and is supposed to isolate the inflammation site from surrounding tissues. For example, chronic liver fibrosis may occur if the liver is constantly influenced by toxins, viruses, or metabolic disturbances. Liver damage is caused by the hepatocytes death, the main type of liver cells that secure the functioning of the organ. As hepatocytes die and are replaced with connective tissue cells, liver functions decrease, and if a patient receives no treatment, cirrhosis may develop. Cirrhosis is a fatal illness: patients with it live for 2-4 years and die in excruciating pain. In its early stages fibrosis exhibits no symptoms and is often diagnosed when a patient starts to experience serious liver failure.

Currently, there are few efficient methods for treating liver fibrosis, and all of them work indirectly—mainly by means of reducing the anti-inflammatory reactions. Scientists are working on new medicinal drugs that would affect the regulatory mechanisms of connective tissue development. The main role in this process is played by hepatic stellate cells, therefore they have been chosen as the targets of the drugs.

Despite the advantages of the new drugs, their targeted delivery remains a complex task. The solution may lie in the use of magnetic nanoparticles as carriers. The most widely spread therapeutic magnetic nanoparticles are based on iron oxide. Their size varies from 1 to 10 nm, which is smaller than any animal cell, and their movements in the body can be regulated using an external magnetic field. In actual practice nanoparticles are never used in their pure form, but are hybridized with other materials, for example, placed inside polymeric capsules on the stage of synthesis. This allows the scientists to regulate the properties of the particles: their charge, stability in the environments with different acidity, ability to penetrate cells, and so on. Hybridizing also reduces their possible toxicity.

Hybrid nanoparticles can be used not only to treat, but also to diagnose liver diseases. If molecules that bind specifically with liver connective tissue cells are placed on the surface of such particles, one can use MRI to visualize the areas of their accumulation and thus identify the sites of cirrhosis. The new method might help the patients avoid painful biopsies that are currently considered a standard procedure in liver fibrosis diagnostics.

"Targeted drug delivery using magnetic nanoparticles is not a new approach; for example,

they are currently being clinically tested as the carriers of docetaxel, a drug against prostate cancer. Studies suggest that magnetic nanoparticles can effectively accumulate in the functional tissues of the liver and therefore can be used as drug molecule carriers in the therapy of liver fibrosis. Our laboratory works in the same field: for example, we carry out the tests of 'magnetic tweezers' allowing one to move single cells from one place to another. We are also involved in the synthesis of nanoparticles for biomedical applications," said Valeria Rodionova, the head of the Laboratory for New Magnetic Materials.

More information: Kateryna Levada et al, Magnetic-Assisted Treatment of Liver Fibrosis, *Cells* (2019). DOI: 10.3390/cells8101279

Provided by Immanuel Kant Baltic Federal University

APA citation: Magnetic nanomaterials become an effective treatment against liver fibrosis (2020, January 21) retrieved 21 October 2021 from https://medicalxpress.com/news/2020-01-magnetic-nanomaterials-effective-treatment-liver.html

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