# A new targeted nanosystem improves brain drug delivery for the treatment after a stroke

**Direct brain administration through the carotid artery of nanomaterials carrying drugs that boost tissue recovery could be an effective method to reduce the undesirable effects in other organs and improve the arrival of the drug into the brain.**

The study, developed in the framework of the European project **MAGBBRIS**, led by researcher **Anna Rosell** (VHIR), **has been carried out by an interdisciplinary team of the Vall d'Hebron Research Institute (VHIR), the Institute of Materials Science of Barcelona (ICMAB, CSIC), the Basque Center for Neuroscience, the SAS Institute of Experimental Physics in Slovakia and the San Raffaele Scientific Institute in Italy.**

Ischemic strokes are caused by the blockage of a cerebral artery that prevents proper blood flow to a particular region of the brain, thus hindering the arrival of oxygen and nutrients to the brain cells producing neurological deficits in a few minutes. Currently, the existing acute therapies are based on the restoration of blood flow, which have greatly improved the stroke-related survival. However, of those stroke patients that survive, many remain disabled with cognitive, motor and/or sensory sequelae.

In this sense, the use of drugs that enhance tissue repair would be key to reduce these sequelae and improve the lives of stroke survivors. The arrival and proper release of drugs to the stroke-affected brain in a minimally invasive and safe way is still a challenge.

In this context, a study led by the group of Neurovascular Diseases of the Vall d'Hebron Research Institute (VHIR) has shown, in animal models, that the administration of nanomaterials through the carotid artery, with the ability to encapsulate and release drugs could be an effective method to improve the effective and safe localized release on the affected brain areas after a stroke. The results are published in the *Journal of Cerebral Blood Flow & Metabolism*.

The study analyzes the use of nanocapsules designed by the Nanoparticles and Nanocomposites group of the Institute of Materials Science of Barcelona (ICMAB-CSIC) to be administered endovascularly towards the cerebral area affected by stroke with a microcatheter through the carotid artery.

**"Mechanical thrombectomy is one of the acute treatments for ischemic stroke, the aim of which is to remove the thrombus by inserting a device through the artery. This gives us the opportunity to administer, at the same time and in the same space, neuroprotective or neuroreparative drugs to help reduce the sequelae of a stroke"**, explains Alba Grayston, researcher of the Neurovascular Diseases group of the VHIR and first author of the study. She also received the young researcher award with this work at the European Stroke Organisation Conference 2021.

The research team analyzed the use, through this route, of biodegradable and biocompatible nanocapsules that allow to encapsulate drugs and subsequent release them once administered.

https://icmab.es

info@icmab.es

**Campus de la Universitat Autònoma de Barcelona**
08193 Bellaterra, Catalunya, Espanya
**Telf.:** +34 935 801 853
**Fax.:** +34 935 805 729

These nanocapsules are functionalized with magnetic nanoparticles so they could be retained in the brain region of interest by implanting magnets under the skin.

**“In addition, the presence of fluorescent molecules on the surface of the nanocapsules, allowed monitoring their distribution in different organs once administered endovascularly”** explains Anna Roig, head of the Nanoparticles and Nanocomposties grup at ICMAB.

Thus, the presence of the nanocapsules is observed mainly in the affected area of the brain up to 48 hours after, which would ease the desired slow and sustained release of the administered drug over time.

The results also prove the safety of this system, since no bleeding, new thrombi formation or sustained lack of blood flow was observed after administration.

The proposed local endovascular administration of nanocapsules significantly improves the arrival of the drug in the affected region of the brain, while reducing its accumulation in other organs such as the liver. This selective route would therefore decrease the side effects while increasing the therapeutic efficacy of a given treatment.

**"Our results demonstrate the safety and efficacy of the endovascular route to administer nanoparticles to the brain after an ischemic stroke, using animal models. We hope that in the future they can be used to administer drugs for the treatment of this pathology through this route"**, concludes Anna Rosell, head of the Neurovascular Diseases group at VHIR.

The work is developed within the framework of the EuroNanomed MAGBBRIS project, together with the collaboration of the Clinical Biochemistry group at VHIR, the Institute of Materials Science of Barcelona (ICMAB, CSIC), the Achucarro Basque Center for Neuroscience, the SAS Institute of Experimental Physics (Slovakia), and the San Raffaele Scientific Institute IRSCCS (Italy).

## Article:

**Endovascular administration of magnetized nanocarriers targeting brain delivery after stroke**
Alba Grayston, Yajie Zhang, Miguel Garcia-Gabilondo, Mercedes Arrúe, Abraham Martin, Peter Kopcansky, Milan Timko, Jozef Kovac, Oliver Strbak, Laura Castellote, Sara Belloli, Rosa M Moresco, Maria Picchio, Anna Roig and Anna Rosell
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