Regenerative Medicine and 3D Printing Technology in the Treatment of Myocardial Infarction

- The CARDIOPATCH project, funded by the EU Interreg Sudoe Programme, aims to develop a smart biotechnology solution capable of regenerating damaged tissue after infarction.

- A secondary aim of the project is to create an excellence network to foster R&D and innovation applied to the biomedical sector in South West Europe.

- The project is headed by a consortium of nine institutions from Spain, France and Portugal.

Cardiovascular disease (CVD) is the number one cause of death globally. This group of disorders accounts from 45% of deaths in Europe and, according to figures from the *European Heart Network*, is estimated to cost the EU economy €210 billion each year.

It is in this context that the CARDIOPATCH project is being developed. Co-funded by the EU Interreg Sudoe Programme, via the European Regional Development Fund (ERDF), it is investigating new treatments for myocardial infarction and aims to provide solutions to improve patients' quality of life.

Headed by Navarra University Clinic (CUN), the project involves nine centres from Spain, France and Portugal with expertise in cardiology, cell therapy, nanotechnology, 3D printing, bioengineering and technology transfer.

CARDIOPATCH, which had its kick-off meeting on the 15th and 16th of December and is expected to run into April 2023, will concentrate on developing a "smart" patch able to regenerate tissues damaged by infarction.

With this aim, the project partners will work on a collagen fibre patch impregnated with mesenchymal stem cells taken from body fat. The patch is currently in the first phase of a clinical trial on patients with chronic ischaemic cardiomyopathy.

The CARDIOPATCH team aims to optimise the therapeutic benefit of the patch using genetic modification and cell reprogramming techniques.

“To design the new solution, we will genetically modify mesenchymal stem cells from adipose tissue using microRNA and viral vectors that induce expression of proangiogenic and cardioprotective proteins. This will stimulate the formation of new blood vessels in damaged areas of the heart and facilitate their repair,” explains Felipe Prósper, director of the Navarra University Clinic Cell Therapy Department and project chief scientific officer.

The regenerative capacity of the patch's collagen membrane will also be enhanced by adding cardiomyocytes, which are the cells that make up the cardiac muscle. “These cells will be generated using cell reprogramming techniques derived from induced pluripotent stem cells, i.e. artificially created stem cells,” he adds.

In addition to therapeutically validating the new patch, the project also aims to develop another two products: a roll-up 3D device which will allow the patch to be implanted by means of less invasive methods than currently available, and a 3D system to generalise production and streamline transport of the patch.

“The surgical technique currently available for implanting the patch into patients is via thoracotomy. However, we are hoping to develop a roll-up 3D device that will enable us to implant it via mini-thoracotomy. In this way, a new, roll-up design of the patch would allow us to introduce it via a small incision and guide it to the damaged area of the heart. Once there, it would be unrolled and attached to the lesion, activating regeneration,” says Prósper.

An Excellence Network to Foster Biomedical R&D and Innovation

In addition to developing advanced solutions, another of the aims of the CARDIOPATCH project is to create an “Excellence Network” to foster R&D and innovation in the biomedical sector in South West Europe, with the intention of extending industry 4.0 technologies into the healthcare sector.

The CARDIOPATCH Excellence Network will foster cooperation with public authorities in participating regions by rolling out tools and services to keep them informed of the latest developments in regenerative cardiac medicine, aiding the strategic decision-making process.

The project also aims to involve society. To do this, it will organise a series of outreach activities and training workshops on breakthroughs in research.

With a total budget of €1.419 million, the CARDIOPATCH consortium is made up of CUN, CIMA University of Navarra, via the Foundation for Applied Medical Research, the Institut de Recerca de l’Hospital de la Santa Creu i Sant Pau, LEARTIKER technology centre, communication agency GUK, Centre Hospitalier Universitaire de Toulouse, the University of Montpellier (UM) - Institut des Biomolécules Max Mousseron (IBMM), GenIbet Biopharmaceuticals and the Instituto de Biologia Experimental e Tecnológica.

The project also has the support of associate partners Viscofan, Sodena and the Nouvelle-Aquitaine, Euskadi, Navarre Euroregion (NAEN).

Partners in the CARDIOPATCH European consortium:

Spain:

- Navarra University Clinic
- CIMA Universidad de Navarra, via the Foundation for Applied Medical Research
- Fundación Institut de Recerca de L' Hospital de la Santa Creu i Sant Pau
- LEARTIKER (Spain)
- GUK Komunikazio Aholkularitza

France:

- Centre Hospitalier Universitaire de Toulouse
- Université de Montpellier (UM) - Institut des Biomolécules Max Mousseron (IBMM)

Portugal:

- Instituto de Biologia Experimental e Tecnológica
- GenIbet Biopharmaceuticals S.A.

Project Full Name: Network of Excellence for the development of Advanced Therapies of Myocardial Infarction Treatment based on Regenerative Medicine and 3D Printing.

Acronym: CARDIOPATCH