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PRESS BRIEFING

Right into the heart: micropump brings stem cells into dead heart tissue

Stem cells from the cardiosphere can regenerate damaged heart muscle tissue. However, the low survival rate of the cells during transplantation is a sticking point. In the EU project POSITION II, a research team from Fraunhofer EMFT is working with 45 partners on a new approach to solving this problem: A special encapsulation protects the sensitive stem cells, while a smart catheter with an integrated micropump ensures safe and precise placement in the heart muscle tissue.

The good news is that the chances of surviving a heart attack are better today than ever before. The bad news: Patients affected often have to struggle with remaining secondary damage (heart insufficiency), which not only affects the quality of life, but also reduces life expectancy. The reason for this is the loss of heart muscle tissue caused by the interruption of oxygen supply during the heart attack. The longer the supply was interrupted, the more massive the damage. Current treatment options are limited to symptom relief. It is now known that cardiosphere-derived cells (CDCs) are capable of rebuilding heart muscle tissue. However, this promising therapy until now often fails because the CDCs have a low survival rate after transplantation.

In the EU project POSITION II, researchers from 43 organizations and 12 countries are working on a new approach to successfully implant the sensitive stem cells permanently into the heart muscle tissue. For this, the CDCs are encapsulated in a three-dimensional alginate-poly-L-lysine-alginate matrix. Initial results from the laboratory are encouraging: cell viability did not decrease over one month, and the phenotype, differentiation potential, gene expression profile, and growth factor release of the CDCs were maintained after encapsulation.

The second challenge is to transport the stem cell encapsulations as precisely and carefully as possible to the heart tissue. For this purpose, Fraunhofer EMFT scientists are developing a microdosing unit which is integrated into a smart catheter. This enables the cells to be pumped through the catheter right into the heart without the pressure in the heart and fluidic back pressure affecting the dosing accuracy. The central element is a piezoelectric micromembrane pump realized at Fraunhofer EMFT with dimensions of only 5x5x0.8 mm³ To achieve the necessary pressure and flow, the research team

Fraunhofer EMFT
conducts research and development on sensor systems and actuators for people and the environment at its locations in Munich, Oberpfaffenhofen and Regensburg. The competences of the approx. 130 employees include manufacturing-oriented microtechnologies, innovative sensor solutions, microdosing and secure electronics.

adapted the pump chamber and optimized the piezo assembly as part of the project work. The stability of the flow rate was tested extensively under variable conditions and the results were compared with the estimates and calculations made during the design. Currently, the researchers are analyzing the limits of the actuation voltage in order to further optimize the pump characteristics.

First experimental trials with the smart catheter in a clinical setting show promising results. After an initial evaluation in the project, the system is to be improved in detail before it can then be tested in clinical trials and used to treat heart attack-related damage.

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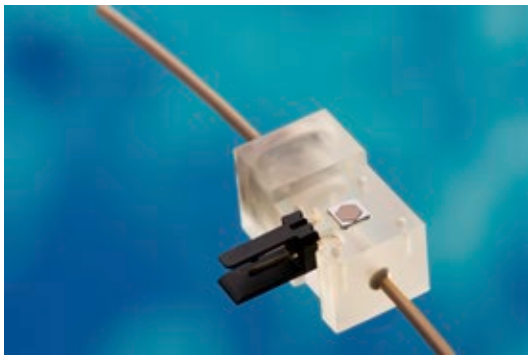
POSITION
innovation in smart medical instruments



Smalles micropump in the world with dimensions of 3,5 x 3,5 x 0,6 mm^3

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