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GlowBrain

Project Summary

GlowBrain
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Combining Stem Cells and Biomaterials for Brain Repair – Unlocking the Potential of the Existing Brain Research through Innovative *In Vivo* Molecular Imaging

The main objective of the proposed project GlowBrain was to upgrade and unlock the existing excellence in brain research with specific twist in activities based on development of stem cell and biomaterials applications.

The core idea of this project was based on combined biomaterials and stem cell applications in the brain monitored by combined bioluminescent imaging (BLI) and magnetic resonance imaging (MRI). This allowed to enhance the stem cell delivery and integration in the brain and to monitor both the stem cells and their effects in the living animals. The institutional capacities were upgraded and a GlowBrain platform was assembled in order to achieve the top-notch research organized in a unique way, not present elsewhere in Europe. Exchange of know-how with partnering institutions helped to collect and implement the knowledge to make the platform functional.

Our main S&T objective was to introduce a novel approach for stem cell based therapy of nervous system. This was achieved by using the biomaterials to enhance and control stem cells, and by in vivo monitoring of stem cell behavior after transplantation through complementary combination of two imaging modalities - bioluminescent imaging (BLI) and magnetic resonance imaging (MRI). In order to decrease the most common obstacle in stem cell applications, low survival and integration rate of cells faced with hostile environment, we used biomaterials which supported formation of 3D cellular networks.

BLI was used to in vivo monitor molecular events in the brain with the help of the specific transgenic animals carrying luciferase as bioluminescence reporter under promoter of genes relevant to the brain repair and regeneration. The appropriate mouse lines were collected in our facility.

MRI was used to in vivo precisely localize transplanted stem cells in the brain. Apart from precise anatomical location, MRI was used to distinguish brain pathology (in particular after ischemic lesion through middle cerebral artery occlusion) and repair processes in the mouse brain. In order to be visible the stem cells were labeled by ultra-small

superparamagnetic iron oxide (USPIO) visible by MRI. This allowed to track the transplanted stem cell population and to assess their distribution within the brain.

The advantage of combination of BLI and MRI is that the brain can be visualized both by luciferase markers and superparamagnetic particles. This enabled visualization of the brain by MRI and characterization of its reaction by luciferase as gene expression marker by BLI. The setup of such a complete capacities upgrade was very complex and it was based on our previous knowledge and abilities, combined with twinning and exchange of know-how with our partners.

The ability to visualize the brain in the living animals represents a leading edge asset, which together with all other already existing expertise establishes the highly versatile preclinical platform for brain research.