Institut de Bioenginyeria de Catalunya

COLLABORATIVE IBEC INTERNATIONAL PhD PROGRAMME

Position

1. Project Title/ Job Position title:
   Advanced Engineering of Nanotherapies for Macrophage Modulation in Neuroblastoma (VENOM)

2. Research project/ Research Group description

Neuroblastoma, a highly aggressive pediatric cancer, is characterized by a tumor microenvironment (TME) enriched with tumor-associated macrophages (TAMs) that exhibit a hybrid phenotype, combining pro-inflammatory (M1) and pro-tumor (M2) markers. This hybrid state reflects the TME's complex and dynamic signaling, driving immune suppression, tumor growth, and resistance to therapies. The VENOM project aims to leverage an existing 3D biomimetic model developed at IBEC to replicate this hybrid TAM phenotype in vitro.

Our goal is to reprogram TAMs into an M1 phenotype, transforming the tumor microenvironment (TME) into a pro-inflammatory, anti-tumor state to enhance the effectiveness of existing therapies. To achieve this, we will create hybrid nanocarriers by combining functionalized nanoparticles that specifically target M2 macrophages with neuroblastoma M2-derived extracellular vesicles (EVs). This dual-targeting approach ensures precise TAM targeting. The EVs contribute natural homing properties through their surface markers improving specificity and reducing off-target effects. These hybrid nanocarriers will deliver compunds designed to induce M1 polarization, reprogramming TAMs to bolster anti-tumor immunity.

The project will be conducted at the Institute of Bioengineering of Catalonia (IBEC) for 3D model development, EVs isolation and in vitro testing, and at the International Iberian Nanotechnology Laboratory (INL) for nanocarrier development and validation. Two research stays are planned:

- Drexel University, Philadelphia (USA): At Dr. Kara Spiller's Lab, a leader in immune-modulatory biomaterials, the trainee will integrate hybrid nanocarriers into a therapeutic patch designed for post-surgical application.
- Sant Joan de Déu Hospital, Barcelona (Spain): At Dr. Jaume Mora's Lab, the trainee will validate the immune patch and nanocarriers in vivo using a spontaneous neuroblastoma metastasis mouse model, evaluating TAM reprogramming, tumor progression, and survival.

3. **Job position description (max. 2.000 characters)**

The PhD candidate will play a pivotal role in the VENOM project, which focuses on developing innovative, patient-specific treatments for aggressive pediatric cancers, with a primary emphasis on neuroblastoma. This translational research integrates nanotechnology, 3D biomimetic modeling, and immunotherapy to reprogram TAMs into an anti-tumor phenotype

Key Responsibilities:

- Develop and optimize 3D biomimetic scaffolds that replicate the TME to study TAM behavior and polarization in neuroblastoma models.
- Design, fabricate, and characterize nanocarriers for M2 TAMs specific to promote their polarization toward an M1 anti-tumor phenotype.
- Perform in vitro studies using the 3D models to evaluate the nanocarriers' efficacy
- Develop a therapeutic patch embedding the nanocarriers
- Conduct in vivo validation of the hybrid nanocarriers and the therapeutic patch using a spontaneous neuroblastoma metastasis mouse model.
- Collaborate closely with multidisciplinary and international teams to advance the project's objectives and participate in short research stays at partner institutions to achieve key milestones.
- Contribute to scientific publications, presentations, and project dissemination efforts to communicate the research findings effectively.

Ideal Candidate Profile:

- Strong academic background in bioengineering, nanotechnology, or molecular biology.
- Experience in 3D tissue models, nanomedicine, or in vivo cancer research.
- Familiarity with pediatric cancer cell culture, confocal microscopy, and imaging techniques is desirable.
- Strong analytical and collaborative skills to thrive in a multidisciplinary and international research environment.

Group Leader IBEC

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Collaborator in the other institution

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